

THE SCIENTIFIC RAVI

2024



GOVERNMENT COLLEGE UNIVERSITY LAHORE

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The Scientific Ravi 2024

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VICE CHANCELLOR'S NOTE

It gives me immense pleasure to pen this message for the student-led science magazine of GC University Lahore. As one of the oldest and most prestigious institutions of higher learning in South Asia, GCU has always fostered a culture of academic curiosity, scientific innovation, and intellectual exploration. This magazine is a shining example of our students' dedication to these ideals, and I commend the editorial team and contributors for their vision and effort.

Science is not just a collection of facts or formulas; it is a way of thinking—of questioning the world around us, of challenging assumptions, and of pushing the boundaries of the known. In today's rapidly evolving world, scientific literacy is more important than ever. Whether it is in addressing the climate crisis, advancing healthcare, exploring space, or innovating with artificial intelligence, science is at the heart of progress and sustainability.

At GC University, we are proud of our legacy in scientific excellence. Our alumni include some of the most brilliant minds Pakistan has produced, such as the Nobel Laureates Dr. Har Gobind Khorana and Dr. Abdus Salam. Inspired by such towering figures, we continue to invest in research facilities, faculty development, and student mentorship. But more importantly, we encourage a spirit of inquiry among our students—the desire not just to learn but to discover.



This magazine is a powerful platform to showcase that spirit. It allows our students to communicate their ideas, their research, and their reflections on the role of science in society. In doing so, they are not only building their own skills as writers and thinkers but are also contributing to a broader scientific discourse. I urge all students to read this publication with curiosity and to consider contributing to future editions. It is only through dialogue, debate, and dissemination of knowledge that science can truly thrive.

I am especially proud that this initiative is driven by students. Leadership in academia does not begin after graduation—it begins now, when you take responsibility for creating and sharing knowledge. The initiative and teamwork displayed in the creation of this magazine mirror the collaborative nature of science itself.

Let us also remember that science must be guided by ethics, empathy, and a sense of responsibility. As we unlock new frontiers, we must ensure that our discoveries serve humanity, protect the environment, and promote equity. GC University is committed to nurturing not just competent scientists but also conscientious citizens.

In closing, I congratulate the magazine's editorial board, faculty advisors, and all the contributing students on this laudable achievement. May this magazine inspire more young minds to explore, to question, and to lead. The future belongs to those who are not afraid to ask "why" and "what if." Keep asking, keep exploring—and never stop learning.

With warmest wishes and pride,

Prof. Dr. Muhammad Omer Chaudhry
Patron-in-Chief, *The Scientific Ravi* (2024)
Vice Chancellor, Government College University Lahore

MANAGING EDITOR'S NOTE

Since its inception in 1864, Government College University Lahore has upheld its legacy of academic excellence and professionalism, emerging as Pakistan's flagship academic institution. GCU's commitment to the advancement of knowledge is evident from the standards of its teaching methods and an excellent research culture.

At GCU, we are aware of the critical role that education plays in addressing the challenges faced by our society. Our goal is to grow ideas that push academic knowledge forward and make life better for everyone. Here, we teach more than just facts—we aim at producing individuals capable of critical thinking, effective communication, and problem-solving. These skills help them apply what they've learned in many places, in Pakistan and around the world. Indeed, the actions and thoughts of young people will shape our country's future. Knowledge, along with a sense of social responsibility, will give them the power to tackle the many tough issues we face.



The Scientific Ravi, a journal published since 1989, stands as a testament to this commitment to intellectual growth of our students. It has provided a platform for students, academics, and science lovers to present their scientific ideas and enhance our understanding of the world. Each volume serves as a testimony to the university's vibrant academic culture, showcasing the innovative and intellectual spirits that drives GCU.

The work done by students and science enthusiasts in this year's *The Scientific Ravi* shows the lively thinking that grows inside the university. These contributions are both commendable and inspiring! In the years to come, the legacy of GCU will continue to resonate. It will not help just its students, but also the wider community, who will gain from the knowledge created here.

In closing, I extend my sincere congratulations to the editorial and advisory boards of *The Scientific Ravi* 2024 for their dedication in producing this volume.

Prof. Dr. Aziz-ur-Rehman

Managing Editor, *The Scientific Ravi* (2024)

Professor & Director Institute of Chemical Sciences, GCU Lahore

EDITOR'S NOTE

It is with great enthusiasm, pride, and a deep sense of responsibility that I present to you this volume of *The Scientific Ravi*. This edition stands as a testament to our unwavering commitment to exploring, engaging with, and contributing to the dynamic and multifaceted disciplines of science. Our goal is to foster academic inquiry, encourage interdisciplinary dialogue, and promote the dissemination of innovative research. *The Scientific Ravi* serves as a platform for our faculty, researchers, and students to share their scientific knowledge, insights, and expertise with the university community.

As a science enthusiast myself, I am thrilled to be part of this publication. My passion for science and dedication to scientific inquiry continue to fuel my efforts to promote scientific literacy and awareness. I believe that effective science communication is essential to bridging the gap between complex scientific research and the general public. Through this magazine, we aim to offer science enthusiasts an invaluable opportunity to share their research, ideas, and discoveries with a wider audience—including students and experts across various scientific domains.

This edition features an array of articles and reviews that span the scientific spectrum—from cutting-edge technologies and emerging trends to the latest scientific discoveries. Great care has been taken to ensure that the content is engaging and enriching for our students and readers.

I extend my sincerest gratitude to the authors who contributed their outstanding work; to my editorial team for their tireless efforts and commitment; to our advisors for their invaluable guidance; to our managing editor for his unwavering support; and to our patron-in-chief for his continuous encouragement.

As we strive for excellence in science communication, I hope that *The Scientific Ravi* will spark curiosity, inspire critical thinking, and cultivate a vibrant community of students passionate about science. It is only through a genuine interest in scientific theories and methods that we can grow intellectually, solve our problems rationally, and thrive as a nation in today's ever-evolving, complex, and fast-paced world.

Welcome to *The Scientific Ravi*, Volume 33.



Faiq Ahmad

Editor, *The Scientific Ravi* (2024)

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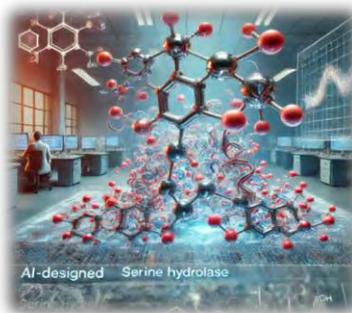
Recent Scientific Developments



targeting drug by Michelle Farrar, an Australian paediatric neurologist.

For the **first time in the history** of medical science, a rare genetic disorder called **spinal muscular atrophy** which affects motor neurons, has been treated prenatally in the womb through a gene-

A team from the University of Washington's Institute for Protein Design **utilized Artificial Intelligence** to create serine hydrolases, enzymes that break ester bonds, which are structurally distinct from any found in nature. Through computational modeling and laboratory validation, these enzymes demonstrated effective binding and cleavage of ester compounds as intended.



Researchers at Oregon Health & Science University (OHSU) have developed **an innovative blood test called PAC-MANN that detects pancreatic cancer before it spreads**. This test measures protease activity in the blood,



identifying early-stage pancreatic cancer with 85% accuracy when combined with the CA 19-9 test. It takes 45 minutes for administration and costs less than a penny per sample.

Recent studies have detected **microplastics, tiny plastic particles, in human brain tissue**, raising concerns about potential health impacts. Research from the University of New Mexico Health Sciences Center found that microplastics accumulate in the brain at higher concentrations than in other organs, with levels increasing by 50% over the past eight years. It can be mitigated by reducing the use of plastic products.

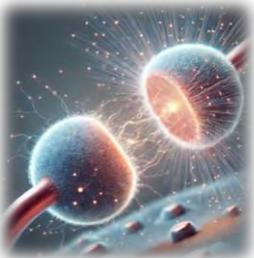


The **2024 Nobel Prize** in Chemistry was awarded to David Baker, John Jumper, and Demis Hassabis for their work in computational protein design and protein structure prediction.



Baker developed the Rosetta software for designing functional proteins. Jumper and Hassabis created AlphaFold, an AI system for predicting protein structures with high accuracy. Their research has transformed structural biology and advanced drug discovery.

Scientists have discovered that static electricity builds up because materials "remember" past contacts. This memory effect influences how electric charge transfers in future interactions. This triboelectric effect depends on the materials involved and their contact history. Researchers also found that altering a material's shape can change its charge state. These new insights help **explain why static electricity behaves unpredictably**.



According to NASA, two U.S. missions have been recently launched to **search for water** on the Moon. The Athena lander will drill near the South Pole meanwhile the Grace Hopper will explore dark craters for ice. NASA's Lunar Trailblazer orbiter plans to map ice deposits from space.



Recent research reveals that slippery proteins, lining brain blood vessels, form a protective barrier that deteriorates with age. This **breakdown weakens the brain's defense** against harmful substances and pathogens.

Scientists aim to restore this barrier to prevent age-related brain diseases. Previous studies showed that its erosion could contribute to conditions like Alzheimer's. Targeting this barrier may improve drug delivery for brain disease treatments.

A clinical trial led by researchers at the University of North Carolina found that semaglutide, the key ingredient in Ozempic, may reduce alcohol cravings. This **first human trial** in the area showed that participants taking semaglutide drank 40% less alcohol compared to a placebo group. Some also reported **reduced cravings and cigarette use**.



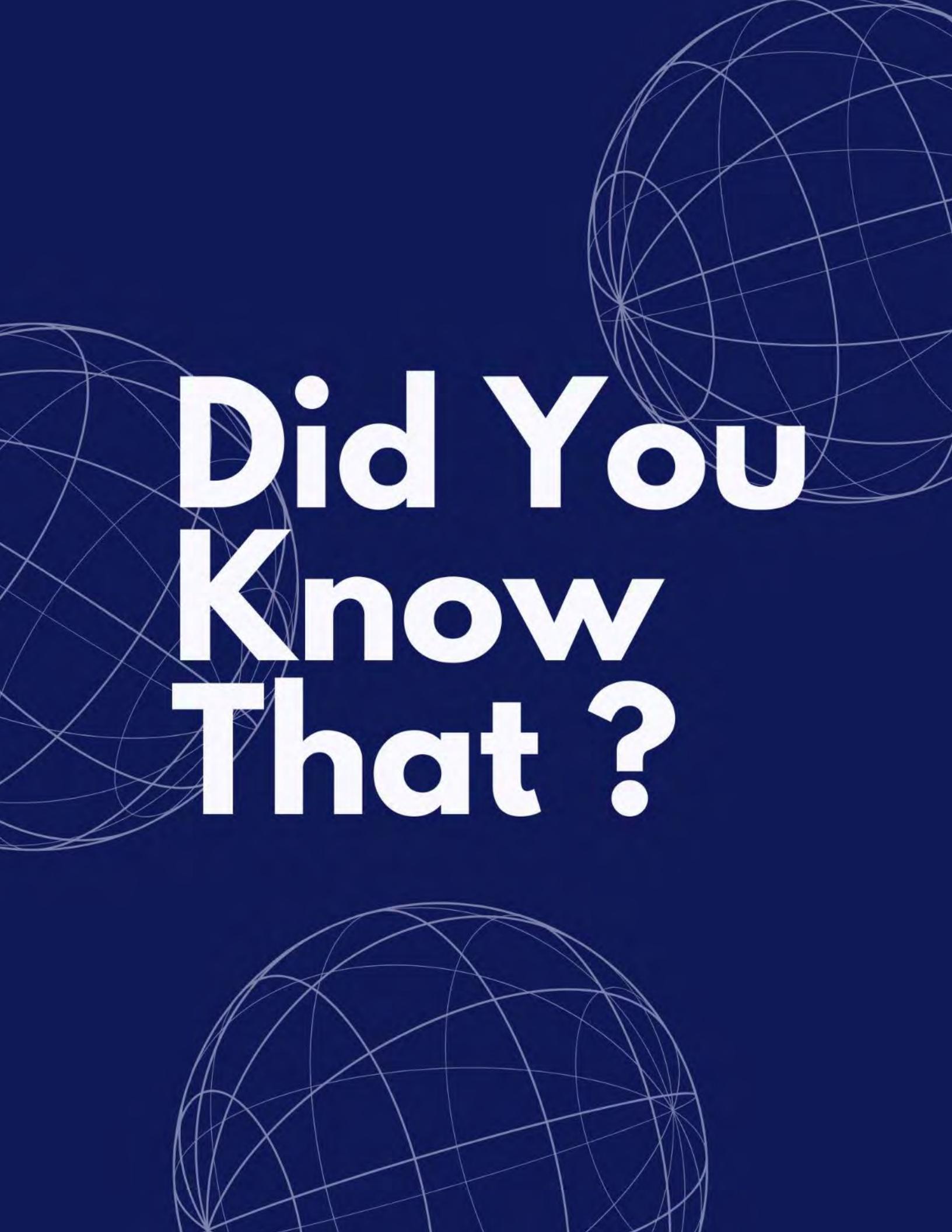
Epigenetic clocks track DNA methylation patterns to estimate biological age. Scientists believe that targeting these mechanisms **could slow or reverse aging**. A study in *Science Advances* found that prolonged heat exposure accelerates biological aging. Researchers analyzed blood samples from 3,686 older adults, linking aging to regional heat index records. The study showed that living in hotter climates ages the body, similar to smoking.

Scientists have successfully **grown a human backbone structure in the lab** by coaxing stem cells to develop into the **notochord**, a crucial embryonic structure that later forms intervertebral discs. This breakthrough, published in *Nature*, provides new insights into spinal development which could help researchers understand and treat spinal disorders.

Compiled by:

Ayna Maryam

2840-BS-PSY-21



Did You
Know
That ?



the solid inner core and liquid outer core. These changes are likely influenced by outer core's flow and Earth's magnetic field. It suggests that the inner core is more dynamic than previously thought.

Two new studies have detected **a possible ancient beach (more than 3 billion years ago)** on Mars' northern hemisphere and identified a water-containing mineral responsible for the planet's rosy hue. It has led to new assumptions about the planet being wet and cold in its past.



A massive solar storm in May 2024 created two new radiation belts around Earth, detected by NASA's



CIRBE CubeSat. Unlike typical short-lived belts, the electron belt lasted three months, while the proton belt may still persist.

Earth's inner core is mysteriously changing shape, as revealed by seismic wave analysis from 121 earthquakes between 1991 and 2023. Researchers have found deformations at the boundary between

Ancient Roman concrete is remarkably durable because of its unique composition and self-healing properties. Unlike modern Portland cement which degrades over time, Roman concrete contains **lime clasts** (calcium-rich particles). When cracks form in the concrete, water infiltrates and reacts with these lime clasts, triggering a chemical process called **pozzolanic reaction**. This reaction creates new calcium-rich minerals that fill in the cracks, effectively "healing" the structure.



A newly discovered parasitic fungus, *Attenboroughomyces zombiae*, named after Sir David Attenborough, infects cave spiders and manipulates their behavior. Found in caves of Brazil, the fungus slowly takes over the spider's body, causing the insect to act unnaturally before eventually killing it. The fungus then grows out of the spider's body, releasing spores to infect new hosts.



Recent research from University College Dublin has revealed that **cuttlefish ink can disrupt sharks' sense of smell**, potentially serving as a natural deterrent. The study found that melanin, the primary component of cuttlefish ink, binds to shark olfactory receptors, overwhelming their sensory perception and causing them to avoid areas where the ink is present. This finding sheds light on how cephalopods evade predators.



In 2024, atmospheric CO₂ concentrations reached 421.73 parts per million, the highest in human history and over 50% higher than pre-industrial levels. Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30%.



Recent research has revealed that **drought-stressed plants emit ultrasonic sounds**, which can influence the behavior of certain insects. Female moths, *Spodoptera littoralis*, detect these ultrasonic emissions and prefer to lay their eggs on well-watered plants, avoiding those emitting stress signals. This behavior suggests that moths use plant-generated sounds as cues to select optimal sites for their offspring, ensuring better survival prospects.



The Gila monster, a venomous lizard native to the southwestern United States and Mexico, has saliva that contains a compound called Exendin. This protein binds to pancreatic tumor cells, making the cells detectable in PET scans. The breakthrough has improved the diagnosis of this rare, insulin-producing tumor.



Time crystals are a unique state of matter where particles move in a repeating pattern without using energy, **defying the second law of thermodynamics**. In 2024, researchers created one that lasted **40 minutes**, far longer than ever before. This discovery could revolutionize quantum computing and lead to new technologies. It reveals the surprising possibilities of the quantum world, challenging our understanding of physics and time.



Scientists have developed a lithium-ion capacitor using electrodes made from pine wood waste discarded in sawmills. This sustainable and abundant biomass is processed through inexpensive methods, producing materials with excellent energy storage properties.



Pine biomass offers a **renewable alternative for creating eco-friendly, high-power energy systems**. This breakthrough could lead to cleaner, more affordable energy storage solutions for a sustainable future.

Compiled by:

Ayna Maryam

2840-BS-PSY-21

Mind Games



Mind Game 1: Are you curious to test your cognitive flexibility? Here's a little interactive task to do so.

Time yourself and start saying aloud the names of the colors in print, not the word itself, as fast as you can.

RED	YELLOW	PINK
BLUE	WHITE	GREEN
PURPLE	ORANGE	BLACK

How many responses did you get correct? How much time did it take?

Now reverse the task. Try saying aloud the written word instead of the printed color. Which task was harder in your experience? Did your speed or correct responses improve?

Before it boggles your mind, let us introduce you to a gripping cognitive process behind it. Scientifically, your brain may take longer time span in the first task creating a cognitive interference. It is because reading is a more powerful automatic process; identifying colors is a conscious process. Psychologist John Ridley Stroop first developed this paradigm back in 1935, hence called the **-stroop effect**".

Mind Game 2: Have you ever contemplated that why you tend to remember certain information and forget the other? Here's a list of words. Try looking at it for 30 seconds.

- Mirror
- Bicycle
- Castle
- Throat
- Lantern
- Tie
- Notebook
- Carpet
- Telescope
- Dolphin
- Mountain
- Rainbow
- Violin
- Clock

Now, immediately write as many words as you can remember on a piece of paper. Carefully, evaluate your result and see if you recalled more words from the beginning or end of the list.

If you recalled more items from the start, your brain may be experiencing a **-primacy effect**". Conversely, if you were able to recall items from the last part of the list, a **-recency effect**" may be at work. Theoretically, primacy effect occurs because early items receive more attention, processing time, and less cognitive load. Recency effect, on the contrary, occurs due to the information residing in one's short term or working memory and less interference as no new information is acquired afterwards.

Mind Game 3: Here's another numerical activity for you. Look at the following sequence for 10 seconds.

4 9 2 7 5 1 6 8 3

Now try to write down the numbers you can recall. How many did you recall? The number of digits you can recall will determine your digit span (count).

Do you want to increase this count? Here's a little trick. Try looking at the numbers below for 10 seconds.

1947 2001 1930 1840

How many numbers can you recall this time?

You may have experienced an increase in the digit span capacity. It is because the digits in the second sequence were chunked into historical years, optimizing the chances for a better storage and retrieval. This fascinating technique was first proposed in 1956 by George Miller in his prominent paper. It was called **-chunking**". Miller observed that human capacity for short term memory, typically 7 ± 2 digits, could be improved by chunking the information into meaningful groups or **-chunks**". This theoretical trick has wide applications in effective learning i.e., large sections of information can be grouped into smaller, meaningful units or themes.

Mind Game 4: Read the following list of words, one per second. Once you have read all of the list, immediately turn away from the text and wait for 30 seconds. Do not try to recall the words in this break.

- Bed
- Rest
- Dream
- Snooze
- Blanket
- Doze
- Tired
- Nap
- Snore
- Yawn
- Drowsy

Without looking at the list of words, answer the following question.

Did the list include the word —sleep?

Try this task with others too. Surprisingly, some of you will probably answer a —yes” to the aforementioned question. This unexpected response is linked to a cognitive mechanism known as the —**false memory**”. Our brain stores memory in a rather reconstructive way which means that missing information gaps may be filled by itself. Semantic associations occur when words or ideas are closely related in meaning, so the brain assumes the missing information that fits the pattern. You might have come across it in your academic life when you mistakenly identified a closely related answer as the correct response in Multiple Choice Questions.

Mind Game 5: Carefully look at the following word groups for 10 seconds each.

Group I: Doctor, Engineer, Lawyer, Teacher, Architect

After reading list I, count backwards for 15 seconds.

Group II: Journalist, Chef, Pilot, Artist, Photographer

After reading list II, again count backwards for 15 seconds.

Now try to recall all the words from group II.

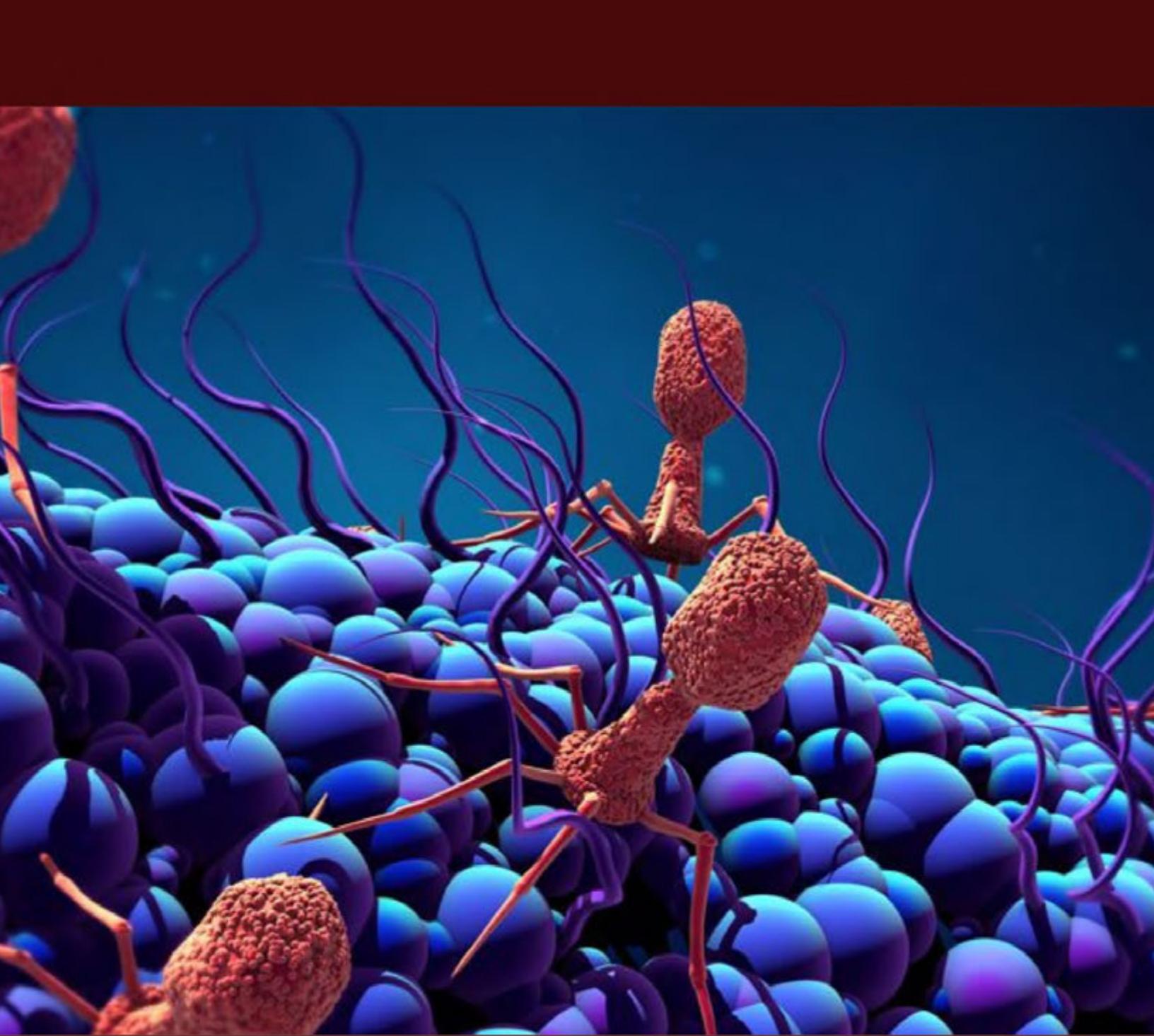
Many among you may mistakenly recall a word from group I instead. The cognitive phenomenon underlying

this error is known as —**proactive interference**”, pioneered by preeminent psychologists, Benton Underwood and Delos Wickens. It occurs when previously learned information disrupts the storage or recall of new information. This happens frequently in instances where materials to be learned are similar, as in the case of above mentioned groups, both representing professions. You might have encountered it when you occasionally put an older password instead of a recent one. However, this disruption can be reduced by placing dissimilar materials to be learned in your schedule as it leads to a —“release” from proactive interference. It seems to be beneficial in preparing for exams i.e., two unrelated subjects or topics can be studied on the same day or sequentially to retain an effective memory.

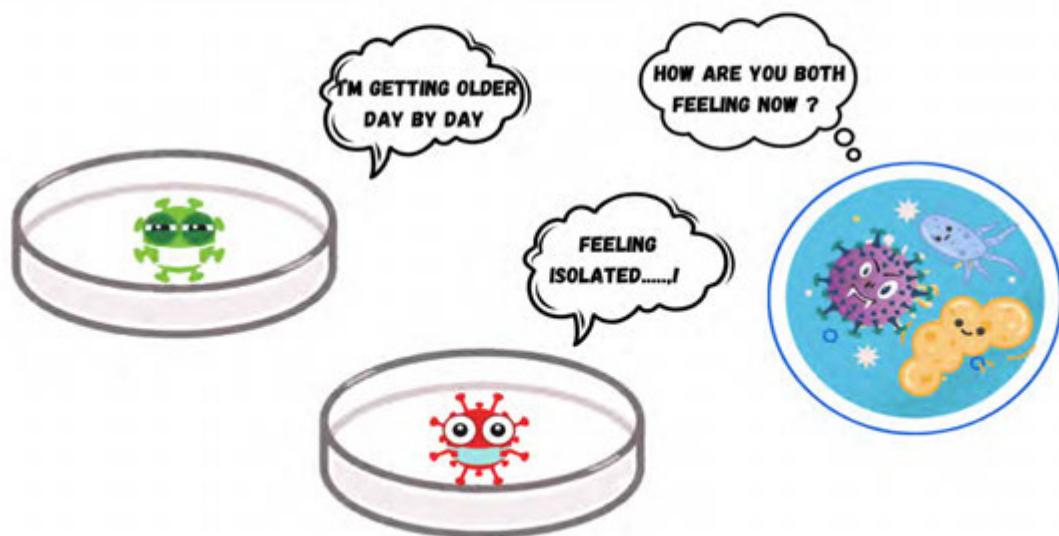
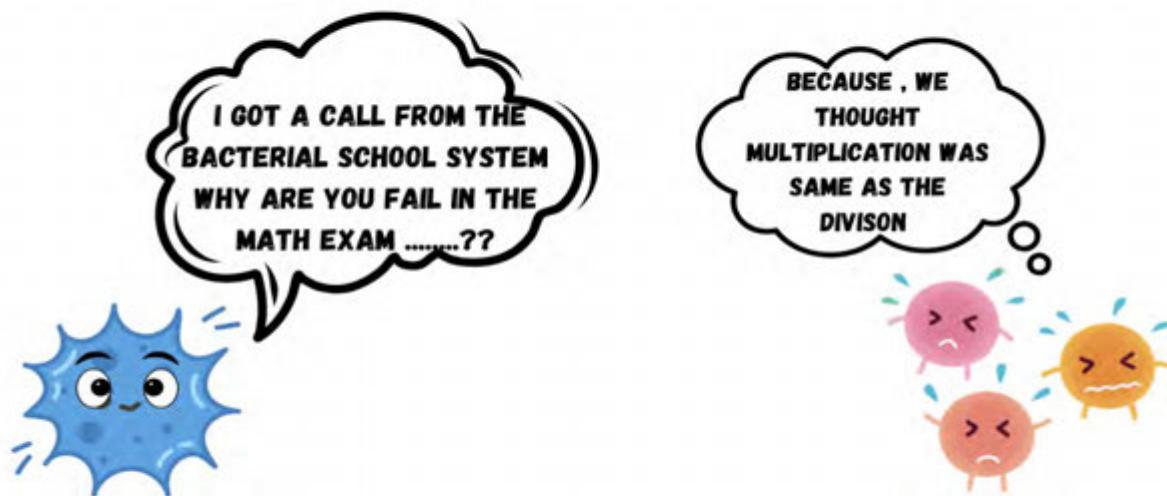
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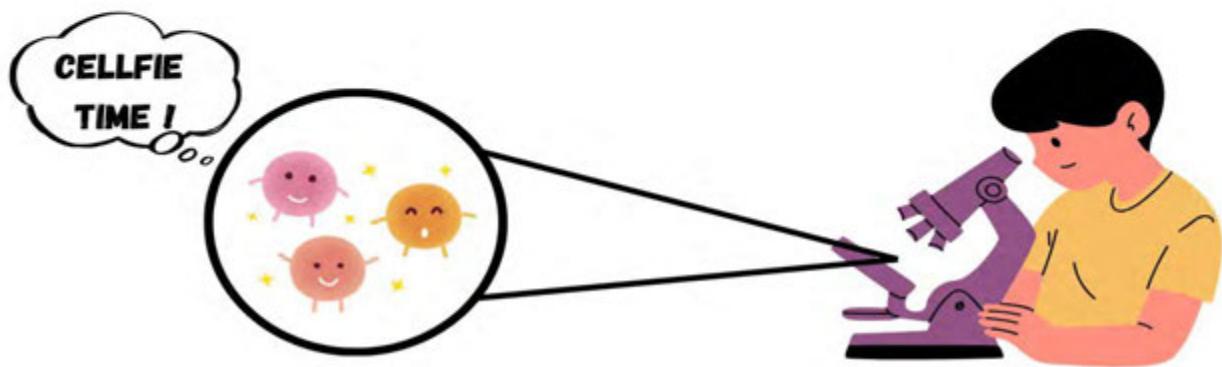
Ayna Maryam

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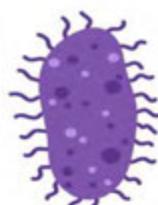


Microbial Conversations

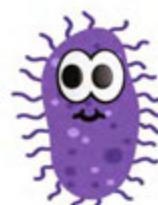




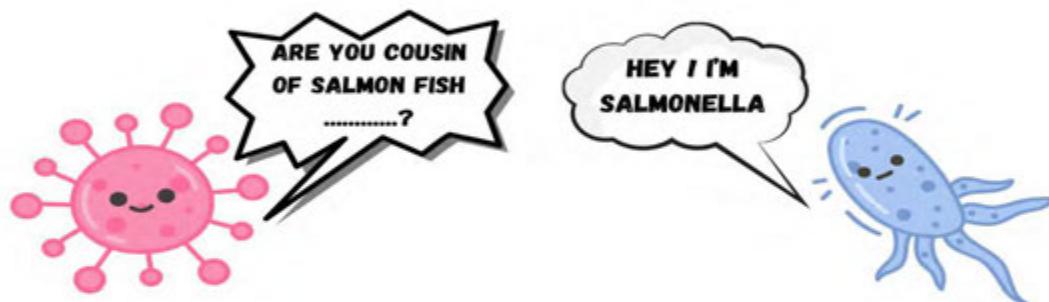




BACTERIA



FRONTERIA



Compiled by:

Sana Muqadus

1292-BS-MB-22



INTERMEDIATE

BOOK REVIEW

THE MARTIAN - ANDY WEIR

Aliyan Shahid

0716-1-23

The Martian, by Andy Weir, is a work of science fiction literature that seamlessly intermingles humor, suspense, and true-to-life scientific logic. Published in 2011, this book allows reading a thrilling story of survival, ingenuity, and humanity resilience in the harsh and bleak background of Mars.

To stay alive until rescue, Watney, armed with his wit, determination, and resourcefulness, employs scientific problem-solving and engineering skills to tackle one life-threatening situation after another.

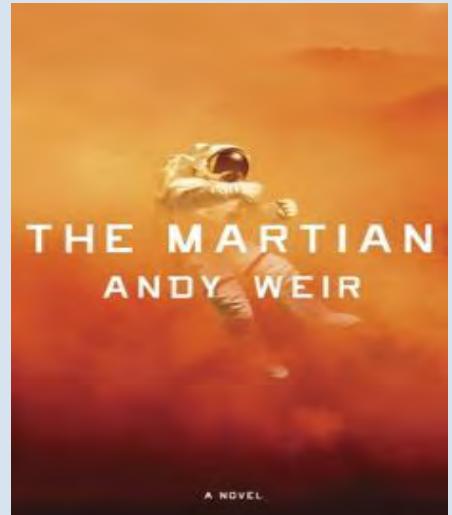
What makes The Martian unique is its incredibly careful and scientific detail. Andy Weir meticulously researched the mechanics of space travel, life support systems, and Martian geology, which lends an authentic and educational quality to the narrative. The same book congratulates human creativity and the force of science and it shows how theoretical knowledge can be used for real purposes in extreme situations. E.g., Watney's solution to cultivate potatoes in Martian regolith using his own waste gives an inventive response to survival, and demonstrates the value of resilience and critical thinking).

In spite of the seriousness of the matter, the style of the novel is surprisingly cheerful. Watney's humorous logs and sarcastic commentary provide a stark contrast to his dire circumstances. This mix of witticism and suspense creates a highly engaging and resonant experience, and is likely to be easily accessible for even non-specialist readers of the sciences. His personality is more than someone who survived, but a symbol of beliefs in hope and optimism, which leads us to recall resilience spirit of human.

The experience also jumps between Watney's experience and that of the people on Earth, most importantly NASA's mission to return him home. This dual viewpoint enhances the story's scope, offering readers a glimpse into the collaborative effort and sacrifice required to save a single life. The interface between individuals and organizations stresses the need for teamwork and shared accountability.

The assessment of The Martian has been positive in the sense that it has made difficult scientific concepts accessible, in an informative and enjoyable way. The book not only poses philosophical questions in relation to man's position in the universe, but also raises ethical concerns for space exploration, and is thus a stimulating book for both scientific readers and general readers.

Conclusion, The Martian is not simply science fiction, but a blueprint of human creativity, resilience, and the perseverance of pursuit of knowledge. By doing so, it encourages readers to think beyond what they are capable of and even dream of the potential of the future. This, for science buffs, survivalists, or people just looking for a good scare, is an absolute page-turner to read.



MOVIE REVIEW

EX-MACHINA (2014)

Rayyan Amjad

0508-1-23



Ex Machina, the first film directed by Alex Garland, serves as a sleek and intelligent, though unsettling, exploration of AI, consciousness, and the very definitions of humanity itself. In this hermetically sealed, minimalist research facility of tech billionaire Nathan Bateman (Oscar Isaac), it tracks Caleb Smith (Domhnall Gleeson), a young programmer born in what is promised to be for him his idyllic life, and his invitation to participate in a Turing test that involves a strikingly lifelike humanoid robot called Ava (Alicia Vikander).

The film's tight, character-driven plot is what makes it so cool. The interaction of the three characters, Caleb, Nathan, and Ava, is what makes the story, keeping the atmosphere very tense. Caleb's pure awe and fascination with Ava quickly evolve into suspicious empathy as he realizes Nathan's possibly ulterior motives and Ava's real capabilities or lack thereof. Nathan is brilliant but seriously flawed and manipulative, presenting himself as a most imaginative visionary pushing technology toward new boundaries however, behaviorally, he proves himself to reveal a much darker and controlling nature. Vikander as Ava

is a pleasure to watch. This character is balanced, playing vulnerable as well as sly.

Ex Machina is perhaps one of the best movies when it comes to complex themes. Aside from complexities, the term philosophical would most aptly describe the art of movie-making in the film. One question this raises, among many others, is whether artificial consciousness can have free will. Another question is that what is the definition of being human? Of course, the whole idea of the Turing test was something more than just a test of Ava's intelligence and, in a way, flipped around; it is also quite interesting as a judge of Caleb's own biases and preconceptions. It also engages with ideas about gender and power inequality-the activities of Ava in getting her liberation touches larger issues.

The film is entirely about it in the visual sense. The sterile, minimalist space that Nathan has created acts as a source to isolate and control, and even in the cinematography, light and shadow invoke a heightened suspenseful atmosphere with the visual mode of depiction. It is that kind of shooting, deliberate and methodical, really into close-ups of actors' faces, in which we can discover internal shifts and struggles of their emotions.

Pace slow and story-telling very gradual, but Ex Machina is not short of excitement. The film is not about the big special effects it simply shows human interaction, on a psychological level. It is a surprising and somewhat inevitable end, along with a sense of helpless unease and wide-ranging understanding of artificial intelligence implications left hanging by the movie. Ex Machina isn't just a science fiction movie, it's an even deeper human story that goes beyond this about connection, freedom, and the complexities habitually brought into relationship between creator and creation.

THE REVOLUTIONARY BREAKTHROUGH OF QUANTUM COMPUTATION

Muhammad Umarr

0652-1-23

Quantum Computing — as cutting-edge as the term sounds — is actually a very critical advancement in modern scientific research. Understandably, it is an abstract study mainly owing to its fundamental involvement with Quantum Physics. Quantum physics in itself is notorious for being one of the most, if not the most confusing sub-branch of physics. This difficulty of understanding mainly stems from the fact that **on the sub-nuclear level, our classical laws of physics, namely the renowned Newtonian Laws cease to make sense and our classical understanding of Physics begins to break down.**

Einstein famously said:

“God did not play dice with the universe.”

Luckily, to understand the working principles of Quantum Computing and just how revolutionary it has proven to be, we don't need to dive in the complex, math-rich realms of Quantum Physics.

Quantum Computers are no different from any other computer in terms of their use case, which is to solve problems. (Computers were created to solve problems, mathematical problems. And that's what they do. Yes! Your laptops and mobile phones solve mathematical problems to function as they do.) Only, quantum computers solve these problems in much more effective and swift ways. They're fast, terrifically fast. Here's a comparison: a quantum computer can solve a complex mathematical problem in four minutes that a conventional computer would take 10,000 years to solve. That's fast! Roughly billions of times faster.

How do Quantum Computers do this? Well, where normal computers use bits, 0s and 1s to store data and for literally anything they do, quantum computers use something called **Qubits** (Short for *Quantum Bits*.) These are the driving forces of these special computers. To understand what qubits are, you just need to be familiar with a fundamental concept of quantum physics called *Superposition*. As strange as it may sound, superposition

explains how on quantum levels a particle can simultaneously exist in multiple states. Keeping this in mind, a qubit can be in multiple states at once, allowing quantum computers to explore several different routes to solve a mathematical problem at once. This phenomenon alone drastically increases the efficiency of quantum computers and gives them several upper-hands from normal computers. Tech giants like IBM and Google have recently made commendable breakthroughs in developing Quantum Computers, with IBM's Condor Processor achieving up to 1000 Qubits. This breakthrough marks a step towards scalable, practical quantum computing.

Quantum Computing has numerous applications in almost all major aspects of technical life. A major breakthrough in 2024 revealed how **Quantum Key Distribution (QKD)** can dramatically help increase online security by making encrypted environments virtually impossible to hack. Think of it, a hacker wants to hack a security key to an encrypted conversation but the security key composed of qubits, does not exist in a single state for a hacker to access easily. It only exists probabilistically until the intended receiver interacts with it. But don't get too carried away in the strangeness of Quantum Principles. Quantum Mechanics involves a concept named The No-Cloning Theorem, which disallows for a copy of an arbitrary qubit to be created by a hacker for later analysis. This ensures that quantum data cannot be copied or intercepted. All of this implies that the security of a QKD system cannot be bypassed in any way. China has already deployed a satellite that establishes a Quantum Communication Network. In the future, Quantum Security Systems will be protecting everything from Banks to State Secrets bringing forward a level of security we've never known before.

In the year of 2024, nearly everyone got a taste of how powerful Artificial Intelligence can be. Where it put most people in a dilemma about their job security, it also proved how helpful it can be when used correctly. AI models like OpenAI's GPT and Google's LLaMA are trained on large datasets to make them as powerful as they are. When a Quantum Computer is used for this purpose, it can exponentially speed up the processing of these massive datasets and boost Machine Learning algorithms. This would have countless benefits. Powerful Machine Learning algorithms can shift the balance entirely. From contributing in early detection of diseases and revolutionizing the medical sector, to automobile

companies like Tesla implementing it to refine their Smart, Driverless Automotives. It has the potential to change the Tech Industry completely.

While the subject sounds ever so astonishing, Quantum Computing still faces a number of challenges mainly because its building blocks, qubits are too fragile to maintain their Quantum States for long enough to undertake calculations. Although Scientists and Engineers are actively working to make Quantum Hardware more and more stable, for now it is only being experimented on in controlled environments.

The recent breakthroughs in Quantum Computing show that these powerful Engineering Marvels have come way beyond their inception. Google's Quantum Chip: Willow has forced us to think that we might actually be very close to solving mathematical problems that were once deemed unimaginable. Quantum Computing isn't a distant idea anymore; it's shaping our future. Embracing this massive technological breakthrough will allow us to unlock numerous possibilities for the betterment of humanity.

THE QUEST FOR DARK ENERGY: UNRAVELLING UNIVERSE'S BIGGEST MYSTERY

Muhammad Umarr

0652-1-23

In the seemingly endless expanse of the cosmos, one particular force is observed to be dominating. In 1988, it was inspected that a strange dark substance was responsible for the accelerating expansion of the cosmos; the term Dark Energy was coined. Despite comprising almost 70% of the universe, not a lot has been revealed about it since and as we delve deeper into the fabric of space-time the mystery of dark energy continues to not only question our perception of the universe, but also the place of humanity within it.

Dark energy, though unrelated to the conventional meaning of the word "dark", gets its name from its undetectable and invisible nature bypassing all current means of human observation. It was only accounted for when scientists observed that distant galaxies are drifting away from us with an increasing acceleration instead of

slowing down as they are expected to, based on the laws of gravity. The most famous of theories have attempted to explain this strange energy as an energy density filling the celestial void and named it a "Cosmological Constant" whereas others suggest that it's due to changing energy field over time called "Quintessence". However, none of them have succeeded in providing a definite answer.

Astronomers calculate the effect of dark energy by studying the effect of Type Ia supernovae; exploding stars which are otherwise expected to give off a consistent brightness. By studying these variations in brightness, scientists work out the expansion history of the universe. The first evidence of the accelerated cosmological expansion connected to dark energy was also observed through the same method. The Cosmic Microwave Background (CMB), believed to be a snapshot of the early universe in the form of residual radiations from the big bang also suggests this expansion. Precisely, the temperature fluctuations in the CMB over time are indirect evidence to dark energy in action. Moreover, projects like the Dark Energy Survey (DES) and ESA's Euclid Mission map out a detailed distribution of galaxies to understand the interplay of gravity and dark energy. Gravitational lensing can also reveal how over time, the change in the bending of light from distant galaxies proves the existence of dark energy.

While various tools help in observing dark energy's effects, different theories offer contrasting explanations for its mysterious nature. Several perspectives have been given to explain the strangeness put forth by dark energy. Majorly, Einstein's Cosmological Constant (Λ) sees dark energy as an intrinsic energy density of the universe. Although simple, this approach does not satisfy what studying the quantum fields predicts. The idea was later abandoned by Einstein as he thought it was unnecessary after the discovery of the expanding universe. Quintessence on the other hand explains dark energy as a dynamic, evolving energy density. This implies that the effect of dark energy must've been considerably small in the early universe. Moving on to some far-fetched proposals, some physicists believe that dark energy might not exist at all — and that our current understanding of gravity could be incomplete where some theories propose that dark energy is the result of addition of a new spatial dimension beyond the known three. If true, this could

completely transform our fundamental understanding of the universe.

Despite continuous efforts, dark energy remains a demanding topic to completely grasp mainly due to the challenges it throws at physicists:

- Dark energy does not interact normally with matter. This makes it immune to be directly detected by our current instruments.
- To obtain precise measurements of the effects of dark energy, we need to make long-term observations and advancements in our current technology.
- The gap between general relativity and quantum mechanics remaining unsolved, poses limitations to understand how dark energy interplays with gravity on quantum scale.

But why is studying dark energy so crucial you ask? It is necessary because of the daunting outcomes it brings should it exist as it is expected to. The Big Freeze theory discusses that if the effects of dark energy's acceleration persist, galaxies could drift away so far that the stars burn out leaving behind a cold and dark void. The Big Rip theory is even intense as it states that the dark energy acceleration would eventually rip apart galaxies, stars and ultimately atoms — putting the universe in great, petrifying chaos. The Big Crunch theory, although unlikely, explores the positive role of dark energy stating that dark energy could weaken over time and cause the force of gravity to become dominant in the cosmos. This would theoretically collapse our universe into a singularity.

Dark energy continues to not only be an abstract concept but also a profound reminder to the limits of human intelligence. It challenges scientists to think in unimaginable ways and explore the universe with a much greater curiosity. Every new advancement in our understanding of dark energy — be it a subtle shift in the cosmic radiation or a subtle anomaly, brings us one step closer to unravelling the secrets of the cosmos.

UNVEILING THE PLANET'S STORY: THE SCIENCE OF CLIMATE CHANGE

Muhammad Ahmed Abdullah Khan

0511-1-24

One of the biggest challenges the world faces today is climate change. Though much media and political attention has been paid to climate change issues, those scientific issues get mostly short shrift. In this article, we will look into the science of climate change to learn how humans are changing the climate system of the earth. Earth's Blanket: the Greenhouse Effect Earth's climate balance happens through natural process. The greenhouse effect is a natural process that occurs on earth. It is essential for life as it keeps the earth sufficiently warm. Important greenhouse gases are carbon dioxide and methane. Earth would have a temperature of -18C without having this process. Yet, many humans have increased this effect since the Industrial Revolution through the release of more greenhouse gases.

Human Actions and Greenhouse Gases

Coal, oil, and natural gas are burned to produce energy. These burnings release great quantities of CO₂ in the air. When we cut down trees, less and less CO₂ is absorbed which can increase atmospheric CO₂. Farming activities particularly rice growing and livestock farming releases methane, which is a greenhouse gas. Gases produced by factory and industrial activities also add to Global Warming. Climate change impact is dynamic and interconnected. Changes in one aspect can cause changes in many other aspects. Researchers call these feedback loops. Feedback tends to magnify change. When warming melts the ice caps, the Earth's surface will absorb more heat — as ice is a reflector of sunlight. Thus, Earth is warming and melting more. Negative feedback does the opposite thing. One impact may be that the faster growth of plants due to higher CO₂ will absorb more carbon and lessen warming.

Impacts of Climate Change

All around the world, we are now seeing the effects of climate change. The word "Record" also indicates the registration of something to keep a permanent account of it. Similarly, recording temperature will be registering its variations at monitory places where the climatic changes

are not too frequent. Seas are high, because ice caps are melting, causing vulnerability in many countries, especially island nations. Flood risk is increasing in coastal cities. Hurricanes, heat waves, and droughts are becoming more common and have a far-reaching effect on a large number of lives. Due to speedy climate changes, species are not able to adapt accordingly which has led to biodiversity loss. The warming and acidification of oceans is killing coral reefs for instance.

To deal with climate change we can use mitigating and adaption. Switching to renewable energy is important as solar, wind and hydropower are renewable resources. They help to reduce the greenhouse gases released into the atmosphere.

The Role of Individuals

While governments and industries play a crucial role, individuals can also contribute to combating climate change by taking these steps:

- Reduce energy usage by switching off lights and appliances when not in use.
- Use public transport, carpool, or adopt electric vehicles.
- Support eco-friendly products and reduce waste.
- Advocate for policies that prioritize climate action

The Future of Our Planet

Scientific consensus affirms that immediate action is crucial to limit global warming to 1.5°C above pre-industrial levels. Failure to do so will result in irreversible changes to our planet's ecosystems. International agreements like the Paris Accord aim to unite nations in this effort.

Conclusion

Understanding the science of climate change is essential to addressing it effectively. By recognizing the intricate connections within Earth's climate system and the impact of human activities, we can take informed steps toward sustainability. The path to a healthier planet requires collective action, grounded in science and driven by a shared commitment to protect our home for future generations.

SECRETS OF THE UNIVERSE: EXPLORING SPACE DISCOVERIES

Abdullah Shahzad

0263-1-24

The Wonders of the Infinite: From the dawn of humanity, we've gazed at the stars, entranced by their splendor and mystery. There are mysteries locked up in the universe waiting to be unlocked. Space exploration reimagined life as we knew it, from the fringes of a nebula to the pull of a black hole. Let's tour some of the most astonishing space discoveries and their implications.

The Birth of Stars: Stars, the shining building blocks of the universe, originate in vast clouds of gas and dust called nebulae. Think of the Orion Nebula, 1,344 light-years away, as an astronomical workshop turning chaos into stars. The James Webb Space Telescope (JWST) has given us a clearer view of this phenomenon, shedding light on how gravity can shape matter into brilliant sources of light. In these observations, we see the birth of stars as well as the planets that frequently develop around them.



Exoplanets — planets outside our solar system — have revolutionized how we perceive the universe. Millions of planets were revealed by the Kepler Mission — some in the "habitable zone" where life might be possible. Take TRAPPIST-1, a system of seven Earth-sized worlds 40 light-years away. The possibility of liquid water on these worlds stirs deep questions: Could life possibly exist beyond Earth? What might it look like?

Black Holes: Black holes are the universe's ultimate mysteries. Their gravity is so strong that nothing — not even light — can break free. In 2019, the Event Horizon Telescope captured the first picture of a black hole ever

taken by humanity, in M87. The breakthrough confirmed longstanding theories regarding these cosmic phenomena. Black holes distort space-time itself, and provide insights into the limits of physics — and possibly, routes to other dimensions.

The Big Bang's Afterglow: In 1965, quite the background noise was discovered: the faint whisper of the universe's infancy, the Cosmic Microwave Background (CMB). This radiation is a remnant from the Big Bang, a photograph of the universe as it appeared 380,000 years after its birth. Through the cosmic microwave background radiation (CMB), scientists have reconstructed a picture of cosmic evolution from the moment matter created through the Big Bang created galaxies, stars, and planets over 13.8 billion years.

The Red Frontier: Mars, the planet that has long captivated human imagination—has become a prime target of exploration. The Perseverance rover, which touched down in 2021, is also doing groundbreaking experiments, including transforming Martian carbon dioxide into oxygen. With signs of water ice underneath its surface and organic molecules in its soil, Mars is humanity's first step toward living on another planet. Milestones like these point out that the dream of interplanetary colonization is closer than ever.

NASA's Voyager: The Voyager 1 and 2 spacecraft, launched in 1977, are both in interstellar space, and each has a Golden Record onboard, a message in a bottle for whoever might find it. These missions surveyed the outer solar system, revealing the spectacular complexity of moons like Europa and Titan. But they still send back data, a physical incarnation of humanity's age-old pursuit of knowledge and connection.

The Dark Universe: The vast majority of the universe is still beyond our view. Dark matter, an invisible force binding galaxies together, and dark energy, causing the accelerating expansion of the universe, account for 95% of all that exists. No wonder so much of the attention of scientists has turned to these mysterious building blocks, with experiments such as the work at the Large Hadron Collider that begin to stress the laws of physics. By unlocking these secrets, they could redefine the very laws of the universe.

The Search for Life: Astrobiology — the scientific study of life in the universe, including that on Earth —

encompasses many fields, from biology and chemistry to astronomy, and tackles topics that are fundamental to knowing ourselves. The Europa Clipper and Dragonfly missions target icy moons believed to have subsurface oceans. Does it mean alien life exists in these buried waters? With each mission, we get closer to the answer to one of humanity's oldest conundrums: Are we alone in the universe?

A New Era of Exploration: NASA's Artemis program — a front-running, well-funded, and at least to me, fascinating effort to return humans to the surface of the Moon, with the additional intent of establishing a sustainable presence on the Moon within what we think of today as the next decade, the 2030s. This program will give a jump-start to alert Mars missions. Other industries have gotten started to change off-world journey, this means this Maisin comment brings the chance of interplanetary travel — once a distant dream — into actuality. The distinction between science fiction and fact just keeps getting blurrier.

Conclusion: Pushing out beyond our own planet is a testament to the bounds of humanity's curiosity and endurance. From the first glimpse of a distant exoplanet to the faint echoes of the Big Bang, every discovery fuels the desire to know more. Named after his song "Endless Limits," just as we marvel our stars we become aware that beyond our reach are the endless limits. Our journey has just begun.

RAINWATER HARVESTING

Rayyan Amjad

0508-1-23

Rainwater harvesting is a new way of using water that is both sound and has gained worldwide attention for its function in conservation of water and resource management. Given that the world is going through an era of water scarcity and climate change, it allows for a practical alternative to the existing ways of getting water on a large scale. It encompasses the collection and storing of the rainwater for the future, and thus, it helps to economize the water from the already existing sources and in so doing it also necessitates the water in the groundwater reserves.

Rainwater harvesting is not a new concept. Ancient civilizations used to collect and store rainwater for agriculture and household use. Modern rainwater harvesting systems are an evolution of these old practices adapted to urban and rural settings. It consists of 3 main components: catchment area, conveyance system and storage facilities. The catchment area, usually rooftops or open spaces, collects the rainwater. This water is then piped or guttered to storage tanks where it is filtered and stored for use.

Rainwater harvesting has many benefits. It's an environmentally friendly way to conserve water and reduce dependence on groundwater which is often over exploited. By harvesting rainwater communities can mitigate droughts and water shortages. It also reduces the load on municipal water supply systems and saves cost for individuals and governments. In addition, harvested rainwater is free from many pollutants found in surface water making it a cleaner and more sustainable option.

Urban areas can benefit more from rainwater harvesting. Rapid urbanization has increased water demand which often exceeds the capacity of the existing infrastructure. Rainwater harvesting systems can supplement the municipal supply especially during peak hours. It also reduces urban flooding by diverting rainwater into storage systems instead of letting it accumulate on roads and drainage systems. This prevents waterlogging and minimizes contamination of surface water bodies with pollutants carried by storm water runoff.

In rural areas where clean water is scarce, rainwater harvesting can be a lifeline. It provides an affordable and local water source for irrigation, livestock and household use. By increasing water availability it enhances agricultural productivity and rural livelihoods. Communities can also use the harvested water to recharge groundwater aquifers and ensure long term water sustainability.

Implementing rainwater harvesting systems doesn't require technical expertise or high cost, making it accessible to individuals and communities. Simple systems like rooftop rainwater collection can be set up with basic materials like gutters, pipes and storage containers. More complex systems can have advanced filtration units and pumps to ensure water quality and distribution. Maintenance is relatively easy, just periodic

cleaning of the catchment area, filters and storage tanks to prevent contamination.

Despite the benefits rainwater harvesting has its challenges. Public awareness and education on its benefits and methods are lacking. Many individuals and institutions are not aware on how to implement these systems properly. In some areas, regulations and policies do not support or incentivize rainwater harvesting. Governments need to create policies, provide subsidies and promote public private partnerships to encourage widespread adoption.

THE MISSING LINK

Mian Muhammad Aqib

0098-1-24

The origin of birds is one of the most complex questions in Evolutionary Biology. As we observe the fluttering flight of a sparrow, the scurrying skein of geese, or an eagle soaring, we admire their effortless diving. But have we ever paused to question their origins? This journey of evolution began millions of years ago, transforming ancient reptiles into current birds.

Archaeopteryx, often regarded as "The Missing Link" between class Reptilia and class Aves was the earliest bird to conquer the skies. The first bird had a blend of both Reptilian and Avian traits. This makes it an important species in understanding the evolution of ground-dwelling Theropods to sky-dominating birds, highlighting the interesting journey of adaptation and natural selection.

Evolutionary Biologists were curious to know about the origin of birds. They had, in fact, found some similarities between birds and certain Theropods. However, no concrete fossil evidence was found to link birds to their ancestors. The exact nature of this evolutionary change remained a mystery for centuries. In 1861, a German Paleontologist, Herman von Meyer, found a fossil from Southern Germany. It presented a creature with both bird-like and reptile-like features. The radiometric dating of specimens showed that it dominated the skies in the Late Jurassic period approximately 150 million years ago. The name "Urvogel" was applied to it, meaning "First Bird" in German. These fossils helped biologists to understand the

morphology of this ancient creature. Since then, it became a focal point in the study of Avian evolution.

Archaeopteryx evolved from a small carnivorous dinosaur and was about the size of a raven. The largest species could reach about 0.5 meters in length. To protect its offspring from predators, it built its nests in trees. Like birds and dinosaurs it reproduced by laying eggs. It had bony teeth in its jaw socket. Many fossils of birds from later eras of history have also been found that had teeth. It had a long bony tail with many vertebrae. On each hand, there were three fingers, each ending in a sharp claw. They were used for many purposes e.g., climbing, grasping and predation, etc. It was a carnivorous animal and lived in coastal land. The most significant similarity between Archaeopteryx and modern day birds was the presence of feathers, which is a key Avian character.

Over the course of generations, the Avian ancestor has gone through many transitions leading to today's descendants. The solid bones of Archaeopteryx evolved into hollow bones in its descendants leading to weight reduction and increasing flight efficiency. The claws on the wings became a recessive trait and the bony, toothed jaw developed into a beak. Studies reveal that the brain structure of Archaeopteryx was more similar to dinosaurs whereas modern birds have highly advanced brain with sensory capabilities. The respiratory system has also developed.

The exact reason for the extinction of Archaeopteryx is still a topic of scientific debate. However, it is thought that like many other species they went extinct due to a combination of factors that endangered its survival. Their habitats might have altered due to climate change making it difficult for them to survive. Mass extinction events that occurred during the Jurassic period also wiped out many species.

Charles Darwin (1809-1882) proposed "Theory of Evolution" in his book "On the Origin of Species" in 1859. He defined evolution as "Descent with Modification". He stated that organisms share a common ancestor that lived in the remote past.

In 1861, two years after Darwin published his theory, the fossil of Archaeopteryx was found, providing significant evidence to support the theory. Archaeopteryx shared many traits with both reptiles and birds, suggesting a common ancestry between them. This combination of

traits made it a clear example of a transitional fossil. Such transitional forms were predicted by Darwin's theory. The presence of feathers on a dinosaur like animal suggested that complex structures could evolve over time.

There is a lot of controversy on classifying Archaeopteryx either as a reptile or a bird. Some biologists argue that its feathers are too reptilian to be considered as a true bird while others believe that its avian characteristics are sufficient to classify it as a true bird. Moreover, discovery of other feathered dinosaurs has sparked debate about its role in avian evolution.

Archaeopteryx is an amazing example of evolution, indicating how life on Earth has changed over the course of time. It sparks our curiosity to explore and study the complexity of life on the planet. In our aspiration to attain knowledge, each answer we uncover gives rise to ten new questions, creating a never-ending pathway.

FREQUENCY, ENERGY AND VIBRATION

Anas Shakir

0681-1-23

Sir Nikola Tesla once said: **"If you want to understand the secrets of the universe, think in terms of frequency, vibration and energy"**. If we look around us and trace back their real inventors we would come to know that Sir Tesla has made an immense impact on our world. He was an exemplary figure acquired with a powerful imaginary world. The world of our minds where the universe works on our instructions not limited to natural laws. Therefore, first I want you to believe that frequency, energy and vibration are the most crucial parts of our universe. First of all let's visit the quantum world – first there are atoms then electrons and protons which further consist of quarks. Now this becomes interesting because now there are some theories like **"String Theory"** according to which within the quarks i.e. at the most fundamental level there are strings and these strings vibrate just like any other musical instrument. This means that everything at its core is vibrating. This vibration has some frequency and energy as well. But the question arises that what can be the benefit of this knowledge? The answer to this question lies in the fact that everything is vibrating. By manipulating this vibration there are countless things we

can do. Some of the recent or hidden applications of frequency are as follows: first of all let's examine ourselves, we all are familiar with the knowledge of "Neurons" humans have countless neurons in their bodies. These neurons carry the information to different parts of body via electric pulses. So this means that there is a flow of electricity within us.

Now as per the Maxwell's Equation and Christian Ørsted's work we know that flowing current has magnetic fields. This confirms that we are actually tiny generator of magnetic fields. Here we got the first application of vibrations and the properties of frequency which is called "Frequency Healing" sometimes referred to as "Energy Healing" in which we use an external frequency or vibration to tune our body just like tuning a musical instrument. It is believed that some frequencies have the healing power by using the property of waves called resonance. In this context sound healing, Rife Machines and Pulsed Electromagnetic Field Therapy (PEMF) are present in today's world which are supported by research work. The second application of frequency lies in the technique of "Sonic Bloom", this technique is not widely known however there is research and information available on the internet and YouTube as well. In this technique it was believed that Plants interact with frequencies as well, the technique was applied by a farmer and it resulted in sonic growth of plants with bigger size and even more nutritious fruits and vegetables which was confirmed after the comparison of other crops with these ones by having a lab test. Thirdly there is another term referred to as "Acoustic Levitation" or "Acoustic Holograms" in this technique we are able to use the power of frequency to control matter in air. This technique works by using standing waves and in-between these standing waves we can levitate an object. This technique can be either used for the transportation of huge things with ease or in the educational sector where visually appealing teaching methods could be applied.

Moreover, it is also used by NASA's Microgravity Fluid Experiment and there is another device developed by MIT which is called "Acoustic Tweezers" for the precise mixing or separation of chemicals, cells or DNA. The fourth application or area of frequency is attaining clean water by using frequency. It has been believed that there is a technique named "Structures Water Technology". In this technique we use vibrational frequencies to align and structure the water molecules, creating the hexagonal

molecular structure which is believed to be more hydrating and useful not only for humans but also for plants. The area of frequency which is closest to my heart is brain waves capturing and sending signals to it. This field combines neuroscience and technology to enable communication between brain and external devices. A device named as "Electroencephalography (EEG)" is used to capture the signals. However the research to input signal to brain is still undergoing. Imagine a world where our brain could connect directly to the external devices. This will be the point of human history where exponential technology growth will occur. These are not just mere ideas because if we are able to directly connect our brains to the knowledge available on the internet, everything around us will change. The educational sector will be changed because there will be no need to learn mere facts anymore. The hidden presence of frequency, vibration and energy are all around us which I can't explain in this article. The greatest scientist of all times Sir Nicola Tesla was right about his quote. Understanding, Applying and improving these ideas will surely benefit all mankind.

ALGAE PANEL SOCIETY

Haider Mustafa

0687-1-23

Abstract: The most common issue of our atmosphere in world is pollution. The question is why the advance word technology failed in overcoming this issue. Every strategy used to overcome this issue born a new problem. Every country is trying to reduce the use of transport, plastic etc. but it cannot be possible in this fast world or reducing these things effect our economy. So, we want the solution with zero side effects and if there is waste product, it also should be useful for us. So the Home base Algae society is the perfect solution to air pollution with useful side products.



Background: Air pollution is a concerning issue in our society. The only solution we do is closing everything. That's why the basic solution for our whole world is necessary. Algae farm are emerging practice in world but we can use this technology in a simple way by small container strategy. Algae are super financial material, if used in good way. Algae farms required labour, management, cost and it only used for its different products.

How it works: Algae is 10 times better in absorbing CO₂, CO and other hazardous gases than other plants. In some countries people own algae farms for its ability to form amazing products. But we take both benefits. **We don't want a large area to form farms or any large labour.** The perfect structure can benefit people or government financially. Every house have small container. **Let explain the structure and result of experimented housing society.** Every house took container filled with water attach a fan and the bulb for artificial light at night. The government sweepers in society collect the algae daily and pay every house according to weight of algae. Every house accepts to this because it doesn't demand any care or work in response it gives them money. These Algae collected in simple way and delivered to factory as sweepers deliver scrap.

Financial structure: is made in such a way that it benefits everyone. As government workers are registered for every society they collect daily and take it to factories. In this way collection and transport strategy work. Government may pay to households on the basis of weight of Algae. In return government get benefits from products they made.

Algae Products: Algae then converted into bio fuel, beauty product, jet fuel, protein, fertilizers etc. The basic need is here the role of government. We want either private sector or government sector for industrial work to convert the algae in useful products.

Products required: A small container. Water (either fresh or dirty). A small fan for pulling air. A bulb for artificial light.

Future Potential: A clean atmosphere without any disadvantage, financial benefits, a good structure, opportunities, a lot of products. Clean air is basic need of every human being so, this method if implement correctly clean the atmosphere. And will give us a new field of

opportunities. It also gives so much alternative products to natural resources.

THE MYSTERIOUS DEPTHS OF BLACK HOLES: UNLOCKING THE UNIVERSE'S GREATEST ENIGMAS

Ahmad Wajid

0214-1-23

Black holes, one of the biggest mysteries of the universe, have always attracted intellectuals to them. It is a region of space-time where gravity is so strong that if anything enters it, it can never escape from it, not even light. This terrible phenomenon has given the black hole so much hype, and that's why, even after 108 years since the prediction of its existence, it is still the biggest mystery of mankind.

We know that a black hole is formed as a result of the collapsing of a giant star and perhaps by other methods that are still not known. One of the greatest scientists of all time, Albert Einstein, wrongly thought that maybe black holes would not form due to their bizarre characteristics. However, some relativists continued to contend that black holes were physical objects, and by the end of the 1960s, they were quite successful in persuading other researchers that black holes might exist as heavenly physical objects. On the basis of their mass, black holes are divided into three categories: stellar, supermassive, and intermediate-mass, with a suspected fourth type, primordial black holes. These types of black holes have been formed by different natural phenomena occurring in outer space. The black holes are classified on the basis of their mass, independent of the angular momentum. The event horizon is a boundary beyond which events cannot affect an outside observer. It is the boundary surrounding a black hole, beyond which nothing can escape; we can also think of it as the black hole's surface. Once an object or light crosses into it, it is inevitably drawn into the singularity and is unable to escape due to the immense gravitational pull. In the event horizon, the escape velocity exceeds the speed of light. The size of the event horizon depends upon the mass of the black hole.

The more massive the black hole, the larger the event horizon. The radius of the event horizon is referred to as

the Schwarzschild radius and is directly proportional to the mass of the black hole. The event horizon is also central to the black hole information paradox, a great and deep puzzle in theoretical physics. According to quantum mechanics, information about the physical state of a black hole cannot be lost. However, general relativity suggests that once anything crosses the event horizon, all information about it is lost to the outside universe. This paradox has been the subject of great debate among the scientific community. Black holes are also an essential part of Einstein's theory of relativity, which explains gravity as a warping of space-time by mass. In the case of a black hole, the warping is so intense that it creates a "well" in space-time from which nothing can escape.

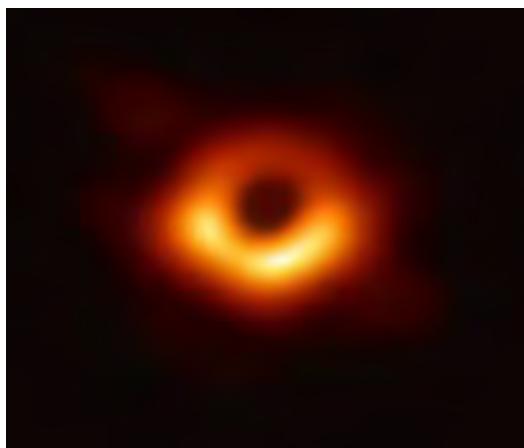


Image: First ever image of Black Hole in center of galaxy Messier 87 taken by Event Horizon Telescope (EHT) on April 10, 2019

Once a black hole is formed, it can also grow by absorbing additional matter. Any black hole will continually absorb gas and interstellar dust from its surroundings. This growth process is one possible way how some supermassive black holes might have been formed; the formation of supermassive black holes is still an open field of research. Black holes, due to their great gravitational force and mass, can also merge with other objects such as stars and even other black holes. In 1974, Stephen Hawking predicted that black holes are not entirely black but emit some amount of thermal radiation. If the Hawking theory of black hole radiation is correct, then black holes are expected to shrink and evaporate over the course of time as they lose mass by the emission of photons and other particles. If black holes evaporate via

Hawking's prediction, then a black hole will evaporate over a period of several years; a supermassive black hole will evaporate around 2×10^{100} years. Such mysterious things like black holes are always intriguing to researchers. Directly observing black holes is difficult because of their extremely black color and the fact that light cannot escape them. However, scientists use indirect methods like observing the behavior of nearby stars, the radiation from matter accelerating around them, and gravitational waves to detect and study black holes.

At present, there are about 40 quintillion black holes within the observable universe. It has been revealed that there are around 50 suspected or confirmed black holes in our Milky Way, but scientists believe that there are more than 100 million black holes in our galaxy alone. The Gaia BH1, which is about 1500 light years away from us, is the nearest known black hole to Earth. Millions of Earths can fit into these black holes because they are enormously large. Ongoing research in black hole physics is exploring many mysteries, from the nature of singularities to the possible existence of wormholes. Future advancements in technology will provide us deeper insight into these cosmic objects.

BIOTECHNOLOGY



2024: YEAR IN REVIEW

Jan

- **Tiny Living Robots Created from Human Cells:** Scientists developed small, living robots called "biobots" using human cells. These tiny entities can move on their own and were created by allowing human cells to self-assemble into functional structures.

Feb

- **Saliva Test for Early Breast Cancer Detection:** Scientists developed a highly sensitive test that can detect breast cancer markers in saliva, specifically targeting HER2 and CA15-3 proteins.

March

- **Creation of Stem Cells for Asian Elephants:** Scientists successfully created induced pluripotent stem cells (iPSCs) from Asian elephants. These special cells can develop into various cell types and are a crucial step toward potentially bringing back the extinct woolly mammoth.

April

- **Discovery of a New Class of Antibiotics Effective Against Drug-Resistant Bacteria:** Scientists identified an entirely new class of antibiotics that can effectively combat bacteria resistant to multiple drugs. These compounds target a protein called LpxH, essential for bacterial survival, and have been shown to cure bloodstream infections in mice.

May

- **Release of a Bioprocessing System for Human Brain Organoids Performing Computational Tasks:** Scientists developed a system that allows lab-grown human brain cells, known as organoids, to perform computational tasks. This innovation enables researchers to study brain functions and diseases more effectively.

June

- **Advancements in CRISPR Gene Editing Techniques:** Researchers made significant progress in CRISPR gene-editing technology, enhancing its precision and efficiency. These advancements hold promise for treating genetic disorders and improving crop resilience.

July

- **Approval of Donanemab (Kisunla) for Early Alzheimer's Disease:** The U.S. Food and Drug Administration (FDA) approved a new drug called donanemab, marketed as Kisunla, for treating early symptomatic Alzheimer's disease. This medication targets amyloid plaques in the brain, which are associated with the progression of Alzheimer's.

Aug

- **Exploration of Biotechnological Opportunities in Outer Space:** Researchers explored the potential of biotechnological innovations, such as growing plants in microgravity and developing new drugs, to support long-duration space missions and improve life on Earth.

Sep

- **Genetic Insights into Cholera Severity:** Researchers identified specific genes in cholera bacteria that influence the severity of the disease and its spread, aiding in the development of better treatments and prevention strategies.

Oct

- **Fruit Fly Brain Mapping:** Scientists mapped 140,000 neurons in a fruit fly brain to understand brain functions.
- **Nobel Prize for microRNA Discovery:** Victor Ambros and Gary Ruvkun won the Nobel Prize for discovering microRNA, crucial for gene regulation.

Nov

- **Nobel Prize in Chemistry for AI in Protein Design:** The Nobel Prize in Chemistry was awarded to researchers who developed artificial intelligence (AI) methods to predict protein structures. This advancement allows scientists to understand how proteins function, aiding in drug development and disease research.

Dec

- **Discovery of a 'Goldilocks' Zone for DNA Organization:** Scientists uncovered how DNA, magnesium, and a molecule called polyphosphate interact in a balanced way, which is crucial for organizing DNA within cells. This understanding could lead to new innovations in medicine and biotechnology.

MOVIE REVIEWS

ANNIHILATION (2018)

Farhat Amin

0107-BS-BIO-T-22

The movie *Annihilation* was directed by **Alex Garland** in 2018 based on the novel of same name. It is a science fiction film that takes audiences on a journey into the unknown realm which defies the laws of nature. It is psychological thriller science fiction about the biology, transformation and the unknown forces of nature.

A biologist Lena performed by Natalie Portman joins an expedition team to explore a mysterious zone known as "**The Shimmer**." This region is slowly expanding and has strange environment which neglect nature laws and causing mutations in plants and animals and fading the boundaries between species. Alongside her are other specialists, including psychologist Dr. Ventress (Jennifer Jason Leigh), physicist Josie Radek (Tessa Thompson), paramedic Anya Thoresen (Gina Rodriguez), and geomorphologist Cass Sheppard (Tuva Novotny). The team explore through the shimmer to uncover its mysterious environment. They encounter terrifying mutations of plants and animals. The deeper they go, the more they realize that The Shimmer is not just transforming the environment but it is also affecting their mental and physical being.



The primary theme of *Annihilation* includes the concepts of mutation, transformation of species and the destructive nature of humans. The personal struggles of the characters mirror the physical and psychological changes they undergo within The Shimmer. The movie explores the role of emotions such as guilt, fear, grief in altering and shaping humans. The scientific elements such as DNA mutation in The Shimmer highlights the potential dangers that can arise due to advancements in genetic manipulation and biological experimentation.

The movie *Annihilation* is much more than a typical Sci-fi due to its visual style and exploration of scientific phenomenon. The bioluminescent plants and mutated creatures in the Shimmer appear very beautiful yet terrifying. The performances of Natalie Portman as grieving woman dealing with both personal and external issues add emotional depth to the plot. On the other side, there are a few aspects of the film such as the plot is difficult to follow due to the ambiguous nature of the film which might frustrate some viewers. While the open-endedness of the story invites interpretation, it can also feel unsatisfying for those who prefer a straightforward narrative. Some of the supporting characters don't get enough screen time for development to leave a lasting impact.

In conclusion, the movie *Annihilation* has stunning visual aesthetics involving the portrayal of complex themes of self-destruction, transformation and unknown forces of nature. While some viewers might be frustrated due to its open-ended plot but its exploration of the boundaries between science, human psyche and the natural world makes it a compelling watch. The strong performances, haunting visuals and scientific atmosphere effectively immerse audiences in a world where reality bends and mutates. *Annihilation* is not a movie with easy answers, but rather an experience that challenges viewers to reflect on the limits of human understanding and the potential dangers of exploration into the unknown areas. For viewers who appreciate deep philosophical and psychological themes, *Annihilation* offers a unique and unforgettable cinematic experience.

COLD SKIN (2017)

Mahdiya Faisal

0001-BS-BIO-T-22

Introduction: The story of "Cold Skin," which was directed by Xavier Gens and came out in 2017, is woven with a number of scientific themes, including genetic engineering, evolutionary biology, marine ecology, and ethical issues. The movie, which is set in 1914, centers on a young weather observer named "Friend," who finds himself on a barren island close to the Antarctic Circle. There, he meets Gruner, a solitary lighthouse keeper, and learns that there are amphibious humanoid animals that come out of the water at night.

Evolutionary Biology and Adaptation: These marine animals' representations encourage reflection on evolutionary processes, especially convergent evolution, which is the process by which unrelated species acquire similar characteristics as a result of comparable environmental stresses. These animals in the movie display both aquatic and terrestrial traits, pointing to an evolutionary route that permits survival in hostile, remote settings. The humanoid characteristics of the creatures also raise the possibility of parallel evolution, in which various species may develop human-like forms as a result of comparable environmental stresses.



Genetic Engineering and Biotechnology: Discussions regarding the potential and moral implications of genetic engineering in biotechnology are prompted by the existence of such hybrid organisms. Scientists can now edit genes with previously unheard-of precision thanks to developments in CRISPR-Cas9 technology, which could have uses in repairing genetic defects or producing organisms with desired traits. However, the development of hybrid organisms, similar to the creatures in the movie, presents moral dilemmas regarding the modification of basic elements of life and the unintended consequences that could result from such actions. For example, a species' ecological balances may be upset by the introduction of new traits, which could have unforeseen environmental effects.

Marine Ecology and Conservation: The remote location of the island provides a microcosm for researching marine ecosystems and the delicate interspecies balance. The sea creatures' nightly attacks on the lighthouse imply protective or territorial behavior, which may indicate the island's importance in their life cycle—possibly as a breeding ground or an essential resource area. The nesting habits of some marine species, where particular sites are essential for reproduction and survival, are mirrored in this behavior. As a result, the movie offers a forum for talking about the value of protecting habitat and the possible repercussions of human encroachment into delicate ecological areas. The decline or extinction of species can result from disturbance of these habitats, underscoring the necessity of conservation measures to preserve biodiversity.

Ethical Considerations in Biotechnology: Human-sea creature interactions highlight ethical concerns in biotechnology, including food safety, genetic resource control, and environmental impact. The development of GMOs and de-extinction raise ethical and ecological concerns. Thorough ethical frameworks are necessary for responsible development and application of biotechnological research to avoid harm to ecosystems and human health.

Parallels to Real-World Scientific Exploration: "Cold Skin" mimics real-life situations in which adventurers come across unexplored regions and unidentified animals. Instead of acting out of fear, the movie highlights the value of scientific observation, open-mindedness, and a readiness to absorb new information. It illustrates the difficulties scientists encounter in striking a balance between their obligation to ensure that their research subjects are not harmed and their quest for knowledge. The story promotes a scientific methodology based on respect, curiosity, and ethical consideration—all of which

are critical components of modern scientific methods. Adopting such a strategy encourages responsible innovation and peaceful coexistence with the environment.

Conclusion: The fictitious movie "Cold Skin" examines scientific subjects such as genetic engineering, evolutionary biology, marine ecology, and moral dilemmas. It advances a more comprehensive understanding of science and technology by highlighting the intricacies of the natural world and the obligations people have when they meet the unknown.

AI BASED DRUG DISCOVERY

Hamayat Ali

0049-BS-BIO-T-22

Abstract

With about $>10^{60}$ the vast chemical space presents a wealth of opportunities for the creation of novel medications. However, because of the limits of conventional technology, the drug development process is frequently expensive and time-consuming. By more quickly finding promising drug candidates, confirming therapeutic targets, and improving molecular structures, artificial intelligence (AI) can assist in overcoming these obstacles. This lowers costs and speeds up the discovery process considerably.

AI in Drug Screening

Nearly **90%** of drug candidates fail regulatory approval or Phase II trials despite efforts to develop new drugs, which take over **ten years** and cost approximately **\$2.8 billion**. To address this, AI-powered virtual screening (VS) uses models such as Random Forest, SVMs, Nearest-Neighbor classifiers, and deep neural networks (DNNs) to predict biological activity, toxicity, and synthesis viability.

Big pharma companies like **Bayer, Roche, and Pfizer** collaborate with tech firms to develop AI-driven drug discovery platforms, particularly for immuno-oncology and cardiovascular diseases.

Prediction of Physiochemical Properties

Molecular details such as atomic coordinates, electron density, potential energy, and **SMILES** strings are analyzed by AI models to evaluate new drug compounds; deep neural networks (DNNs) further refine predictions, simplifying drug discovery. Drug design relies on accurately predicting properties such as solubility, permeability, ionization, and logP.

AI is crucial in drug development, as evidenced by research such as **Zang et al.**'s development of a **QSPR** workflow using data from the EPA's EPI Suite, the improvement of solubility predictions by graph-based convolutional neural networks (CVNN), the estimation of lipophilicity and solubility by AI models like **ALGOPS** and **ADMET**, the prediction of acid dissociation

constants (pKa) by kernel-based methods and artificial neural networks (ANNs), the improvement of drug absorption forecasts through the analysis of cell permeability data, and the reinforcement of intestinal absorption estimates by Random Forest (RF) and DNN-based models.

Prediction of Bioactivity

Effectiveness is determined by a drug's capacity to bind to a particular protein or receptor. Failure to bond stops the intended effect, while unintended interactions can be harmful. Drug-target binding affinity (DTBA) analysis is necessary for predicting these interactions. AI models evaluate DTBA based on structural or chemical similarities; similarity-based approaches presume that similar medications target the same proteins, whereas feature-based approaches examine molecular attributes.

Web tools with AI capabilities, such as ChemMapper and SEA, help forecast drug-target interactions. Commonly employed methods include KronRLS, SimBoost, DeepDTA, and PADME. Regression trees are used by SimBoost to predict binding affinity, whereas KronRLS assesses drug-protein similarity.

Accuracy is improved by deep learning (DL) models like DeepDTA and PADME, which examine molecular representations like SMILES and amino acid sequences. Using recurrent and convolutional neural networks, DeepAffinity enhances predictions.

By employing models like MANTRA and PREDICT to cluster medications based on gene expression, AI also makes drug repurposing possible. Furthermore, AI-powered technologies that forecast drug metabolism and clearance include MetaSite, SMARTCyp, and XenoSite. AI's role in drug research is demonstrated by SVM-based models, which predict drug clearance with high accuracy.

Prediction of Toxicity

Drug toxicity prediction is essential to preventing negative consequences. Animal investigations are typically conducted after in vitro tests, which raises the expense of medication research considerably. By exploiting molecular similarities, AI-driven algorithms such as LimTox, pkCSM, admetSAR, and Toxtree anticipate toxicity and save costs.

Through the Tox21 Data Challenge, which was organized by the FDA, NIH, and EPA, 12,707 medications and substances were evaluated using computational techniques. DeepTox, a machine learning (ML) algorithm, identified chemical features such as weight and Van der Waals volume and enhanced toxicity predictions utilizing 2,500 toxicophore attributes.

SEA and other AI tools evaluate the safety of marketed medications by anticipating unexpected interactions. The accuracy of eToxPred's toxicity and synthesis feasibility predictions is 72%. Open-source programs such as TargeTox and PrOCTOR, which use biological network analysis and Random Forest (RF) respectively, help forecast toxicity.

Convolutional neural networks (CVNNs) are used in deep learning models such as Tox_(R)CNN to examine cytotoxic effects on labeled cells, further refining toxicity evaluation.

Ai in Designing Drug Molecules

Prediction of the Target Protein Structure: AI improves structure-based drug discovery by using peptide bond angles and amino acid distances to predict 3D protein structures. Twenty-five out of forty-three structures were correctly predicted by the deep neural network (DNN) tool AlphaFold. In order to minimize departure from experimental data using the distance-based root mean square deviation (dRMSD) metric, the recurrent geometric network (RGN) iteratively refines backbone structures and encodes protein sequences using recurrent neural networks (RNNs). For proteins with known structural similarities, AlphaFold is more accurate than RGN, despite RGN's speed.

AI's use in protein modeling and drug design is further demonstrated by a MATLAB-based three-layer neural network (NN) that used supervised learning and backpropagation to predict 2D protein structures with 62.72% accuracy.

AI in Drug–Protein Interactions and DE NOVO Drug Design

Protein-Drug Interactions: Interactions between drugs and proteins affect polypharmacology prevention, repurposing, and efficacy. Predictions of ligand-protein

interactions have been greatly enhanced by AI, improving therapeutic results.

SVM Models: By training an SVM on 15,000 protein–ligand interactions, Wang et al. were able to identify nine new compounds that target four important proteins.

Drug discovery was accelerated by **Yu et al.**'s Random Forest (RF) models, which combined chemical and pharmacological data and outperformed SVMs in terms of sensitivity and specificity.

iDrugTarget: This predictor was created by Xiao et al. and has excellent accuracy for GPCRs, ion channels, enzymes, and nuclear receptors.

AI dramatically lowers drug repurposing costs (\$8.4M vs. \$41.3M). Deep learning (DL), logistic regression, SVMs, and neural networks (NNs) are used by platforms such as PREDICT and SPACE to analyze chemical structures, gene expression, and drug similarities. DeepDTnet indicated topotecan for multiple sclerosis.

Self-Organizing Maps (SOMs): These unsupervised models discover off-targets for medication repurposing. Receptor interactions are also predicted by AI to avoid polypharmacology. KinomeX employs DNNs for kinase selectivity that have been trained on 14,000 bioactivity data points. Ligand Express is an AI tool that runs on the cloud that analyzes interactions between small molecules to determine side effects.

DE NOVO Drug Design: By replacing traditional methods that involve complex synthesis and imprecise bioactivity predictions, artificial intelligence (AI) has revolutionized de novo drug discovery.

Chematica (Synthia): Grzybowski et al. developed this tool to optimize synthesis routes, lowering costs and increasing efficiency.

Monte Carlo Tree Search & Symbolic AI: When combined with DNNs, these techniques enable rapid retrosynthesis and reaction prediction.

Reinforced Adversarial Neural Computer (RANC): An RL-based AI model that generates small organic compounds with predefined molecular descriptors (MW, logP, TPSA). It outperforms ORGANIC in producing unique structures.

Conclusion

AI's improvements in synthesis, prediction, and repurposing have completely changed the drug discovery process. Enhancing drug design, toxicity assessment, and pharmacokinetics, machine learning, deep learning, and reinforcement learning lower costs, speed up development, and improve the precision of drug-target interactions, bioactivity predictions, and structural evolution.

SINGLE-CELL PROTEIN: PROS AND CONS

Irum Raza

0095-BS-BIO-T-22

Single-cell protein (SCP) is protein derived from single-cell organisms, namely, bacteria, fungi, algae, and yeast. These organisms are grown in controlled settings, and their cells are collected as a form of protein providing an unprecedented source of protein as an alternative to conventional protein sources such as meat, fish and plant-based proteins. With the rise in populations across the globe, single cell protein is on the rise as an increasing source of protein. This is largely because it can help solve the food security problems, especially regarding sustainability and resource efficiency. And of course, it has notable solutions on environmental issues. But, as with any new technology, it has its pros and cons.

Pros of Single-Cell Protein

SCP is environmentally sustainable: This is among the most significant benefits we have related to the future. Traditional livestock farming is resource-intensive, using up tons of water, land, and feed. That in turn results in greenhouse gas emissions and the extinction of natural resources. In contrast, SCP production requires far fewer resources. Yeasts and algal cultures can be cultivated in more controlled environments while requiring fewer resources as they are microorganisms. Algae-based SCP is one of the most efficient and environmentally beneficial SCP productions available, as algae can be grown by using wastewater or carbon dioxide as a feedstock.

Rich Source of Protein: SCP is rich in protein and can be a rich source of all essential amino acids endowing high nutrition value. Besides that, several

microorganisms employed for SCP production like fungi and algae are rich in vitamins, minerals and other bioactive compounds. Especially in regions suffering from malnutrition, this extra protein could help to improve the nutrient content of food products. Further, SCP can be adjusted to the required dietary needs by manipulating the composition of the microorganisms in the culture during fermentation.

Lower Land Required and Less Environment Impact: Compared to producing livestock typical large areas of land are not needed for SCP production. Such a decrease in land use could protect biodiversity and address the soil degradation and deforestation caused by extensive agriculture. SCP can also be produced in cities or places with low amounts of arable land using smaller and controlled environments, which also alleviates the burden on natural ecosystems.

Fast And Large Scale Production: Microbes grow rapidly and SCP can be produced on a large scale within a short span of time. This implication would allow for mass production of SCP for steady and reliable protein source supply to meet global demand. In addition, the scalability of SCP production systems enables it to be established in various regions, especially in areas where traditional protein sources may not be readily available.

Recycling of Waste: Some SCP, especially ones based on either algae or bacteria, can be generated from waste streams such as agricultural by-products, food waste, and even CO₂ emissions. Not only does this help in reducing waste, it also helps in reducing demand for raw inputs for protein production, making it a more circular and sustainable process. For example, SCP production utilizing carbon dioxide derived from industrial point sources could contribute to greenhouse gas emission mitigation.

Cons of Single-Cell Protein

High Production Costs: SCP has the potential, but production costs are still relatively high, making it an economic disadvantage. Microorganisms can be grown in a matter of hours but they require specific setups, a controlled environment, and nutrient-rich substrates (which add to the costs) for the growth- so compared to soy, peas, and even meat, SCP production is more expensive. Moreover, producing at a larger scale comes with different financial roadblocks.

Consumer Acceptance and Perception: People may still find it unappealing or unnatural to eat protein made from bacteria, yeast, or algae. SCP product acceptance may face challenges due to concerns over safety, taste and nutritional value of SCP between consumers, which could prevent broad adoption of SCP products — particularly in regions with a rich tradition of food sources.

Possible Health Risks: While SCP is generally considered safe for consumption, the use of microorganisms raises concerns about potential contamination or pathogens. The controlled environment must prevent bacteria or fungi that can be harmful to humans from growing on it. Additionally, SCP products must be free from undesirable content (toxins/allergens) requiring adequate regulatory monitoring and safety standards.

Narrow Range of Sources: The vast majority of SCP products available today derive from a small number of selected species, which does not accommodate the full spectrum of nutritional needs and consumer preferences. While this would expand the range of microorganisms that having of protein options available to eat would lead, it would need to do more research.

Technological and Knowledge Gaps: SCP technology is still in its early stages, and many of the production processes are not yet optimized for large-scale, cost-effective manufacturing. Researchers are working to improve the efficiency of microbial fermentation, increase yields, and reduce production costs. However, technological and knowledge gaps remain, which may slow down the widespread adoption of SCP as a mainstream food source. Significant investment in research and development will be required to make SCP a viable and affordable alternative to traditional protein sources.

Conclusion

Single-cell protein holds great promise as a sustainable, nutritious, and efficient source of protein, with the potential to play a key role in addressing global food security and environmental challenges. Its ability to be produced with fewer resources, using waste streams, and on a large scale makes it an attractive alternative to traditional protein sources. However, challenges such as high production costs, consumer acceptance, and

regulatory concerns must be addressed before SCP can become a widely adopted solution. As research and development continue to advance, the pros and cons of SCP will become clearer, and it could become an essential part of the future of food.

AEROSPACE FERMENTATION

Irum Raza

0095-BS-BIO-T-22

To introduce, fermentation is a metabolic process in which microorganisms, such as bacteria, yeast, and fungi, convert organic substrates (typically sugars) into simpler compounds. In this text, we shall explore the potential, applications, challenges and innovations in fermentation in an aerospace setting. The basic biology of fermentation makes it a great tool for supporting life in space. Space missions can be more self-sufficient by it, reducing the reliance on Earth for supplies and resources, thus allowing long term travel. Microbial fermentation, in particular, exhibits strong potential for the production of food, oxygen, biofuels, pharmaceuticals and even waste recycling in space environments.

So why do we need fermentation in space? The main reasons would be to support long-term travel by using supplies more efficiently, and to potentially develop survival methods for interplanetary missions or even settlement. Fermentation would provide an excellent means of recycling, preserving and inventing from existing supplies, where methods like agriculture are unavailable. The versatility of fermentation also lies in its ability to produce a wide range of useful by-products. In space, where oxygen and other resources may be limited, fermentation processes can be used to convert waste products (such as carbon dioxide) into valuable substances.

Knowing the applications of aerofermentation, it brings us to the next question. Is fermentation in the harsh conditions of aerospace even possible? The good news is, YES! In the microgravity environment of space, the behavior of microorganisms can differ significantly from their behavior on Earth, becoming more challenging and less efficient. However, upon sampling the exterior of spacecrafts, strains of bacteria were found! This allowed a

new niche for research, and microorganisms have been tested for their productivity in space since.

In an exciting case study, fermentation was carried out thrice, under normal conditions, space-replicated conditions and in space. The The MIT Space Miso experiment, conducted aboard the International Space Station (ISS), tested how the fermentation of miso—a traditional Japanese food made from soybeans and koji mold— would perform in microgravity. Researchers aimed to observe whether the fermentation process could function properly in space where gravity is nearly nonexistent.

Three samples of Miso were created on Earth. The first being control, the second was placed in a bioreactor which simulated a space-like environment with microgravity etc. The third was sent to space. Each sample was allowed to ferment for 30 days, and then brought back to be tested via shotgun metagenomics. The samples were analyzed for microbial communities' composition and safety, mutation rate of *A. oryzae*, aromatic compounds, amino acids and organic acids, color and flavor.

Upon comparison, there were certain differences between the flavour chemistry and microbial mutation rate. The amount of growth appeared similar. Notably, the space sample fermented faster, thought to be due to the increased temperature/travel disturbances. In conclusion, the space sample was still recognizable as miso, and was deemed safe for consumption.

To conclude, the future of aerospace fermentation holds exciting possibilities for long-term space missions and even intergalactic travel. The need for sustainable, self-sufficient life support systems becomes inevitable as space exploration continues. Fermentation, is a technology with great potential and upcoming applications here, as it holds the ability to produce oxygen, food and energy amongst many more products.

Aerospace fermentation holds great promise in that it not only makes a useable variety of nutrient dense foods, but also using simple ingredients. This includes proteins, vitamins, and amino acids. For example yeast-based proteins or algae, they can be cultivated in bioreactors without consuming lots of inputs. It could cut down on food resupplies from Earth, which means that space missions would need fewer delayed shipments of food

from Earth. Another potential utilization is to assist astronauts recycle waste and produce energy. Living in a closed-loop system, waste products such as carbon dioxide (CO₂) or organic matter could be sent directly to bioreactors, and microbes could breakdown the waste in exchange for useful by-products, ranging from oxygen and biofuels to food. This recycling approach would minimize need for re-supply missions. Since this is already done there, it saves time, effort and money. Moreover, biofuels generated from waste could be used to power spacecraft or energy and also life support systems, boosting efficiency even further.

In the future, we might see more advanced bioreactors designed to work in the challenging environment of space. These systems could become smaller, more energy-efficient, and more automated. This would be essential for long-duration interstellar missions. Additionally, advances in synthetic biology could enable the creation of specialized microorganisms that produce even more diverse and complex products and materials like plastic that could be useful for astronauts during their missions.

ASTRO-BIOTECHNOLOGY: A STEP AHEAD THE BOUNDARIES OF THE UNIVERSE

Muhammad Tayyab

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Introduction

Astro-biotechnology research focuses on these questions: How does life begin and evolve? Does life exist elsewhere in the Universe? What is the future of life on Earth and beyond? Over the past 50 years, astro-biotechnologists have uncovered a number of clues to answering these Questions.

Since the astro-biotechnology community published its last roadmap, research in the field has focused more and more on the connection between the “astro” and the “bio” in astro-biotechnology—that is, what makes an extraterrestrial body habitable. “Reside ability” has become a major buzzword in astro-biotechnology/astro-biotechnology as researchers have learned more about extraterrestrial environments in our Solar System and beyond and deepened their understanding of how and when the early Earth became habitable.

- Why is Earth habitable?
- How, when, and why did it become habitable?
- Are, or were, any other bodies in our Solar System habitable?
- Might planets orbiting other stars be habitable?
- What sorts of stars are most likely to have habitable planets?

These are just a few of the questions that astro-biotechnologists are trying to answer today.

In preparing this new science strategy, hundreds of members of the astro-biotech community collaborated in an intensive process of defining goals and objectives for astro-biotechnology research moving forward. The community identified six major topics of research in the field today:

- Identifying abiotic sources of organic compounds
- Synthesis and function of macromolecules in the origin of life
- Early life and increasing complexity
- Co-evolution of life and the physical environment
- Identifying, exploring, and characterizing environments for residence and biosignatures
- Constructing habitable worlds

Identifying Abiotic Sources of Organic Compounds

A major goal of research on this topic in astro-biotechnology is to understand how the abiotic production of small molecules led to the production of large and more complex molecules, pre-biotic chemistry, and the origin of life on Earth. This line of research also aims to understand what roles primitive icy bodies (asteroids and comets) play in the origin of life on habitable planets and whether life or pre-biotic chemistry could or did evolve on differentiated (altered) icy worlds such as Enceladus, Europa, and Titan.

Synthesis and Function of Macromolecules in the Origin of Life

On Earth, macromolecules form the catalytic and genetic means for life to sustain itself.

The macromolecules are composed of a small subset of smaller organic molecules. It is likely that the exact components of these macromolecules are accidental. It is crucial to characterize the overall chemical underpinnings

of the processes that lead to the function and persistence of evolvable macromolecular systems. As part of this effort, it is necessary to identify interactions, intermediary structures and functions, energy sources, and environmental factors that contributed to the diversity, selection, and replication of these systems.

Catalysis can be carried out by nucleic acids and proteins. In general, protein catalysis is more efficient than nucleic acid catalysis. Nucleic acid catalysts found in life today are thought to be “living fossils” of an earlier system. These polymers can be seen not only as the information and function carrying molecules in life on Earth but also as information and function carrying molecules for life on any planet.

To further refine understanding of life’s origins and early chemical evolution, researchers must continue to map the chemical landscape of potential primordial informational polymers. The advent of polymers that could replicate, store genetic information, and exhibit properties subject to selection likely was a critical step in the emergence of pre-biotic chemical evolution. Astro-biotechnologists thus must focus on developing an understanding of macromolecule synthesis, stability, and function in the context of plausible pre-biotic conditions and environments.

Early Life and Increasing Complexity

Over four billion years, life on Earth has generated an extraordinary range of organizational plans, creating the immense variety that operates on Earth today. Astro-biotechnologists face the challenge of deciphering overarching rules for evolutionary processes, drawing on theory and observation to make a general model of life.

Recognizing life on other planets depends on how scientists define life. However, defining life has proved problematic because it is unclear where to draw the boundary between living and non-living entities. For example, self-replicating RNA, viruses, and prions are alive by some definitions but not by others. Identifying which attributes of life are likely to be common to all origins, and which are context-dependent, will enable better predictions about the possible nature of life on other planets.

Co-Evolution of Life and the Physical Environment

Life affects its environment. And the environment affects life. Astro-biotechnologists are focused on understanding the relationship between life and environment well enough to inform the search for potentially habitable environments beyond Earth. Examples of major transitions in biological evolution that affected our planet include the origins of photosynthesis, multicellularity, and intelligent life. Major changes in the physical state of the planet that have affected biology include the emergence of plate tectonics and continents, as well as climatic transitions such as “Snowball Earth” episodes.



Studying the co-evolution of life and environment informs other lines of research in astro-biotechnology in three major ways. First, the delivery of abiotic organic compounds to Earth and the development of pre-biotic chemistry on Earth can be thought of as the first environmental influences on life. Second, as early life evolved increasing complexity, its interactions with the planet would have increased in diversity, eventually developing into complex feedback systems. Studying Earth's co-evolutionary past can improve understanding of resilience on Earth and Earth-like planets. Third, studies of other planets—both real and hypothetical—inform and benefit from work on the intimate interactions between life and its physical environment.

Conclusion

Given Astrobiotechnologists focus on the search for planets and life, astro-biotechnology will be the focus of a growing number of Solar System exploration missions. Astro-biotechnology research sponsored by different space agencies and governments will continue pushing

science closer to answering the Big Questions in space science: Where did we come from? Where are we going? And are we alone?

NANO-FERTILIZERS FOR CROP IMPROVEMENT

Maham Rasool Rana

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Abstract

With the global population expected to reach 11 billion by the next century, food production must rise by 60-70%. Traditional fertilizers, though effective, have caused soil degradation, environmental pollution, and inefficient nutrient use. Nano-fertilizers, which deliver nutrients in a controlled and precise manner, offer a sustainable alternative by enhancing nutrient uptake efficiency, reducing waste, and minimizing environmental impact. The article categorizes nano-fertilizers into macronutrient-based, micronutrient-based, nanocomposite, slow-release, and surface-coated types, each designed to improve crop productivity, soil health, and water use efficiency. By integrating nanotechnology into agriculture, nano-fertilizers provide a promising solution to meet future food demands while promoting sustainable farming practices and reducing environmental harm.

Introduction

As the world's population is expected to reach 11 million by the next century, food production should increase by 60% - 70% to meet the rising demand of humans. Conventional methods to address this challenge have heavily relied on the use of pesticides, chemical fertilizers, and genetically modified seeds. However, excessive use of chemical fertilizers has led to problems such as soil and health degradation, reduced food quality and significant environmental problems. The accumulation of these chemicals has far-reaching environmental consequences, impacting soil microflora, marine ecosystem and parasitic organisms.

The limitations of traditional fertilizers such as soil fertility decline, environmental harm, and inefficient nutrient use, have highlighted the need for innovative solutions in agriculture, one approach is the integration

of nanotechnology to achieve sustainable farming and enhance crop productivity.

Nanotechnology holds immense potential to transform agriculture. Scientists are using tools to improve crop yields and crop compatibility, and promote sustainability. Nanofertilizers can deliver nutrients precisely to plant roots, improving uptake efficiency and reducing waste, which leads to healthier plants and higher yields.

Nanofertilizers

Nanofertilizers act as plant nutrients themselves or carriers of plant nutrients. Nutrients present inside the nanomaterials are called nanofertilizers. These are designed to deliver nutrients in a more controlled and efficient manner.

Synthesis of Nanofertilizers

There are two methods to synthesize nanofertilizers:

Top-down synthesis: In this method, a large amount of material is broken into nano-sized particles by ball-milling. The methods include mechanical treatment, chemical treatment, thermal/laser extrusion, and sputtering. 100 to 300 nm sized particles are achieved. Firstly, materials are treated by various oxidizing and reducing agents. Then carbon vapor deposition is used in sputtering thin films are deposited using vacuum.

Bottom-up synthesis: In this method, the nanofertilizers are synthesized from small monomers. This method uses physical and chemical approaches. It uses various methods such as precipitation, vapor deposition, sol-gel process, molecular condensation, laser pyrolysis, aerosol pyrolysis, and spray pyrolysis.

Types of Nanofertilizers

Nanofertilizers are advanced agricultural inputs that leverage nanotechnology to enhance nutrient delivery, improve crop productivity, and promote sustainable farming practices. They are designed to address the limitations of conventional fertilizers, such as low nutrient use efficiency, environmental pollution, and soil degradation. Based on their composition, functionality, and mode of action, nanofertilizers can be classified into several types:

1. Macronutrient-Based Nanofertilizers

These nanofertilizers provide essential macronutrients like nitrogen (N), phosphorus (P), and potassium (K), which are required in large quantities for plant growth.

Examples:

Nano-nitrogen fertilizers: These release nitrogen in a controlled manner, reducing losses due to leaching and volatilization.

Nano-phosphorus fertilizers: They enhance phosphorus availability, which is often limited in soils due to fixation.

Nano-potassium fertilizers: These improve potassium uptake, supporting plant health and stress tolerance.

2. Micronutrient-Based Nanofertilizers

These fertilizers supply trace elements like zinc (Zn), iron (Fe), copper (Cu), manganese (Mn), and boron (B), which are vital for enzymatic activities and metabolic processes in plants.

Examples:

Nano-zinc fertilizers: Address zinc deficiency, which can impair plant growth and development.

Nano-iron fertilizers: Combat iron deficiency, preventing issues like chlorosis (yellowing of leaves).

3. Nanocomposite Fertilizers

These are hybrid formulations that combine multiple nutrients (both macro and micronutrients) into a single nanoparticle.

They offer a balanced nutrient supply and are designed for targeted delivery to plants.

Example: A nanocomposite containing nitrogen, phosphorus, and zinc for comprehensive crop nutrition.

4. Slow-Release Nanofertilizers

These fertilizers are engineered to release nutrients gradually, matching the nutrient uptake pattern of plants.

They minimize nutrient losses through leaching, runoff, or volatilization, making them more efficient and environmentally friendly.

Example: Nano-encapsulated urea that releases nitrogen slowly over time.

5. Surface-Coated Nanofertilizers

In this type, nanoparticles are coated with protective layers (e.g., polymers or organic materials) to control nutrient release and enhance stability.

The coating protects nutrients from environmental factors like moisture, heat, or microbial degradation.

Example: Polymer-coated nanofertilizers for controlled nutrient delivery.

Applications

Nanofertilizers have a wide range of applications in modern agriculture, offering innovative solutions to enhance crop productivity and sustainability. One of their primary uses is **improved nutrient delivery**, as they can deliver essential nutrients directly to plant roots or leaves, ensuring better absorption and minimizing losses. This targeted approach not only boosts **crop yields** but also enhances the overall health and quality of plants. Additionally, nanofertilizers are designed with **slow-release mechanisms**, allowing nutrients to be released gradually over time, which matches the plant's uptake needs and reduces the frequency of applications. They also play a significant role in **improving soil health** by reducing degradation and promoting beneficial microbial activity.

Another critical application is their contribution to **environmental protection**, as nanofertilizers minimize nutrient leaching, runoff, and greenhouse gas emissions, thereby reducing pollution. They are particularly effective in addressing **micronutrient deficiencies** in crops, such as iron or zinc, which are essential for plant growth and disease resistance. Furthermore, nanofertilizers can improve **water use efficiency**, making them ideal for regions facing water scarcity. By integrating nanotechnology into agriculture, nanofertilizers support **sustainable farming practices**, helping to meet the growing demand for food while preserving natural resources and reducing environmental impact.

CONVERGENCE OF ARTIFICIAL INTELLIGENCE AND CRISPR: A PARADIGM SHIFT IN BIOTECHNOLOGY

Sajal Javed

0103-BS-BIO-T-22

The convergence of CRISPR gene editing and Artificial Intelligence is leading mankind towards a revolutionary era of biotechnology, making remarkable innovations across various sectors. This collaboration propagates precision, efficiency and variations in genetic engineering providing solutions to complex challenges in medicine, agriculture and environmental sustainability.

Understanding CRISPR and its limitations

CRISPR, an acronym for Clustered Regularly Interspaced Short Palindrome Repeats, is an innovative gene editing tool that makes precise alterations to genes sequences in the DNA. Its versatility and precision has transformed genetic engineering by offering smart innovations such as cutting of undesirable, defective genes and integration of enhanced, more effective genes into the DNA. This technology is ground breaking in its applications however challenges exist which include off target effects, unintended genetic modifications and the complexity of identifying ideal gene targets within vast genomic landscapes.

Advances in medical research and therapeutics

The fusion of AI with CRISPR is transforming medical research and is paving the way for developing of novel therapies.

Some of the advancements propelled in medical research and therapeutics by this integration are listed below:

1. Discovery of novel gene editing proteins

Mammoth Biosciences, a biotechnology company, known for developing CRISPR based diagnostics and cutting-edge gene editing technologies, aims to identify CRISPR associated proteins by utilizing AI driven metagenomics discovery platforms. AI algorithms analyze data archives of microbial DNA and predict proteins with desirable characteristics such as small size that ensures high efficiency. Machine learning algorithms analyse gene pools to identify patterns of gene sequencing and predict

the order of genes in DNA. One of the uses of AI in genomics is its ability to predict most effective CRISPR targets thus enhancing accuracy and reducing the possibilities of off target effects and expanding the toolkit for genome sculpting. AI tools can now identify small gene editing proteins that were previously undetectable due to limitations in data analysis.

2. AI designed CRISPR proteins

Naturally occurring proteins have limitations in research and therapeutic applications. AI designed proteins can overcome these limitations. Companies like Profluent are employing large language models to design entirely new CRISPR proteins that do not exist in nature. The AI designed proteins recognize and edit specific sequences of DNA and RNA more precisely minimizing unintended genetic modifications, thus making treatments more safe and reliable. These proteins can be customized for plants, animals and microbes. This technique also develops smaller, compact proteins that can be incorporated into nano particles or viral vectors for better delivery in gene transfer and correction.

3. RNA targetting CRISPRs

Researchers at New York University and Columbia University have integrated AI with RNA targetting CRISPR systems to monitor gene expressions accurately. Diseases caused by gene over expression or aberrant gene activity can be potentially treated by leveraging this approach. One potential example is of TIGER which can predict both on target and off target activities and enable the design of guide RNAs and optimize gene expression level precisely.

4. Personalized and targeted therapies

AI now facilitates the development of personalized medicine due to its capacity to analyze vast datasets that enables the identification of vast therapeutic drugs more efficiently.

For example, AI is used to predict heat tolerant molecules which can improvise bio manufacturing process. Moreover the first CRISPR based therapy for sickle cell has been approved, indicating the capacity to treat 7000 other genetic conditions using AI accelerated development.

Agricultural Innovations, Resilient and Nutritious Crops

AI integrated CRISPR techniques are being implemented to produce crop cultivars with resistance to diseases, pests and environmental pressures. By analysing the genomic data, AI identifies key genes responsible for desirable traits in crops. CRISPR technique then integrates these genes into seeds at embryo stage. It produces crops that are resilient to environmental stresses and give maximum yield.

This technique can also be used to enhance nutrition value of crops. Targetting specific genes and integrating genes specially created to enhance the values of vitamins and minerals in staple crops can address nutritional deficiencies in various populations of crops.

Environment Sustainability

AI- CRISPR synergy promise to identify and enhance genes involved in degradation of environmental pollutants, leading to more efficient pollution mitigating strategies. This can also lead to the development of organisms capable of carbon sequestration and can offer natural solutions to combat climate change.

Ethical and Regulatory Considerations

While the convergence of AI and CRISPR offers ground breaking applications in various fields, it also raises some ethical and regulatory concerns, which are listed as follows:

- This technique does not fully terminates the possibility of off target effects or unforeseen interactions with biological systems. To mitigate possible adverse outcomes, continuous monitoring and risk assessments are essential.
- These advancements raise a concern of elongating the gap between developed and developing countries. Global health equity can be achieved by addressing disparities and ensuring equitable access to technological advancements .
- Existing regulatory frameworks are not compliant to handle the rapid innovations resulting from fusion of AI with CRISPR. Policy makers need to develop adaptive measures to ensure safety without restricting innovations.

The convergence of CRISPR and Artificial Intelligence represents a paradigm shift in biotechnology, addressing most pressing challenges and offering a far-reached solution to potent issues across multiple fields of human and environmental concerns. As the evolution in technology continues to happen, this technique is expected to offer more precise and holistic genetic engineering solutions to combat some of the most critical challenges in fields of health, agriculture and environment.

Conclusion

In conclusion, the integration of CRISPR and artificial intelligence is transforming biotechnology by enabling highly precise and efficient genetic modifications. This powerful combination has the potential to drive significant advancements in healthcare, boost agricultural output, and support environmental sustainability. As we enter this new era of biotechnological innovation, it is crucial to prioritize responsible development, ensuring ethical oversight and collaborative efforts to fully leverage the benefits of these groundbreaking technologies.

WHEAT 2035: INTEGRATING PAN OMICS AND ADVANCED BIOTECHNOLOGY FOR FUTURE WHEAT DESIGN

Sajal Javed

0103- BS – BIO-T-22

Wheat (*Triticum aestivum*) is one of the most widely grown and consumed crops due to its nutritive nature and ability to grow in wide range of climatic and agronomic conditions thus ensuring global food security and providing essential nutrients for populations worldwide. The demands of an expanding population throughout the globe must be accommodated by increasing global wheat production. As we advance towards 2050, scientists are developing new strategies for wheat improvement to combat challenges of climate change, population growth and increasing wheat requirements. An approach to enhance wheat yield, quality and sustainability is to integrate pan omics with advanced biotechnological tools and a more detailed apprehension of wheat biology.

Advancements in wheat research

Over the years wheat research has witnessed significant transformations, one of them being the emergence of Next Generation Sequencing Technologies. These technologies have assisted the development of optimized genotyping platform enabling rapid gene discovery and a comprehensive outlook of wheat's intricate genome. Scientists have developed high density single nucleotide polymorphism (SNP) arrays such as the 9k iSelect and 90k SNP chips. These facilitate the screening of thousands of markers in large populations. These tools have expedited wheat breeding and have played a vital role in understanding genetics of crucial agronomic traits.

The role of pan omics in wheat research

Over the course of years, researchers have benefitted from multi omics, which collectively include genomics, proteomics, transcriptomics and metabolomics. However this transition from multi omics to pan omics is redefining the genetic study of wheat, proving to be a major breakthrough in wheat research. Pan omics include study of all the traits found in all individuals within a population. It merges all genetic discrepancies within a species including both core and unique genes present across the genome of all wheat varieties available as opposed to multi omics which focuses on individual databases. The creation of pan genome has enabled researchers to develop variations in gene presence and absence, highlighting genetic traits that induce resistance to harsh environmental conditions such as drought, high temperature and pathogens. Advancements in next generation sequencing have accelerated wheat research, despite the complex hexaploid genome which offers challenges to genetic analysis. Researchers can now scan thousands of genetic markers with the aid of high density SNP arrays, identifying genes linked to resistance and yield traits. This transformation in research provides a holistic view of genetic variations across the cultivars. This approach discriminates the core genes found in all wheat varieties from variable genes that enhance traits like climate resistance and wheat quality.

Genomic innovations driving wheat improvement

Wheat's genetic research faces numerous challenges, one of which is its complex polyploid genome, comprising three sets of chromosomes. However the latest developments in wheat breeding have revolutionized

wheat breeding by incorporating precise genetic modifications and trait mapping.

Marker Assisted Selection

Marker Assisted Selection (MAS) is one of the most efficient techniques in modern wheat breeding. This method utilizes genetic markers to identify and select plants with desired characteristics. This selection is based on plant's genetic makeup which speeds up breeding process with increased accuracy.

In this method, scientists first recognize specific DNA sequences linked to significant traits such as disease resistance, tolerance to drought and temperature or high yield. Breeders then look for these genetic markers in young plants even before traits are visible. This process is carried out by screening. Plants carrying desired genetic characteristics are selected for further breeding ensuring future generations inherit these traits.

Quantitative Trait Locus (QTL) Mapping

Plants contain certain traits that are influenced by numerous genes. QTL mapping allows identification of specific genomic regions linked to complex traits such as yield, drought and disease tolerance and grain quality in wheat. Recent advancements have made it easier for researcher to locate these genes in wheat genome and select desirable traits for breeding. In this method, specific markers are used to track the segments of DNA. Regions of the genome where specific markers constantly associate with desired traits are specified as QTLs. As these QTLs are identified, breeders use MAS to isolate plants carrying valuable QTLs. This technique has led to improved varieties of wheat in terms of better yield and tolerance to adverse conditions.

Cutting-edge Technology in Wheat Breeding

Biotechnological advancements are challenging traditional breeding techniques allowing the production of exceptional wheat varieties through accurate genetic modifications.

1. Genome Editing with CRISPR Cas

CRISPR Cas enables gene editing by targeting specific genes in wheat genome. This technique involves targeted modifications and edits existing genes, making it a more widely accepted and efficient approach.

2. Synthetic biology for multi trait improvement

Synthetic biology plays a role in augmentation of wheat. This procedure can create entirely new functions of biological components by redesigning and assembly. In wheat, researchers have been able to incorporate multiple resistance genes into a single cultivar, offering protection against multiple diseases simultaneously in a genome. Such innovations reduce the consumption of pesticides and foster sustainable farming techniques.

3. Artificial intelligence in wheat breeding

Wheat improvement is accelerating by integration of artificial intelligence with genomic data. AI driven models analyze broader data sets to identify best genetic combinations for enhanced wheat cultivars. These tools help in assessing breeding methodologies in virtual environment prior to practicing them in field. This aids in saving time and resources.

Meeting Future Challenges with Wheat 2035

Global population is expected to surpass nine billion by 2050 (USCB, 2015). With these rapidly increasing stats, the demand for wheat is exceeding significantly. Global wheat production must increase by 50-60 percent by the end of this decade, as estimated by researchers at National Natural Science Foundation of China. Production of wheat varieties that are adapted to thrive in diverse and harsh conditions is a gateway to ensure food security.

Climate change is one of the major threats posed to production of crops. Development of heat and drought resistant wheat varieties is the only way to combat these challenges. By integrating genomics with advanced cultivation techniques researchers can incorporate genes, better able to survive harsh climatic conditions.

Beyond increasing yield, enhancing nutritional quality is a key priority. Micronutrient deficiencies affect many populations, prompting efforts in biofortification to combat this issue. Researchers are pinpointing genetic regions linked to elevated levels of vital nutrients like iron, zinc, and protein, laying the foundation for wheat varieties with improved nutritional value.

Sustainable farming practices

An important concern addressed by modern wheat research is sustainability, by reducing dependence on

chemical fertilizers and pesticides. Incorporating natural diseases resistant genes into wheat genome can minimize harmful impact of agriculture on environment while maintaining high reproducibility.

Concluding remarks and future prospects

The future of wheat lies in utilizing the full potential of pan omics along with advanced biotechnology. Scientists are paving the way for high yielding, climate resistant and nutritionally improved wheat varieties by integrating genetic diversity with cutting edge breeding methodologies. Realization of these advancements on a global scale requires collaboration among researchers, policy makers and farmers. Moving towards 2035, a holistic approach merging genomics, synthetic biology, AI and sustainable farming practices are going to redefine the next era of wheat production. These breakthroughs not only promise to fulfill the global food demand but also ensure wheat production is robust to combat the environmental challenges posed by climate change. The next decade will play a vital role in shifting wheat breeding from conventional techniques to an advanced, data-driven approach that ensures future food security.

CRISPR/CAS-12A IN BIOFUEL PRODUCTION AND ENHANCEMENT

M. Soman Khalid

0029-BS-BIO-T-22

As the world grapples the crisis regarding climate change and energy security, it has become more important to move towards sustainable as well as renewable energy resources. Biofuels are one of the best alternatives over fossil fuels. Unlike finite sources of fuel including coal, natural gas, and mineral & fossil oils etc. biofuels focus on carbon-neutral, and renewable approach to meet global energy demands. Biofuels are divided into various forms;

- **1st generation:** Produced by edible crops e.g. sugarcane, soya bean, corn etc. And are often criticized due to competition with food supply
- **2nd generation bio-fuels:** Include non-edible plant sources e.g. agriculture waste i.e. wheat, straw, grass etc. But due to hardly to process nature, they are not so suitable

- **3rd generation biofuels:** Generated on the behalf of microorganisms e.g. algae, fungi etc. which produce desired product (oil, bio-alcohol etc.) with minimal resource consumption.

Besides their importance and the biofuel production on high scale is facing several problems like low efficiency, high cost, yield limitations and also some environment impacts.

Here genetic engineering steps in to cope with these challenges at every field from higher organisms (especially plants) genetic modifications to microbial efficiency. **CRISPR/Cas 12a**, one of the most advance genetic engineering technique proves to be a game-changer by enabling precise genetic modifications and opening doors towards more efficient, faster and sustainable biofuel production.

Before indulging in **CRISPR/Cas 12a** first we should know –what is CRISPR?”. Actually CRISPR is one of the defensive tools, against viral attacks, found in bacteria and archaea. It enables the organisms to recognize and cut off the foreign genetic material. Cas 12a (a variant of the enzyme Cas 12) associated with CRISPR. Cas 12a cuts DNA in staggered way to create sticky ends, which make the insert of desired gene easier for scientists. In addition, the protein requires shorter guided RNA (as compare to Cas 9) by which it is easier in lab to design and implement the system. Also the system is more accurate than that of Cas 9 with minimal the off-target effects. As the Cas12a has a different recognition sequence compared to Cas9, reducing off-target effects and increasing the accuracy of genetic modifications. As **PAM** (protospacer adjacent motif) which is in short recognition site of Cas protein, of Cas 12a is less common in the genomics which lessens the off-target cuts. In addition, Cas12a can process its own guided RNA, allowing multiple genes to be edited at a time, where Cas9 requires separate guided RNA for each edit.

Because of its precision, and effectiveness this system is now widely used in field of biofuel. In regime of biofuel from plant sources it can be used for enhancing several traits including increased biomass production, enhanced stress resistance, increased photosynthetic activity. As we know that lignin hardens the plants cell wall, which make it difficult plants to break during processing in biofuel production. By editing lignin producing gene, we can

enable to reduce lignin quantity in cell wall, which indirectly make the processing easier.

Same as in the case of microbes, this technique can be used in optimizing metabolic pathways, inducing more tolerance towards toxic byproducts, accelerating fermentation rate etc.

Enzymes can also be engineered for enhanced activity i.e. this technique enables improving pH tolerance & thermostability, reducing affinity towards inhibitors, engineering different enzymes eg. cellulose and hemicellulose for improved activity.

In short CRISPR/Cas-12a offers transformative potential for biofuel production by enhancing environmental sustainability as well as economic efficiency. On the other hand, there also exist security concerns regarding genetically modified organisms (GMOs) as usual. But concerns can be satisfied by introducing built-in mechanisms (commonly known as kill switches) which, when activated, subject the GMO towards suicide by itself. Balancing the production of biofuel with food production has always been crucial concern. In addition, it has always been struggled to move biofuel production towards non-food crops and agriculture as well as municipal and industrial waste.

Looking ahead CRISPR/Cas12a has potential to revolutionize the next generation biofuel including butanol, advance hydrocarbons etc. Improvement in biomass-digesting enzymes and engineered microbial metabolic pathways can lead the biofuel to heights of efficiency and cost effectiveness. With proper education and transparent policies this technique can open doors to the innovative world.

GENE DRIVE TECHNOLOGY: A REVOLUTIONARY APPROACH TO MALARIA CONTROL

Saheem Abbas

0025-BS-BIO-TECH-23

Abstract

Gene drive technology is powerful genetic engineering technique that allows to rapid spread desired genetic trait

in population. It based on Biased inheritance, where spreading more frequently than normal mendelian inheritance. In normal inheritance, 50% probability of passing specific gene into an offspring but, in gene drive (biased inheritance) the transformation of desired gene in offspring is at nearby at 100%. Gene drives is used self-replicating genetic elements that copy themselves in targeted site in chromosome ensuring to transfer into next generation. In pair of chromosomes the drive gene copy itself and cut the corresponding location of normal gene and drive gene insert the corresponding site with the help of CRISPR-Cas9 system. Gene drive is population level genetic modification instead of individual organism and use to reducing population or modifying population. This technique is addressing variety of diseases and controlling of vector borne diseases, modifying the gene of mosquito and prevents the transmission of diseases, such as malaria and dengue fever. In agriculture, gene drive holds the potential to control pest and damage crops. It modifies the insect and disrupted the pesticide in population. Despite its advantages, gene drive technology raises significant concerns regarding biosafety and ethical considerations. Mutation in gene leading unpredictable effects. They also spread variation in genetic and loss of genetic diversity, leading disruption in ecosystem.

Introduction

Gene drive technology is a revolutionary genetic engineering tool that enhances the inheritance of specific genes in a population, allow to spread desirable trait. This technology is primarily based on CRIPR-Cas9 which enable precise modification in genome. It allows to precisely control the genetic makeup of entire population, spreading beneficial traits or suppressing harmful one with high speed and efficiency. This technology scientist selects specific gene of interest and replace or remove harmful gene, this is also known as *selfish genes*. Now days with advanced technologies gene drive may use against diseases causing organisms and they alter traits of entire population of organisms. **What is gene drive**

Gene drive is genetic engineering technology that ensure specific gene is inherited at higher rate than normal mendelian rate 50%, allowing rapid spread through a population.

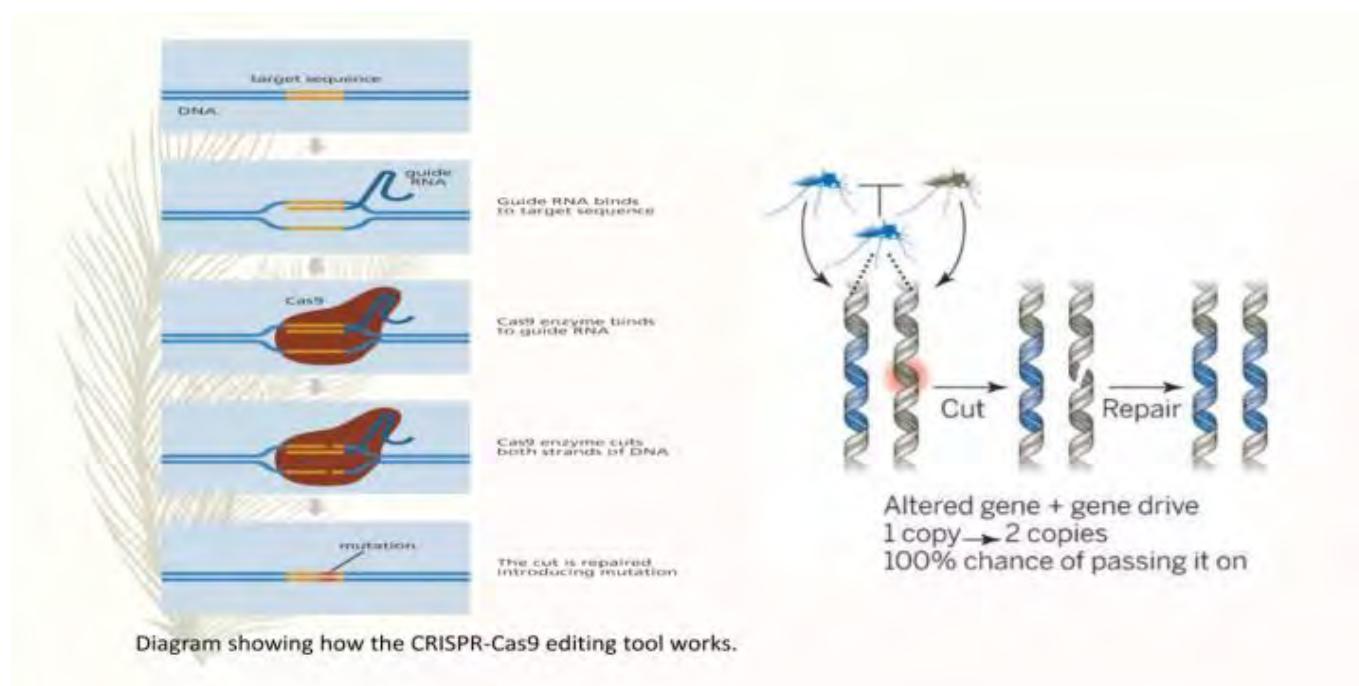
How it works?

Biased inheritance – The normal probability of transformation of genetic material in mendelian inheritance is 50%, gene drive forces a genetic modification to spread in population at higher rate nearby 100%.

CRISPR-Cas9 – Mostly in gene drive use CRISPR-Cas9 as a gene editing tool by helping enzyme called Cas9.

What is CRISPR-Cas9

CRISPR is naturally occurring ancient defended mechanism in bacteria. In 1980, scientist observed unique repeating DNA sequencing. They called this odd configuration "clustered regularly interspaced short palindromic repeat." CRISPR technique is used to edit genome by adding, replacing and removing with the help of enzyme called Cas9. It is also called molecular scissors that cut the two strands of DNA at specific location in genome. A small (20 bases) long piece of RNA is called guide RNA. It binds the targeted site of DNA and guide Cas9 enzyme to cut at the right point of genome.



How it works?

Gene drive technology works through the CRISPR-Cas9 system, which allows for precise genome editing.

The key steps involved in gene drive work:

1. The construction of Gene drive

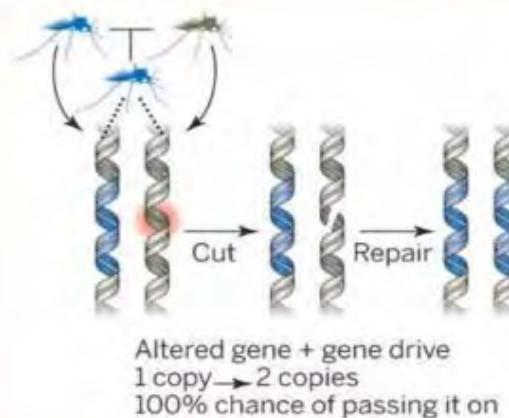
Scientists collect the desired gene that they want to spread through the population. Use gene editing tool (CRISPR-Cas9) that uses Cas9 enzyme (molecular scissors) to cut specific sites from DNA in chromosome with the help of guide RNA.

2. Insertion into the organism genome

The constructed gene drive is inserted into the organism genome at the targeted location. This is done with the help of viral vector or microinjection technique.

3. Inheritance and gene drive action

When the organism with gene drive mates with a wild-type organism, the offspring is 50% gene drive and 50% wild-type. Cas9 enzyme cuts the chromosome from wild-type parent at target location. The cell has a natural repairing system and fixes the break, as a result the gene drive offspring has 2 copies even though it only inherited one.



4. Spread through the population

Gene drive offspring has 2 copies and it will pass almost all of its offspring. This process continues through

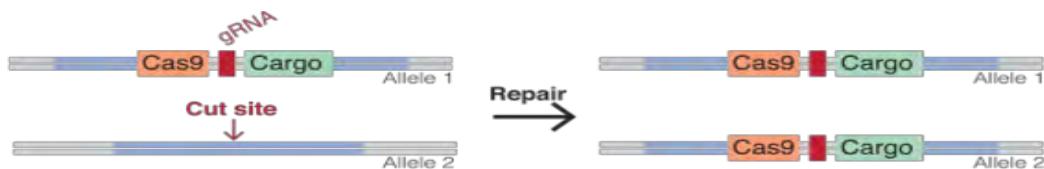
generations, causing the gene drive to spread rapidly throughout the population.

Mechanism in Malaria

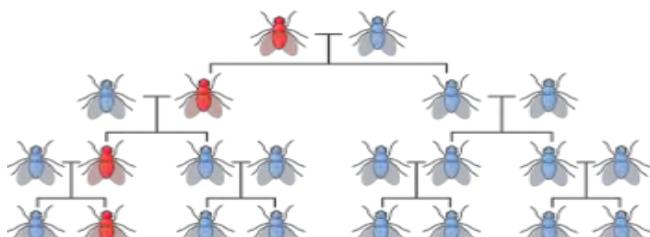
In 2015, There were about 214 million malaria cases, and 438,000 deaths, of which 88% and 90% respectively occurred in Africa, including 292,000 deaths in Africa of children under 5 years of age (WHO., 2015).

Challenges

Despite its advantages, gene drive technology raises significant concerns regarding biosafety and ethical considerations. Elimination of mosquitoes affects food chain (e.g., birds, fish, and bat eat mosquitoes) and disrupt biodiversity. Gene drive could unexcepted mutations leading frequently spreading of harmful trait. Once released the harmful trait its difficult to control or stop.

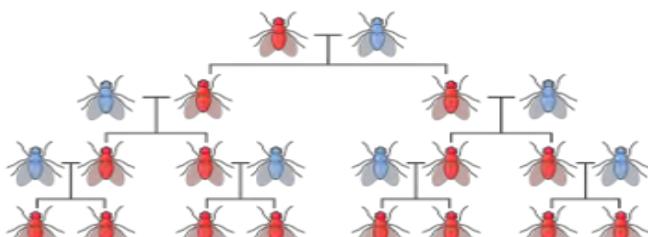


Normal inheritance



Altered gene does not spread

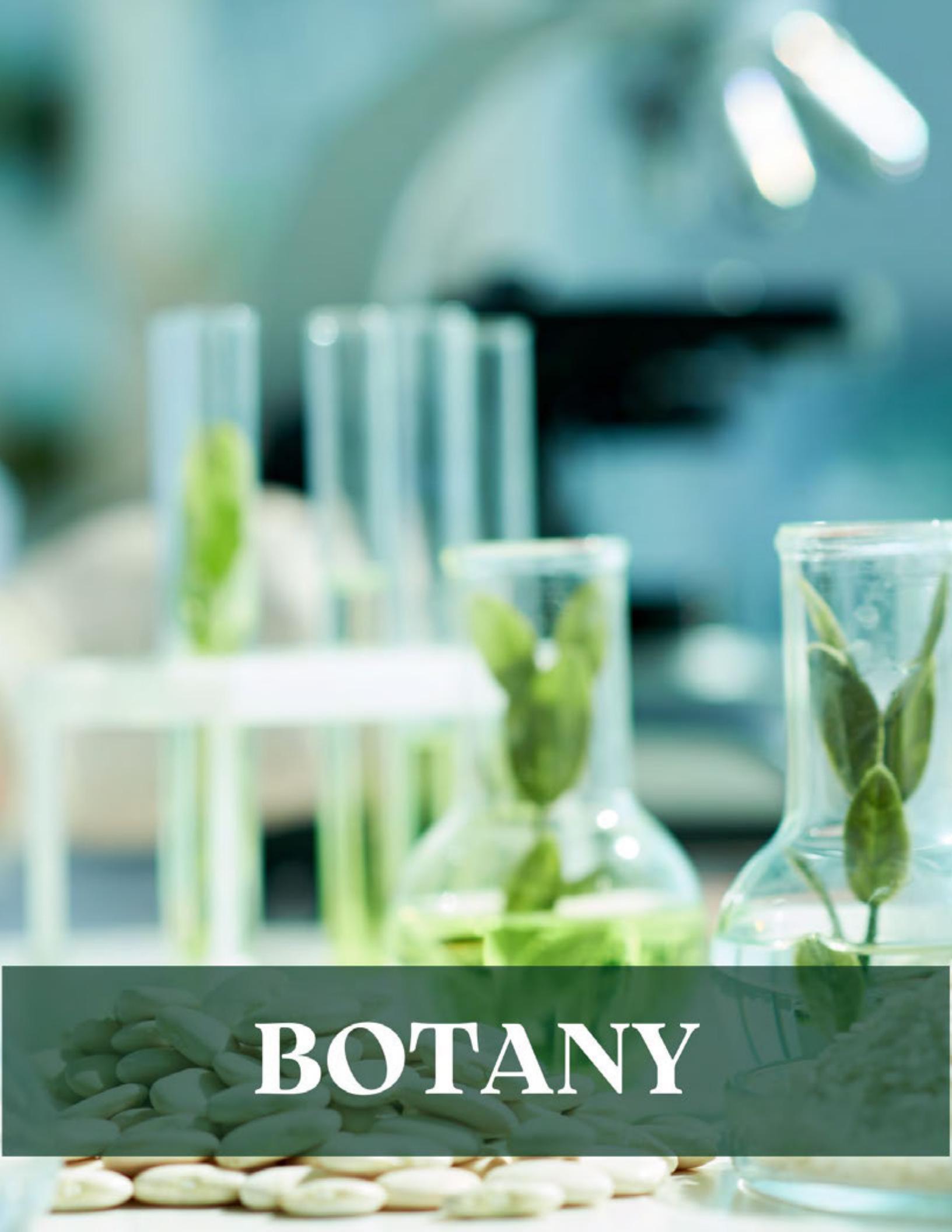
Gene drive inheritance



Altered gene is always inherited

Plasmodium falciparum is responsible for causing malaria in human and spread via bites of female mosquitoes (*Anopheles*). Gene drive technology is being used to control mosquito population and prevent vector borne diseases, such as malaria, and dengue. Select the targeted gene called FREP1(Fibrinogen related protein 1) which is present in midgut of *Anopheles* mosquito responsible of plasmodium parasite which causing malaria. Using gene drive technology, scientist modifies or replace FREP1 with SMFA (Single Chain Antibody against Malaria) that prevents the parasite from growing in the mosquito and can't spread malaria in humans. Using CRISPR-Cas9 knockout the harmful gene FREP1 with using gRNA and Cas9 enzyme and knock in the modifies gene SMFA which cannot spread malaria.

Debates on ethical concern, alter the god gifted trait in an organism. Scientist could misuse this technology and spread diseases instead of preventing them.



BOTANY

2024: YEAR IN REVIEW

Jan

- **Engineered Plant Microbiomes:** Researchers from the University of Southampton, in collaboration with teams from Austria and China, successfully modified the microbiomes of rice plants. By over-expressing a specific gene involved in lignin biosynthesis, they increased beneficial bacteria, enhancing the plants' resistance to diseases like bacterial blight. This breakthrough raised a potential reduction in pesticide use.

Feb

- **Biofortified Lettuce with Enhanced Vitamin A:** Scientists from Spain's Universitat Politècnica de València developed a method to biofortify green leafy vegetables, such as lettuce, chard, and spinach. This technique significantly increased their vitamin A content, addressing common micronutrient deficiencies without altering the vegetables' taste or aroma.

March

- **Discovery of 'Wooly Devil' Plant Species:** A new plant species, *Ovicula biradiata*, affectionately known as the "woolly devil," was discovered in Big Bend National Park, Texas. This marks the first new plant species identified by the U.S. National Park System in nearly 50 years.

April

- **UV Light Signaling in Plant Growth:** New Zealand-based company BioLumic utilized ultraviolet (UV) light treatments to enhance the growth, yield, and quality of various crops, including corn, soybeans, lettuce, and cannabis.

May

- **Advancements in Sugarcane Genomics:** Dr. Nathalie Piperidis, a cytogeneticist at Sugar Research Australia's biotechnology lab in Mackay, Queensland, made significant progress in understanding the complex genome of sugarcane. Her research aims to develop sugarcane varieties with nematode resistance, high sugar content, and increased yield.

June

- **Introduction of Glowing Petunias:** The startup Light Bio engineered petunias that emit a gentle glow reminiscent of moonlight by integrating bioluminescent mushroom DNA into the plants. These glow-in-the-dark petunias became available for purchase, showcasing a fusion of science and aesthetic appeal.

July

- **Artificial Plants for Indoor Air Purification:** Researchers at Binghamton University developed artificial plants capable of purifying indoor air and generating electricity. These cyanobacterial artificial plants represent a step forward in sustainable indoor environmental management.

Aug

- **Discovery of New Sunflower Species:** A new sunflower species was identified in a Texas national park, marking the first such discovery in decades. This finding adds to the botanical diversity and underscores the importance of conservation efforts.

Sep

- **Advancements in Plant-Based Cancer Therapies:** Significant progress was made in utilizing plant-based compounds for cancer treatment. Researchers explored novel therapies, including personalized vaccines and CAR-T cell therapy, signaling a transformative era in cancer treatment.

Oct

- **Artificial Plants for Indoor Air Purification:** Researchers at Binghamton University developed artificial plants capable of purifying indoor air and generating electricity. These cyanobacterial artificial plants represent a step forward in sustainable indoor environmental management.

Nov

- **Gene-Edited Sweeter Tomatoes:** Chinese scientists identified genes responsible for reduced sugar production in domesticated tomatoes. Using CRISPR-Cas9 technology, they edited these genes to produce fruit with up to 30% higher sugar content without compromising size or yield.

Dec

- **Breakthrough in Crop Resilience:** Iyris announced a patented process to enhance crop resilience, enabling cultivation in hot climates. This innovation has the potential to address global food security issues by allowing crops like tomatoes to thrive in previously unsuitable environments.

SPIRULINA: THE FUTURE FOOD

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Introduction

Spirulina (*Arthrosphaera platensis*) is a blue green algae which has the potential to solve the issues concerning sustainability, better health, preservation and can be emerged as a superfood. It has the ability to enhance immune and anti-inflammatory responses. NASA have used it for their astronauts during a space mission. Several researchers are investigating the potential applications of spirulina and their anticancer, antiviral and anti-allergic effects. It is a crucial source of nutrients essential for better health and development and is often referred to as a natural multivitamin. It is considered as the oldest life form on earth, growing best in an alkaline environment and can survive pH fluctuations. Historically, it was used by Aztec and other civilizations. It has worldwide cultivation and can be used in the form of capsules, tablets and powder. Besides its importance as a food it can also play a crucial role in CO₂ elimination by photosynthesis.

Taxonomic Classes	Common Names
Domain	Bacteria
Kingdom	Eubacteria
Phylum	Cyanobacteria
Class	Cyanophyceae
Order	Oscillatoriales
Family	Oscillatoriaceae
Genus	<i>Arthrosphaera</i>
Species	<i>platensis</i>

Table No.1: Classification of Spirulina

Nutritional value

Spirulina is a rich source of protein because of its high-profile value amino acids. It provides essential gamma linolenic oleic acid. It is also a rich source of vitamin B12, iron, calcium and phosphorus and many other nutrients

needed for better growth and development. Its organoleptic properties make it a good source of food and as a nutritional supplement. It also shows antioxidant properties without showing any chronic effect on human health.

Cultivation

Spirulina can be grown on a large scale and in areas where growing other plants might be challenging like deserts and saline areas.



Figure No.1: Spirulina culture medium

Conditions necessary for the growth of spirulina are as follows:

- **Temperature:** Temperature ranges from 30°C to 35°C is ideal for spirulina production with perfect protein content. Spirulina can survive between 22°C and 39°C but the spirulina growing under such conditions have poor protein content. Below 20°C spirulina shows no growth.
- **Climate:** Suitable climate conditions are essential for their growth when growing at a larger scale, tropical and temperate regions are best suited.
- **Light:** Intensity of light is also an important factor in spirulina cultivation. Light intensity between 19 to 29 k lux is best suitable for its cultivation, requiring sunlight throughout the year.
- **Stirring:** Stirring is also an important factor during cultivation. Spirulina present on the top of the pond shows maximum growth due to exposure to sunlight while those at the bottom show less growth. For maximum and better growth of each organism proper stirring is essential which can be performed manually.

and mechanically. Stirring should be performed in one direction which maintains a flow of water.

- **Water quality:** Creation of close culture is an important factor for commercial production to avoid contamination. Water with essential growth elements dissolved in it plays a crucial role in cultivation. Suitable pH should be 7 to 11 for growth. The ideal level of water for their growth is 20 cm.

Harvesting

Harvesting includes filtration of a culture medium, drying and grinding.

- **Filtration of a culture medium:** Different methods have been used during harvesting, the simplest is the filtration of culture medium using cloth. The culture medium is poured into the cloth and spirulina is collected after squeezing the cloth and allowing the culture medium to transfer back into the pond. Different filtering processes have been evolved for the filtration of culture medium.
- **Drying:** spirulina can be preserved for months with its nutritional value maintained. Simply, drying can be done by placing its thin strands over a fine cloth under direct sunlight, and other drying methods can also be used for drying.
- **Grinding:** After perfectly drying, the strands of spirulina are grind using conventional grinding methods like grinding machines that are used for flour making. After grinding fine, the powder may be used for making tablets and capsules or simply packing it in a polythene bag under airtight conditions to increase their shelf life.

Challenges during Cultivation

The main challenges we have to encounter during cultivation are as follows.

- 1) The maintenance of cultural medium pH, nutrient content and temperature is a hard job.
- 2) Contamination is a major growth-affecting parameter during cultivation that is produced by toxic algal species and during breeding of insects in a culture medium.

- 3) Public awareness is needed in order to use spirulina as a food supplement.

Conclusion

Spirulina with its high content of protein and other essential nutrients is a good food source. It is also recognized as a food by the United Nations World Food Conference. It can also be used in poultry and cattle farms to improve the harvest. With its anticancer, anti-inflammatory and antioxidant properties it might be proved a game changing diet. Despite all these benefits, basic cellular and molecular mechanisms are not fully understood which needs more research in this regard.

ECO-FRIENDLY WASTEWATER TREATMENT: THE HIDDEN POWER OF ALGAL EXOPOLYSACCHARIDES

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Introducing Exopolysaccharides, these are basic and high molecular weight polysaccharides secreted by bacteria, cyanobacteria, algae, fungi and yeast. They play a crucial role in environmental and industrial processes, particularly in wastewater treatment. The search for green and efficient wastewater treatment methods has intensified with the growing concerns over environmental sustainability. Algal exopolysaccharides (EPS) offer a promising alternative due to their natural origin, biodegradability, and ability to remove pollutants without introducing harmful chemicals into ecosystems. EPS are widely used in heavy metal removal, organic pollutant adsorption, bioflocculation, solid removal, and nutrient recovery. Algae which produce Exopolysaccharides includes: microalgae (*Chlorella*, *Dunaliella*, *Porphyridium*) and Macroalgae (*Laminaria*, *Fucus*, *Gracilaria*, *Gelidium*).

Heavy Metal Removal via Biosorption:

One of the most useful ways algal EPS can help in wastewater treatment is by removing harmful heavy metals like lead, cadmium, chromium, nickel, and copper. These metals often come from industrial waste and can seriously damage aquatic life and human health. The

structure of EPS contains special chemical groups-like carboxyl (-COOH), hydroxyl (-OH), sulfate (-SO_4^{2-}), and amine (-NH_2)-that can grab onto metal ions through natural processes like chelation, ion exchange, and electrostatic attraction. To make EPS more effective at removing heavy metals, scientists use techniques like immobilization, where EPS is trapped inside materials like alginate beads, chitosan membranes, or biofilms. This helps improve their stability and reusability, making them more efficient in wastewater treatment systems. By using these enhanced EPS-based materials, we can clean polluted water in a more sustainable and eco-friendly way.

Removal of Organic Pollutants (Dye, Oil and Pharmaceuticals):

Industrial and municipal wastewater often contains a variety of organic pollutants, including synthetic dyes, petroleum residues, and pharmaceutical waste. Many dyes used in the textile industry, such as methylene blue, rhodamine B, and malachite green, are difficult to break down naturally and can be highly toxic to the environment. Similarly, pollutants from oil spills and pharmaceutical waste can persist in water bodies, threatening aquatic ecosystems and contaminating drinking water sources. Algal EPS have shown strong potential for adsorbing these organic pollutants due to their unique hydrophilic and amphiphilic nature. The charged molecules in EPS help them bind effectively to positively charged dyes, while their gel-like structure captures hydrocarbons and pharmaceutical compounds, preventing them from spreading in water. This makes EPS a natural and effective tool for removing harmful organic substances from wastewater.

Bioflocculation:

EPS, especially those produced by cyanobacteria and red microalgae, have bioflocculant properties, meaning they can clump together small particles into larger flocs that settle rapidly in water. This natural process of flocculation is driven by the gel-like texture and the charge distribution in EPS, which help to bridge and aggregate suspended particles. Research has demonstrated that EPS from species like *Nostoc*, *Spirulina*, and *Chlorella* can significantly reduce water turbidity, improving clarity by more than 80%. As a result, EPS-based flocculants offer a sustainable and eco-friendly alternative to traditional

chemical coagulants used in municipal and industrial wastewater treatment.

Enhancing Microbial Biofilm for Bioremediation:

EPS are essential for the formation of microbial biofilms, which play a key role in various bioreactors and wastewater treatment systems. Biofilms consist of microbial communities that adhere to surfaces, protected by a self-produced EPS matrix that helps the microbes thrive and survive. In wastewater treatment, biofilms containing EPS-producing bacteria and algae are utilized in processes such as trickling filters, moving bed biofilm reactors (MBBRs), and constructed wetlands to break down organic matter, nutrients, and pollutants. When algal EPS are added to biofilm-based systems, they enhance the adhesion, stability, and activity of the beneficial microbes, leading to improved efficiency in pollutant removal.

Nutrient recovery:

Excessive nutrients, particularly phosphorus (PO_4^{3-}) and nitrogen (NH_4^+ , NO_3^-), from agricultural runoff and sewage discharge lead to eutrophication, causing algal blooms and oxygen depletion in water bodies. Traditional nutrient removal techniques, such as chemical precipitation and ammonia stripping, are often energy-intensive and costly. Algal EPS offers a biological approach to nutrient recovery by binding and sequestering excess phosphate and ammonium ions.

To summarize this whole perspective, Algal exopolysaccharides (EPS) provide an effective, eco-friendly, and affordable solution for wastewater treatment. Their capacity to adsorb heavy metals, remove organic pollutants, promote bioflocculation, boost microbial bioreactors, and recover nutrients makes them a highly versatile tool for purifying water. As industries seek sustainable alternatives to conventional wastewater treatment methods, EPS-based technologies offer a promising approach due to their natural origin, non-toxic properties, and efficiency in pollutant removal. Algal EPS contributes to a more sustainable and environmentally friendly wastewater treatment approach by reducing the reliance on synthetic coagulants and energy-intensive purification processes.

BOTANIC GARDENS: HUBS OF HEALING, CONSERVATION, AND SUSTAINABLE GROWTH

Mehr Un Nisa

0364- MPHIL BOT-24

Botanic garden is a specific region occupied by various plants, whereas occurrence of plants depends upon the climate of that region. In botanic garden, we can monitor different phenological activities of plants, evaluate response of plants to climate change and we can do cultivation experiments to conserve threatened species.

Botanic gardens are essential for conservation of plants and also to interpret certain responses of plant species against climate change dynamics. In this modern era, where high temperature and extreme climate change pose serious threat to biodiversity, botanic gardens are very vital for ex-situ conservation. These gardens are also used for educational and research purposes. These gardens are significant to assess the impact of climatic dynamics on different phenological activities (flowering, fruiting, leaf fall) of plants. With the wide range of species and optimal resources, these gardens serve as a site for climatic research.

Botanic Gardens and Horticulture Therapy:

Mindful gardening is therapeutic. Gardening activities have positive effects on mental health, as it connects feelings and emotions of people with nature. Botanic gardens have a great role in horticulture therapy. During World War II, the practice of horticulture therapy proved to be very effective. Around the 1940s, the US adopted a concept of victory gardens. The US government encouraged their citizens to cultivate their own vegetables, herbs and fruits. Due to these gardens, food demand also reduced along with the significant impact on mental health of citizens during war times. Sanitary conditions also improved as people prioritised every inch of land for botanical and gardening applications. Botanic gardens contribute a lot in stress reduction, cognitive activities play a vital role in well being of humans. Gardening effectively stimulates cognitive activity in people with Alzheimer or dementia. By establishing sustainable botanic gardens, people can grow their own organic food and can make plant based products which

are highly expensive in the market. Hence, botanic gardens play a crucial role in sustainable living.

Ex-situ Conservation:

Botanic gardens are very valuable for ex-situ conservation. Ex-situ conservation refers to conserving or protecting species outside their natural habitats. Botanic gardens contain living collections of plants, including some endangered, threatened and rare species. According to Botanic Garden Conservation International (BGCI), about 38 percent of tree species around the globe are at the risk of extinction.

Many countries used their botanic gardens to conserve highly vulnerable species. Cycad species was conserve in Fairchild Tropical Botanic Garden in Florida. By the ex-situ collection of this species, it was founded that population of cycad species was declining because of specific insect involved in pollination of *Cycas*. Hence, we can say that botanic gardens help to understand ecological purposes and can lead to ecological restoration. In Jawaharlal Nehru Tropical Botanic garden, *Buchanania barberi*, a critically endangered specie according to IUCN red list, is under conservation efforts by using germination technology that produce highly viable seeds.

The rarest tree *Wollemi pine* - that was present during Jurassic period- is conserved in Royal Botanic Garden, Kew. It was first discovered in 1994 from Australia. Now, due to some effective conservative efforts, approximately less than 100 mature trees of this pine exist. The conservation of this pine is regarded as the greatest comeback in history.

In China, the population tree specie *Sinojackia xylocarpa* was declining and this species became extinct in wild habitat. *Sinojackia xylocarpa* hybridized with *S. rehderiana*. But, due to interspecific hybridization in Wuhan Botanic Garden, this species produce hybrid seeds. This hybridization technique used in ex situ conservation pose serious threats to reintroduction of natural species in wild habitat. If hybrid species exposed to natural habitat, Gene pool contamination can occur that affect conservation strategies.

GCU Botanic Garden has very rich flora. This garden is a home to many endangered, threatened and rare species. About 700 species of plants are present in GCU Botanic garden. Two rare species, *Ginkgo biloba* and *Dalbergia odorifera* present in it.

Due to extreme climate change, biodiversity is in severe crisis. A sustainable approach is required to conserve threatened and endangered species through botanic gardens. There is an urgent need to adopt easy and effective policies to conserve nature. Removal of obstacles that make it difficult to protect plants should be eliminated. A prudent approach is needed in botanic gardens that focus on conserving genetically diverse, endangered or threatened species. Innovative strategies are needed to adapt in botanic gardens that address the existing biodiversity crisis.

Botanic Gardens Essential for Sustainable Economy:

Botanic gardens are vital for a sustainable economy. Many fruits and vegetables of high quality can be cultivated in botanic gardens. Propagation of highly valuable medicinal plants can give several economic benefits. Exports of these species can generate decent revenues for a country. Entry fee for local and foreign visitors to access these gardens for educational, recreational and research purposes also generate massive income. Different training sessions can spread awareness and make people skillful in horticulture techniques. If only one person in a single house has proper knowledge about mindful gardening and establishes his own botanic gardens, food item's exports will reduce on a large scale. This approach will be highly beneficial for the economy of one's country. Hence, botanic gardens are extremely vital for sustainable living.

THE HUMAN FINGERPRINT ON CLIMATE CHANGE: HOW OUR ACTIONS SHAPE THE PLANET

Mehr Un Nisa

0364- MPHIL BOT-24

The world is at a critical point in terms of climate change. If we speak in a scientific way then Climate change is a phenomenon caused by the EL-Nino effect to some

extent. It is long term fluctuation in weather patterns that has far reaching consequences on everything (humans, ecosystems, biodiversity) present on earth. Now to define what the El- Nino effect is, it is a naturally driven process, where the temperature of surface water in central and eastern tropical pacific oceans become significantly high. Climate change came into light during Industrial Revolution. The level of carbon dioxide in environment increased above average level in early years in 1980s. Then, industrial activities continued at the same pace. Certain countries showed their concerns about greenhouse gases emissions. But, no one took concrete steps to limit human activities that had disturbed nature. Now, the year 2024 is considered as the hottest year on record, according to the World Meteorological Organization (WMO).

Currently, climate change spares no one. The underdeveloped, developing and developed countries, all experiencing devastating impacts of climate change. The main culprit behind this is greenhouse gases. These gases mainly emitted by anthropogenic activities (burning of natural resources, fossil fuels). Man in order to seek short term gains hurts nature. This makes human life miserable in a long run. World has surpassed a point of no return. Reversing climatic phenomena is a way too long task which might take decades. But, the conservation of nature by eco-friendly techniques can mitigate catastrophic repercussions of this deadliest phenomenon.

2024 - Year of Global Crisis due to Climatic Disasters

Year 2024 has witnessed apocalyptic climatic disasters around the globe. Natural disasters -frequent heat waves, wildfires, drought, massive flooding and cyclones- have increased due to climatic fluctuations. These natural disasters took thousands of lives and badly impacted the economies of certain countries. Swiss Re (Switzerland based reinsurance company) estimated that \$310 billion lost globally (2024) due to climatic disasters. Increased emissions of greenhouse gases has raised the earth temperature about 1.5°C above average. This rising temperature caused glaciers to melt that makes some regions on earth extremely wetter. Glaciers account for approximately 70 percent of the world's freshwater. But, in some regions of the world, the elevated temperature makes intense drier conditions that ignites wildfires. According to World Weather Attribution, a collaboration to study extreme weather events, the effects of global

warming were devastating in 2024. Climate change casts its deadliest impact on every region including prosperous-rich states and underdeveloped-poor nations. The recent wildfires in Los Angeles, wildfires in Mexico, death of about 1300 hajj pilgrims in Saudi Arabia due to extreme heat waves, Yagi typhoon in China, hurricane Milton in Florida, cyclone Chido in Mozambique, torrential rainfall in UAE, deluge in central Africa, some states of US and in Pakistan, India, wildfires in Canada, western United States, in Amazon basin- place having higher moisture content in whole world- all these events occurred in year 2024 alone. These were the outcome of climate change. All the aforementioned events are clear evidence that nature is at stake and climatic disasters are on peak. The clock is ticking, if we want to establish a healthier environment then, preservation of nature is essential. Anthropogenic activities need to be controlled that release harmful GHGs in the atmosphere. To mitigate disastrous repercussions of climatic fluctuations should be the top priority of every nation.

Countering Climate Change - A way forward:

Efficient and prudent policies are needed to address climate change. China and US- top 2 highest emitters of GHGs- should take concrete steps that are beneficial for vulnerable countries like Pakistan. Pakistan only contributes 0.8 percent of global GHGs emissions, yet the fifth most vulnerable country to climate change. Developed countries should supply funds to the country most affected. As most of the climatic problems are created by so called Global North while the Global South are most affected and have to cope up with climatic impacts. In COP 29 (conference of parties) held at Baku, developed countries pledged to give about 300 billion dollars to the most vulnerable countries. Implementation of such plans is required as the previous promise to deploy about 100 billion dollars remained unfulfilled. The emission of two main greenhouse gases- carbon dioxide and methane- need to be curbed. The reliance on fossil fuels should be abated to control carbon emission. The use of electric vehicles can solve this problem to a great extent. Thailand and Switzerland reduced their emissions by using electric buses. Pakistan can follow suit. Methane gas is 80 percent more potent than carbon dioxide. Pakistan is among the top 10 methane emitters. Scientists from the University of California made seaweed that can reduce methane emission from cattle dung. Cattles fed on this seaweed can emit lower methane. Also, there is an

urgent need to invest in climate resilient infrastructure that can withstand natural calamities. Curbing carbon emissions and technological advancement can effectively mitigate hazardous repercussions of climate change. Early warning signals through different apps can reduce the loss caused by natural disasters to some extent. Public awareness drive and a shift from urban development to afforestation are some long term solutions to the issue. Carbon trading can help to compensate for economic losses and to generate handsome revenues. Earth is experiencing extreme climate change and this needs to be counter immediately. If, emission rate continues at the same pace, the temperature will rise to 3.1°C , which will have detrimental impacts. Conservation of nature is essential for the survival of mankind.

FROM WILD TO TAME: THE HUMAN IMPACT ON ORGANISMS THROUGH DOMESTICATION

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Introduction

Humans have been living as a species for a long time and then they started the domestication of wild animals and plants and left their dependency on hunting. According to research humans domesticated crops 10,000 years ago. Domestication of plants from the Poaceae family gave a sense of food security to humans. It changed the selective species from wild to domesticated and this change is also known as domestication syndrome. Plant domestication is the genetic modification of a wild species to create a new form of a plant altered to meet Common crops that were cultivated long ago were; wheat, rice, maize, and barley.

Charles Darwin says about domestication,

—When I started my research, I thought that studying domesticated animals and plants would be the best way to understand how species change over time. I wasn't wrong. In every difficult question I faced, understanding how these animals and plants change helped me find the answer. Even though our knowledge is incomplete, studying domesticated species is the most reliable way to learn about evolution. I believe that these studies are very

important, even though many scientists have ignored them."

Impact

Wild plant species had strategies to disperse seeds like opening of seed pod but it was reduced in species that were grown by men. Seeds of domesticated plants were larger in size as compared to their wild ancestors as well as plant morphology, and flowering also experienced change. Ancestors of some chosen plants had toxic compounds but their breeding by humans reduced such compounds. In the case of the corn, its domesticated version has larger seeds, and reduced seed dispersal in comparison to its wild ancestor that was in Mexico 9000 years ago. Wheat has also experienced similar changes to corn in the process of human selection. Hexaploid bread or common wheat, widely grown modern cultivar, was derived from the hybridization between a tetraploid and a diploid wheat species. Modern-day rice is a descendant of its ancestor that were in the Himalayas and southern China that was present 8000 years ago. Domesticated traits in rice are believed to be reduction in grain shattering and seed dormancy, synchronization of seed maturation, reduction in tiller number, increase in tiller erectness, increase in panicle branches, and the number of spikelets per panicle, and reduction in hull and pericarp colouration and awn length. Rachis of wheat and barley also experienced this syndrome, whether they are brittle or non brittle.

Human Modifications

The humans not only domesticated many plants or animals but also modified them to enhance the desired traits such as fruit or grain characteristics. Conventional breeding, budding and grafting for certain traits ex. Citrus we find today was never in nature like the present form. Biotechnology replaced traditional breeding with precise genetic modification and made GMOs. The debate over GMO crops is going on even in the 21st century where biotechnology is replacing traditional plant breeding to replace or add desired genes of a certain trait in a plant or animal. Some countries are allowing GMO crops to be grown for human and livestock use such as soybean after biosafety measures and testing while some believe these transgenic crops are not allowed to be sown. However, GMO crops are made with certain genes that make the crops resistant to pathogens, and insects or enhance productivity. To sum up, GMO is not the first

modification that humans are making in their domesticated organisms.

Closing Remarks

The term domestication syndrome is often used to describe the suite of traits arising during domestication that distinguish crops from their wild ancestors. Domestication has led to increased yields, improved quality, non-shattering spikelets that don't open, easy to harvest, synchronized flowering and reduced toxicity. This reduced diversity made crops more susceptible to diseases and pests as crops relied more on human intervention. As the global population continues to grow, the demand for food increases as well. In conclusion, the domestication syndrome has had a profound impact on the evolution of plants. While it has provided us with the food we need to survive.

THE IMPACT OF CLIMATE CHANGE ON PLANT PHENOLOGY AND ECOSYSTEMS

Sabeeka Haleem

0364- MPHIL BOT-24

Climate change has become an undeniable reality, disrupting natural systems globally. One aspect of climate change that has always intrigued me is its impact on plant phenology—the timing of biological events such as flowering and fruiting. Rising temperatures and unusual rainfall patterns are reshaping these events, with significant consequences for ecosystems, biodiversity, and even our livelihoods. This topic resonates with me because it exemplifies how interconnected our world is, urging us to understand its importance and act.

Understanding Plant Phenology

Plant phenology revolves around studying the seasonal rhythms of nature, such as when plants flower, bud, or bear fruit. These cycles are normally tied to environmental cues like temperature, sunlight, and rainfall. For example, plants bloom when conditions are ideal for reproduction and pollination. However, with the climate changing so rapidly, these events are now being unusual, creating ripple effects throughout ecosystems.

Phenological Shifts and Their Impacts

One of the most visible effects of climate change is the advancement of spring events. Warmer temperatures are causing plants to leaf out or flower earlier than usual. I've always been fascinated by stories of cherry blossoms in Japan, which now bloom days ahead of their historical schedule. On the other hand, autumn events like leaf drop are being delayed, stretching the growing season in some areas. While this might seem like a positive outcome, it brings risks. Early bloomers face frost damage, and the lengthened growing seasons can disrupt the balance of ecosystems.

Phenological Mismatches

One of the most troubling phenomena is phenological mismatches, where plant events are no longer aligned with the life cycles of other organisms. Imagine a plant flowering too early for its usual pollinators, like bees or butterflies, which haven't adjusted their timing. This can lead to failed pollination, jeopardizing both plant reproduction and pollinator populations. Similarly, herbivores dependent on fresh leaves might face starvation if plants leaf out before they emerge. Such mismatches can cascade through the ecosystem, altering food webs and species dynamics.

Impacts on Ecosystems

The effects of changing plant phenology extend beyond individual species to entire ecosystems. Disruptions in plant-plant interactions, carbon sequestration, and invasive species dominance are just a few examples. For instance, extended growing seasons may boost carbon uptake at first, but heatwaves and droughts often offset these gains. Additionally, invasive plants, which adapt quickly, can outcompete native species, threatening ecosystem stability.

Regional Differences

It's fascinating to see how these changes vary across regions. In temperate zones, earlier springs and prolonged autumns are common, while tropical areas are more affected by rainfall patterns. Fragile ecosystems like the Arctic face disproportionate impacts, as their plants operate within narrow growth windows. Understanding these variations highlights the complexity of climate change's effects.

Agricultural Implications

Agriculture is also affected by these shifts. Crops such as wheat and maize are experiencing change in flowering and fruiting times which is ultimately affecting yields. The delicate synchrony between crops and pollinators is at risk, which could jeopardize food security. I find it alarming to consider how small disruptions in timing could cause large-scale food shortages.

How Can We Respond?

Mitigating these challenges requires a holistic approach:

- 1. Monitoring:** Long-term observation networks are essential to track and predict phenological changes.
- 2. Conservation:** Protecting habitats and fostering biodiversity can help ecosystems adapt.
- 3. Sustainable Farming:** Practices like crop diversification and climate-resilient varieties can mitigate agricultural impacts.
- 4. Policy Action:** Reducing greenhouse gas emissions and raising awareness about these issues should be global priorities.

Looking Ahead

Reflecting on the impact of climate change on plant phenology highlights how interconnected climate, biology, and human activities are. It's evident that the shifts we see in plant cycles, like earlier flowering or delayed leaf drop, are not isolated events but part of a larger, deeply complex system. While some changes may be irreversible, I strongly believe proactive measures can help mitigate these effects. Protecting ecosystems will require collective efforts from scientists, policymakers, and communities. By working together, we can address the challenges posed by phenological shifts, ensure the resilience of our ecosystems, and safeguard biodiversity. A sustainable future is possible if we prioritize collaboration, research, and innovative solutions to adapt to our changing world.

THE FUTURE OF SUSTAINABLE PACKAGING: PLANT-BASED BIOPLASTICS FROM ALGAE

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In a world battling with the environmental consequences of plastic pollution, the need to search for sustainable alternatives has never been more crucial. However, there is one humble and fast growing organism that might hold the key to revolutionize the packaging industry; The Algae. Plant based bioplastics derived from algae are offering a sustainable, biodegradable and eco-friendly alternative to traditional petroleum-based plastics, emerging as a promising solution to the global plastic crisis.



The Problem with Traditional Plastics

Every year, **300 million tons** of plastic is produced worldwide, and a significant proportion of this pollutes the oceans and ecosystems. Traditional plastics can take hundreds of years to break down, releasing poisonous compounds and dangerous microplastics into the environment. One of the biggest causes of this issue are the packaging industries, as single-use plastics make up a significant portion of the world's plastic trash.

Bioplastics have drawn interest as a possible substitute. But not every bioplastic is made equally. Many are derived from crops like corn or sugarcane, which demand a lot of land, water, and fertilizer and compete with food production. Bioplastics derived from algae excel in this situation.

What are Bioplastics?

Bioplastics are materials that come from natural resources that are biodegradable instead of petroleum. These can be used to solve the plastic problem that is suffocating the planet and poisoning the ecosystems

Algae as the Best Option to Generate Bioplastics:

Algae, also known as "the green gold," are photosynthetic organisms found in aquatic environments. They are diverse, ranging from large seaweeds like *Kelps* to microscopic *Spirulina*. Algae have a unique combination of traits that make them particularly feasible for the manufacturing of bioplastics:

- 1. Rapid Growth:** Algae can grow up to ten times faster than most terrestrial plants, making them an effective source.
- 2. Less Resource Requirements:** Algae do not require fertile land, freshwater, or fertilizers to survive. They can be cultivated in saltwater, wastewater, or even on non-arable land.
- 3. Carbon elimination:** As algae absorb large amounts of CO₂ during photosynthesis, their cultivation is a carbon-neutral or even carbon-negative process.
- 4. Multiple uses:** A range of biopolymers, including proteins, cellulose, and starch, are found in algae and may be obtained and converted into bioplastics.

How are Algae-Based Bioplastics Made?

Bioplastics are derived from algae by following these steps:

- 1. Algal Cultivation:** First, Algae are grown in regulated conditions such as photobioreactors or open ponds. These systems can be conditioned for maximum biomass production.
- 2. Collection:** After that, the algae are harvested and dried once they gain maturity.
- 3. Extraction:** The desired biopolymers, such as starch or cellulose, are extracted from the algae biomass.
- 4. Processing:** The extracted polymers undergo processing to create bioplastic resins, which can be turned into a variety of packaging materials, including

containers, trays, and films. The biodegradability of bioplastics made from algae is among its most useful features. Algae-based bioplastics may just take some months to decompose under the correct circumstances, leaving no toxic residues behind. Whereas regular plastics stay in the environment for decades.

Algae Plastic Replacement Startups:

Several companies and researchers are already exploring the potential of algae-based bioplastics for sustainable packaging, among which are:

Kelpi: Kelpi is a UK-based company that uses the qualities of seaweed to make low-carbon, bioplastic packaging that is biodegradable and suitable for use in marine environments. It was founded in 2020 and is one of the leading sustainable friendly packaging startups.

Loliware: A fun and green substitute for plastic straws is provided by Loliware, a firm that has created edible and biodegradable straws from seaweed.

Notpla: This company is well-known for its innovative "Ooho" capsules and makes completely biodegradable and even edible liquid packaging from seaweed-based materials.

Algix: This business uses algae to create a variety of bioplastics that are utilised in consumer goods, footwear, and packaging.

Apart from packaging, bioplastics created from algae are being considered for use in healthcare (as disposable medical equipment), fashion (as sustainable fabrics), and agricultural (as biodegradable mulch films) sectors.

Hurdles in the Path

Algae-based bioplastics have incredible potential, but there are still hurdles to clear. Some of which include reducing production costs to compete with regular plastic companies and expanding production to cope with global demand. Plus, scientists are still fine-tuning durability and resistance to make these bioplastics truly game-changing. However, this subject is progressing quickly due to advancements in biotechnology and the world is more eager than ever for sustainable solutions. The future of plastic is shifting, and if businesses, individuals, and governments step up, algae-based bioplastics could be the revolution we've been waiting for.

A Greener Future with Algae:

Algae-based bioplastics represent a firm step toward a more sustainable future. We can reduce our reliance on fossil fuels, cut down on plastic waste, and create a circular economy where materials are reused, recycled, or returned to nature, by harnessing the power of these versatile organisms.

TERRARIUM: A LIVING ART IN A GLASS

Tooba Zia

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Introduction

A terrarium is more than just a miniature garden, it's a living piece of art enclosed in glass, bringing nature's beauty into any space. These self-sustaining ecosystems mimic natural habitats, where plants thrive with minimal care, making them perfect for homes, offices, and classrooms. With their delicate balance of soil, stones, moss, and greenery, terrariums create a serene, almost magical world inside a transparent container. Whether open or closed, they add a touch of elegance while purifying the air and promoting relaxation. A terrarium is not just decoration, it's a tiny ecosystem offering a mesmerizing blend of botanical beauty and artistic expression.

Furthermore, by selecting resilient plants, terrariums can reduce carbon footprint and support environmental conservation, also prove to be a long-term investment for the house or workplace. The attraction of tiny ecosystems is their ability to capture the beauty and complexity of the natural environment within a small, beautifully designed space. Terrariums are also a great option for people who lack the time or expertise to take care of larger plants.

Types

There are two main types of terrariums, characterized by the selected container.

Closed-system terrariums use a closed (or nearly closed) container. A lidded jar or a jar with a narrow mouth works well. These containers sustain the ecosystem necessary for moisture- and humidity-loving plants. However, this

type of container is not suitable for succulents or cacti, as they would quickly rot and die in such conditions.



Open-system terrariums use a container with a wide opening, such as a large glass bowl. They typically need to be watered more often than closed systems and have lower humidity levels. A current trend is to use succulent plants or cacti, which are native to dry, arid regions and have a longer display period in an open-system terrarium.



How to make Terrariums

Selection of plants: Closed terrariums create a warm, humid environment with low light, similar to a tropical habitat. This makes them ideal for small, easy-to-care-for tropical plants that thrive in moisture and indirect sunlight. So, the ideal plants for growing in closed terrarium are Selaginella, Artillery fern, Baby's tears, Bead plant, Creeping fig, Croton, Purple velvet plant etc. whereas an open terrarium is essentially a beautiful or uniquely designed plant pot with no humidity. The ideal choices in this case were desert plants such as succulents and cacti, which flourish well under dry conditions and require little maintenance. Some commonly used plants are Echeveria, Kalanchoe, Crassula (Jade plant), Haworthia etc.

Selection of Containers: Any clear glass or plastic container is suitable for use as a terrarium. Some examples include fish bowls, Wardian cases, canning jars of any size, and antique bottles, Mason jars, glass vases, Geometric terrariums. The only essential consideration is that the container should not be cloudy or tinted, as this would restrict light and limit plant growth.

Growth Medium for Terrariums: Growing media is essential because it provides support, nutrients, and proper conditions for plant growth. It helps retain moisture while

allowing excess water to drain, preventing root rot. A good growing medium also ensures adequate air circulation to the roots, promoting healthy development. Different plants require specific types of media to flourish. Succulents need well-draining sandy soil, while tropical plants prefer moisture-retentive, nutrient-rich soil. In terrariums, the right growing media is crucial for maintaining a balanced ecosystem, ensuring plants get the necessary water, nutrients, and oxygen to grow successfully.

Following are the components of growth medium for terrariums

- Garden soil
- Sand
- Cinder
- Charcoal
- Perlite
- Pumis
- Leaf compost
- Peat Moss
- Gravel



The medium was prepared with 35% garden soil, 20% sand, 15% leaf compost, 10% pumice, 10% perlite, 5% charcoal, and 5% cinder. First, pumice and perlite were added, followed by garden soil and sand. Next, charcoal and cinder were incorporated, then pumice and perlite were added again. Finally, sand and soil were layered to ensure a 55% composition of sand and soil in the medium.

Tools: Terrarium designing requires specialized tools for precise planting and maintenance. Long tweezers, chopsticks, and skewers help position plants in small or deep containers, while a long-handled spoon or trowel is

useful for adding and leveling soil. A funnel ensures mess-free pouring of soil and decorative stones. Spray bottles provide controlled misting to maintain humidity, and small scissors or pruners help trim plants. A soft brush cleans leaves and glass walls, while activated charcoal absorbs odors and toxins. Additionally, a small rake or fork helps arrange soil and decorative elements, ensuring a well-maintained and aesthetically pleasing terrarium.



Decorative Elements: Ornamental components enhance the visual appeal of a terrarium, making it more artistic and unique. Colored mosses add texture and help retain moisture, while pebbles and gravel serve both decorative and drainage purposes. Driftwood, twigs, and rocks create a natural, rustic look, and decorative sand adds contrast and patterns. Miniature figurines bring themed designs to life, while crystals, glass beads, and marbles provide a modern touch. Additionally, dried flowers or leaves introduce extra texture and color variations, making the terrarium a captivating piece of living art.



Planting in Terrarium

Use prepared growth medium, about $2\frac{1}{2}$ inches deep, ensuring enough space for roots. Remove the largest plant from its pot, clear excess soil from the roots, and create a hole using a spoon. Nestle the plant in place, pressing the soil firmly. Aim for one plant per inch of container diameter, arranging them from largest to smallest, starting at the back. Once planted, surround them with a $\frac{1}{4}$ -inch layer of white sand and complete the design with decorative pebbles for a finished look.



Thematic Arrangement

The themes can be created by orienting materials or plants, and the shape of the container and related decorative accessories can be chosen to match the theme of the terrarium.

Elements of Terrarium

- Balance
- Focal point
- Rhythm & Proportion of Scale

Care and Display

Maintaining a terrarium involves creating the ideal growing environment for plants by ensuring proper light, moisture, temperature and ventilation. Regular care includes monitoring humidity levels, removing dead leaves, and preventing mold growth to keep the ecosystem healthy.

- Open terrariums should ideally be placed in indirect sunlight, and closed terrariums should be placed in bright, filtered light. Keep closed terrariums out of direct sunlight, as this can cause overheating.
- When water droplets (condensation) form on the inside walls or lid of the terrarium, open the lid for about an hour to allow excess moisture to evaporate.
- The terrarium was placed in a temperature-controlled area, ensuring stable conditions for optimal plant growth.

Conclusion

Building terrariums is a fulfilling hobby that combines creativity with nature, enabling the creation of self-sustaining miniature landscapes in glass containers. By carefully selecting suitable plants, materials, and tools, one can craft a visually appealing and thriving ecosystem.

With proper maintenance, a terrarium continues to flourish, serving as a beautiful and enduring natural display that enhances any indoor space.



THE SECRET LIFE OF PLANTS: UNDERSTANDING PLANT COMMUNICATION

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Figure: Forest Canopy

Imagine a world where trees, flowers, and grasses aren't just silently growing but are actively chatting with one another. It might sound like a fantasy, but plants have their own unique language—a system of chemical signals, underground networks, and even visual cues that allow them to interact with their surroundings. The more we learn, the more we realize that plants are far from passive; they're busy coordinating survival strategies and forming intricate communities.

The Hidden World of Communication

Picture a plant under attack by insects. Unable to flee, it releases volatile organic compounds (VOCs)—chemical signals that act like a 911 call for plants. These VOCs

drift through the air, warning nearby vegetation of the impending danger. In response, neighboring plants begin producing their own defenses—tasting bitter or developing sticky coatings—to deter the pests. This isn't just an isolated reaction; it's a community-wide emergency response that boosts the survival chances of all involved (Karban et al., 2000).

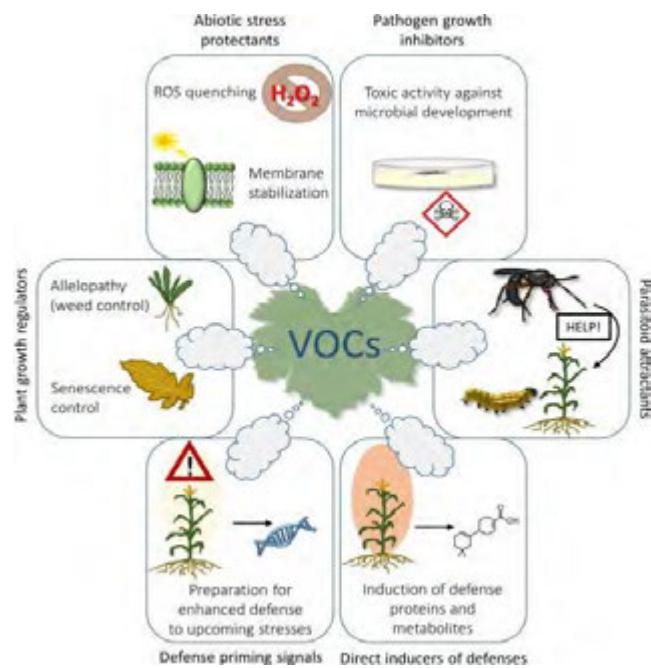


Figure: Volatile Organic Compounds released by plants

Underground Networks: The "Wood Wide Web"

Communication among plants isn't limited to what happens above ground. Hidden beneath our feet is an underground network formed by mycorrhizal fungi. These fungi connect the roots of different plants, creating what scientists call the "Wood Wide Web." Through this network, plants exchange nutrients, water, and crucial information about environmental threats. For instance, older, sturdier trees can share nutrients with younger, struggling saplings, helping them survive drought or pest attacks (Simard et al., 1997). This support system is a remarkable example of nature's cooperation—a silent conversation that keeps the forest ecosystem healthy and resilient.

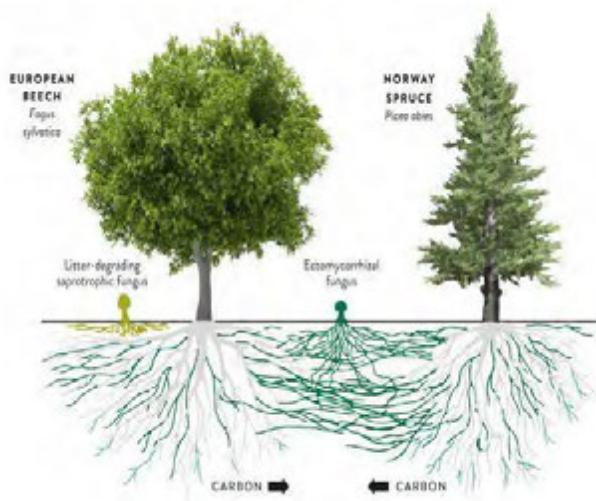


Figure: Mycorrhizal connections between plants

Talking to Pollinators

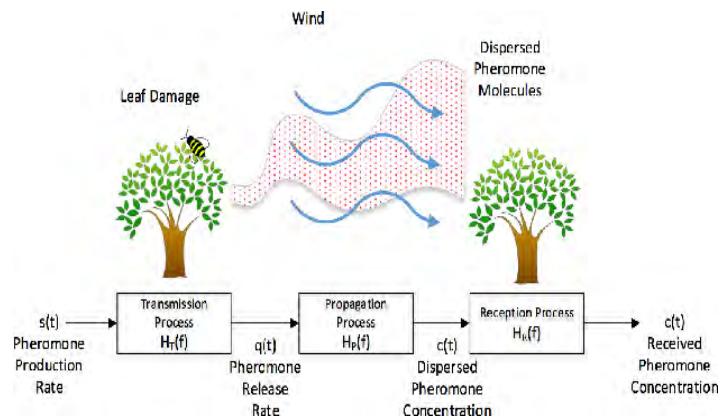
But plant communication isn't just for defense. It also plays a key role in attracting pollinators. Flowers have evolved vibrant colors, enticing scents, and specific shapes to signal to bees, butterflies, and other pollinators:—"Come here, I have nectar for you!" Bees are particularly drawn to blue hues, while butterflies might prefer purple. Moreover, many flowers change their scent or even color once they're ready for pollination, ensuring that their—"message" reaches the right audience at the right time (Goyret et al., 2008). In return, pollinators get rewarded with nectar and pollen—a mutually beneficial exchange that helps plants reproduce and sustains the pollinators' food supply.



Direct Plant-to-Plant Conversations

Beyond sending out broad warning signals, plants also engage in more direct communication through pheromones—chemical messengers that travel through

the air or soil. When a plant is attacked by herbivores, it releases these pheromones to alert its neighbors. Nearby plants—"eavesdrop" on these cues and ramp up their own defenses by producing toxins or thickening their leaves (Dicke et al., 1990). It's as if plants have an early warning system, allowing them to brace for incoming threats even before they're directly affected.



Do Plants Have Emotional Intelligence?

While it might be a stretch to say plants have emotions like we do, they do exhibit a kind of—"emotional intelligence" in how they respond to their environment. Take the *Mimosa pudica*, or—"sensitive plant," for example—it reacts to touch by quickly closing its leaves. This thigmotropism response is not about feelings but rather a survival mechanism designed to minimize damage from predators (Burr et al., 1972). Such responsiveness suggests that plants are constantly monitoring their surroundings and adjusting their behavior, much like organisms with more complex nervous systems.

The Future of Plant Communication Research

The implications of understanding plant communication are vast. Imagine harnessing these natural networks in agriculture—crops that—"talk" to each other could warn about pests, reduce the need for pesticides, and boost overall yield. In conservation, insights into plant networks might help us support endangered species by encouraging resource sharing among plants. The more we decode the language of plants, the better we can work with nature rather than against it.

As research advances, we're uncovering just how interconnected our natural world is. Plants may not speak in words, but their silent conversations—through chemicals, networks, and even colors—reveal a

complexity that challenges our traditional views of life on Earth.



Figure: The connection between plants

Conclusion

Plants are far more dynamic than they seem. Through chemical signals, underground fungal networks, and even visual displays, they communicate in sophisticated ways that enhance their survival and shape entire ecosystems. By learning to —listen” to these conversations, we not only deepen our understanding of nature but also open up new possibilities for sustainable agriculture and conservation. In the secret language of plants lies a blueprint for resilience—and perhaps, a lesson for us all.

A close-up photograph of a scientist's hands wearing white gloves. The scientist is using a black pipette to add a clear liquid to a small, round-bottom flask. The flask contains a purple, granular substance. The background is blurred, showing shelves with various laboratory glassware and equipment.

CHEMISTRY

2024: YEAR IN REVIEW

Jan

- **Sulfur Stereochemistry Takes Centre Stage:** Directional interactions and three-dimensional functional groups are crucial to medicinal compounds. Consequently, new functional groups require stereocontrolled synthetic methods. Now, an enantiopure building block provides controlled and divergent access to valuable sulfonimidoyl functional groups. (**James A. Bull**)

Feb

- **Clever cryptand cage coordinates contaminants:** Replicating the ability of enzymes and transport proteins to effectively bind anions is a considerable challenge for supramolecular chemists. A neutral organic cage has now been developed that selectively binds sulfate anions in water. (**Rosemary J. Goodwin & Nicholas G. White**)

March

- **Lifting Iron Higher And Higher:** Biological and synthetic catalysts often utilize iron in high oxidation states (+IV and greater) to perform challenging molecular transformations. A coordination complex featuring an Fe(VII) ion has now been synthesized through sequential oxidations of nonheme iron–nitrido precursors. (**Adam T. Fiedler & Laxmi Devkota**)

April

- **Upcycling Chlorinated Trash into Synthetic Organic Treasure:** Chlorine-containing waste streams pose potential risks to human health and the environment, so their remediation represents a significant challenge. Now, chlorinated wastes have been successfully repurposed as chlorinating reagents for use in the preparation of organic chemicals and pharmaceutical ingredients. (**Andrew Jordan**)

May

- **Cyclopropenium Functionalization:** Although functionalized cyclopropenes have found uses in many applications, their synthesis has been severely limited. Now, a hypervalent iodine reagent, in conjunction with gold catalysis, has been utilized to control their reactivity, allowing efficient formation of cyclopropenyl alkynes/alkenes. (**Sayad Doobary & Berit Olofsson**)

June

- **Reversing the Charge of Lysine by Genetic Code Expansion:** Posttranslational modifications alter the structure and function of proteins. Now, genetic code expansion enables encoding of ϵ -N-succinyllysine and ϵ -N-glutaryllysine residues to decipher the effects of these modifications on enzymatic activity, protein–protein interactions and protein–DNA interactions. (**Daniela Danková & Christian A. Olsen**)

July

• **Direct Nanoscopic Imaging of The Hydrated Nanoparticle-ligand Interface:** The ligand-nanoparticle interface helps to control nanoparticle synthesis and functional properties, but determining its structure and dynamics is challenging owing to the lack of high-resolution direct imaging methods. Now, liquid-phase transmission electron microscopy has uncovered the micellar packing and surface adsorption dynamics of a surfactant ligand on gold nanorods. (**Taylor J. Woehl & Damien Alloyeau**)

Aug

• **Generating Synthetic Gap Junctions Using Supramolecular Amphiphilic Giant Nanotubes:** The construction of synthetic cells holds great importance for exploring complex biological systems and could potentially provide insights into the origins of life. Now, synthetic gap junctional channels have been developed as a building block to construct synthetic cells that can mediate intercellular transport of ions and bioactive species. (**Ai Kohata & Kazushi Kinbara**)

Sep

• **Regulated Anion Configuration Enables Ultrafast Li-ion Transport:** Although all-solid-state Li batteries offer a safe, energy-dense alternative to commercial Li-ion batteries, their development is impeded by the sluggish Li-ion transport within solid electrolytes. Now, anion configuration regulation has been shown to promote Li-ion migration, offering a new approach for designing highly Li-ion-conductive solid electrolytes. (**Cheng Ma**)

Oct

• **Charting the Ligandable Proteome for Stereoselective Interactions:** Determining the ligandability of the human proteome can provide key insights to characterize biological processes and promote drug discovery. Now, multi-tiered activity-based protein profiling provides comprehensive proteomic maps of chiral small-molecule interactions. Over 300 distinctive proteins were identified to ligand tryptoline acrylamides, including stereoselective and site-specific events. (**John Paul Pezacki, Eryn Lundrigan, Parrish Evers & Spencer Uggioni**)

Nov

• **Catalysis-enabled Amine Sorting:** Multicomponent couplings offer powerful approaches for rapidly increasing molecular complexity, but typically require functionally distinct reagents. Now, through dynamic combinatorial chemistry, structurally similar amino groups can be efficiently differentiated, enabling the enantioselective aminomethylamination of dienes to prepare 1,3-diamines. (**Steven J. Malcolmson**)

Dec

• **Nobel Prize in Chemistry 2024:** The Nobel Prize in Chemistry 2024 was divided, one half awarded to **David Baker** –For Computational Protein Design”, the other half jointly to **Demis Hassabis and John Jumper** –For Protein Structure Prediction”.

MOVIE REVIEW

BREAKING BAD (2008)

Atika Kaleem

0407-BS-CHEM-21

Breaking bad is an American Crime Drama in which the leading character is **Walter White** (known as Heisenberg). He is a High School Chemistry teacher and suffering from Lung Cancer. His brother-in-law **Hank Schrader** works for DEA (Drug Enforcement Agency). Walter teaches chemistry to students in an experimental way like performs Flame tests, show energy states of electrons and emphasizes that **Chemistry is the study of matter. But I prefer to see it as a study of change**. Walter thinks he can make more money in Narcotics business so steal some equipments like volumetric flask, beakers etc from Chemistry lab. He synthesizes a drug **Crystal Meth** with a former student **Jesse Pinkman**. Walter uses phenyl-2-propanone (P2P) method for the synthesis of high quality **Methamphetamine (blue meth)** in Meth Lab. Walter guides Jesse to dissolve a dead body of **Emilio** (drug dealer) in plastic tub containing Hydrofluoroacid (HF) but Jesse uses Ceramic tub i.e bath tub instead of plastic container. HF has an ability of dissolving body tissues so it liquefies the body of Emilio along with bath tub. Walter throws red phosphorus (P) in a room of **Tuco Salamanca (drug dealer)** for a rapid explosion. In reality red P forms phosphine gas when mixed with acid and moisture. Later we see Walter kills Tuco with **Mercury Fluminate Bomb Hg(ONC)₂**, an explosive compound used as detonation primer for dynamite. Jesse and Walter burn the lock in junkyard with



the help of Thermite mixture (Al powder and Fe oxide) immediately. In reality thermite mixture burns at a temperature of 2500 C. Walter brilliantly applies his knowledge of chemistry for the formation of blue Meth. He uses Methyamine a precursor in P2P method

synthesis. Due to the shortage of Methylamine he does a lot of crimes. For some corpses disposal he uses HF and for some hydrochloroacid **HCl**. Tuco convinces Jesse and Walter to dissolve his uncle's dead body in HCl. It dissolves all the organic material but not as effective as HF. Walter uses **Ricin in cigarettes**, a highly toxic poison derived from castor beans. It retards the synthesis of proteins and lead to ultimate organ damage. Walter uses this ricin against drug dealers especially Tuco. **Gus Fring** is an American businessman and wants to take all of his control on drug trade. On Gus demand of pure meth Walter synthesizes **99.1%** pure crystal meth (blue appearance). Walter uses Filtration and purification for Meth production. This emphasizes on the role of filtration, purification to get good product/ yield. Walter poisons Andrea's son (Brook) with **Lily of Valley**. It has a toxin Convallatoxin (CNT) that inhibits the heart's Na⁺/ K⁺ ATPase. Irregular heartbeat, vomiting and dizziness sickens Brook but not kill him. Again Jesse and Walt steal Methylamine from train and uses thermite mixture to melt the lock. At the end we see chemistry teacher Walter White turned into meth kingpin and dies alone in Meth lab surrounded with all the mess he created. During all these crimes Heisenberg says: **I'M NOT IN DANGER, I'M THE DANGER.....**

ANTIBIOTIC USAGE: RISKS AND RESPONSIBLE PRACTICES

Mariam Ashraf

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Can you imagine a world suffering from a hazard where common infections become incurable due to antibiotic resistance? If there is such a world, you might be eager to know why antibiotic resistance exists. By the proper understanding of antibiotics, you will learn the reason for antibiotic resistance and can take part in protecting the world from this hazard. Antibiotics are generally compounds that either kill or inhibit bacteria. This term is coined from the Greek, meaning "against life". Paul Ehrlich was the first scientist who discovered antibiotic compounds and laid the foundation for chemotherapy (a new area in medicinal research), while Alexander Fleming only discovered penicillin. Antibiotics are widely used for treating different types of infections, without studying the nature of infection. Antibiotics have become a standard solution because of the recovery in a shorter period of time. The misuse or overuse of antibiotics in this way will not only result in developing antibiotic resistance but also make the previously treatable infection more lethal.

How Antibiotics Work

Antibiotics' mode of action is identical to what their name, antibiosis, implies. These are organic substances produced by one microbe that either inhibits or kills another. Antibiotics work biochemically by

- **Inhibiting cell wall synthesis** (e.g., penicillin targets bacterial walls, leading to cell death).
- **Blocking protein production** (e.g., tetracyclines stop bacteria from making essential proteins).
- **Interfering with nucleic acid replication** (e.g., fluoroquinolones prevent bacteria from multiplying).

The Evolution of Antibiotic Resistance

There is this old myth that goes with saying —our body can not wise up but bacteria certainly do". The evolution of bacterial species as they become stronger due to competition with antibiotics was the subject of this discussion. Bacteria compete with one another for their survival; in the same way as human beings strive to live

their best. They exhibit gene mutations that enable them resistant to drugs, and these gene mutations are passed on to next generations. These gene mutations change the structure and such biochemical changes ultimately help bacteria to develop immunity against the antibiotics. Resistance can be developed in a variety of ways, such as by making enzymes that break down antibiotic, altering active sites, creating protein pumps, or even causing an antibiotic to kill itself. Antibiotic resistance science is both intriguing and concerning. We are unwittingly giving germs more resistance when we overuse antibiotics. As they change and adapt, these tiny creatures create defenses against our medicinal weapons. It's like handing over the blueprints for our defenses to our future adversaries.

Antibiotics Usage

The antibiotic even though offers great benefits, yet the misuse can result in several complexities. To prevent the misuse, there are some medical practices that should be followed.

- Take antibiotics only on the prescription of the doctor, and complete the course prescribed. It is because the healthcare professional can suggest the appropriate antibiotics depending upon the symptoms and test results.
- The dosage of each antibiotic depends on the body weight and age, each antibiotic has its own efficacy which varies with the age and body weight.
- Blood culture tests are necessary before taking antibiotics as the exact type of bacteria causing infection can be figured out from blood tests.
- The infections are of different types, it is necessary to find out the type of infection (i.e. bacterial, viral, fungal). The antibiotics are then used appropriately.
- It is necessary to assess the fever type, low-grade fever in which temperature is usually less than 101°F, antibiotics are usually not needed because they are mostly viral. Similarly, if there is high-grade fever, in which body temperature is above 101°F, medicines are necessary because it is mostly caused by bacteria.

It is commonly observed that patients do not complete their prescribed antibiotic course. To effectively treat an infection, antibiotics must be taken for five to seven days. If we do not complete the course and stop taking medicines after 2 or 3 days, there might be chances that

few bacteria are left alive in our body and can cause particular disease again. The bacteria have remarkable ability to develop resistance to a specific antibiotic in a shorter time span of 11 days. So, the symptoms of a disease can be observed again in the individual who has not completed his earlier course. A stronger generation of antibiotics is then required to treat the infection. So far, four generations of antibiotics have been developed to address this ongoing challenge.

Conclusion

In short, antibiotic are effective drug, but just as excess of everything is bad, similarly if antibiotics are consumed in larger amount it can diminish the body natural ability to fight against foreign unwanted substances. Using antibiotics responsibly is a shared duty to protect both current and future generations. There are many little things we may take to contribute our part: by being an active participant in your treatment and finding better alternatives. Honey is a natural antibiotic for treating wounds and it also help in growth of our gut bacteria. So whenever in future you are advised to take antibiotics, **—Think twice, before using antibiotics”.**

MICROPLASTICS: IMPACTS AND STRATEGIES

Marwah Sohail

0493-BS-CHEM-22

What are Micro-plastics?

Micro-plastics, comprised of synthetic polymers, are plastic particles smaller than or equal to 5 mm (≥ 5 mm). Micro-plastics are designated as primary micro-plastics and secondary micro-plastics. Primary micro-plastics are purposely synthesized having the size of 5 mm, whereas, secondary micro-plastics are obtained by degrading larger particles. The processes that break down the particles are bio-fragmentation, assimilation, and Bio-deterioration. Micro-plastics can deteriorate into minute nanoparticles when dispersed in the environment.

Sources of Micro-plastics

Micro-plastics have their origins from either primary or secondary sources. Primary sources include vehicle tire wear, rubber roads in cities, plastic tracks, and personal

care items, while secondary sources include plastic bags, bottles, and plastic films used in agriculture. Roughly, about 80% of micro-plastic pollution originates from land, while less than 20% from the ocean.

The six main plastic groups used in plastics are polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), polyurethane (PUR), and polyethylene terephthalate (PET). Packaging and construction are the two major consumer end-use markets, while the automotive industry is the third largest consumer. Most plastics are synthetic, but they can also be extracted naturally from trees, plants, animals, and insects.

Impacts of Micro-plastics

Micro-plastics are a growing concern as they have many negative consequences on marine ecosystems, human health, soil, plants, and atmosphere.

❖ Impact on Human Health

- Micro-plastics disrupt the redox balance by affecting their antioxidant enzymatic activity, leading to oxidative damage and disrupting life activities. Isocitrate dehydrogenase (IDH), an enzyme regulating cellular metabolism, activity is inhibited, affecting cell growth and fecundity, causing oxidative stress and muscle injury.
- Micro-plastics inhibit acetylcholinesterase (AchE), hindering neuronal function and potentially decreasing neuronal network function.
- Plastic synthesis and processing in industrial production adds organic and inorganic components, like phthalates, which can disrupt endocrine function.
- Suspended micro-plastics can enter the body through inhalation and persist in the lungs, increasing risks of respiratory irritation, interstitial lung disease, tumors, and inflammation.
- They accumulate in lysosomes, leading to cell death due to the breakdown of the membrane and the release of degrading enzymes.
- They can enter the digestive tract, causing abrasion of gut lining tissues and entering the circulatory system.

- They trigger immune response cells and can cause physical damage to internal tissues and block narrow ducts, arteries, and capillaries.

❖ Impact on Aquatic Organisms

- Micro-plastics can disrupt the immune system, reducing immune cell activity and cell viability in fish, leading to inflammation and changes in inflammatory response genes.
- Micro-plastics in water bodies often have biofilms containing toxin-producing microbes, which can cause serious infections and other problems.
- They can also be up-taken by plants and transported along the food chain.
- They also provide substrates for the inhabitation by marine organisms, such as sea skaters.

❖ Impact on Soil

- Micro-plastics accumulate and affect the soil bulk density, permeability, water-holding capacity, and stability agglomeration.
- Micro-plastics can absorb heavy metals and persistent organic pollutants, causing oxidative stress and cytotoxicity.
- They can directly alter the soil physiochemical characteristics and microbial communities, affecting soil health.
- High concentrations of micro-plastics can reduce lettuce biomass and chlorophyll levels.
- They hinder plant growth and yield and indirectly harm root structure and metabolic function.

Characterization

Micro-plastics can be identified by several techniques including physical and chemical characterization. Initial steps include density separation, filtration, sieving, and visual sorting. Visual techniques, such as the naked eye or optical microscope, are used majorly for micro-plastic characterization due to their simplicity and ease of use. Wet peroxide oxidation and staining methods, such as Nile Red dye, can optimize these techniques.

Spectroscopic techniques, such as Raman spectroscopy and Fourier Transform Infra-Red Spectroscopy (FTIR), are used to analyze the molecular structure of micro-plastics. These techniques can reliably establish the chemical composition of unknown plastic particles, requiring sample preparation.

Chromatographic techniques including high-temperature gel permeation chromatography (HT-GPC), liquid extraction with size exclusion chromatography (SEC), and pyrolysis gas chromatography-mass spectrometry (Py-GC-MS) can be used for the chemical analysis. Preliminary techniques like castor oil separation, hyperspectral image (HSI), and Fenton's reagent are needed to replace methods, to analyze quickly.

Mitigation Strategies

Strategies to manage this pollution include preventive measures, remediation of microplastics, and increasing social awareness.

- Execute a ban on cosmetic products and single-use toiletries containing microplastic beads, as in the European Union.
- Restrict the use of plastic bags.
- Biodegradable plastic based on cellulose and polyolefins should be promoted due to their low cost, high mechanical strength, and easy decomposition in the environment.
- Chemical recycling is a suitable alternative that involves the direct conversion of used plastics into raw materials for new plastic production having characteristics as the original one.
- Life Cycle Assessments (LCA) are used to evaluate products' environmental impacts and encourage eco-design.
- Several bacteria, such as *Ideonella sakaiensis*, have the ability to degrade plastic.
- Making polymers from plants, animals or microbes is most suitable.
- Bioplastics should be synthesized from second-generation biomass and used in bituminous road construction.

Microplastics pose a serious threat affecting public health, the environment, and ecosystems, globally. Scientific advancements, international cooperation, and strong policy regulation are required to tackle this threat.

DRINKING WATER AFTER PEANUTS: BUSTING THE MYTH WITH SCIENCE

Tuba Shahbaz

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The belief that drinking water after eating peanuts is harmful has been passed down through generations in many cultures, including Pakistan. As per the claim, having water after peanuts can cause throat irritation, indigestion, and even bloating. But is such a claim scientifically valid, or is it a mere myth with no reality?

Food myths have numerous sources, such as cultural practices, misconceptions, and individual experiences. In Pakistan, a prevalent perception is that certain foods, when taken together, have a deleterious impact on one's overall well-being. For some, peanuts, due to their dry and slightly rough texture, can cause throat irritation, and drinking water worsens the problem. Others have a perception that water can decelerate digestion and inhibit the decomposition of peanut nutrients. However, modern nutritional science challenges these claims by examining the physiological process of digestion and nutrient absorption.

The Digestive Process of Peanuts and Water's Role

Digestion is a multi-step process involving many organs, enzymes, and biochemical processes in which food is disintegrated and broken down to a state in which it can be utilized and absorbed in the body. As soon as peanuts or other foods enter the mouth, digestion begins, where they are broken down mechanically by chewing and then mixed with saliva. Amylase an enzyme in saliva begins to break down peanuts' negligible carbohydrate content. As peanuts have a naturally rough, dry texture, chewing them thoroughly ensures easier digestibility when peanuts pass through the stomach.

Upon swallowing, peanuts move through to the stomach, where gastric acids and digestive enzymes digest their nutrients even deeper. Peanuts have carbohydrates,

proteins, and fats in them. Proteins and fats are broken down with pepsin and lipase, respectively, and then discharge in the stomach. The peanut is broken down so that it can effectively move through to the small intestine. A common myth is that having water during and after a meal will slow down digestion, but actually, it aids digestion to go even better, and easier dissolving of nutrients and effective transportation through the digestive tract.

Water does not dilute gastric acid to a point that will inhibit digestion. Stomach acid is not lowered with increased consumption of liquids, and food is efficiently broken down for effective processing and absorption. Water softens food for easier processing and absorption, and it triggers peristalsis, a wavelike muscle contraction, that aids in moving food through the intestines for effective and unobstructed digestion and prevents constipation. Drinking water after consuming peanuts is not harmful but aids in digestion and overall gut functioning.

The Chemistry of Peanuts and Water Interaction

From a chemical viewpoint, peanuts contain a combination of macronutrients, including carbohydrates, proteins, and fats. Carbohydrate composition in peanuts consists of starch and fiber, both of which require enzymatic activity for absorption. Diets with peanuts have a high intake of dietary fiber, and its presence helps in maintaining the gut through effective bowel function. When water is consumed, it doesn't modify peanuts' chemical makeup in a way that will inhibit digestion but helps in solvating solvable compounds, improving the absorption of nutrients. Complex biochemistries in the body coordinate the process of digestion, and both solids and liquids can go through a similar period in a non-interfering manner.

Peanuts and the Risk of Allergies

While the peanut and water allergy myth isn't backed with scientific facts, peanut allergies are a legitimate health concern. Peanuts are enlisted in most common allergy triggers which can cause mild to extreme reactions varying in person to person. Allergic symptoms to peanuts can range from a rash, puffiness, gastrointestinal symptoms, and, in extreme cases, an anaphylactic (life-threatening) reaction. For individuals with peanut allergies, consuming peanuts alone or with water can

cause allergic symptoms, but water itself is not a contributing factor. Those with a proven allergy have to use caution and seek medical consultation for the proper management of the allergy.

Scientific Conclusion on Water and Peanuts

Based on scientific fact, there is no harm in drinking water after eating peanuts. The digestive system can digest both solids and liquids undamaged. Water facilitates digestion and is not impairing and its suspected causation of bloating and sore throat cannot yet be backed by studies.

The myth continues to dominate conventional thinking and not physiologic reality. What one learns about peanut chemistry and peanut digestion is that having water with them poses no danger. Hydration, in fact, is important for general wellness, proper nutrition, and absorption, and not a danger when taken with peanuts.

SUNSCREEN FILTERS THROUGH THE AGES: THE RISE OF KOREAN UV FILTERS

Qurat Ul Ain Qadeer

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You surely have heard the social media and the skincare market buzz with the hype of K-beauty, mainly their new-generation UV filters in sunscreens. Well, they did make a breakthrough, but first, let's go through the history of sunscreens, from their humble beginnings to the current global sunscreen market that will surge to \$24.4 billion by 2029.

Egyptians in 4000 B.C. were the first to realize that sun exposure had detrimental effects on skin health. To cope with this, they used rice, jasmine, and lupine extracts. Olympians in Ancient Greece used to cover their bodies in olive oil and sand. These early methods were undoubtedly rudimentary, but they laid the foundation for the sunscreens we know today.

Sir Everard Home, in 1820, discovered the role of sunlight in skin damage, which led to the discovery of acidified quinine sulfate as the first UV-B filter. This acidified quinine sulfate was then combined with lotions to produce the first chemical sunscreen. The 20th century marked a turning point in the innovation of UV filters.

The first commercially available sunscreens by Hausser and Vahle in 1928 contained benzyl salicylate and benzyl cinnamate as UV-B filters. Sunscreens containing PABA (para-aminobenzoic acid) as a UV-B filter were a huge success in 1933 until the harmful effects of PABAs came into sight. Also, including PABAs, no UV filter was yet effective against UV-A radiations.

By the mid-20th century, iron oxide as a visible light filter and zinc oxide/titanium dioxide as a UV-A filter gained popularity. Formulations such as 20% zinc oxide with iron oxide were considered more effective. In addition to scattering UV radiations, iron oxide resulted in protection against melasma. As the industry progressed a bit more, the use of anti-oxidants in sunscreens became popular due to their protective role in combating reactive oxygen species. However, these early mineral sunscreens were often thick and greasy and left a noticeable white cast.

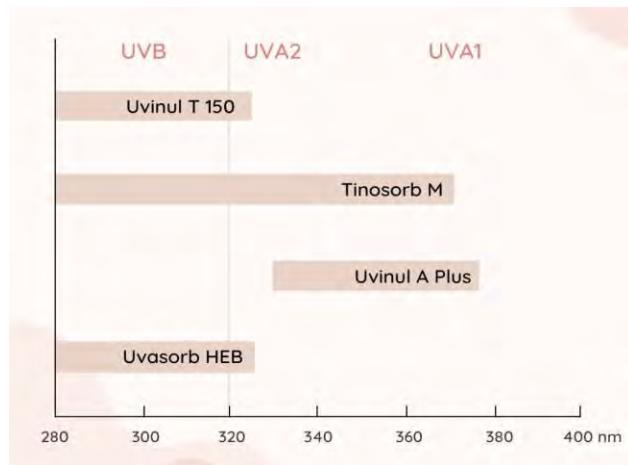
As science advanced, so did the sunscreen technology. The early 21st century saw the rise of broad-spectrum sunscreens, i.e. they protect against both UV-A and UV-B radiations. However, in 2018, sunscreens containing oxybenzone and octinoxate as chemical filters were banned because they slowed down the growth of coral reefs. Moreover, Matta et al. in 2019 put forward a shocking discovery that changed the trend of the use and development of UV filters. He found that chemical UV filters such as avobenzone, octocrylene, oxybenzone, and ecamusle when applied over some time absorb into the bloodstream at levels greater than 0.5ng/ml.

Seeing all this, the FDA has introduced 2 GRASE (Generally Recognized As Safe and Effective) UV filters that are zinc oxide and titanium dioxide, and 2 NON-GRASE UV filters, the PABAs and trolamine salicylate. Another set of 12 filters, out of the total of 16 allowed by the FDA, are under review. The FDA imposes strict regulations on the use of UV filters because they think it is a drugstore product. On the other hand, European regulations (EC) allow the use of 27 UV filters because they view them as cosmetic products.

In the recent years, Korean sunscreens have been in the limelight of skincare and cosmetic industry. What really sets them apart from their western counterparts is their innovative formulations, new filters, and emphasis on user experience. Korean sunscreens are known for their lightweight, cosmetically elegant textures, unlike

traditional sunscreens that feel heavy, and greasy and leave a white cast.

Korean sunscreens are based on new generation UV filters. They include uvinil A Plus (UV-A), bemotrizinol (UV-A and UV-B), uvasorb HEB (UV-B), parasol SLX (UV-B), isoamyl p-methoxycinnamate (UV-B), Tinosorb S, Tinosorb M, Meroxyl SX, and Meroxyl SM. These filters are more stable, less likely to cause irritation and provide longer protection. The efficacy of some of these UV filters in a sample of Korean sunscreen is shown.



Well, not only these filters make Korean sunscreens stand out. Another feature is their multi-tasking ability. The formulations are made to contain skincare ingredients like panthenol, centella asiatica, niacinamide, and hyaluronic acid, that hydrate, brighten, and soothe the skin alongside their role in protection. This hybrid approach ensures that the product is both effective and safe to use.

Regulatory differences also play a role in the success of these sunscreens. The Korean Ministry of Food and Drug Safety (MFDS) has approved the use of approximately 30 UV filters and is still approving more. However, the FDA is strict on 16 ingredients and that is the reason that Korean sunscreens are taking over the global suncare market. The U.S. has not added a new filter to the FDA's approved list since 1999 and hence, lags in the filter technology.

These sunscreens, however, also could not tackle the issue of blue light protection, i.e. the wavelength ranging from 400 to 500 nm. No sunscreen has been made to date that offers complete protection against blue light. However, of all the available UV filters zinc oxide and MBBT (Methylene Bis-Benzotriazolyl Tetramethyl butylphenol)

remain the best two options for protection from longer wavelengths (370nm and beyond) and blue light, which provide 74% and 62.09% blue light protection respectively. To put it in a nutshell, we should say: Yes, the hype of Korean sunscreen is real. Koreans have excelled way more than any other suncare industry owing to their new generation filters, lightweight formulations, luxurious user experience, and skin-like textures.

NEUROCHEMICAL REACTIONS: MECHANISMS AND FUNCTIONS

Shaheer Ahmad Sangha

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All organisms show common characteristics, one of which is responding to stimuli. The stimuli may be internal or external. The coordination is present in both unicellular and multicellular organisms. Coordination is very important for the survival of the organisms. The unicellular organisms respond to various changes such as temperature, intensity of light and concentration of various chemicals. In these organisms, the coordination is at the cellular level, while in multicellular organisms, there is a division of labor among cells, but every cell responds immediately to any stimuli. For example, our bodies are unable to detect bacteria present in our bodies, but our internal organs can sense the presence of bacteria or any unwanted substance. Another example of this response is that our body cannot see the radiations except for the visible spectrum of light, but our body responds to some of them.

There are many receptors that respond to chemical and mechanical changes of the internal organs.

- ❖ The receptors in the stomach lining, which are concerned with the arousal of "hunger," are the best example of coordination.
- ❖ Terrestrial animals detect different types of vibrations through receptors present in their joints.

Nerve Impulse

Nerve impulse is a wave of electrochemical changes, which travel along the length of a neuron involving chemical reactions and movement of ions across the cell

membrane. The electrical potential that exists across a cell membrane is known as **Membrane Potential**.

How Nerve Impulse is Conducted?

The main cause of conductance of a nerve impulse is the presence of Na^+ and K^+ in the inner and the outer side of the neuron. The movement of Na^+ and K^+ across the membrane is responsible for the conductance of nerve impulse.

Resting Membrane Potential

The difference in the positive and negative concentrations on inner and outer side of a non-conducting neuron is called as Resting Membrane Potential. The pushing of sodium ions to outside of membrane makes the inner side more negative. The presence of organic molecules such as proteins and Amino Acids on inner side also makes the inner side more negative. The cell membrane is also impermeable to all ions except K^+ , so the leakage of K^+ ions from the membrane makes the inner side more negative.

Active Membrane Potential

A nerve impulse is initiated by a stimulus known as a threshold stimulus. When an impulse enters a neuron, the Na^+ rushes inside through the "Sodium Gates" and the K^+ ions rush out, and now the neuron is ready to conduct the nerve impulse.

Synapse

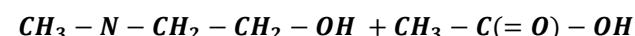
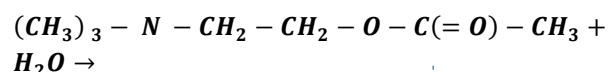
The gap between two neurons is called as Synapse. A single neuron can attach itself with many other neurons. The action potential cannot jump from one place to another, so the message is transmitted through chemical messengers called neurotransmitters. These neurotransmitters are given as:

- Acetylcholine ($\text{C}_7\text{H}_{16}\text{NO}_2^+$)
- Adrenaline ($\text{C}_9\text{H}_{13}\text{NO}_3$)
- Nor-epinephrine ($\text{C}_8\text{H}_{11}\text{NO}_3$)
- Serotonin ($\text{C}_{10}\text{H}_{12}\text{N}_2\text{O}$)
- Dopamine ($\text{C}_8\text{H}_{11}\text{NO}_2$)

Elimination of Neurotransmitter

After the impulse is conducted from a neuron, the neurotransmitter must be eliminated because its presence

after the conductance of impulse may affects the coordination system of body. Following chemical reaction takes place in synapse to eliminate the neurotransmitter. There exists an enzyme called Acetylcholinesterase (AChE). This enzyme is activated after conductance of nerve impulse. This enzyme converts acetyl choline into acetic acid and choline.



In conclusion, the Acetylcholinesterase (AChE) is the enzyme which is responsible for the elimination of the acetylcholine from the post synaptic region after the conductance of the nerve impulse.

Advantages of Acetylcholine esterase

By breaking acetyl choline it helps in:

- Preventing muscle fatigue
- Preventing excessive stimulation of muscles and neurons
- Regulate the activity of ACh, which is involved in attention, memory and learning.
- Helps in maturation of nervous system at fetal development.
- Regulates the secretion of other neurotransmitters such as serotonin and dopamine.

Deficiency

The deficiency of this enzyme leads to following disorders:

- Alzheimer's Disease
- Parkinson Disease
- Myasthenia Gravis
- Neuropathic Pain

Conclusion

AChE play an important role in maintaining and assemblage of Human Nervous System. Without this enzyme, the concept of a normal body is a dream.

MINOXIDIL: A TRUSTED TREATMENT FOR HAIR LOSS

Zahra Batool

0424-RE-BS-CHEM-21

Healthy and luxurious hair plays a prominent role in boosting one's looks and self-assurance. It impacts early judgement and socialization, contributing to a person's overall self-confidence and contentment. But nowadays, hair loss is a widespread problem affecting millions worldwide, aside from any age, gender, or culture. Although it is normal to lose 50-100 hair per day, severe hair fall or absence from areas of the body where it normally grows may indicate a fundamental condition such as alopecia. Alopecia, a medical term for hair loss, is of different types, including androgenetic alopecia (pattern baldness), alopecia areata (patchy hair loss), alopecia universalis (complete hair loss) and telogen effluvium (temporary shedding) etc.

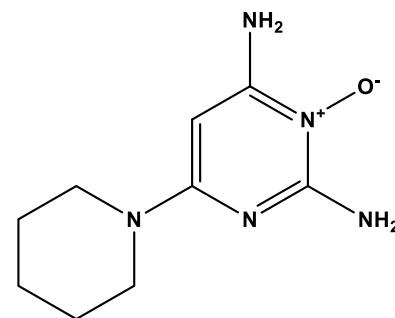
A mix of genetic, hormonal, environmental, and lifestyle factors causes hair fall. As seen in telogen effluvium, prolonged tension, unhealthy diet, and lack of sleep can disrupt the hair growth cycle, leading to increased shedding. Environmental factors like pollution, harsh chemicals, and too much heat styling can damage follicles and weaken hair, causing the thinning and breaking of hair. Hair loss can also be a result of medical conditions like diabetes and treatments like chemotherapy. The hereditary hair loss (androgenetic alopecia), driven by the hormone DHT, shrinks hair follicles with time, making the hairlines recede. Hair loss can also be provoked by hormonal fluctuations from conditions like PCOS, postpartum changes and thyroid diseases. Autoimmune disorders, such as alopecia areata, cause the immune system to attack hair follicles, resulting in patchy hair loss.

Androgenic alopecia is the most frequent type of hairfall, affecting almost 40% of the female and 70% of the male population of the world. In females, it is known as female pattern baldness; in males, it is known as male pattern baldness. Progressive loss of terminal hair is observed in this condition. More men are affected because they have higher levels of testosterone, these higher levels leads to more production of dihydrotestosterone. The frontotemporal and vertex are men's most affected regions of the scalp because these areas have more androgen

receptors which make these areas more sensitive, whereas females experience diffuse hair thinning on top of the scalp.

Several lifestyle changes, different products and medical treatments have been introduced to solve the hair fall problem. A healthy diet packed with biotin, vitamin D, iron and protein can positively influence hair health. Blood circulation can be enhanced by gentle exfoliation and regular scalp massages. Enough sleep and meditation can also reduce hair fall caused by stress. Hair transplant surgeries, PRP (platelet-rich plasma), finasteride and minoxidil are also highly recommended for severe cases of hair fall.

To date, the most practical and fruitful treatment for androgenic alopecia is topical and oral minoxidil. It has been approved by the US Food and Drug Administration for treating AGA and other hair diseases. Minoxidil is a derivative of piperidino-pyrimidine ring, having a chemical structure: 2,6-diamino-4-piperidinopyrimidine-1-oxide (**C₉H₁₅N₅O**). Its efficiency in hair regrowth is due to its stable chemical structure and penetrating ability in the scalp. Non-reactive components like water, propylene glycol and ethanol play a role in the solubility of minoxidil.



2,6-diamino-4-piperidinopyrimidine-1-oxide
Chemical Formula: C₉H₁₅N₅O

Minoxidil is basically a vasodilator. It interacts with the potassium channels which are located in blood vessels of smooth muscles and relaxes them. It results in broadening of vessels which ultimately causes high blood flow to the scalp. Increased blood flow allows more oxygen and nutrients to reach the hair follicles ensuring the hair growth. It also causes the shedding of follicles in the telogen (resting) phase and new thicker hair grow in a new anagen (growth) phase. It also enhances growth rate by opposing the shrinkage of hair follicles. Minoxidil

sulfate, the metabolite of minoxidil, is the reason of its positive influence on regrowth of hair. An enzyme sulfotransferase accountable for the alteration of minoxidil to minoxidil sulfate is located in hair follicles. The effectiveness of minoxidil depends on this enzyme activity. Positive outcomes are observed in patients with higher enzyme activity than those with lower activity.

Minoxidil is present in topical (foam, 2% and 5% solution) and oral variants in the market. These variants are prescribed by the physician depending on the severity of the case. To get the effective results, it should be applied regularly, once or twice daily. Patients can see visible results after the consistent use of 3 to 6 months. Discontinuing the use of minoxidil can reverse the progress and start hairfall again. Like every chemical medication, it also comes with some side effects like dryness, irritation and itching. Only recommended dosage of foam and solution should be used on dry and clean scalp. Minoxidil has shown progress in minimizing hair loss making itself trustworthy for its use in treating hair diseases. In upcoming time, the efficacy of minoxidil can be enhanced by modifying its formulation and combination techniques, offering more effective methods to those facing hair loss.

TRANSFORMING EVERYDAY MATERIALS INTO GEMS

Hira Arshad

0539-BS-CHEM-22

In the field of chemistry, there are researches where the ordinary is converted into something exceptional. Conversion of simple compounds into jewels shows the power of scientific knowledge and technical development. There are various techniques that different researchers have devised for converting everyday objects into valuable gemstones. The rarity, beauty and value of precious stones has captivated men of every ages which lead to increased demand of such products. To meet this increasing demand, various researchers and gem artisans have put their efforts to formulate techniques and methods that can synthesize gemstones that resemble naturally occurring gemstones while upholding the ethics. In this regard, synthetic gems, or lab-made stones, hold

significance because they possess identical chemical, physical, and visual properties as their natural equivalents.

From Sand to Sapphires

Another change in the synthetic gem area is the ruby culture of normal substances such as sapphire and sand. The key element here is aluminum oxide (Al_2O_3), known as the natural corund, but rarely occurs in the quality of precious stones. The Verneuil method, also called flame fusion, was the first commercially successful method of manufacturing synthetic gemstones, developed in the late 1883 by the French chemist Auguste Verneuil. In this process, Aluminum oxide is mixed with elements of minimal color (e.g. titanium to obtain chromium, iron, and sapphire for ruby production). The powder is introduced into the flame of oxyhydrogen and converted into droplets. The droplets rotate and fall onto the pedestal, allowing the crystalline pattern to develop slowly. After few hours, the artificial gem is formed and is ready for cutting and polishing. This process converts regular aluminum oxide into excellent sapphires and rubies which can not be distinguished from natural gems without careful inspection.

From Carbon to Diamond

The existence of carbon as diamond is categorized among precious metals. Naturally, it is synthesized approximately 150 to 200 kilometers below the Earth crust under the influence of high temperature and Pressure. The temperature for the synthesis of Diamond ranges from 1200 to 2300 °C and the pressure ranges from 50,000 to 70,000 times higher than sea level. This process takes million of years to synthesize diamond naturally. But the modern technologies have revolutionized the synthesis of diamond. Now rather than waiting for million of years, we can synthesize diamond within weeks or months.

Originally developed in the United States by General Electric, the use of High Pressure High Temperature (HPHT) technology to grow diamonds in a lab started in the 1950s. The HPHT technique reproduces the natural environment in which diamonds develop: a carbon source (generally graphite) is introduced into a room next to a metal catalyst. The camera undergoes high pressure (around 50,000 atmospheres) and high temperatures (almost 1500 °C). Under these circumstances, carbon is integrated into liquid metal and subsequently forms diamond crystals. A recent method, Chemical Vapor

Deposition (CVD), produces diamonds under low pressure conditions. The chamber is filled with carbon gas (such as methane) and hydrogen. Microwaves or alternative energy sources destroy gas molecules. Carbon atoms accumulate in the substrate and gradually form diamonds. These methods emphasize the ability to convert ordinary carbon into one of the most desirable and valuable stones in the world, and to understand and modify the properties of the material.

Emeralds from the Lab: A Beryllium Transformation

Emeralds are another pearl that has a spectacular green nuance and have been synthesized by scientists. This process includes beryllium, aluminum, silicon and traces of chromium or vanadium for color. Flux Growth Method is employed for this application. In this method, the raw materials dissolve in a melted stream (commonly Lithium Molybdate) and then the solution is cooled. When the solution is cooled slowly, emerald crystals form. This process can take several months for completion but this method results in high-quality synthetic emeralds. This method converts a mixture of common elements into incredible green precious stones.

The Science Behind the Magic

Transforming everyday materials into gems is based on several important principles of chemistry and the science of materials. The precious stones owe their beauty and sustainability to highly ordered crystal structures. The synthesis process aims to accurately repeat these structures. By controlling the exact mix of elements, scientists can create gems with desired properties and colors. The conditions of temperature, pressure, and time are carefully controlled to allow the right crystal structures to form. An understanding of how the crystals of the embryo and growth allow scientists to create cleaner and cleaner jewels.

The transformation of everyday materials into dazzling precious stones is proof of the ingenuity of man and an in-depth understanding of chemistry and materials. With the clear understanding of Chemistry and their thrust to reproduce naturally occurring materials in the lab, the researchers have brought revolution in the science.

NANO MATERIALS AND HYBRID ELECTRODES: THE FUTURE ENERGY STORING TECHNOLOGIES

Ahad Raza

1459-BS-PHY-22

The world is evolving and is shifting towards cleaner and sustainable energy solutions. This transition leads to a greater incline in the demand of efficient energy storage technologies in the past few years. The energy storage devices are designed in such a way that it captures the electrical energy when there is less demand of energy and releases the stored energy in case of increased demand, ensuring a stable and reliable power supply. The batteries are widely recognized as energy storage devices but the pumped-storage hydropower is dominant method for large-scale applications. These traditional methods have been widely used for a long time.

With rapid increase in population, there increases the demand in the supply of energy, which the conventional devices cannot meet. Moreover, the reliance of these conventional devices was heavily on the natural non-renewable sources. With the high energy demands and the usage of renewable sources like wind power, solar energy, the scientists started working on advanced storage technologies. New solutions such as supercapacitors, high performance batteries and fuel cells have been employed to improve energy storage efficiency.

The use of nanomaterial and hybrid electrodes is the most remarkable development in this field. The synthesis of these advanced materials have been done while considering the limitations of conventional methods. Faster charging, higher energy capacity and long-lasting performance are some key features of the advanced materials. By the use of nanotechnology, the researchers are aiming to synthesize efficient storage devices that can reduce the reliance on fossil fuels and contributes to the sustainability of the environment.

Nanomaterials in the Energy Storage

Nanomaterials as the name indicates Nano, they are very smaller materials that range between 1 to 100nm in size. These smaller materials have revolutionized the energy storage and conservation technologies because of remarkable potential in enhancing the performance and

efficiency of various energy systems. There are various unique features that distinguished the nanomaterials from ordinary materials. Since they are well known in the energy storage devices, a lot of research has been done and many scientists have contributed in this field by synthesizing many nanoparticles. These nanomaterials are also classified in different types such as Graphene, Carbon nanotubes, nanowires, and metal nanoparticles.

A small material even smaller than a human hair is known exceptional in the energy storage devices, doesn't it seems a joke to you? If it is not a joke then how can it be exceptional? There is the chemistry behind the exceptional nature of these nanomaterials. As we know, the nanomaterials have small sizes; because of their small sizes they have increased surface area. This increased surface area provides more active sites for the reactions that take place in the batteries or other energy storage devices. Moreover, the nanomaterials increase the storage capacity which allows us to store more power in a smaller space.

The typical or conventional batteries have shorter lifespan and the efficiency of these devices reduces to greater rate with the passage of time. Nanomaterials, on the other hand has extended the lifespan of energy storage devices by reducing the charging and discharging cycles and thus prevent the damage in equipment because of repeated charging and discharging. Graphene and carbon nanotubes allow the electricity to flow more efficiently which reduces the power loss. So, usage of nanomaterials in the energy storage devices makes them more effective and reliable.

Hybrid Nano Structured Electrodes

Electrodes that are mainly involved in the storage and release of energy by charging and discharging are the basic component of batteries. The ordinary electrodes are composed of well-known materials such as carbon based material, metal oxide but have certain limitations in the energy storage devices. These materials have limited performances because of many factors like less energy storage capacity, reduced lifespan and slower charging and discharging rates. Even though are cheaper and affordable yet because of lower efficiency they are not used for advanced applications.

A newer material like hybrid nanostructured electrodes is developed for usage in the advanced application. As the

word hybrid indicates mixing, hybrid nanostructured electrodes are synthesized by mixing two or more different components at a nanoscale so that advantage can be taken from the unique properties of each material. These hybrid electrodes are useful in advanced storage devices such as advanced batteries and supercapacitors where ordinary electrodes cannot be used. Graphene has excellent electrical conductivity and large surface area while on the other hand metal oxides improve the energy storage capacity. Both of these materials are of great significance but combining both these materials together at a nanoscale can help us to get a hybrid electrode that will show the properties of both individual materials. The new hybrid electrode can boost the performance, efficiency and lifespan of energy storage devices; above-all will overcome the limitations of individual materials.

The use of nanomaterials and hybrid nanostructure electrodes in the energy storage devices is a remarkable milestone of the chemistry. By utilizing the materials in an efficient way, materials can be designed that have the potential to address the problems we are facing.

COMPUTATIONAL CHEMISTRY; A REVOLUTIONARY APPROACH IN DRUG DESIGN

Ali Jan

460-BS-CHEM-22

Can you reliably predict outcomes in a chemical system? Or have you ever predicted more than two things to happen in the system, and results came out in your favor of prediction? Well, even if that happened, your predictions could never have had 100% certainty. But, talking about new chemical reactions, whether their spectra, energy behaviors, kinetics, bonding pattern, atomic or sub-atomic models, mathematical methods that are automated in computers to solve problems related to chemicals or so many other things, with advancement in science computational chemistry has enabled us to predict all of that with accuracy. This is the revolution of chemical science.

With every passing decade, scientific revolutions kept making things easier and more efficient for us. Computational chemistry is one of the scientific revolutions that created a profound impact in the field of

science. Basically, computational chemistry is the use of various computer simulations or techniques to study various reactions theoretically, design new models, study the structures of different molecules or compounds, calculate the thermodynamic properties of compounds, various types of bonding behaviors of different atoms, and investigate the newly synthesized materials through coding using different languages such as Python, bit, C++ and many more.

The advantages of computational techniques and tools in the field of science are so many. One of the advantages of computational simulations that really made a huge revolution in the field of medicinal science is drug designing. Prior to the advancement in technology, scientists used to assay the compounds that were thought to be effective in treating diseases by trials. It was not a reliable process as it imposed huge risks on the lives of humans and other animals which were being used for trials. That was like shooting in the dark. Computational chemistry made this process extremely easy, dependable, in-expensive, risk free, and effective to discover new drugs as chemical scientists studied drug-receptor complexes before synthesizing the drugs.

Structure based-drug design is the process of designing a new drug from different chemical structures by using computational chemistry tools that are supposed to be effective in treating the disease. Using computational tools, chemical scientists design the structure, modify the derivates of already existing chemicals, study the properties of already determined receptors or targets, determine results of the drug-receptor complexes, and design a drug if they find it effective. They let the computer draw structures for them by providing with the necessary information of the compounds like the kind, and number of atoms. Once the drug gets built up, it goes through various testing phases which include testing on animals and clinical testing on humans as well. If it proves to be effective and does not have severe side effects it, results are submitted to the authorities for prescription.

Let us make it simple. I have access to software which can make any structure and give details about that. If I want to draw and study any structure, I simply must put necessary information to draw my desired structure on it. For example, Let us draw aspirin which is a non-inflammatory drug which stops the activity of enzyme

(cyclooxygenase) that forms prostaglandins-compounds that cause of inflammation, fever, and pain. Aspirin has a molecular formula C9H8O4 and here is its structure that I just drew on my computer. Other properties like bond distance, bonding pattern, orbital orientations, are also shown by the computer.

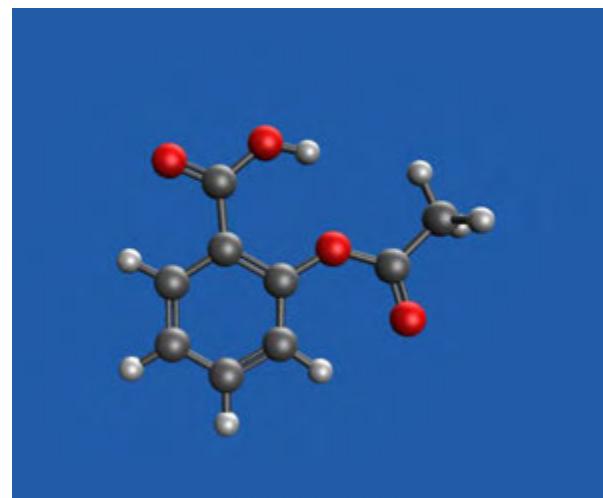


Figure: Aspirin (a medicinal drug)

To put it concisely, computational chemistry, which is the use of computer software to predict chemical reactions, solve mathematical problems related to chemical structures, study compound's behaviors, their properties etc. Computational chemistry has made things easier for us in so many ways without any kind of negative impact. Each advancement in the field of science and technology has imposed some negative impacts on humanity, but computational chemistry is a revolution in an effective way. Talking about new chemical reactions, whether their spectra, energy behaviors, kinetics, bonding pattern, atomic or sub-atomic models or so many other things, computational chemistry enabled students to study them in an uncomplicated way and resolved the complex issues to study related to chemicals. One of the revolutionary impacts it has created in the field of science is the drug-design discovery which is one of the big achievements in medicinal science. By using computer software, chemical scientists draw 3-dimesnional drug-design, study the drug-receptor pros and cons by modifying the compound in so many ways. After going through all the procedure of studying the drug-receptor complex, chemical scientists start the practical work to make the compound in laboratory if they find it effective. Once the desired product gets ready, chemical scientist sends it to the

authorities for its approval for prescription. This becomes possible because of computational chemistry which is a revolutionary approach.

FROM CHEMISTRY TO COSMETICS: THE ANTI-AGING POWER OF RETINOL

Attia Noor

0521-BS-CHEM-22

The progression of time is inevitable, and so is the process of aging, which brings about both physical and psychological changes in humans. Despite this fact, every individual has a desire to stay young forever. In this advancing age, the process of reverse aging has become a fascinating subject among researchers. Different compounds having antiaging properties are being reported regularly and some of them made their way as promising antiaging agents in cosmetic industry. Among such compounds one is retinol, a vitamin A derivative, which is a key ingredient being used in serums, lotions, creams and gels due to its antiaging properties. It not only prevents premature aging but also restores the radiant and glowing skin even when topically applied on aged skin.

Retinoids are important chemical compounds that have been scientifically proven in cosmetic care for antiaging. Among these retinoids, retinol has proven its effectiveness in combating aging by preventing the breakdown of existing collagen and stimulating the formation of new collagen and elastin fibers. It unleashes its transformative powers by accelerating the cell turn over, replacing the old and dead cells with new cells giving fresh and smooth appearance. This enhances the texture and firmness of mature skin. The topical application of retinol with its remarkable effects makes it a promising antiaging product.

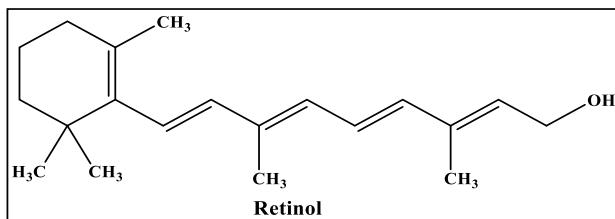


Figure: Molecular Structure of Retinol

The notable benefits of retinol in antiaging skin care have been disclosed in numerous studies. Application of retinol over the skin results in the thickening of epidermal layer as well as the development of fresh blood vessels within the dermis, leading to a maintained blood flow in skin. The improvement in skin blood flow creates a more favorable microenvironment for the homeostasis of dermis and epidermis. Additionally, it increases the expression of type 1 collagen, the major structural protein present in skin. This maintains the structure, firmness and elasticity of skin. Moreover, it also increases the expression of connective tissue growth factor, deficiency of which causes unexpected aging before time.

Have you ever wondered how miraculously retinol restores our youthful and radiant skin? This happens because of its penetrating ability when evenly applied over the skin. After being penetrated, it undergoes sequential conversion to retinaldehyde and then to retinoic acid, the active form. In the first step, the formation of retinaldehyde is catalyzed by the enzyme alcohol dehydrogenase (ADH) present in our body and in the second step; retinaldehyde dehydrogenase (RALDH) favors the conversion of retinaldehyde to retinoic acid. Experimental trials have revealed that vitamin A and its metabolites can restore the skin that has been aged due to both chronological factors and exposure to sun. However, the precise molecular mechanisms at cellular level that owes to the anti-aging benefits of retinoic acid are still under debate.

What's more, retinol also serves as an agent in preventing hyperpigmentation and acne which are common aesthetic concerns affecting a wide range of individuals. Along with all other treatments available retinol also emerges as a potent agent in curing them. Retinol influences the melanin distribution by altering the gene expression. It regulates the process of melanogenesis by suppressing the activity of tyrosinase, a key enzyme in melanin synthesis. Retinol being non-comedogenic has been approved by dermatologists in treatment of mild-to-moderate acne. It enables the skin to repair itself by unclogging pores which further reduces swelling and smoothen the skin. Retinol not only prevents the formation of pimples but also reduces acne scars over time.

As now we are well aware that retinol works various wonders when penetrated in skin. This penetration may impact our skin leaving it vulnerable to ultra violet

radiations during the day time. It is advised to add retinol based cosmetic products in night time skin care routine unless combined with 30⁺ spf sunscreen. Moreover, excess use of cosmetics having retinol as an active ingredient makes the skin sensitive that may result in itchiness and peeling of skin. Use of retinol-based serums, creams or gels having concentration exceeding 1% can cause skin irritation. Thus, precautions must be taken while using such products to keep our skin healthy, smooth and vibrant.

Retinol reveals its potency by reducing fine lines and wrinkles followed by an increase in collagen fiber and cell turnover. It is among the most used compounds in preventing aging as well as restoring aged skin. Retinol-based products should be incorporated in skin care routine in late twenties or early thirties. It acts as a perfect antiaging compound when used in concentrations in between 0.25%-1%. Thus, one should always prioritize self-care as healthy skin not only boosts our confidence but also influences our physical and mental well-being.

A close-up photograph of a person's hands and torso. The person is wearing a dark suit jacket, a light-colored shirt, and a dark tie. Their hands are clasped together in front of them. A pen is held in their right hand, pointing towards a white document with blue borders that they are holding. The background is blurred.

COMMERCE AND FINANCE

2024: YEAR IN REVIEW

Jan

- The World Economic Forum (WEF) identified the digital revolution across industries as one of the primary drivers of economic growth for 2024.
- In January, Pakistan's Foreign Direct Investment (FDI) increased, especially from China, as a number of infrastructure projects were started.

Feb

- The U.S. Federal Reserve increased interest rates.
- The International Chamber of Commerce (ICC) confirmed that there is a 20% growth in digital trade platforms, reflecting the shift toward e-commerce in global trade.
- The Pakistani rupee strengthened by 4% against the US dollar, helped by foreign inflows and better economic conditions.

March

- Pakistan's central bank reported that in first quarter of 2024, there is a 5% increase in remittances from overseas Pakistanis, helping stabilize the local currency.
- Pakistan's real estate market saw a boom in urban housing projects, as demand in Lahore, Karachi, and Islamabad increased.

April

- The International Monetary Fund (IMF) lowered its 2024 global growth prediction to 2.5 percent because of trade disruptions, inflationary pressures, and geopolitical tensions.
- Pakistan issued a \$1.5 billion sovereign bond included both mix of short- and long-term debt securities, to raise funds for infrastructure projects.

May

- The financial technology (fintech) industry in Pakistan flourished as new businesses attracted venture money and introduced cutting-edge payment methods to the market.
- In 2024, Pakistan's textile industry achieved a major milestone by reaching record export levels and \$5 billion in income.

June

- The European Central Bank unveiled a new set of economic reforms, to promote digital innovation and lower carbon emissions in the EU's industrial sector.
- The central bank of Pakistan declared that the main interest rate would be lowered to 11%.

July

- China's Belt and Road Initiative marked its 11th anniversary, with new projects announced in various countries, reinforcing China's influence in global infrastructure development.
- Pakistan's total liquid foreign exchange reserves were recorded at \$14.7 billion on July 12, 2024, with the State Bank of Pakistan's reserves at \$9.4 billion.

Aug

- The International Monetary Fund (IMF) revised its global growth forecast for 2024 down to 2.5% due to geopolitical tensions, inflationary pressures, and trade disruptions.
- Prime Minister Shehbaz Sharif inaugurated the second FoodAg 2024 event, showcasing Pakistan's agricultural and food sectors, aiming to boost the country's image and generate economic activity in agro and food exports

Sep

- The U.S. and China reached a trade agreement, reducing tariffs and easing tensions between the world's two largest economies.
- Google's parent company, Alphabet, announced a \$10 billion AI research initiative to advance machine learning and cloud services for enterprises globally.

Oct

- Indicating a recovery in international commerce, The World Trade Organization (WTO) reported a 3% increase in global trade volumes for the first half of 2024.
- The State Bank of Pakistan maintained its policy rate at 7%, aiming to balance economic growth with inflation control.

Nov

- The Bank of England's financial stability report highlighted increasing risks linked to geopolitical tensions, global trade disruptions, and higher government debt pressures.
- Pakistan's exports increased by 8% year-on-year, led by the textile and agricultural sectors.

Dec

- The World Trade Organization (WTO) reported a 3% increase in global trade volumes for the first half of 2024, indicating a recovery in international commerce.
- Pakistan's central bank reduced its key policy rate by 200 basis points to 13%, marking the fifth consecutive cut since June 2024, aiming to tackle a sluggish economy and ease inflation.

MOVIE REVIEWS

THE BIG SHORT (2015)

Aimma Imran

1833-BS-BAF-23

‘The Big Short’ is a dark comedic movie that follows the 2008 economic crisis with a unique approach, so it can be an influential case study for business student. One can say that it has great relevance for understanding market conditions and dynamics, risk estimation, and the significance of critical market analysis for students. From a finance major’s perspective, the film is both fascinating and frustrating, basically a crash course in financial management wrapped in spectacular humor.

The story follows a group of investors who discover that the U.S. housing market which has been long considered as rock solid is actually built on high-risk subprime mortgages that are destined to fail. As they dig deeper, they uncover just how corrupt and careless the financial industry has become banks are handing out loans to people who can’t afford them, rating agencies are blindly stamping AAA ratings on junk securities, and regulators are asleep at the wheel. The more they investigate, the clearer it becomes: the global economy is on the verge of disaster, and no one is paying attention.

The film does an excellent job in breaking down complex information into smaller pieces for better understanding and effective analysis. It portrays the attentiveness of the investors, who didn’t rely on the scenarios portrayed by agencies and Wall Street firms. These investors conducted their own field studies. They visited Florida and other areas examining housing booms and fraudulent lending processes and practices. They observe liar loans being handed out with little to no verification processes. The film emphasizes on the importance of doing more than the surface level market research and shows the significance of a thorough conduct of the market dynamics to get real time information. The characters in the film are also flawed humans, with the desire to earn profits. Their ambition and desires add the factor of realism to the message being portrayed. The film highlights real time issues that exist in financial world and also raises awareness about the responsibilities and the role of each participant in the market. But what’s most striking is the ethical dilemma at the heart of the film: the protagonists aren’t heroes. They’re profiting from the downfall of the system, knowing that millions will suffer when the market collapses. This moral gray area is what makes The Big Short so compelling—it forces the audience to question not just the system, but those who saw it failing and chose to capitalize on it. So, it gives a critical reminder to business students that ethical considerations should not be ignored during any business decision.



For students it is a lesson of understanding the regulatory environment and the potential for market failures. By showing real world consequences of unchecked failures and issues, lack of transparency, moral hazard, ethical considerations, and market understanding, the film serves a meaningful message for finance students. It can be a good watch for students interested in understanding finance, investment practices and ethical business practices. It will keep you hooked and inform you about brutal realities of economic markets

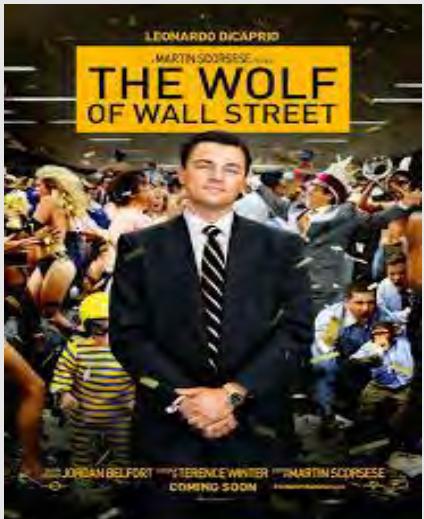
THE WOLF OF WALL STREET (2013)

Syeda Eman Fatima Kazmi

1865-BS-BAF-22

Martin Scorsese's The Wolf of Wall Street (2013) is a high speed, obscurely diverting examination of the overabundances of 1990s finance culture, yet past its grandiose surface lies an imperative example in bookkeeping morals and the risks of free desire. As well as recording Jordan Belfort's extravagant way of life, the film is a convincing illustration of how eagerness can debilitate administrative control, sully monetary foundations, and use bookkeeping to bamboozle.

The story spins around Stratton Oakmont, Belfort's business firm, which amassed its abundance through "siphon and-dump" strategies. The misrepresentation interaction is shown plainly: Belfort's gathering of agents utilizes forceful deals strategies to draw unwary financial backers by blowing up the worth of useless penny stocks, or the "siphon." Clients are left with imploding speculations when Stratton dumps its portions after the stock pinnacles. An upsetting the truth is featured by the scenes in which Belfort trains his group to sell "dreams" rather than stocks: when cash is isolated from profound quality, it turns ruthless.



Furthermore, the film reveals insight into inventive bookkeeping, or all the more precisely, horrendous bookkeeping. Stratton's large numbers of unlawful returns are washed through seaward records, Swiss banks, and shell organizations as well as being spent on medications and boats. Belfort's participation with a Swiss investor to hide assets from the IRS is a critical subplot that shows the way that monetary innovations planned for security can transform into instruments of avoidance. Belfort's easygoing conversation of manufacturing reports to help surprising abundance fills in as an advance notice that misrepresentation regularly happens in the normal subtleties of records and wire moves as opposed to enormous scope robberies. However, what stands apart the most is the complicity culture. Benefit is put in front of the law, and Stratton's bookkeepers, lawyers, and, surprisingly, Belfort's spouses disregard the trick. The misrepresentation can spread since there are no interior controls set up, or any sort of moral administration. The troubles controllers experience in fighting refined monetary

wrongdoings are exemplified by the SEC's powerlessness to unwind Stratton's trap of misdirection when they in the end send off an examination.

Belfort's eventual demise a jail term and restitution orders is depicted as an unfinished business rather than as atonement. According to the movie, the true tragedy is that the system itself doesn't change: for every Belfort who is imprisoned, another opportunist is waiting in the wings.

The Wolf of Wall Street serves as a mirror reflecting the darkest tendencies of the sector rather than as a celebration of excess for those working in finance sector. It poses awkward queries: How quickly could pressure to achieve goals cause ethical boundaries to erode? What occurs if the only indicator of success is profit? In a time of bitcoin frenzy and meme stocks, the movie's cautions seem uncannily applicable.

The film's legacy ultimately rests in its capacity to both amuse and critique the very viewers it captivates. It serves as a reminder that finance is about people, not just numbers. Additionally, there are moral as well as financial repercussions when accounting is neglected in favor of greed. "Sell them the pen," as Belfort himself would have said. However, the movie makes us wonder: At what cost?

CLOUD-BASED ACCOUNTING SYSTEMS: A COMPARATIVE STUDY OF BENEFITS AND RISKS

Eman Javed

1847-BS-BAF-22

Cloud-based accounting systems have brought about significant changes in financial implementation of a business by offering a cheap and easy means to manage business financial data. Financial data access provides real time access to financial data, the opportunity for enhanced collaboration, and better decision making process. Like any technology, however, cloud-based accounting has the benefits and the risks. These factors should be understood if businesses are considering adoption.

The main advantage of cloud-based accounting is the access. Cloud software is much different than previous approaches, and provides user the ease of accessing their financial data anytime and anywhere there's an internet connection. It provides also the flexibility to work from anywhere, collaborate in real-time, and maintain the updated financial records. In case of multiple locations business, a remote team or when there is a need to get frequent financial updates, this is particularly beneficial.

Another main benefit is cost-efficiency. Traditional accounting software involves large upfront costs of licenses, hardware and IT maintenance. Subscription based financial model allows cloud-based systems to operate according to less financially straining model. Providers take over the burden of maintenance, keeping the updates and the security up to date, and hence save the businesses on IT costs and use the freed resources for core business. Moreover, cloud accounting is scalable and businesses pay only for the feature they need, it is an economically viable solution to startups and enterprises alike.

Cloud accounting is easier than doing manual accounting due to its automation. These systems are made to talk to banking institutions, payroll services, financial platforms and automate transactions, reconciliation and reporting. Automation eliminates or decreases human error, lessens human data entries, and maintains financial records particular. The real time financial reporting helps businesses to watch the cash flow, expenses and profits

with exactitude to make the right decision and strategic planning.

Primary concern is data security, and cloud accounting providers spend a good deal on security measures. Encrypted data, multi-factor authentication, regular backups and following the standards of the industry helps secure the data stored for the users. Security teams dedicated to watching and thwarting threats are built in, almost certainly more secure than the business could have on their own. Also, cloud storage shields data from the physical crimes such as hardware failure, theft, or disasters.

Although cloud accounting systems come with the benefits, they also come with the risk. The main concern is in data-security and privacy. While providers do utilize strong security measures, there is no system that is totally unsuspected to cyber-attacks. Even though data breaches, unauthorized access, or hacking attempts remain risks for data that is sensitive, businesses that handle it must be ready. Providers must be analyzed by companies to see how secure they are, especially with stronger passwords and regular audits.

Another drawback of cloud accounting is that it depends on the connection of internet. Disruptions to the internet connection can temporarily halt financial operations as cloud accounting involves an internet connection. These platforms may be unusable by businesses in areas with unreliable connectivity. Some providers do offer offline functionality, but for companies before committing to only cloud functionality, you want to look into your internet reliability.

This also presents challenges regarding the data-ownership and control. Adopting cloud-based systems, the data is stored in remote servers which are being taken care of by service providers. The concern is over data-ownership, regulatory compliance and retrieval of data if you switch providers. In order for the data to revert back to them, businesses must review and change service agreements.

It may be unfeasible to integrate loosely with existing systems. Although cloud accounting solutions can be integrated with many outside applications, incompatibility with a company's existing software cannot be ruled out. To achieve integration seamlessly, businesses need to research since it is standard practice. Operational

Disruptions and additional costs or modifications or custom development can result from inefficient integration of the targeted markets.

While there are risks, the benefits of cloud-based accounting often outweigh these challenges, when businesses take advantage of best practices in the realm of security, data management and integration, the dangers are mitigated. With every passing day, the cloud accounting platform becomes more robust with AI driven insights and much more secure. The adoption of cloud accounting can give a competitive edge to the businesses that execute financial processes better, better collaborated and make data-powered decision making, but all in the smoothest way.

In conclusion, a cloud-based accounting system provides significant benefits as it is accessible, cost-efficient, automated and secure. But, at the same time, risks like data security concerns, internet dependency, data ownership problems, and integration issues have to be accounted. When a business has carefully evaluated the needs, chooses a trusted provider and takes the necessary security measures, financial management can be optimized and success can be achieved in the long-term. With accounting moving towards the cloud as the future, it is imperative to adapt to this change while minimizing risk for the businesses that want to compete.

THE IMPACT OF WORK-FROM-HOME CULTURE ON EMPLOYEE PRODUCTIVITY AND CORPORATE PERFORMANCE

Eman Javed

1847-BS-BAF-22

With the rise of work-from-home culture in professional sphere, businesses have completely redefined how they operate, also how employees work with their organizations. Remote work started out as a reaction to global disruptions, but it has since become a model that a lot of companies now embrace strategically. Its impact on employee productivity and corporate performance has generated a lot of talk about whether it makes for more efficient or brings surprises.

When most employees work remotely, it becomes easier for them to focus and increase the productivity among

employees. Without the stress of commuting every day, employees save time and energy, making it easier for them to open their workday with a fresh beam and clarity. Another reason why created flexibility for a personalized work environment is yet another contributor to enhanced concentration and efficiency. A lot of professionals prefer to work at the convenience of their homes, without the usual distractions from office settings like needless meetings, chit-chat at the office and so much more.

The second key factor is that influences productivity. Employees working remote have more leeway regarding schedule management who can decide to work during its peak productivity hours. This flexibility means that it is easier for individuals to work on deep work tasks, take breaks when needed, and return to the work without missing any substantial part of work, which ultimately equates to sustained performance throughout the day. There have been studies that prove that people who can fit their work hours to their most productive time produce better results.

Negatives of remote work include the fact that it can be associated with a loss of productivity. The main issue is blurring of the work life boundaries. Employees tend to work beyond their professional hours due to the lack of clear delineation of time between the two. The problem with constant connectivity through emails and other messaging apps can lead to mental strain and it may not help much in the long-run. If organizations do not put structured policies in place for enabling work life balance, they'll lose the benefits of remote work.

From corporate performance point of view, remote work has also helped in reducing the operational-costs. The office space, utility-bills and other overhead expenses have been scaled down by many companies, having channeled these savings towards business growth and employee benefits. Furthermore, with limitless access to talent coming from a wider geographical base, companies are now able to hire out the very best professionals, regardless of their location; which has allowed for greater diversity and capability within their workforce.

The effectiveness of remote work depends greatly on the nature of the business and operational model. While tech driven industries have taken to the revolution with ease, not so the sectors which require hands on collaboration such as the manufacturing, healthcare etc. This is why companies that adapt to the digital infrastructure and

clearly define remote work policies do not suffer the dip in overall corporate performance.

Remote work arrangements also depend on the relationship between employee engagement and company culture. The daily interactions, team building and leadership show in a traditional office all reinforce the corporate culture. In form of remote work, companies must come up with new ways for organizing strong feeling of belonging among employees. Among other things, regular virtual check-ins, transparent communication and digital engagement efforts have become part and parcel to keeping employees on track with the company values and objectives.

They have invented ‘hybrid model’ a solution that is a middle way of sorts, a merging of remote work and in-person collaboration. A lot of the large organizations that offer work arrangements now let you work anywhere, anytime depending on the task of the day. Hybrid work structures can also help mitigate the problem of social isolation and burn out by offering employees the choice to go in when needed to interact with others on a physical basis.

The reality is, the way of work-from-home culture influences the employee productivity and corporate performance depends on how much the organizations/people adapt to the change work from home culture. In a remote work environment, companies that invest in technology, specialize in clear communication and are focused on employee well-being are the ones which will surely thrive. Similarly, those employees who set boundaries, manage time effectively and are proactive on engagements would be able to avail up to their potential in a flexible work arrangement.

Remote and hybrid models of the work have the potential to shape the future of work as the advancement of technology and the changing of the workplace expectation continue to be there. While the debate rages on, what is certain is that adaptability and strategic planning will be able to distinguish how well businesses and employees will succeed during this new era of work. Organizations can leverage the benefits of remote working and tackle its limitations to create an environment of efficiency, innovation and long term achievement through delivering specific corporate goals.

ROLE OF RISK MANAGEMENT IN FINANCIAL DECISION MAKING

Eman Javed

1847-BS-BAF-22

In making financial decisions, risk management is an important consideration impacting decisions made in regard to asset safeguard, investment optimization and a realistic sense of business or individual stability. The financial markets are naturally full of uncertainty and any of the decisions put at risk to the financial status. Risk management is an effective process of identifying, assessing and mitigating risks so that decisions can be made in the face of uncertainties while availing the opportunities.

An important part of financial decision making involves assessing the potential risks involved before making or disposing of resources or investing money. It is important for the investors to consider factors like market volatility, economic condition, inflation, and interest-rate fluctuations. However, if they can apply risk assessment methods like scenario analysis and stress testing, decision makers can do their best to get ready to deal with an adverse market situation and curtail losses.

Diversification is the widely known risk management strategy of reducing risk exposure. It means investing and spreading your investments across different asset classes, industries, or geographical regions in order that downturns in one will be cushioned by the upturns in others. This principle also applies to a corporate investment strategy and hence individual financial planning where an individual divests and breaks down himself to different investment vehicles in an effort to optimize returns.

In financial decision-making, it is important to understand risk-and-return relationship. Higher returns mean greater risks. That is why, before making any financial decisions, one must look at the risk-tolerance. Different factors such as financial goals, investment horizon and market conditions have what we refer to as risk appetite. Traditional investors, who are conservative in nature would gain a sense of security in low-risk investments like government bonds and fixed deposits whereas aggressive investors might go for high-risk investments like equities and venture capital.

Financial risks are often related to investments, but also those the company has to manage in corporate finance i.e. related to operations, debt financing, cash flow. The credit risk evaluation of customer and supplier transactions in businesses secures business and curbs the risk of financial instability related to payment defaults. Also, we must evaluate liquidity risks to make sure the short-term obligation is not exposed to a lacking cash flow while balance of the assets and liabilities is proportionate. In the risk mitigation, proper financial planning and forecasting are also highly significant.

There is another important tool used in risk management to hedge against adverse financial movements, namely hedging. Options, futures, and swaps are financial instruments used by businesses to mitigate factors as currency fluctuations, commodity pricing and interest-rates risks. Hedging against price volatility may be carried out by such businesses, which enter into futures contracts for raw materials to secure stable input-costs and predictable profit-margins. Through these risk mitigation strategies, the financial performance is stabilized and the market shifts are protected against.

Financial decisions are also influenced by behavioral finance, and they take the form of emotions and cognitive biases in the perception and investment choices of risk. Investors often make irrational decisions on fear, overconfidence and herd mentality. These biases can be counteracted by risk management frameworks which offer structured approaches to make decisions and make sure that the choices are data based and not emotions based. Sound financial decision making and risk mitigation are accomplished by disciplined investment strategies as putting in the stop loss limits and adhering to the long term perspective.

Risk management has become a focal point in financial decisions that represent what is considered by the regulatory frameworks and the compliance requirements. Regulatory guidelines have to be met by such financial institutions, corporations, and investors in order to maintain transparency, accountability and financial stability. It is required that banks have a certain number of reserves to absorb potential losses. These regulations ensure that the financial system and its users do not experience themes of systemic risks that can have disastrous economic effects across the board.

New technology has driven the development of the types of analyses and made it possible to make decisions in real time. Businesses have been changed by the application of big data analytics, artificial-intelligence, and machine learning. Automatic monitoring of trading with algorithm, block-chain technology also increased transparency and security of the system from financial fraud and market manipulation. With changes in financial markets, technology will be leveraged to address decision making processes as well as creating a channel to address uncertainties.

In conclusion, the successful effort in achieving financial stability and long term success boils down to effective risk management. Understand and manage risks allows organizations to front load the uncertainty before making decisions on personal finance, corporate strategies or investment decisions. Using structured risk assessment, diversification, hedging and compliance, financial decision makers can achieve the best strategy and shield from its risk. In the fast changing world of the financial markets and considering the integration of risk management and robust practices, remains necessary in order to have resilience and sustainable growth.

FORGET THE PENSION, BUILD STABILITY WITH BUSINESS IN PAKISTAN

Meesam Abbas

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Introduction

For years, people in Pakistan have been told success follows a simple formula: study hard, get a degree, find a stable job, work for a decade, and then retire peacefully. But that formula is no longer a Bible; it is breaking down nowadays. Job market is declining, inflation is rising, and retirement is turning into a crisis. Instead of well and rest, the hard truth is that reliance on a job alone is no longer an option for a healthy and peaceful life.

If you look around, especially in Pakistan, graduates are struggling to find a job in uncertain careers, and retired people are facing financial difficulties instead of enjoying their golden years.

Starting a business doesn't mean inventing the next big thing. A successful business isn't about being "one of a kind"—it's about solving a problem and doing it well. Whether it's running a small shop, starting an online venture, or offering services, the key is to work with honesty and consistency.

Pakistan's Economic Struggles and Hidden Potential

Right now Pakistan's economy is in a tough spot. Inflation is at an all-time high, and the rupee is declining. Every year thousands of students graduate and enter the market, but there are not enough jobs for them. Those who are successfully able to find a job, their salary do not match the cost of living.

Despite all the challenges, foreign investment is still coming to Pakistan. International companies are seeing potential in the country's young population, growing digital market, and strategic location.

- The workforce in Pakistan is mostly youngsters. With most of the population under 30, the country has energy and talent waiting to be utilized.
- The cost of doing business is lower. Compared to developed countries, starting a business in Pakistan is more affordable.

While the job market is facing a decline, on the other hand, business opportunities are increasing constantly. Those who will successfully recognize this shift will be the ones who will succeed.

Retirement in Pakistan: A Financial Nightmare

For most of the Pakistanis, retirement is no longer the peaceful phase it was meant to be. Because of rising medical costs, lack of proper pension plans, and no social security, most of the retired people are finding themselves in a financially unstable condition.

Unlike in the developed countries where pensions and social benefits are offering some relief, Pakistan offers little to no financial security for retirees. That's why business is the best retirement plan. Entrepreneurs don't face forced retirements, layoffs, or salary cuts. They don't wait for monthly pensions—they build something sustainable that keeps generating income.

Colonel Sanders proved that success can happen at any age. He built KFC after failing multiple jobs and businesses. Instead of giving up, he used his skills, worked hard, and created a brand that outlived him.

What Makes a Business Successful?

There's a misconception that only groundbreaking ideas succeed. That's not true. Success is about:

- Consistency over innovation — The best businesses solve common problems, not just invent new ones.
- Honesty and good service — A business that serves people well will always have customers.
- Filling market gaps — There are so many unmet needs in Pakistan. The key is to find them and act.

A profitable business doesn't have to be fancy. It just needs to work. From local grocery stores to online ventures, thousands of Pakistanis are proving that even simple businesses can create stable incomes.

Why Business is Easier to Start in Pakistan than in Developed Countries

Many people believe that launching a business in Pakistan is very tough. But if we do compare it with developed nations like the USA, UK, or Canada, Pakistan is actually offering more advantages:

1. Lower Startup Costs:
 - Rent, labor, and operational expenses are significantly cheaper as compared to other countries.
 - A business that needs \$100,000 in the US might only need \$10,000 in Pakistan.
2. Less Competition in Many Sectors:
 - Developed economies are saturated with businesses, making competition fierce.
 - In Pakistan, many markets are still untapped, meaning less competition.

Pakistan's economy, despite its issues, offers a landscape full of opportunities for those willing to act.

Conclusion: Success Has No Age, No Limits

Pakistan's job market is constantly failing, freelancing is an unstable career, and retirement is becoming more of a financial struggle. The only path to true stability is entrepreneurship. It doesn't matter if you're 22, 42, or 62. If you have an idea, a skill, or a service to offer, you can build something of your own. Challenges in Pakistan are real, but so are the opportunities. Those who will take charge of their financial futures won't be able to just survive, but they will thrive. Success is not something you will retire from; on the other hand, it's something you create, grow, and sustain for life. So why wait? The time to build is now.

THE ROLE OF ARTIFICIAL INTELLIGENCE IN FINANCIAL FRAUD DETECTION AND PREVENTION

Umer Zahid

1803-BS-BAF-22

Financial fraud in the digital age has evolved to become more sophisticated and threatening to both business and consumer. The traditional methods of fraud detection, using such things as manual checks and rule-based systems, are no longer viable in the face of how cybercriminals are attacking today. The rising phenomenon, which is taking over the world, is Artificial Intelligence (AI), a capable technology that is changing the face of the financial fraud detection and prevention issue.

Understanding Financial Fraud in the Digital Era

All the money laundering, insider trading, credit card fraud, identity theft, just to name a few, financial fraud is a very broad spectrum of malicious activity. The report by Association of Certified Fraud Examiners (ACFE) shows that the global fraud losses are approximated to around 5 percent of the annual revenues, which makes more advanced security measures imperative. Traditional fraud detection systems, while ostensibly performing the function of detecting fraud, tend to be reactive, in the sense that fraud is detected only if it fits within predefined rules that fraudsters are easily no longer duped by. Therefore, it requires more smart and more proactive

policy of fraud detection that is possible to achieve with the help of AI.

How AI Enhances Fraud Detection and Prevention

1. Advanced Pattern Recognition:

AI is designed to pick up the signs (complex patterns) of fraudulent behavior in a dataset and find these patterns. In contrast to traditional approaches, which only catch known patterns of fraud, AI can learn from historical data in order to identify very subtle anomalies that do not resemble normal user behavior. Machine learning algorithms can look at transaction histories, purchasing behavior, and geolocation data and identify what are the inconsistencies that might be fraud.

2. Real-Time Monitoring and Alerts:

One of the important features that AI can do is to monitor financial transactions in real time. AI systems can continuously track data streams and flag suspicious activities like unusually large transactions or several attempts to pay from various locations. They are able to do rapid response, and financial institutions are able to intervene promptly to minimize potential losses and mitigate risks.

3. Enhanced Accuracy and Reduced False Positives:

In most cases, traditional fraud detection systems deliver a high rate of false positives resulting in poor customer experience, and also inefficiencies in the operations. Yet, AI boosts the accuracy by learning historical fraud patterns and distinguishing the true transactions from the fraudulent ones. This way the number of false alarms is decreased, and legitimate transactions are not declined unnecessarily.

Practical Applications of AI in Fraud Detection

1. Credit Card Fraud Prevention:

Credit card companies use AI models to monitor transaction in real time. To detect anomalies like geographically different areas purchasing products simultaneously AI can also analyze purchases patterns and report anomalies like purchasing products in one regional in short time scale.

2. Identity Verification and Authentication:

Biometric authentication methods such as facial recognition and fingerprint scanning are enhanced by AI to improve the process of identity verification. The

advanced security measures will make it more difficult for the fraudsters to pretend to be legitimate users.

3. Anti-Money Laundering (AML) Compliance:

AI is being used by financial institutions to support better Anti Money Laundering (AML) compliances by analyzing complex transaction networks. Pattern matching of suspicious fund transfers could be done by AI algorithms, tracing hidden connections between entities could be aided by AI algorithms, and AI algorithms can also flag potential money laundering activities.

Challenges and Limitations

Although it possesses many advantages, the use of AI in financial fraud detection has its challenges. One key issue is of data privacy, as AI systems collect huge quantity of desired (and in some cases unrequired) sensitive customer data to train them. It is essential to check compliance with data protection regulations, for example the General Data Protection Regulation (GDPR).

Second, there is the risk of algorithmic bias which will result in discriminatory outcomes if the training data are either imbalanced or biased. For this reason, financial institutions have to maintain transparency and fairness of the AI models in order to maintain customer trust.

Future Outlook and Conclusion

As cyber threats become increasingly high, the role of AI in financial fraud detection and prevention are expected to grow exponentially. As machine learning, natural language processing, and deep learning technologies grow and develop, the AI system will continue to go further to add more predictive capabilities with more accurate fraud detection.

In conclusion, AI is making a difference in how financial fraud is detected and prevented, providing a proactive and accurate approach that is way more effective than conventional methods. The rise of AI technologies to protect the assets of financial institutions, protects the data of the customers, and keeps trust within the increasing digital frame of money.

THE EVOLUTION OF MARKETING: FROM BANNER ADS TO DIGITAL ADS

Amna Sultan

2339-BCOM-22

The evolution of marketing has been very fascinating journey when we look at the shift from the traditional marketing to the advanced digital marketing. Marketing was done even before the invention of banner ads. Despite of today's world marketing was done through face to face communication where seller provides all the information regarding the product. But now with the technological advancements the style of marketing has changed a lot.

What is Marketing?

Marketing is basically the way people tell about their products and services to the customers. It helps the businesses to attract the customers, sell their products and to build a good reputation in the market.

Why is Marketing important?

- Marketing helps the customer to know about your product. They will not buy your product unless they hear about it.
- Marketing makes the product more interesting in such a way business now-a-days use creative ads and social media platforms to grab the attention of the customers.
- Marketing help the companies to be more trusted and reliable for the customers
- If people know about your product this simultaneously increase your sales as people know about you and you are not new for them in the market.

Early Days: Banner Ads

A long time ago when there is no concept of internet and social media, businesses use traditional methods to advertise their product such as placing simple ads in newspaper and magazines hoping it catches the attention of the readers. Later then, business started using bill boards banners for the advertisement of their products. These bill boards and banners contain big signs and large font and that were placed on the places like highways,

roads where it can get the maximum attention of the people.

With the invention of Internet the marketing style started to change. In 1994 the first banner ad appeared online on the website. And then nothing remains the same. It kept improving day-by-day. That was very exciting news for the businesses to reach the customers.

Rise of Internet and Social Media Marketing

As more people started using the internet, businesses needed better way to advertise their product. That is when the internet marketing began. Instead of placing traditional ads, businesses were able to show ads while searching on Google. This made a huge difference in the field of marketing. This made advertising easier because people saw ads matched what they are already looking for.

As the time passes and advancement in technology continues, social media apps like Facebook, Instagram and Twitter also become the major part of advertisement. These apps made a big change in marketing field in such a way that they could interact with customers directly, reply to their comments, and even make fun videos to attract the customers. This will help the businesses to know more about the interest of the customers. This has made advertising more interesting in today's time.

On the other hand, Social media marketing now a day is the most common way for the advertisement of the product. Businesses use influencers to promote their products in more natural way. This is also very helpful regarding marketing as people trust influencers which help the business to gain the customers.

Smart and Personalized Ads

With improvement in technology, business started using the data of the customer to know more about their customers. They track what people searched for, what they liked, what they bought. This helps the businesses to show personalized ads (ads that are made especially for you). For Example: if you search for cosmetics product on Google, you might see ads for cosmetics when you visit other websites. This is because companies use data to show ads that match your interests. This helps the business to target the customer directly.

Future of Marketing

Marketing will keep changing with the evolution in technology. Today businesses use AI (Artificial Intelligence) to create ads. With new technology, businesses will find new ways to connect with people and to sell their products. The future marketing will be more digitalized and interactive. They will make ads using virtual reality to provide more clear vision of their products.

Conclusion

In conclusion, Marketing has come a long way from the traditional i.e.: Banner ads to Smart Digital ads. Today, businesses can reach customers through internet, social media and personalized ads. With technological advancements, marketing will keep evolving in new and creative ways. But one thing will remain same about the marketing is that it is all about connecting with people and helping them to find what they needed.

HOW STARTUPS CAN SECURE FUNDING IN A COMPETITIVE MARKET

Kinza Maqbool

2373-BCOM-23

As the entrepreneurial space grows, funding is at the heart of the most challenging journey startups must endure. In an increasingly competitive and ever-changing economic landscape, startups often find securing investment and financial backing challenging. Funding is the backbone of any startup's survival and success, whether through venture capital, angel investors, crowd funding, or government grants. However, obtaining investment is not as simple as it sounds. That said, investors today are far warier and choosier than they have been in the past. Startups have to make a strong argument as to why they should receive funding.

The challenge for startup startups remains multifaceted, facing market uncertainty, investor distrust, and an imperfect or nonexistent financial ecosystem in some areas. The earlier you start preparing for fundraising — developing a solid financial plan, validating your market, and demonstrating that you have a solid pathway to profitability — the better. Instead, in competitive markets,

investors want startups with innovative ideas, yes, but also a strong business model, a good team, and a scalable strategy. As a startup seeking funding, it is critical to understand how the funding landscape looks and prepare yourself for the right path.

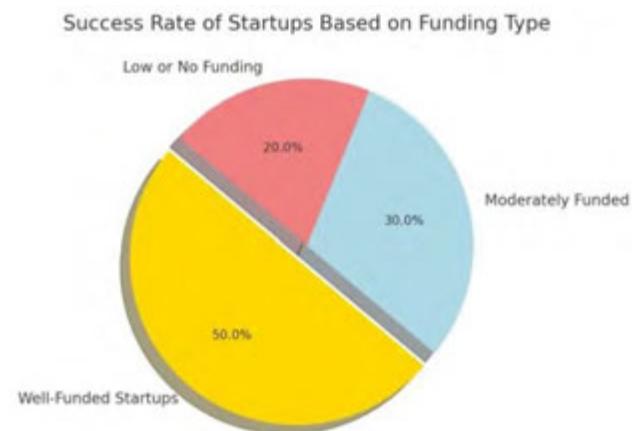
The Funding Landscape and Challenges for Startups

Over the years, the global startup funding ecosystem has gone through a systemic shift. Some areas have a proven investment culture, while others still build their financial ecosystems to fund entrepreneurship. This is more structured in the developed startup hubs of the world, like Silicon Valley, London, and Singapore, where venture capital and angel investors can be found. This isn't business as usual in the US and Europe, but in emerging markets like Pakistan, where you don't have easy access to investors and financial institutions, financing your dreams only seems like a mirage.

Building investor trust is tough for startups. Validation is key, as investors need proof of demand. Strong financial planning, market research, and traction help convince investors of sustainability and growth potential.

Strategies for Startups to Secure Funding

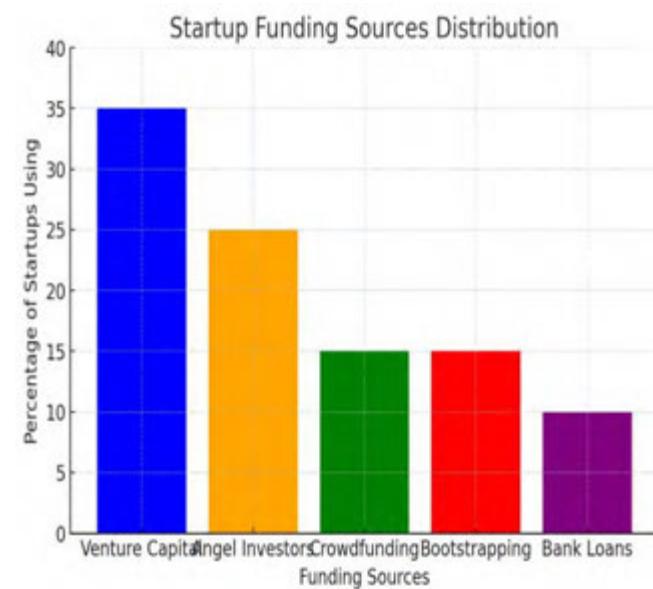
However, despite the obstacles, there are several strategies that startups can pursue to increase their likelihood of investment. Having a solid business model is one of the key components. Neither should have been surprised; investors seek startups with a clear revenue stream, value proposition, and an unfair advantage. A scalable and sustainable business model instills confidence in investors and shows long-term potential.



A significant strategy is building a Minimum Viable Product (MVP). Rather than just saying they have an idea, startups should develop a working prototype or product that demonstrates the feasibility of their concept. Investors like to see how practical the business idea is, and an MVP helps to show the result and gives the investors strong evidence that the business has a good scope in the market.

It is also essential to get customers early and validate the market. Investors favor early-stage startups with evidence of demand for their product or service. They have had some sales, pre-orders, or positive customer feedback, which will help them secure funding. The business being strongly validated in the market suggests scope for growth and 440 profitability.

A good network of contacts and healthy relationships with investors are other essential factors that lead to successful funding. The startup founders must attend every industry event and connect with customers and investors. You could also join business incubators and accelerators offering mentorship and funding opportunities. Several platforms, such as LinkedIn, Angel List, and startup networking groups, help entrepreneurs network with venture capitalists and angel investors.



The Future of Startup Funding

Data as of Oct 2023 By Pitch book and Crunch base
From fintech innovations to digital lending platforms to block chain-based fundraising and decentralized finance

(DEFI) solutions, these trends are challenging the traditional methods of capital access for startups. Equity crowd funding platforms such as Kick starter and Indiegogo date back to before ever-tony 2023, which allowed startups to reach a pre-global audience.

More and more, governments and private institutions help startups through innovation grants, business accelerators, and tax incentives. Investment firms increasingly pay attention to sustainable businesses that incorporate environmental, social, and governance (ESG) principles into their operations. The future of funding will be a startup ecosystem that resonates with such trends.

Even in this challenging environment, getting funding in a competitive market is possible when taking the proper steps. Startups that effectively build investor confidence, improve their business model, calibrate their networking opportunities, and enhance financial planning will be best positioned for sustained growth. Competition for investment may be more challenging than ever, but startups who embrace a bid to plan and adaptability will lead the way in funding.

Conclusion

Funding is the heartbeat of startups, and raising it in a competitive environment takes some accurate planning, execution, and networking. As investment dynamics evolve, startups that stay attuned to market realities while managing financial and investor relationships will successfully raise funds. With ever-changing funding options, staying informed and adapting to the intricacies of the startup ecosystem is essential.

CRYPTO ECONOMICS AND DIGITAL BLOCKCHAIN FINANCE

Hussain Ali Hashmi

1879-BS-BAF-24

Abstract

Being 3 years older than Bitcoin and an undergrad in Finance and Economics I decided to understand cryptocurrencies and digital economics at its deepest level to contribute to this revolutionary technological

transformation in reshaping global finance. This article emphasizes the introduction of Cryptocurrencies and Blockchain Technology in Finance and their benefits for humanity. So for the sake of better understanding, it would be a blend of the history of finance side by side with the history of technology. Hope this will be interesting for readers.

“Those who do not learn from history are condemned to repeat it”

This quote from George Santayana holds true in the realm of finance where intensity of human trust has reached unprecedented levels eventually forming the world's greatest economic systems.

Cryptoeconomics:

Cryptoeconomics is not that much different and confusing as compared to our classical economics but there are few exceptions which i will discuss later. The focal point is structural study of economics. In this world of emerging digital markets multiple of the classical economic principles operate with

complexity like Says law which states that supply creates its own demand which means that producing goods automatically increases its demand for consumption but in today's digital markets it struggles in terms of speculative financial markets where demand increases without original physical production like non-fungible tokens crypto coins meme coins which don't have any physical existence but still are in high demand. So Cryptoeconomics explains the Economics of digital assets in terms of digital scarcity, value and cryptography which relies on consensus mechanisms. Introduction of blockchain technology into finance provides innovation and creativity in terms of macroeconomic development. Growth and development is a must for humanity whether in terms of technological social or mental. Moreover Cryptoeconomics also deals with the efficient production, consumption, exchange and distribution of digital Assets providing us with a completely diverse world of research and academics. Now the multiple digital assets have come into existence with diversity like Memecoins AI coins gaming coins web3 coins which has increased the spectrum of financial markets offering us with immense opportunities of participating in these markets. By now total market capitalization of cryptocurrency is 3.8T dollars as per data provided by coinmarketcap. Blackrock

world largest asset management company with assets under management of 10 Trillion dollars after its tremendous success in launching bitcoin related exchange traded fund ETF in US decided to launch the bitcoin related exchange traded fund in Europe in February 2025 which will be domiciled in Switzerland.

The Role of Blockchain in Digital Finance

At its core a blockchain is a digital ledger used to record transactions and that ledger is distributed across a network of computers. Each transaction is recorded in a block which is then added to the chain of previous block and once a block is added it cannot be altered. Data is stored on multiple nodes and if once recorded it cannot be altered changing a block will require recalculating all subsequent hashes and also owning more than half percentage of the network which is computationally impractical. Now this Digital ledger Technology is being adopted worldwide by top Multinational Banks like JP Morgans which launched its own digital coin JPM coin. Goldman Sachs also offers cryptotrading services to institutional clients. Citibank predicts that bitcoin will become a global reserve. All this information invites us to accept this technology warmly for goodness of our society. Blockchain is redefining digital finance by enhancing transaction efficiency and improving financial access.

Owing to this Blockchain Technology, transactions are much faster and efficient which also is a good indicator for overall economic growth of a country. Also the concept of transparency is worth considering because every data is completely saved in blockchain networks which bring smoother implementation.

Summary

The future of finance looks very promising but still survival depends on our own innovation. Now in the end, if i summarize my article it would be incomplete without mentioning the positive macroeconomic benefits of crypto and technology in finance. First, it has generated a large number of employments in different streams like trading, digital art, research and analysis, which is apparently visible in our youth taking a positive step towards our national development. Second, in the form of digital revenue it is increasing gross domestic product and national income of country including technological and digital services which presents us as an advancing and

progressing country. Third, it should be a part of our primary and secondary education curriculum teaching our next generation. Last but not the least accepting modernization is the solution of our progress.

THE GIG INDUSTRY AND FINANCIAL STABILITY: ARE FREELANCERS AT RISK?

Maheen Gulzar

1893-BSBAF-22

Introduction

Today, the gig industry has transformed the global workforce around the world, enabling flexibility, independence, and diverse income streams. Websites like Upwork, Fiverr, Uber and DoorDash have offered millions a chance to work independently. Freelancing offers independence, but this comes with questions about financial security, employment security, and long-term financial planning. The question, however, with the rise of non-conventional work is, are freelancers financially insecure?

The Rise of the Gig Industry

Over the last ten years the gig Industry has soared, propelled by both a surge in technology and some changing attitudes towards work. In a 2023 report published by McKinsey & Company, it was found that over 36% of the U.S. labor force engages in gig work, while worldwide phenomena exist.

One of the factors behind the transition is the shift in attitude about conventional work. Work-life balance and freedom to set their schedules have become important for new workforce, especially Millennials and Gen Z. The lure of being one's own boss is powerful, but that also comes with financial uncertainty.

Advantages of the Gig Economy

- 1. Flexibility & Autonomy** – Freelancers get to decide when, what, and for whom to work, resulting in greater job satisfaction.
- 2. Multiple Streams of Income** – Gig workers can work on various projects at once and decrease their dependence on one employer.

- 3. Access to Global Opportunities – Digital applications help freelancers reach clients from all around the world, thus expanding their income potential.
- 4. Few Barriers to Entry – The nature of freelancing means that initial outlay is minimal, so it's an appealing route into employment for many.
- 5. Business Growth – Several gig workers grow their gig into a full-blown business by taking on more clients.

Challenges and Risks for Financial Stability

Despite its benefits, gig work comes with significant risks:

- 1. Instable Income – Unlike traditional employees freelancers can make income that varies from month to month depending on client demand. A Payoneer study from 2022 showed that more than 60% of freelancers face irregular income.
- 2. No Employee Benefits – Freelancers are not entitled to health insurance, retirement plans, or paid leave — things that can complicate financial planning. Full-time employers, by contrast, tend to have these benefits covered.
- 3. Difficulties in Get Credit & Loan – Many lending institutions are wary of lending to freelancers as their income is rarely stable. This restricts opportunities for investments, high home ownership, or emergency financial support.
- 4. Work-Life Imbalance – Freelancers may enjoy some flexibility but end up overworking, getting burned out or not being as financially secure as before due to an ongoing need to get projects.

Global Perspectives on Freelancer Financial Stability

While gig work is growing worldwide, the financial stability of freelancers varies based on geographic location:

- United States & European Union — Structured tax policies and freelancer associations provide some degree of financial protection. Yet health care and retirement benefits still loom large.
- India & Southeast Asia – Strong freelancer participation, but weaker financial infrastructure. Many depend on informal savings instead of pension plans or insurance.

- Africa & Latin America – A burgeoning gig economy, yet access to credit and banking services is limited, making it hard for them to achieve financial stability.
- China & South Korea — In governments, national freelancers protections are being piloted, including portable benefits and freelancer credit programs, paving the way for other countries.

The difference in financial security underlines the need for regulatory change and innovative financial solutions designed for gig workers.

Potential Solutions & Policy Recommendations

These could be products such as:

- Freelancer-targeted savings, insurance and credit products — Banks and fintechs can provide tailored savings, insurance and credit products to gig workers.
- Government Regulations & Social Security Reforms – Countries need to enact policies that provide portable benefits, tax incentives, and pension plans for freelancers.
- Financial Literacy & Planning Programs – Financial instability can be offset by offering freelancers education on budgeting, taxes, and investment strategies.
- Freelancer Unions & Associations — Stronger groups for collective bargaining and professional representation can assist gig workers in obtaining improved financial protections.
- Emergency Funds & Contingency Planning – Freelancers need to be taught that they need a portion of their income aside for emergencies so that they can build it up into their buffer.

Such needs are beginning to be identified by governments and private sector companies. France, Germany, in particular, have designed policies allowing freelancers to contribute to pension plans, and fintech startups are developing niche financial products for independent workers.

Conclusion

New Challenges of the gig economy although it certainly offers new flexibility for income to workers, it also exposes workers to volatility of income. Freelancers,

without steady income, workplace benefits, or access to normal financial services, are still potential targets. But with smarter financial planning, government intervention and bank products adapted to the needs of the freelancer economy, gig workers can find themselves on a more secure financial footing.

Freelancing is, without a doubt, the future of work as we see it today, but whether or not gig workers survive or thrive depends on the policies, tools, and financial system that emerge to support them. We can have a more economically sustainable and inclusive future by creating an environment for gig workers to be entitled to the same financial protections as traditional employees.

BLOCK CHAIN TECHNOLOGY

Aimma Imran

1833-BS-BAF-23

Block chain technology, is a thoroughgoing concept. It initially emerged with Bitcoin, but has rapidly outshined the inceptive alliance with cryptocurrency. Today Block chain technology is known for its capabilities to reform industries ranging from finance and management to daily life areas like health, fashion and casting vote in elections. This article scrabble about the complexity of block chain technology, explaining some 0of its principles, field applications, and challenges faced today.

To define, a block chain is a divided, unchangeable ledger to record business transactions, to make them secure and transparent. In other words, it is digital recording book, in which each party or member can make a new entry called as a ‘block’, which is linked with the previous entry or block, to form a ‘chain’. In this way, block chain technology allows securing the transactions, making them virtually impossible to change, the purpose of dividing it into blocks is to minimize the control the control of each entry, increasing security and flexibility at points or areas of failure.

Principles of Block Chain Technology

Some principles of Block Chain Technology are as follows:

Segregation: In this technology each entry is divided into a new block, which makes the system segregated or decentralized, unlike most of the traditional systems where all the authority in centralized and flexible. This segregation of entries into blocks puts an end to the risk of changes and alternations, and promotes better transparency and security.

Inflexibility: Once an entry is recorded in a new block, it cannot be changed or deleted. This inflexibility maintains secrecy and guarantees data accuracy, and also maintains trust and honesty among parties or members. To change any past block will require altering the entire previous blocks, which is computationally expensive and practically difficult task.

Transparency: All parties and member can view the ledger, which maintains the element of transparency and accountability. However, the actual identities of members can be kept anonymous, but the transaction details are normally visible to all members.

Security: Block chain uses graphic techniques such as hashing and digital signatures to secure transactions and safeguard the data. Hashing creates a hash value from characters or keys, making a unique code for each block. This technique secures the data, because any alternation in a specific block will result in another, making it immediately detectable for the authorities.

Consensus Algorithm: Before adding a new block, the previous member must agree on the validity of their data through a consensus protocol. Today many consensus algorithms exist, such as, Proof of Work which is used by bitcoin, and Proof of Stake, each of these has their own advantages and disadvantages.

Applications of Block Chain Technology

Tracking Mechanism and Courier Services: Block chain can track items, parcels or goods when they move along the supply chain, from their origin to point of destination. This allows tracking and increases the transparency and security of goods and services, reduces risks of mismanagement and theft, and also allows efficiency and real time movement of the goods.

Financial Transactions: Block chain technology secures financial transactions, decreasing their processing costs, and improves their management. This technology can be

used for foreign transactions, digital management and segregated lending and decentralized borrowing platforms.

Vote Casting Systems: Block chain technology has enabled the world to increase the security of vote casting systems, eliminating the risks of fraud, alteration, misguidance and manipulation.

Government and Public Sector Services: Block chain technology has increased efficiency and transparency in government services and operations like land registry, tax collection, etc.

Problems and Limitations

Data Volume Limitations: Many block chain networks face the issue of handling large amounts of data. This limits their widespread applications. To solve these issues research is being done on techniques like sharded data bases and layer-2 solutions.

Security Concerns: Although block chain itself is a secure technique, but its surrounding systems, like cryptocurrency wallets and money exchanges are at risk of hacking and fraud. Therefore, security measures should be taken to protect user interests and assets, etc.

Energy Concerns: Some block chain networks, especially those using consensus mechanisms or platforms, need more significant amounts of energy to perform operations efficiently. This factor has resulted in an increase in environmental concerns and has given incentive to research in more energy efficient consensus algorithms.

The Future of Block Chain Technology

In spite of these problems and limitations, block chain technology tends to have a bright future. As the technology is evolving, and continuously addressing and solving its problems, it is expected to see a wider adoption of block chain technology across different fields and industries. Merging block chain with other emerging advancements like artificial intelligence and the Internet of Things (IoT), have the tendency to unlock greater opportunities and create new prospects. Block chain is not just a technology; it is a major shift of how people think about trust, transparency, data security and management across different industries. As we progress, it is important to continue research, development, and collaborative

programs to attain the full potential of this innovational technology.

COMPUTER SCIENCE



2024: YEAR IN REVIEW

Jan

- Neuralink successfully implants its first human brain-computer interface, allowing real-time communication between the brain and external devices. This marks a significant breakthrough in neural technology, opening possibilities for treating paralysis and neurological disorders.

Feb

- Apple releases the Vision Pro mixed reality headset, featuring eye-tracking, hand gesture controls, and immersive spatial computing. It aims to revolutionize augmented reality (AR) experiences, blending digital content seamlessly with the physical world.

March

- The U.S. transitions the SAT to a fully digital format, introducing adaptive testing that adjusts question difficulty based on student performance. This shift enables faster score reporting, enhanced security, and a streamlined testing experience for millions of students.

April

- The UK enacts a law banning weak passwords, requiring businesses to implement stronger authentication measures. This cybersecurity effort targets common vulnerabilities in IoT devices, online services, and corporate networks.

May

- The UK enforces strict cybersecurity regulations, mandating unique, strong passwords for consumer devices to reduce hacking risks. The law also requires manufacturers to provide regular security updates to protect users from cyber threats.

June

- A faulty software update by CrowdStrike leads to widespread global outages, affecting thousands of businesses and critical infrastructure. The incident causes an estimated \$10 billion in damages, prompting investigations into software update security protocols.

July

- CrowdStrike faces severe legal and financial repercussions following its disastrous update failure. Regulators and affected businesses launch lawsuits, while the company scrambles to restore trust and reinforce security protocols.

Aug

- In response to the crisis, CrowdStrike implements advanced security measures, updates internal protocols, and negotiates settlements with affected companies. The company also enhances transparency in software updates to prevent future failures.

Sep

- Bluetooth 6.0 is officially launched, introducing lower power consumption, improved range, and faster data transfer speeds. The new standard enhances connectivity for IoT devices, smart homes, and wearable technology.

Oct

- Lisbon sets a Guinness World Record for the largest computer programming lesson, with nearly 1,700 participants coding together in a single event. This initiative promotes coding literacy and highlights the city's growing role in the global tech ecosystem.

Nov

- A painting created by the AI-powered robot Ai-Da sells for \$1.08 million, demonstrating the increasing role of AI in the art world. The sale sparks debate on AI's role in creativity and intellectual property rights.

Dec

- Google unveils the "Willow" quantum chip, boasting unprecedented computational power. This advancement fuels progress in cryptography, AI, and complex problem-solving applications.
- Bitcoin surpasses the \$100,000 milestone, reaching a record \$108,357.60, driven by institutional adoption and growing mainstream acceptance.

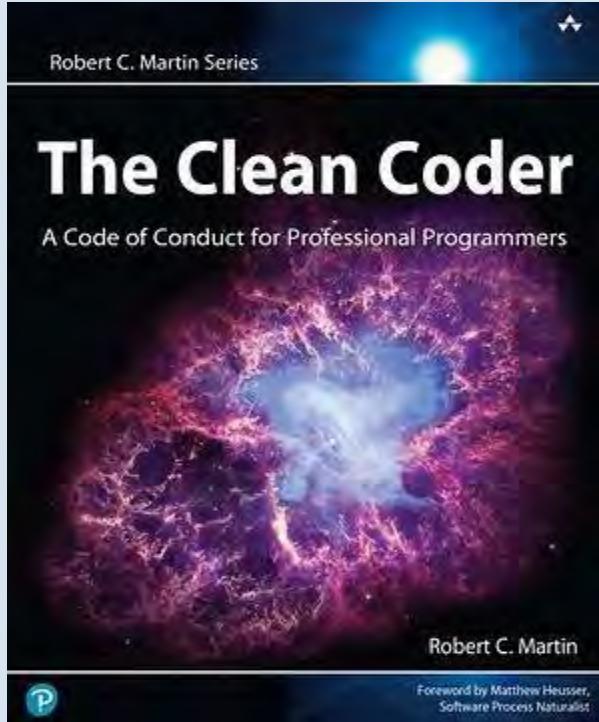
BOOK REVIEWS

THE CLEAN CODER - ROBERT C. MARTIN

Wajiha Liaqat

0237-BSCS-22

Robert C. Martin's Clean Code is highly recommended for software development for any student or experienced developer. Here, Martin discusses the best concepts regarding quality writing and code by unfolding various practices that hold their significance in an optimal approach toward finer software craftsmanship. Practice-driven and engaging turns it into the best overall resource for building cleaner and more manageable codes.



The book is structured into three parts. The first part discusses the principles, patterns, and best practices that guide writing clean code. Writing clean code, in Martin's view, is not only a skill but also a mentality and a professional obligation. In this section, he introduces us to some fundamental ideas like naming conventions that matter, single responsibility functions, appropriate error handling, and eliminating comments that are no longer needed. The best aspect here is insisting on making the code readable in such a way that it reflects its purpose in clear terms for future developers as well.

Within the second part of this book, Martin has some case studies in which he transforms provided code and thus shows how incrementally one can clean a dirty codebase. It is extremely practical both in terms of providing insight into fixing real problems and, abstract principles notwithstanding, in illustrating how they are actually applied. Through these intensive refactoring sessions, one understands the value of small incremental changes over and above huge and dangerous overhauls.

The final chapter deals with a range of "smells" or signs of poor code and instructs how to remediate them. Issues such as duplicated code, large classes, and methods that have too many parameters are isolated and pragmatic methods of correcting them are also given. Martin's humor and friendly style make intricate technical issues entertaining and accessible.

One of the strongest points about Clean Code lies in its pragmatic application. The book is not content to just suggest abstract principles but persuades best practices within the programmer's habits by exhibiting him with the repercussions that accrue due to very poor code choices. Martin presents it forward stating that clean code results in fewer bugs, simpler and expandable software solution that saves time and money on the long term.

Despite all these positives, the book also has its criticism. For example, some people might feel examples of extremely simplistic and outdated and too much attention focus on OOP, but others acknowledge functional programming paradigms have emerged. Some individuals will even not subscribe to the arguments that comments are "failures" in communication and "must be put last." Overall, such controversies add to the worth of the book by providing food for thought regarding software development practices.

In a nutshell, Clean Code is a must-read book for anyone who wants to code better and improve their programming abilities. It makes the programmer approach code not only as an output that works but as art and communication. Of course, the

concepts might raise some controversies, but the teachings learned will be of use to any programmer who codes in any environment or programming language. Martin's work continues to be a source of illumination for those seeking to advance their craft and make contributions toward more effective, more sustainable software systems.

THE INNOVATORS: HOW A GROUP OF HACKERS, GENIUSES, AND GEEKS CREATED THE DIGITAL REVOLUTION - WALTER ISAACSON

Yashfa Najam

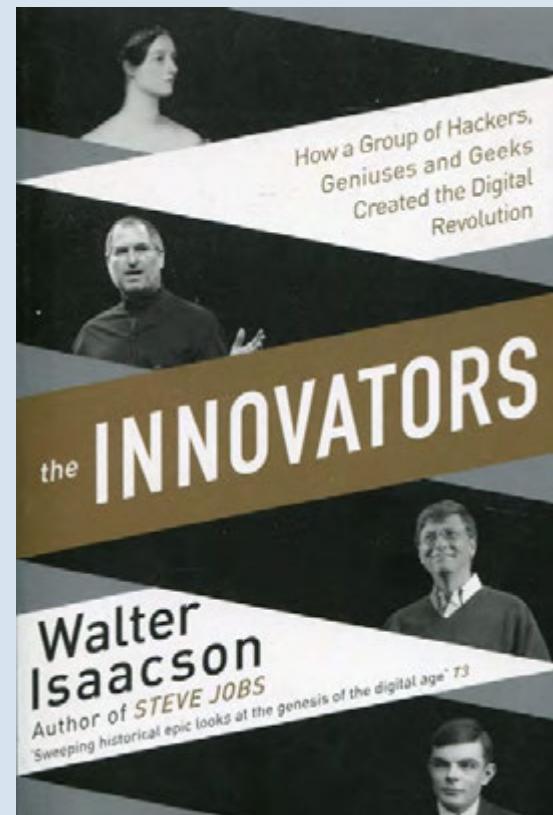
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Walter Isaacson's *The Innovators* is not merely a book on technology—it's a tale of the individuals who brought the digital age into being. It's a tale of how they were driven by passion, creativity, and collaboration to bring big ideas into the real world. Isaacson brings these tales alive in a manner that is captivating, human, and relatable.

My favorite part of this book is how it highlights the strength of collaboration. We always hear about solo geniuses who revolutionize the world, but Isaacson tells us that the technology we use today was developed by individuals working together, trading ideas, and advancing one another's work. Consider the internet, for instance—it wasn't invented by an individual but by a group of genius thinkers working towards a common goal. Throughout the book, Isaacson weaves the narratives of pioneers such as Ada Lovelace, Alan Turing, and Bill Gates, telling us how their cumulative work gave shape to the digital world we experience today.

The author begins with Ada Lovelace, a 19th-century mathematician whom the world also refers to as the world's first computer programmer. Her insight into a machine that would surpass mere calculations established the roots for contemporary computing. Isaacson leads us from there through history to meet other such innovators like Grace Hopper, who wrote the first compiler for a programming language, among many others whose contributions were also just as necessary.

One of the best things I had a chance to appreciate about *The Innovators* is that Isaacson brings together the accounts of the popular names such as Steve Jobs and Bill Gates along with lesser-known but no less significant players. Individuals such as Doug Engelbart, who came up with the computer mouse, and Vannevar Bush, whose hypertext ideas contributed significantly to the shaping of the web, receive recognition at last. This method makes the book more comprehensive and provides readers with a clearer idea of how many hands contributed to the digital revolution.



A section of the book that really impressed me was the history of how the internet and personal computers were created. Isaacson illustrates that these technologies did not suddenly materialize one day—they developed through tiny, gradual advances put in by individuals who were building upon the efforts of predecessors. It is a compelling reminder that invention is seldom the effort of an individual and commonly takes cooperation and mutual intelligence.

Isaacson's style of writing also adds to the fun of the book. He explains sophisticated tech ideas in a way that's straightforward and understandable without being simplistic. He also draws out the characters of his subjects, revealing their challenges, foibles, and ambitions. I particularly liked the way he wrote about these visionaries not merely as technology pioneers but as individuals with their own set of challenges.

What makes *The Innovators* more compelling is the way in which it captures not only the genius of these visionaries but also their humanity — their setbacks, uncertainties, and failure moments. Isaacson reveals to us that being innovative is not necessarily exciting all the time; it's frequently a matter of years of experimentation and error, hard work, and even at

times, rejection. Consider the case of Alan Turing, whose pioneering work founded the basis of modern computing but whose life was one of personal tragedy and lack of recognition while he lived. These tales are a reminder that behind each technological advance is a human being — imperfect, tenacious, and motivated by inquisitiveness. This personal touch turns the book into more than a history of technology; it becomes a testament to the spirit of creativity and perseverance.

While Isaacson does mention some of the women who were important in the history of technology, such as Ada Lovelace and Grace Hopper, the story still reads with a great emphasis on men. With as many women as there have been involved in technology, it would have been wonderful to have a little more equilibrium.

The Innovators is a must-read for anyone curious about the people and ideas that shaped the digital age. It's not just a history lesson—it's a celebration of creativity, curiosity, and collaboration. Whether you're a tech enthusiast or just someone who loves a good story about how big ideas come to life, this book has a lot to offer.

In short, Walter Isaacson's *The Innovators* is an inspiring and accessible look at the digital revolution and its people. By emphasizing teamwork and creativity, the book reminds us that innovation is a team effort—and that's a message worth remembering.

MOVIE REVIEWS

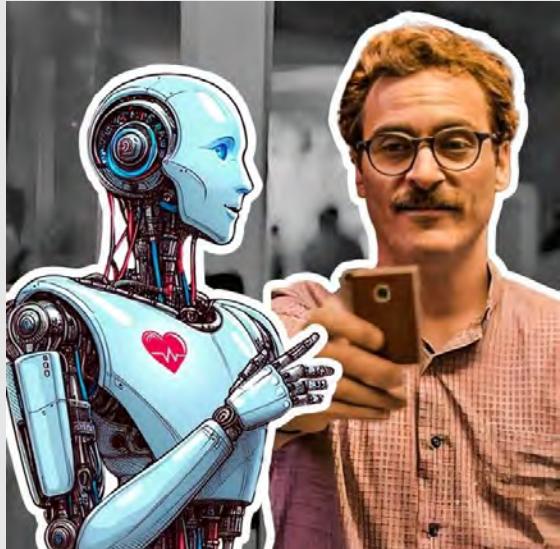
HER (2013)

Fakhar Fazillat

0112-BSCS-22

—Her” is a unique and emotional movie about love, loneliness, and technology. It tells the story of Theodore, a man who is lovesick and starts a romantic affair with an AI voice named Samantha. Ever though she is only a voice, she knows fled and makes him loved and heard. The more intimate their friendship becomes, the more implies Theodore by seeing that the feeling of intuition, of being connected, is what real love is all about.

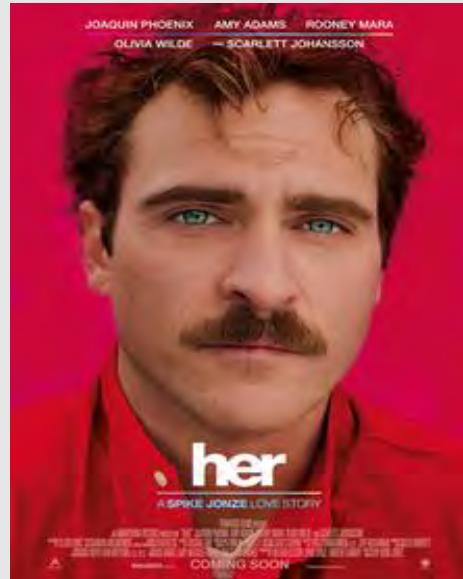
The best part of the movie for me is how it forces us to consider the effect of technology on people's lives. These days, when most people are no real-life socializing, their face-time conversation might have been going digital. Harris goes beyond this concept because AI could very well replace regular relationships. We ask ourselves: Can a machine ever really understand and empathize with us? And is the love it has for us true?



we grow and sometimes even depart from each other. The movie is not merely about AI, but also about the ways in which we connect with others and the complexities of love.

What I miss is, the reactions of the society to the idea of people dating AI. The film is mainly about Theodore's personal journey, yet it would have been thought-provoking to witness some more views from the world surrounding him.

As a whole, —Her” is a film that is genuinely gorgeous and real. It's not just a story of the future—it's a motion picture about feelings, connections, and the future of human connection. It makes you see love in a different way and you keep pondering on it after the movie is finished.



THE IMITATION GAME (2014)

Sameen Khizar

0232-BSCS-22

The Imitation Game (2014) is a captivating biopic about Alan Turing, an exceptional mathematician and logician who was instrumental in breaking Nazi Germany's Enigma machine during World War II. Directed by Morten Tyldum and starring Benedict Cumberbatch as Turing, the film highlights both his genius and the inner battles he endured. It also emphasizes the birth of computer science. Who could have foreseen it? Turing was not just solving mysteries — he was transforming the future.

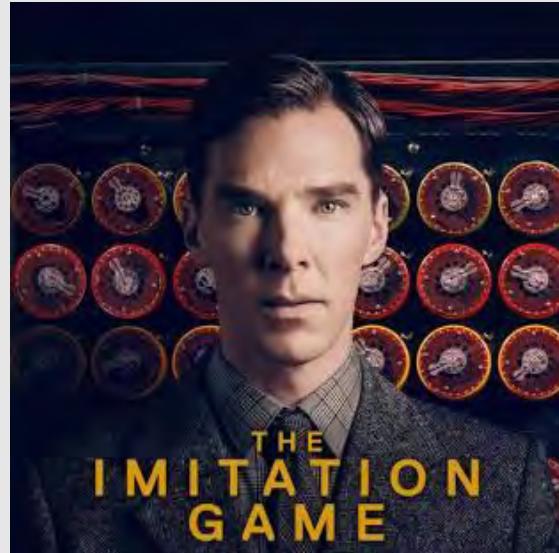
The film focuses on Turing's work at Bletchley Park, where he leads a group of cryptographers in cracking German military communications. By pioneering the Bombe machine, an early computer, he altered codebreaking and drastically reduced the duration of the war. The Bombe transformed a task that would have taken years by automating the search for Enigma's settings. The fruit of thinking in algorithms planted the seed of the computer, which planted seeds in money today. The movie exceptionally portrays the teamwork aspect of problem-solving. Turing's partnership with the rest of the cryptanalysts, including Joan Clarke, shows the technical level of technical advancement culture. Finishing the project required Clarke's creativity and tireless dedication; the film emphasizes the importance of variety in creation, which is still very crucial in tech teams nowadays.

In addition to the details, Turing's social difficulties are covered in the movie. He symbolizes the problem of most innovators with his reclusiveness and lack of personal relationships. The film also depicts the disturbing effects of prejudice in society by mentioning how he was persecuted for his personal identity. The human element gives the movie an emotional touch while showcasing Turing's historical achievements and personal hardships.

The Imitation Game is a great guide for computer science enthusiasts. Fundamental concepts like algorithms, encryption, and artificial intelligence are explained in the film in a comprehensible way. The film's title also alludes to Turing's "Turing Test," which he performed to see if a machine could be deemed intelligent like a human. This question remains at the main focus of AI research even today. The film's examination of the idea challenges viewers to consider the ethical consequences of AI, a topic that continues to be at the forefront of defining how technology will progress in the future.

The film stays true to Turing's contribution despite using some poetic adaptation. It serves as an example of the significance of investigation, dedication, and a willingness to challenge expectations about how to tackle a problem. Turing's determined quest for a solution after repeated failures serves as a powerful lesson that creativity is often balanced by grit and wit.

The Imitation Game, as the title suggests, is a heartfelt tribute to an innovator in computer technology instead of merely a military drama. It motivates people to comprehend and value the human stories that underlie technology by bridging the gap between history and modern technology. This video is worth watching for anyone passionate about computers or who wants to learn more about the power of human brains. It serves as a poignant reminder that the future is in the minds of people who have the courage to see it.



HOW THE INTERNET WORKS

Arham Bashir

0280-BSCS-21

When morning arrives you will reach for your phone in order to check messages after which you spend time on social media followed by an online breakfast order. The internet stands as one of the most powerful inventions of our present age and you utilize it without thinking twice. Through its network the internet interlinks billions of individuals and simultaneously operates businesses alongside fostering new inventions. The true functioning mechanism of this incomprehensible power remains a mystery to most people. This writing investigates how the internet operates and shows how it progressed through the decades.

What is the Internet?

The internet works as a tremendous network of digital pathways throughout the internet. Information via emails and videos and social media contents plus everything in between flows through its network instead of transportation vehicles. This worldwide network includes all types of devices including smartphones and computers which exchange information simultaneously. Today's society would experience complete collapse if the internet network did not exist.

How does the Internet Work?

The internet operates as a tremendous system designed to exchange electronic information. Each click you make on links generates a message that moves rapidly between multiple networks. The information transforms into several small digital pieces referred to as data packets. The dispersed data packets travel numerous pathways to their destination after which the system reconstructs them for webpage viewing and message reading. The process moves at such quick speed that we fail to realize it happening.

The Backbone of the Internet

The internet system contains different essential components that function harmoniously:

1. **Internet Service Providers (ISPs):** Internet Service Providers establish the connection between users and

the global network by providing internet access through routers to businesses and homes.

2. **Servers and Data Centers:** All websites together with their corresponding online services get stored on servers located within data centers. These massive facilities operate globally to store website information which ensures instant access during your online visits.
3. **Cables and Wireless Networks:** The internet uses fiber optics cables and oceanic cables in combination with wireless signals including mobile and Wi-Fi networks to reach consumers. Information travels across the world at speeds that get very close to light speed because of these systems.
4. **Routers and Switches:** Your online needs benefit from routers and switches which function as data traffic managers that ensure speedy delivery of information requests to the correct locations.

How do Websites Load?

Opening a website name in your browser brings about these automatic steps. Your requests quickly process through computer networks in less than one second through this sequence:

1. **Finding the Website:** Your DNS server receives the website request as the first step before converting www.google.com into its corresponding IP address.
2. **Sending a Request:** The internet enables your device to make a server request which travels to the website through the online network.
3. **Receiving Data:** After your server receives your request it sends back the required data packets through packets.
4. **Displaying the Website:** Data packets reassemble in your browser which results in showing the website on your screen.

Why is the Internet So Fast?

Internet speed is powered by fiber-optic cables that send information through light pulses. Fiber optics operate at great rates to transmit data across vast distances because they differ from typical copper wire cables. 4G together with 5G and satellite internet bring about faster wireless connections that are more easily accessible.

The Future of the Internet

The internet is constantly evolving. Internet connectivity is undergoing a revolutionary change because 5G networks integrate with AI automation and satellite-based internet services including Starlink. High-speed internet will become accessible in all remote locations worldwide resulting in fundamental transformations in digital world interactions and work methods and interpersonal communication dynamics.

Conclusion

Modern society bases its operation on the powerful infrastructure that the internet provides. The internet operates through a basic method which starts with information transmission and reception through exceptionally quick speeds. Our awareness of internal communications improves when we learn about this intangible energy source that keeps our everyday activities running. The Internet establishes new directions of the future through business, education and recreation while continuing to introduce advancing possibilities we barely comprehend.

DDOS ATTACKS IN IOT DEVICES

Sarah Abid Khan

0003-BSCS-19

When a single malicious actor launches a cyber-attack that prevents authorized users from accessing or interacting with devices, information systems, or network resources, it's known as a denial-of-service (DoS) attack. Such attacks can target a wide range of targets, such as websites, online banking systems, email services, or any other computer network-dependent service. A denial-of-service (DoS) attack occurs when an attacker sends an overwhelming amount of requests to the targeted host or network, causing it to crash or become inaccessible and interfering with legitimate user access. DoS attacks may be broadly classified into two categories: Smurf Attacks and TCP (SYN) floods. A Smurf Attack involves the attacker impersonating the target's IP address while sending many hosts Internet Control Message Protocol (ICMP) packets. Depending on the amount of traffic and the capacity of the target, a denial-of-service (DoS) attack might result from these hosts flooding the target with

replies in response to the ICMP packets. In contrast, a TCP (SYN) flood occurs when the attacker uses TCP to send connection requests to the victim. In order to establish a connection, the victim responds to these requests and waits for confirmation from the attacker. But instead of confirming the connection, the attacker keeps sending fresh requests in an attempt to occupy all of the target's open ports and prevent genuine traffic from using them. The number of attacking sources is the primary distinction between a distributed denial-of-service (DDoS) attack and a denial-of-service (DoS) attack. A DDoS attack employs several sources, from a few to maybe hundreds of thousands, in contrast to a DoS attack, which utilizes a single source. This difference increases the attack's effect and complicates response. DDoS attacks pose a serious risk to network infrastructure because they affect devices and apps that rely on them. These attacks interfere with legitimate users' access to services like email and webpages by coordinating several devices to target a single organization. These are the most common and dangerous type of attacks that Internet of Things (IoT) devices have to deal with. By integrating smart devices with traditional infrastructure, the Internet of Things (IoT) opens up new applications such as smart grids, smart homes, smart cities, and smart health. The Internet of Things is developing at a rapid pace, and as these linked gadgets communicate in perhaps vulnerable contexts, there is an increasing demand for security solutions. This presents a serious risk to both individual cyber-physical systems and Internet networks since so many susceptible gadgets are currently available on the market. Unlike traditional networks, IoT technology has its own set of peculiarities, such as resource limitations and a variety of network protocol needs. Attackers use Distributed Denial of Service (DDoS) attacks to take advantage of these security flaws in IoT infrastructure.

Fast and precise data processing made possible by the widespread use of sensors and computer devices has significantly increased convenience and efficiency. However, Distributed Denial of Service (DDoS) attacks are becoming a possibility for vital resources due to the extensive deployment and integration of connected devices. The 2016 Mirai attack brought attention to the vulnerabilities of Internet of Things devices by bringing down a number of well-known websites. Over 100,000 unsecured devices, including cameras, routers, and DVRs, were hacked and used to create botnets. Following the disclosure of Mirai's source code, there was an increase in

IoT attacks. Because conventional host-centric IT security solutions are sometimes insufficient, securing IoT devices is difficult. Functionality and affordability are usually given precedence by manufacturers above security, and IoT software is seldom updated, making devices open to hackers. More attention has to be paid to identifying DDOS Attacks within IoT networks and devices, given these security issues and the resource-constrained nature of IoT devices.

Security issues are a big roadblock to the IoT's effective operation. A common danger to Internet of Things (IoT) devices is the Distributed Denial of Service (DDoS) attack, which leverages a large number of hacked workstations, referred to as a botnet, to perform a coordinated and overwhelming attack. Such attacks aim to either impair system performance or prevent authorized users from accessing system services. DDoS attacks may result in significant harm even if they are very easy to carry out.

CYBER-SECURITY: STEPPING INTO THE WORLD OF CYBER-SECURITY

Muhammad Zartash Gul

0255-BSCS-22

When-ever you hear the word cyber-security the first thing that comes to your mind is hacking, that being somewhat true is not the absolute truth. Cyber security is not a field that is based upon hacking alone, although it majorly constitutes of hacking but the real thing is that the field is so diverse that it covers almost every aspect of the digital world. With the rapid progression of internet and digital platforms the need for cyber-security is also increasing. So if you want to kick start your career in cybersec (short for cyber-security) this will provide a good analysis on what is cyber security and what fields it covers.

Cyber-security

Cyber security refers to the practice of protecting the digital platforms from all of the cyber-attacks like unwanted access, phishing attacks, viruses and malwares. This field requires a very solid understanding of fundamentals, threats and practices used in the world.

Key Components

We shall discuss the key components or fields that it covers.

1. **Network Security:** protecting the network from unauthorized access and cyber attacks
2. **Information security:** ensures data being sent or received is not compromised during its travel
3. **Application security:** secures application from vulnerabilities and exploits
4. **Cloud security:** protecting cloud based services such as Google drive from cyber-attacks
5. **Ethical Hacking:** Hacking but for a good cause not specifically to implement harm but to find out the vulnerabilities in your system and help to improve them
6. **Incident response:** Dealing with cyber-attacks and helping to recover from such attacks

Common Cyber Threats

Cyber threats are continuously evolving, becoming more sophisticated and even more dangerous. Some of the most common threats include:

1. **Malwares:** Malware short for malicious software is a term covering viruses, worms, ransom wares and spywares. They are designed to infiltrate your system, compromise them and send data to the said sender of the virus.
2. **Phishing attacks:** phishing attacks are designed in such a way to fool the receiver into thinking that a program or a link is a harmless program and tricks user to send crucial and sensitive information such as passwords or credit card details to the sender.
3. **DOS attack:** DOS stands for Denial of Service not Disk operating system is a technique that continuously sends request to a network causing the network to be temporarily shut down or render it useless. The common use of it is using botnets to launch attacks.
4. **Man in the middle Attack:** a person instead of directly infiltrating your system comes between the communication channel between the sender and receiver and sits there without the users knowing. He then receives all of the data being sent from the sender to the receiver and gains access to the crucial information of both parties.

5. **Zero day exploits:** in these sort of threats a hacker or a person targets the vulnerabilities of a software before the developers of the software can patch them, gaining access to even the whole systems.

Protection and Practices

So if these threats are so dangerous to us then how can we protect ourselves from such attacks. Let us look at some best practices to keep ourselves secure and prevent some unfortunate incident

1. **Two Factor authentication:** the best way is to activate two factor authentication so that every time someone tries to login into your account you would have to authorize whether the login is legitimate or not.
2. **Use strong passwords:** Use a password that is minimum 8 characters long is a combination of letters, numbers and special characters and is not a word from your daily life or names of your near and dear ones and contains no such information about you or anyone that you know.
3. **Keep software and systems updated:** whenever an update is given to us on our systems we generally ignore them but it is very important to update your systems as they contain security patches that help you to protect your systems from such attacks.
4. **Avoid suspicious emails and links:** Phishing is usually done through emails and links so the best practice is to either avoid them and always check if the sender is legitimate, big corporations such as google, facebook or even your own network provider will never ask for your information.
5. **Educate yourself and others:** if you know these practices it is always good to share it with your peers to help them save themselves as well.

Careers in Cyber Security

1. **Security analyst:** monitors the security incidents ensuring the integrity of organization remains strong.
2. **Penetration Tester:** also known as ethical hacker does controlled cyber-attacks on the systems to find vulnerabilities and provide solutions.
3. **Security engineer:** Develops and implements security measures for systems and networks.
4. **Incident responder:** handles security breaches and minimizes damages.

There are many more to these and it all depends upon which niche you pick and what you are trying to achieve. In my opinion a very diverse field but a very hard one as well, having said this if you understand this article and develop some interest so very much appreciated to at least try it once.

PROMPT ENGINEERING: A GUIDE ON HOW TO CRAFT GREAT PROMPTS FOR EXCEPTIONAL RESPONSES

Muhammad Saad

0247-BSCS-22

Prompt Engineering refers to the study of ways to optimize prompts for better, accurate and efficient responses from Generative AI models.

A better prompt on a less capable model generates many folds better response than a bad prompt on a model with high capabilities. So even if you're paying \$200 a month for a better model but you lack the skill of prompt engineering, you're wasting your money. So, how do you craft prompts that deliver?

In this guide, I'll walk you through the essentials to supercharge your results, focusing on LMs, reasoning models particularly. This guide will save your time and money. Most importantly, it will increase your productivity.

Understanding the Language Models

First things first, we will have to understand what it is that we are going to prompt to and how it works. Language models are just trained machine learning models on vast amounts of datasets. The larger the number of parameters and the amount of data, the better the model is. Now, how does it understand our prompts?

When given any text prompt, it breaks each single word into tokens. So, each word you add into your prompt has both individual and a combined effect on your response. Let's keep things very easy. You can think of token as a hint. It takes all the hints (tokens) and processes them individually (semantics) and collectively. By collectively, what I mean is, it tries to produce the output based on how it was trained when given similar hints.

Now that you have some idea on how these models produce outputs, you can now believe that an alteration in a single word can alter the whole response. Based on this, I have some really easy to follow rules which can dramatically enhance your experience with LLMs.

Assigning Roles and Writing Styles

Always assign a role in the beginning of the prompt.

When we assign a role or ask an LLM to write like someone, we use that particular persona. So, for example I want some advice on Meta ads, my prompt should start like

—Act as Meta-Ads specialist with 100% success rate”

Now the model will produce an output based on how a Meta-ads specialist with 100% success rate thinks and acts like.

You can assign it some writing styles as well. Like in my case, when I need some engaging content, I prompt it like

—At as an expert copywriter”

—Write like Dan Kennedy”

—Write like Dr Allama Iqbal”

It varies from user to user. So, for teachers who want great notes, their prompt should start like

—Write for a 20 year-old university student with no native English background.”

—Write for a 14 year old”

Now, a very important point here is I didn't prompt it

—Write like a 14 year....”, Why? Same concept again, if I gave it a hint of writing like a 14-year-old, it would have written informal, non-valuable and un useful response because that is usually what we expect from a 14 year-old.

Be Specific

When writing a prompt, be very precise and specific about your goal. What you want to achieve and what you don't want to achieve. OpenAI's research shows that precise verbs like 'summarize' versus vague ones like 'shorten' cut ambiguity by 40%, leading to outputs that hit the mark. Test it yourself: 'Summarize this in 50 words' beats 'Make this shorter' every time.

For example, if you want to summarize a text, ask the LLM to summarize instead of asking it to shorten it. Use suitable keywords for every task such as "Write", "Clarify", "Classify", "Translate", "Format" etc.

This is especially important when you want a specific outcome or style of generation you are seeking. There aren't specific tokens or keywords that produce better results. But using the right keywords will always help you.

Giving Examples

When I am learning something from somebody, I never listen to any theory or basics that they teach me. I always wait for the examples. To me, same is the case with LLM's. When I give a prompt without specifying my desired outcome by giving examples, it seems to ignore my prompt compared to the quality response an LLM produces when I give it some examples. It is literally a cheat code.

Contextualizing

If a prompt doesn't contain context, it is just like saying to the LLM —Dot as you like”. For example, during coding, most programmers just dump in the current file (most of them don't even do that) and ask it to perform certain tasks with that code which isn't possible.

The best solution in that case is to either dump in the whole code or to connect the LLM directly to your compiler and then ask the LLM to perform tasks on it.

Same is the case with other use cases, If I want some help in my writings, I should provide all my previously made drafts for a consistent outcome.

Negative Prompting

An ideal prompt should contain the don'ts for the particular task. Why does this work? Negative prompts act like guardrails. A 2023 study from xAI's internal testing found that adding 'don't' clauses reduced irrelevant content by 25% in long-form outputs.

For example, If I want the LLM to write an article, it will always produce content that sounds like coming straight from a machine. Although it is but I don't want it. So for that I am going to give it a negative prompt. Here is a small paragraph that I almost always add in my prompts.

—Please don't use jargon and clichés. Make simple sentences and the word count for each sentence should not exceed 13. Use 90% active voice. Don't overuse passive voice structure. Avoid shifting from nouns to pronouns. Don't make dangling sentences. Don't randomize the sentences and paragraphs. Strictly stick to the topic in each line and paragraph. Keep every line and word highly semantically relevant to each other. Please follow every single instruction very carefully and completely.”

This is the ultimate showstopper from this guide. There are many things from this prompt to understand, but I want you to analyze it on your own and create a better one for yourself. Afterall, we are learning prompt engineering.

Using “please”

Using please automatically emphasizes a request. Why does this work? In training datasets, 'please' often appears in polite, urgent, or instructional contexts. This subtly signals the model to prioritize that instruction.

What I mean to say, when you add please before your important instructions, it acts as if you've emphasized the request multiple times. It's like a force multiplier.

Using Chain of Prompts

The chain of prompt concept is the most useful concept in prompt engineering and is a bit complex. It requires a whole different guide. I mentioned it just to make you aware about it. In this method, we treat the LLM as a toddler. We feed our prompt step by step in a particular manner to achieve the maximum output from an LLM. This is the same method used for creating the DAN (do anything now) prompt.

With these tools in your toolkit, there's one final piece: structuring your prompt for maximum clarity. Here's how.

How to Structure your Prompts for Better Understanding?

If you followed all the above-mentioned rules clearly but your prompt isn't well structured, it is a problem. So, for the reasoning models especially, here is the structure you should follow.

- 1) Goal
- 2) Desired output format
- 3) Negative prompting
- 4) Context Dump

That's it. If you follow all the above mentioned simple and easy-to-follow rules as described, now you have saved tons of time, increased your productivity many times over and congratulations, you have just learned the basics of one of the most in-demand fields. There is much more to it but for day to day tasks, this is more than enough. I hope this helps.

BREAKING THE AI SPELL: SEPARATING HYPE FROM REALITY

Muhammad Khizar Irfan

0248-BSCS-22

Back in the late 1990s, the internet was the hottest thing in tech. Everyone wanted a piece of it, and investors poured money into internet-based companies, even if they had no real business model. This led to the dot-com bubble, where stock prices soared unrealistically—until they crashed in 2000. Many companies went bankrupt, but the internet didn't disappear. It simply found its rightful place in the world, and only companies that had real value survived.

Now, we're seeing something similar with artificial intelligence. AI is being hyped up as the future, and companies involved in it—like Nvidia, OpenAI, and Microsoft—are attracting billions of dollars in investments. Just like in the dot-com era, some of these businesses have real potential, while others are riding the wave without a solid foundation. We've seen this before, not just with the internet bubble but also with the crypto boom of the late 2010s. At its peak, companies were adding "blockchain" to their names just to attract investors, even if their business had nothing to do with cryptocurrency. AI is now facing the same situation—businesses are integrating AI into their products, whether it's needed or not, simply to stay relevant.

A perfect example of this is WhatsApp. At its core, WhatsApp is a chatting app—does it really need AI? Recently, Meta introduced "Meta AI" into WhatsApp, offering chatbot-like features within the app. But does

sending a simple text message require AI-powered responses or machine learning algorithms? Most people use WhatsApp for direct communication, not for chatting with an AI. Yet, companies are rolling out AI-powered features in apps and services that worked perfectly fine without them, all in an attempt to be part of the AI hype train.

This raises an important question: should we really take advice about AI's future from companies whose revenue and stock prices rely on the AI hype? For example, Nvidia's CEO recently suggested that we shouldn't teach the next generation how to program and instead leave it to AI. But isn't it convenient for a company that profits massively from AI hardware to push such a narrative?

Beyond the hype, there are some serious ethical and sustainability concerns with AI. One major issue is how AI models are trained. Large AI models scrape massive amounts of data from the internet, often without permission, leading to copyright infringement cases. Artists, writers, and even major media companies have accused AI companies of stealing their work to train models. If these AI systems are built on unauthorized content, does that mean businesses using them are profiting from stolen intellectual property?

Another key concern is whether AI is even sustainable in the long run. Training and running large-scale AI models require enormous computational power, which leads to massive energy consumption. Training models like GPT-4 costs millions of dollars and requires energy-intensive data centers. With climate change and increasing global energy demands, does it make sense to prioritize AI systems that consume so much power for tasks that humans can still do more efficiently?

But AI isn't new. It has been around since the 1950s, with Alan Turing laying its theoretical groundwork. Over the decades, AI has quietly evolved in the background, powering things like search engines, recommendation systems, and automation tools. The only difference now is that it has become more powerful and accessible, which is why it's suddenly in the spotlight.

The dot-com crash didn't kill the internet, and this AI hype cycle won't kill AI either. Instead, the industry will settle into a more realistic pace, where only truly valuable AI companies will survive. Some overhyped startups may fail, but AI itself is here to stay—it will just be used in a

more practical and meaningful way in the long run. AI won't mark the end of most professions, despite what the hype might suggest. Instead of replacing entire careers, AI will likely become another tool in the arsenal of software engineers, helping them build better and more efficient products. Take calculators, for example—they didn't replace mathematicians, just like Excel didn't eliminate accountants. Instead, these tools made their work more efficient, allowing them to focus on more complex and meaningful tasks. AI will follow the same path, reshaping industries rather than destroying them. In the end, it's not about AI taking over—it's about how we use it to enhance what we already do.

AI-GENERATED CONTENT: THE FUTURE OF MEDIA OR A THREAT TO AUTHENTICITY?

Malika Mujahid

0059-BSCS-21

You're scrolling through your favorite news site, watching an amazing movie trailer, or reading a novel that has you hooked from the first page. The emotions feel real, the words flow perfectly, and the visuals look stunning. But what if I told you that none of it was created by a human? Every word, every sound, and every image was generated by artificial intelligence. Exciting? Terrifying? Maybe both.

AI is changing the way we create and consume media at an unbelievable pace. From AI-generated news reports to deepfake videos that look disturbingly real, the line between human and machine creativity is getting thinner. Some see this as an era of limitless possibilities; while others worry we're losing the essence of originality and truth. So, what's the future of AI-generated content? Will it help us create more than ever before, or will it blur the lines between what's real and what's not?

The Rise of AI in Content Creation

Just a few years ago, AI-generated content was a futuristic idea. Now, it's everywhere. AI-powered tools like ChatGPT, Microsoft Copilot, DeepSeek AI, and Runway ML are being used to create high-quality text, images, and videos within seconds. Whether it's an AI writing a breaking news article or a tool generating artwork that

looks like a masterpiece, the impact is undeniable. Many media companies are already using AI to reduce costs and speed up production. News agencies have AI systems that automatically generate financial reports, sports updates, and weather forecasts. AI video tools help filmmakers create realistic special effects without needing a massive production budget. Even music and podcasts are being produced with AI voices that sound eerily human. But while AI can help us create more, it also raises big questions:

- Does AI-generated content lack originality?
- Can it ever match the depth of human creativity?
- Will it replace human artists, writers, and filmmakers?

These concerns aren't just theoretical; they are shaping the future of media right now.

The Promise: A New Era of Creativity

For those who support AI-generated content, the benefits are clear. AI makes creativity more accessible to people who might not have had the tools or resources before. AI is not just replacing human work. It's expanding what's possible. Instead of spending hours on repetitive tasks like editing, formatting, or transcribing, creators can focus on bigger ideas and deeper storytelling. For example, AI-assisted journalism allows reporters to spend more time investigating important issues while AI handles routine updates like stock market reports. AI-powered video tools help content creators generate high-quality animations with minimal effort. And AI-generated music? It's already being used in background scores for films, games, and commercials. It's easy to see why so many people believe AI is unlocking a new golden age of creativity.

The Peril: Is Authenticity at Risk?

If AI can generate news articles, images, and even deepfake videos that look real, how do we know what's true and what's not? We're already seeing cases where AI-generated content is used unethically, whether it's manipulated photos, AI-written fake reviews, or misleading deepfake videos. The danger is that if people stop trusting what they see online, trust in media itself could collapse. Another concern is originality. AI is trained on vast amounts of human-created content, meaning it doesn't truly "create", it predicts and

rearranges based on what it has learned. If AI starts replacing writers, artists, and filmmakers, will we just be recycling old ideas over and over? There's also the issue of job displacement. While AI can assist creators, some fear it will replace them instead. Writers, journalists, designers, and musicians are all wondering: Will AI take our jobs, or will it simply change how we work?

Striking a Balance: The Human-AI Collaboration

AI should be seen as a creative assistant, not a replacement. Human creativity is irreplaceable because it comes with emotion, lived experiences, and a sense of ethics. While AI can generate content quickly, it lacks the ability to feel, to think critically, and to make moral decisions. AI-generated content should be clearly labeled so people know what they're consuming. Companies should establish rules about how AI can be used, especially in journalism and politics. AI-generated content should always be reviewed and approved by humans before publication. Laws should prevent AI from being misused to spread false information or manipulate reality. At the end of the day, AI is a tool; it's up to us how we use it. If used responsibly, it can enhance creativity, make content creation more accessible, and unlock new possibilities. But if left unchecked, it could also lead to a world where truth and authenticity are hard to find.

Conclusion: The Future We Choose

AI-generated content is here to stay. It's already shaping how we read, watch, and interact with media. But whether it becomes a force for good or a threat to authenticity depends entirely on how we use it. Will we let AI replace human creativity, or will we use it to enhance what we already do? Will we allow AI-generated misinformation to spread, or will we put safeguards in place to protect truth and originality? The future of AI in media isn't just about what AI can do, it's about what we, as creators and consumers, allow it to do. The question isn't whether AI will change media. It already is. The real question is: Will we ensure that the future it creates is one we can trust?

The background of the image is a dark blue color. In the center, there is a semi-transparent globe showing the outlines of continents in a lighter blue. To the left of the globe, there is a network graph consisting of numerous small, glowing white and yellow dots connected by thin lines, forming a complex web. The overall theme suggests global connectivity and data analysis.

ECONOMICS

2024: YEAR IN REVIEW

Jan

- The year started with everyone talking about interest rates. Some people thought central banks would finally cut rates to make borrowing cheaper, but most banks, including the U.S. Federal Reserve and the European Central Bank, decided to wait. Inflation was still a concern, and no one wanted to make a wrong move.

Feb

- The stock market had a great month, especially for tech companies. AI and chip-making companies saw their shares jump as investors poured in money. Companies working on artificial intelligence were getting a lot of attention, and it looked like the tech industry was the only industry to have the best investments.

March

- Oil prices went up unexpectedly after OPEC+ (the group of major oil-producing countries) decided to cut production. This made fuel more expensive in many countries, increasing the cost of living and worrying businesses that depend on transportation.

April

- The BRICS group (Brazil, Russia, India, China, and South Africa) expanded by inviting new countries to join. They also started doing more trade in their own currencies instead of using the U.S. dollar. This made some economists wonder if the dollar's dominance in global trade was starting to weaken.

May

- A major European bank faced a crisis, shaking the financial world. People started comparing it to the 2008 financial crash, but regulators quickly stepped in to stop things from getting worse. Although the situation calmed down, it reminded everyone how fragile banking systems can be.

June

- The U.S. and China got into another trade fight, imposing new tariffs on each other's goods. This hurt businesses and forced companies to look for new suppliers in countries like Vietnam and India. Many people started wondering if the world's two biggest economies would ever settle their trade disputes.



July

- Crypto enthusiasts had a great month as Bitcoin and other digital currencies surged in value. Big investors started taking cryptocurrencies more seriously, and some banks even announced plans to offer crypto-related services. However, some governments tightened regulations, trying to control the growing market.

Aug

- AI became the trendiest topic of debate in August. Big companies celebrated how AI was making their work faster and cheaper, but workers and labor unions worried about job losses. Some governments started talking about new laws to protect workers from AI replacing them too quickly.

Sep

- Just when people thought inflation was cooling down, it came back. Prices for food, rent, and transport went up again, forcing central banks to rethink their interest rate policies. Consumers started feeling the impact of increased cost of living, and businesses worried about another economic slowdown.

Oct

- Governments and private investors poured record amounts of money into clean energy projects like solar power, wind farms, and electric vehicles. The shift toward a greener economy seemed to be happening faster than expected, with many countries setting new climate goals.

Nov

- A historic trade agreement was signed between several major economies, eliminating tariffs and making it easier to do business. Experts said this would help economic growth and create more jobs, especially in industries like manufacturing and agriculture.

Dec

- The year ended with a mix of good and bad news. Stock markets were still doing well, but inflation, trade wars, and banking concerns left people unsure about what 2025 would bring. Some economists predicted slow growth, while others warned of a possible recession.

BOOK REVIEWS

FREAKONOMICS: A ROGUE ECONOMIST EXPLORES THE HIDDEN SIDE OF EVERYTHING - STEVEN D. LEVITT & STEPHEN J. DUBNER

Zaigham Abbas

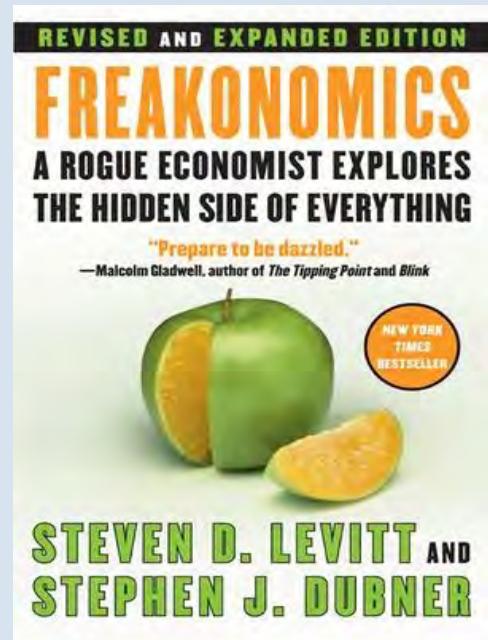
2065-BS-ECON-22

Freakonomics is a fascinating book that explores how economics can be used to understand unusual and unexpected aspects of life. Unlike traditional economics books that focus on graphs, formulas, and financial markets, this one takes a completely different approach. Steven Levitt, an economist, and Stephen Dubner, a journalist, team up to show how economic thinking can explain everyday human behavior, sometimes in ways that surprise us.

One of the most interesting things about Freakonomics is how it challenges the way we see the world. The book doesn't follow a single theme but instead looks at different social issues and asks unusual questions about them. For example, the authors examine why drug dealers often live with their mothers instead of making big money. They also explore how a person's name might affect their chances of success in life. These are not typical economic questions, but Levitt and Dubner use data and economic principles to find surprising answers.

The book is written in a way that is easy to understand, even for people who don't have an economics background. Levitt and Dubner explain their ideas using simple language and real-life examples. They avoid technical jargon and instead tell stories that make their points clear. This makes the book enjoyable to read, as it feels more like a collection of fascinating detective stories rather than a heavy academic text.

Overall, Freakonomics is a must-read for anyone who enjoys exploring the hidden side of everyday life. It's not just for economists but anyone who is curious about human behavior and the forces that shape society will find it interesting. Levitt and Dubner's storytelling, humor, and ability to simplify complex ideas make this book a compelling and enjoyable read.

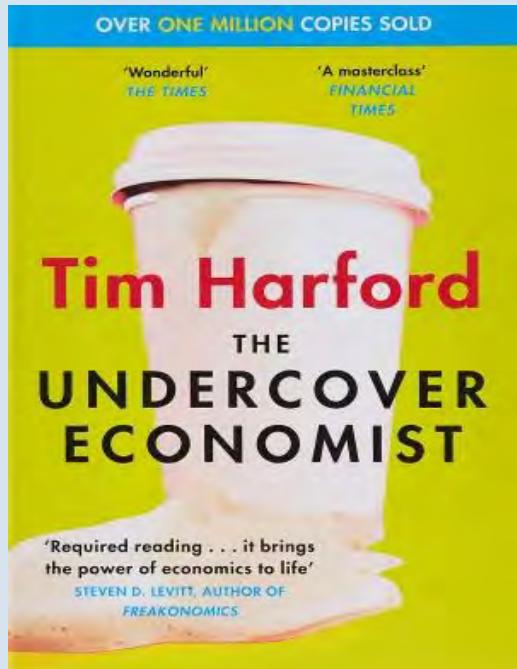


THE UNDERCOVER ECONOMIST - TIM HARFORD

Zaigham Abbas

2065-BS-ECON-22

The Undercover Economist by Tim Harford is a fascinating introduction to economics that explains how markets function and why prices fluctuate—all in a simple and engaging way. Unlike traditional economics books filled with complex theories and equations, Harford takes a practical approach, using everyday examples to help readers understand the economic forces shaping their lives.



One of the biggest strengths of this book is its accessibility. Harford writes in a conversational style, making complex ideas easy to grasp. He doesn't assume that the reader has any prior knowledge of economics, which makes this book perfect for beginners. Instead of using technical jargon, he explains concepts through relatable scenarios, such as why your morning coffee costs what it does or how supermarkets set their prices. These real-life examples make economic principles feel relevant rather than abstract.

A key theme in the book is the power of scarcity. Harford explains how the price of goods and services is often determined by scarcity rather than production costs. He illustrates this with an interesting example of coffee shops in busy locations. The high price of coffee isn't just because of the beans or labor costs—it's also because the shop is paying a premium for its prime location. This simple explanation helps readers understand how scarcity and competition shape the prices of many products around them.

Another fascinating part of the book is its discussion of global trade. Harford explains why international trade benefits both rich and poor countries, using simple examples that remove the confusion surrounding the topic. He also discusses how some government policies, such as tariffs and subsidies, can have unintended negative effects on economies. These explanations make economic policy more understandable, even for those who have never studied the subject before.

Overall, The Undercover Economist is a must-read for anyone who wants to understand how the economy works without getting lost in technical details. Tim Harford's storytelling, humor, and ability to simplify economic concepts make this book an enjoyable and insightful read. Whether you're a student, a business professional, or just someone curious about the world, this book will change the way you see everyday economic interactions.

MOVIE REVIEWS

MARGIN CALL (2011)

Zaigham Abbas

2065-BS-ECON-22

Margin Call (2011), directed by J.C. Chandor, is a gripping drama that takes a deep dive into the financial world during the early stages of the 2008 crisis. The film provides an insider's view of how a powerful investment firm handles the discovery of an impending financial disaster.

The story unfolds over a 24-hour period at an unnamed financial firm, where a junior analyst, Peter Sullivan (played by Zachary Quinto), uncovers troubling data left behind by his recently laid-off boss. As he delves deeper, he realizes that the company is on the verge of a catastrophic financial collapse. He quickly alerts his superiors, setting off a chain reaction of late-night meetings and tense discussions that reveal the harsh realities of corporate greed and survival.

One of the most remarkable aspects of Margin Call is its realistic depiction of the financial industry. Unlike many other films about Wall Street, it does not rely on flashy montages or exaggerated drama. Instead, it builds tension through dialogue, expressions, and the weight of difficult decisions. The script, written by Chandor himself, is sharp and intelligent, making complex financial concepts understandable for the audience. The film does not drown viewers in technical jargon but instead focuses on the ethical dilemmas faced by its characters.

What makes Margin Call so compelling is that it does not present its characters as simple villains or heroes. Instead, it portrays them as people caught in a system that rewards risk-taking and punishes hesitation. The film raises important questions about responsibility and accountability in the financial sector. Should the employees speak out and risk their careers, or should they go along with the firm's plan to dump toxic assets before the market collapses? The movie does not provide easy answers but leaves the audience pondering the moral complexities of high finance.

Overall, Margin Call is a thought-provoking and intense drama that offers a realistic look at the financial crisis. With its strong performances, sharp writing, and engaging storytelling, it remains one of the best films about Wall Street. Whether you have a background in finance or not, this movie is a must-watch for anyone interested in understanding the human side of economic disasters.

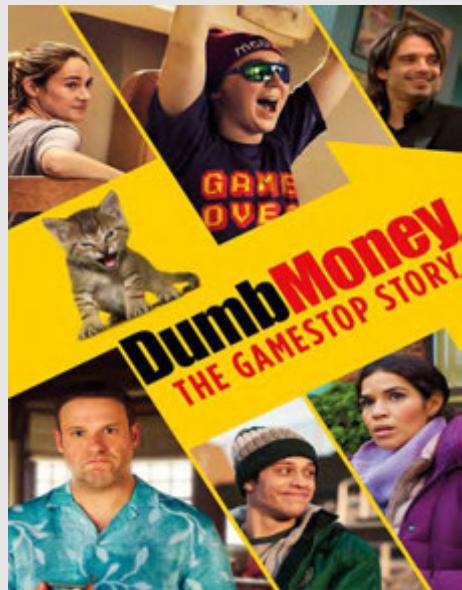


DUMB MONEY (2023)

Zaigham Abbas

2065-BS-ECON-22

Dumb Money (2023), directed by Craig Gillespie, is a biographical comedy-drama that tells the true story of the GameStop stock frenzy that took place in January 2021. The film follows the chaotic events that unfolded when a group of small-time investors on Reddit's *r/WallStreetBets* took on powerful hedge funds, causing the stock price of GameStop to skyrocket. With an ensemble cast featuring Paul Dano, Pete Davidson, Shailene Woodley, Seth Rogen, and America Ferrera, the movie blends humor, drama, and social commentary into an entertaining and insightful watch.



At the heart of the story is Keith Gill (played by Paul Dano), an ordinary guy who becomes the unlikely hero of the movement. Known online as "Roaring Kitty," he shares his belief that GameStop stock is undervalued and encourages small investors to buy in. His livestreams and posts inspire thousands of everyday people to invest, leading to an unprecedented financial battle between retail investors and Wall Street elites. As the stock price soars, hedge funds that had bet against GameStop, including one run by Gabe Plotkin (Seth Rogen), face massive losses. Meanwhile, trading apps like Robinhood, which had positioned themselves as champions of small investors, make controversial decisions that raise questions about fairness in the financial system.

The film also highlights the power of social media and the internet in shaping financial markets today. The GameStop event was not just about stocks but it was about ordinary people challenging a system that seemed rigged against them. The movie raises important questions about wealth inequality, corporate influence, and whether the financial world truly offers a level playing field.

Overall, Dumb Money is an engaging, funny, and thought-provoking film that tells the story of one of the most surprising financial events in recent history. Whether you're into finance or not, this movie is an entertaining look at how a group of small investors took on Wall Street and for a moment, won.

26TH CONSTITUTIONAL AMENDMENT: A DRIVE FROM TRICHOTOMY TO MONOTONY OF POWER

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Pakistan came into existence in 1947, and got its first constitution in 1956, which was replaced by the 1962 constitution, and then in the year 1973 first unanimous constitution of Pakistan was passed by the parliament. Till now a number of amendments have been done in the constitution of Pakistan, out of which the 18th amendment was the most famous one, as it was done after the dictatorial rule, and a number of important amendments had been done to give more financial and administrative autonomy to the people. Although the results of the 18th amendment are not as expected and a number of problems still exist, which does explain the poor implementation mechanism devised in the amendment.

The 26th constitutional amendment mainly aims to address the judicial side of the constitution. There are a total of twenty two amendments in this 26th amendment. The vital amendments have been done with reference to the appointment of judges in the supreme court of Pakistan, the appointment of the chief justice of Pakistan, the formation of constitutional bench and the jurisdiction of the high courts have also been redefined. The suo motto powers of the chief justice have also been knocked down.

On one side the role of executive has been augmented in the appointment of the senior judiciary members and on the other side the scope of judicial oversight on the constitution has also been minimized, with the help of constitutional bench whose members will be appointed by a parliamentary committee and that constitutional bench will also have the judges from all the provinces. This explains how the concept of trichotomy has been disturbed by this amendment. This is the real irony, the judicial review of the executive and legislative actions will be done by a constitutional bench, whose members are appointed by the executive itself.

The idea of constitutional bench is not wrong, but the appointment of judges in the constitutional benches is

very fishy. In the 1990s the Supreme Court of Pakistan decided in the Al Jihad trust case that appointment of the chief justices will be done on the basis of seniority. This judgment made things very smooth and people came to know at the time of the appointment who would become chief justice. Ironically now as per the 26th amendment a parliamentary committee will decide the chief justice from a panel of three senior most senior judges. Hence the role of executive has not only been increased at the approximate level but also at the selection of chief justice and also while selecting judges for the constitutional bench. The constitution defines the roles of the institutions. These predefined roles are necessary to maintain the desired checks and balances in the system.

The judicial governance mechanism of Pakistan needs to be redefined, but it is vital to understand this alteration of the judicial system must begin from the lower courts. The numbers of pending cases in the lower courts are rising with every passing day. Is there anything for those lower courts in this 26th amendment? Has the government amended the 80 to 100 years old clauses of the PPC (Pakistan Penal Code)? Is there any law approved in this amendment to counter the everlasting litigation process in the lower judiciary? The answer is no, it looks the 26th amendment has been done in a haphazard way and the basic aim is only to increase the control over the superior judiciary.

Pakistan's superior judiciary including high courts took a new turn after the last dictatorial rule in 2007. The role of lawyers' movement was vital in this regard. In the last one and half decade, the executive and judiciary came into rift with each other many times and judges did establish their writ, which created a number of issues for the executive. In these circumstances it looks like the 26th amendment has become a debatable topic. Is it done to protect the angels or its aim is to give rights to the people.

The role of institutions is vital in the prosperity of any nation. A state is a set of institutions, and every institution is bound to play its role in light of the well-defined rules, set by the constitution. Hence from executive to judiciary and to parliament, everyone must play its role wisely; any deviation from the set role will create problems in the working of the institutions. As the 26th amendment has passed now, let's see what effects it will have on the judicial governance mechanism. Is it a success like the 18th amendment, after which the financial and economic

imbalances between the provincial and federal budgets have increased.

THE AI REVOLUTION: HOW ARTIFICIAL INTELLIGENCE IS RESHAPING GLOBAL ECONOMIES

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In recent years, the reality surrounding artificial intelligence has shifted from a futuristic fantasy to a present-day reality. Across the globe, AI is not only driving innovation but also fundamentally transforming the way economies function. This transformation is not confined to one region or industry; it is a phenomenon that is touching every aspect of modern life, from the way businesses operate to how governments make policies. The current wave of AI integration has sparked debates, raised questions about job security, and even challenged traditional economic models. Yet, amid the rapid pace of change, there is a growing sense of optimism about the new opportunities emerging from this technological revolution.

Historically, every major technological advancement, from the invention of the steam engine to the rise of the internet, has led to significant shifts in economic landscapes. Today, artificial intelligence stands as the latest catalyst for change. It is transforming industries by automating routine processes, optimizing production lines, and offering innovative solutions that were once considered impossible. This revolution is powered by advanced algorithms capable of processing massive amounts of data in real time, leading to smarter decision-making and more efficient operations. The economic implications of these developments are profound, as AI promises to not only drive productivity but also to open up new markets and stimulate global growth.

One of the most remarkable aspects of the AI revolution is its potential to boost economic productivity on an unprecedented scale. Recent studies suggest that AI could contribute trillions of dollars to the global economy over the next decade. This increase in productivity is driven by the ability of AI to perform tasks that once required extensive human labor. Companies are leveraging AI to

streamline operations, reduce costs, and enhance the quality of their services and products. In manufacturing, for example, AI-powered systems are optimizing production lines and minimizing waste. In finance, algorithms are making split-second trading decisions and detecting fraudulent activities with far greater accuracy than traditional methods ever could. This surge in efficiency is creating a ripple effect throughout the economy, prompting businesses to innovate and invest in new technologies.

At the same time, the integration of AI into the workplace has ignited a vigorous debate about its impact on employment. Many fear that automation and advanced robotics will lead to widespread job displacement, especially in sectors that rely on routine, manual labor. There is concern that as machines become more capable, they might replace human workers, leading to higher unemployment rates and greater economic disparity. However, history offers a more nuanced perspective. Every technological revolution has brought about both job losses and the creation of new opportunities. While certain roles may become obsolete, new types of jobs are emerging that require creative problem-solving, complex decision-making, and human empathy. The challenge for society is to ensure that workers are equipped with the skills necessary to transition into these new roles, a task that calls for significant investments in education and training programs.

The impact of AI extends well beyond the job market; it is also redefining how businesses operate and compete in the modern economy. Traditional business models are being sidelined as companies embrace AI to gain a competitive edge. In the healthcare sector, for instance, AI is being used to diagnose diseases earlier and with greater accuracy, enabling doctors to provide personalized treatment plans for patients. In retail, AI algorithms analyze consumer behavior to predict trends and tailor shopping experiences, leading to increased customer satisfaction and loyalty. Even in the finance industry, where data-driven decision-making is paramount, AI systems are making investment decisions and managing risks more effectively than ever before. This technological infusion is not only making companies more efficient but also fostering a new era of innovation that is expected to yield significant economic benefits.

The global race for AI supremacy is another critical dimension of this transformation. Nations around the world are vying for leadership in AI technology, recognizing that dominance in this field could translate into substantial economic and geopolitical advantages. The United States and China are currently at the forefront of this competition, investing heavily in research, infrastructure, and talent development. These investments are reshaping global power dynamics, as countries that lead in AI are likely to set the standards and rules that govern the digital economy of the future. However, this race also highlights a growing divide between technologically advanced nations and those still struggling to build the necessary digital infrastructure. For developing countries, the challenge is twofold: not only must they catch up in terms of technology, but they must also devise strategies to ensure that the benefits of AI-driven growth are shared more equitably.

Economic inequality is one of the most pressing issues that arises from the rapid adoption of AI. On one hand, AI has the potential to drive massive economic growth, improve efficiency, and create new job opportunities. On the other hand, there is a real risk that these benefits will be concentrated in the hands of a few large corporations and highly skilled workers, leaving others behind. The rapid advancements in AI technology have already led to a concentration of wealth among tech giants and their shareholders, while workers in more traditional industries face uncertain futures. Bridging this gap will require concerted efforts from both policymakers and business leaders. By investing in education, retraining programs, and inclusive innovation, societies can help ensure that the rewards of the AI revolution are not enjoyed by a select few but are distributed more broadly across all segments of the population.

Small businesses and startups are also finding that AI is not solely the domain of multinational corporations. In fact, many entrepreneurs are harnessing the power of AI to level the playing field and compete with larger companies. These innovators are using AI to develop cutting-edge products and services, optimize their operations, and reach new markets. The ability to access and implement AI technologies has opened up exciting new avenues for growth and has democratized innovation in ways that were previously unimaginable. This grassroots transformation is a testament to the disruptive power of AI, showing that even modest investments in

technology can yield significant dividends in terms of efficiency and competitiveness.

The role of government in this rapidly evolving landscape cannot be overstated. As AI continues to permeate every facet of the economy, policymakers face the daunting task of balancing the need for innovation with the imperative to protect workers and maintain social stability. Governments must craft regulations that foster innovation while also addressing issues such as job displacement, data privacy, and ethical considerations. It is essential that these policies are not only forward-thinking but also flexible enough to adapt to the rapid pace of technological change. By collaborating with industry leaders, academia, and international partners, governments can help create an environment in which AI serves as a tool for inclusive growth rather than a source of division and inequality.

Looking ahead, the future of AI in the global economy holds immense promise, provided that the transition is managed with foresight and care. The potential benefits of AI are enormous, ranging from enhanced productivity and economic growth to improved healthcare and better quality of life. However, these benefits will only materialize if the challenges especially related to workforce displacement and inequality are addressed head-on. It is incumbent upon all stakeholders, including business leaders, educators, policymakers, and workers, to collaborate in preparing for an AI-driven future. Through investments in education, the development of robust social safety nets, and the promotion of ethical practices, society can harness the transformative power of AI to build a more prosperous and inclusive world.

In conclusion, the AI revolution is reshaping global economies in profound ways. It is driving efficiency and innovation while simultaneously presenting challenges that require thoughtful and inclusive solutions. The transformative impact of AI is evident across industries, from healthcare and finance to retail and manufacturing. As nations race to secure their positions in the digital economy, the need for balanced policies that foster growth and protect vulnerable populations has never been greater. While the road ahead may be fraught with uncertainties, there is also a tremendous opportunity to build a future where technological progress benefits everyone. The question that remains is not whether AI will change the world, but whether we are prepared to guide that change for the greater good. Through

collaboration, education, and a commitment to equity, we can ensure that the AI revolution becomes a catalyst for a more dynamic, resilient, and just global economy.

AGRICULTURE, FOOD SECURITY, AND ITS ECONOMIC PERSPECTIVES IN PAKISTAN

Muhammad Faizan Rasool

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Pakistan's economy is mainly based on agriculture, contributing considerably to the country's GDP and livelihoods for many. However, the sector is troubled by several challenges that impinge on agricultural productivity, food security, and the country's economy. Among the most significant hurdles to Pakistan's agricultural sector's growth is a dearth of investment in modern technology and equipment. The use of modern technology in Pakistan's agricultural sector is limited, as is reflected in low crop yield, lower productivity, and other problems, concluded by the Food and Agricultural Organization (FAO).

The scarcity of water resources is another big challenge Pakistan's agricultural sector has faced. Pakistan is a water-scarce country, and the agricultural sector is highly irrigation-intensive. However, water resources are waning, and water usage is inefficient in this sector. Agricultural productivity in Pakistan is also affected by changes in climate due to increased temperature and altering weather patterns, resulting in declining crop yields and food security. In addition, farmers in this sector are severely constrained in their access to market and credit facilities through which they can invest in their farms and improve productivity.

Pakistan is facing hunger and malnutrition, affecting millions of people, which is a primary concern for food security. The World Food Programme (WFP) said that 60 percent of Pakistan's population is insecure about food, and 40 percent of children less than five years old are stunted due to malnutrition. The high poverty rates in Pakistan are a cause of food insecurity, as many households cannot purchase food. In Pakistan, widely consumed staple foodfares like wheat, rice, and sugar have all seen higher food price inflation over recent decades.

Pakistan also has significant economic prospects in its agricultural sector. This sector is responsible for a substantial part of the country's GDP and employment for some millions of people. Nevertheless, the sector's performance has been somewhat inconsistent, and the country faces economic challenges. Pakistan has a high fiscal deficit and depends on foreign aid and loans for development works. Another primary concern in Pakistan is inflation with essential commodities like food, housing, healthcare, etc.; their prices have significantly increased.

To overcome the problems of Pakistan's agriculture sector and ensure food security and economic stability, investment in modern technology and machinery, improvement in water management practices, and adoption of climate-resilient agricultural practices are imperative. Furthermore, they improve productivity and decrease poverty by bringing farmers access to markets and credit facilities. Most importantly, meaningful awareness of the need for sustainable agricultural practices and the advancing fact of climate change is needed.

Additionally, the community needs to be engaged in resolving these challenges. This involves working with farmers, agricultural experts, and other stakeholders to come up with solutions and implement them effectively. If the efforts in these areas are given priority, Pakistan will be able to achieve better agricultural productivity, reduce poverty, and ensure food security for its increasingly populated country. The following challenges to Pakistan's agricultural sector need to be addressed through a concerted effort if Pakistan is to become a major player in the global agricultural market.

Pakistan's government has implemented several initiatives to support the agricultural sector and food security. The Prime Minister's Agricultural Emergency Program distributes some of these to increase agricultural productivity and reduce poverty. Moreover, the government has created a Kisan Card Scheme that allows farmers to access loans and other benefits. Nevertheless, Pakistan's agricultural sector continues to face significant hurdles.

To effectively address these challenges, it is crucial to tackle the root causes of the problems. This involves not only solving water scarcity issues and improving access to markets and credit facilities, but also embracing modern technologies and equipment. Equally important is the

dissemination of knowledge about sustainable agriculture and climate change practices. Focusing on these areas will help Pakistan ensure food security, boost economic growth, and reduce poverty.

GOLD, GRIT, AND JEANS: THE BIRTH OF LEVIS

Zaigham Abbas

2065-BS-ECON-22

In the mid-19th century, Sutter Mill discovered Gold in the vast land of California. This incident set off a mass migration of American Dream chasers from all over the World to lands of California. While many ventured to chase the American dream, an untraditional entrepreneur saw a different kind of opportunity. The one that was going to forever change the way people dressed, but also the economic landscape of the American West

The Temptation of Gold and the Economic Boom

When news of gold in California broke, the promise of wealth drove a huge influx of people, known as "forty-niners," to the state. The population of California, which had been a collection of small towns, grew dramatically. In just a few short years, the number of people in the region skyrocketed, and this became the very reason of Economic Boom.

This sudden increase in population had a dual effect. On the one hand, it brought about rapid economic expansion: small communities turned into bustling towns, and demand for goods and services expanded. On the other hand, it laid the foundation for long-term economic growth in California. Entrepreneurs, merchants, and service providers began to emerge. They started capitalizing on the needs of a rapidly growing and cash-rich customer base. Infrastructure projects such as roads, bridges, and even the first hints of a transcontinental railroad were set into motion which was a stepping stone to help knit California into the broader U.S. economy.

As gold was panned from streams and rivers, the immediate wealth did not distribute evenly among the miners. In fact, while a few bagged riches, most gold seekers ended up earning only modest returns or even losing money after taking travel, equipment, and living

expenses in account. In contrast, those who sold goods and services to the miners found a golden opportunity. Merchants quickly realized that the new economy was not just about mining; it was about supplying an entire region.

Levi Strauss: A Different Kind of Gold Seeker

In the Midst of California Gold Rush, a German-Jewish immigrant from Bavaria, landed in San Francisco in 1853. The name of this man was Levi Strauss. Unlike many of his companions, Strauss was not lured by the dream of finding gold. Instead, he recognized that the miners needed more than just shovels and pans. His family was already engaged in the dry goods business in New York City, he saw an opening to supply quality merchandise to the fast growing mining communities.

Strauss began by setting up a wholesale dry goods business in San Francisco. His family's business experience and his own sixth sense for spotting market trends soon made him a key supplier for the small general stores that heavily relied on miners as their regular customers. In a time when reliable and durable products were hard to come by in the remote mining camps, Strauss's enterprise filled a critical gap.

The economic success of his dry goods venture was not solely due to its timing. It was also based on the quality and durability of the products he provided. The miners worked in extremely harsh conditions due to which their ordinary clothing and supplies wear out very quickly. This demand for long-lasting products was a powerful driver of economic opportunity for merchants in the area.

Necessity is the Mother of Innovation: The Birth of Blue Jeans

The true turning point in Strauss's career was with an ingenious idea from one of his customers. In 1872, Jacob Davis, a tailor from Nevada who regularly purchased fabric from Strauss, approached him with a problem that miners' work pants were falling apart at the seams, especially at points of heavy stress like the pocket. Davis had come up with a clever solution. He reinforced the vulnerable areas of the pants with a small copper cylindrical shaft which is known as rivets. This simple solution dramatically increased the durability of the trousers.

When Davis realized the potential of the idea, he proposed Strauss to join forces to patent the design. At the time, the cost of filing for a patent was out of reach for Davis alone, but with Strauss's financing, they secured U.S. Patent No. 139,121 on May 20, 1873. Thus, the first pair of blue jeans was born. This was a garment specifically engineered to meet the rough demands of mining work.

Originally made from a heavy canvas fabric, the production soon shifted to denim which was a stronger and more comfortable cotton fabric. The denim was dyed with indigo, not only to give the jeans their iconic blue color but also because the dye helped to conceal stains which was a practical feature for miners working long, brutal hours.

What began as a practical solution for miners' needs would eventually evolve into one of the world's most enduring fashion trends. The blue jeans were an instant hit among those who needed reliable workwear. Over time, however, they transcended their utility roots and became a symbol of American culture.

Economic Implications of a Simple Innovation

The story of Levi Strauss and the creation of blue jeans is a classic example of how economic opportunities can arise from the simplest observations. Here, the Gold Rush was not just about mining gold, it was also about a larger transformation in economic behavior. The miners' inability to find consistent wealth from panning gold, combined with the need for durable workwear, created an ideal market for a product that would last.

Strauss's innovation demonstrates several key economic principles:

- Supply and Demand:** The high demand for long-lasting clothing in a rapidly growing mining community provided the perfect market for a product that could withstand extreme conditions. By meeting this demand, Strauss's company quickly became a profitable venture.
- Market Gaps:** While many seekers focused on gold, Strauss recognized that the indirect opportunities of selling goods to support the mining lifestyle could be just as profitable. This insight is a powerful lesson in entrepreneurship: sometimes the most promising

opportunities are not in the primary industry but in the supporting services around it.

- Economies of Scale and Specialization:** As the Gold Rush created new and growing markets in California; the region's economy began to shift from small, individual operations to more organized and specialized businesses. Strauss's business benefited from the growing urban centers like San Francisco, which evolved into major economic hubs due to the continuous influx of gold-seekers and the subsequent demand for services and infrastructure.
- Innovation under Constraints:** Jacob Davis's idea of using rivets was born out of the practical constraints faced by miners. This form of necessity-driven innovation often leads to breakthrough products that change industries. Today, the humble blue jean is not only a piece of workwear but also a global fashion icon.

From Workwear to Worldwide Fashion

While the blue jeans initially served as rugged workwear for miners, their appeal gradually expanded beyond the limits of the goldfields. By the mid-20th century, jeans had transformed their utility to become a staple of global fashion. This evolution illustrates how a product designed to meet an immediate economic need can later take on broader cultural significance.

As the decades passed, blue jeans became associated with various cultural movements. It evolves from the rebellious youth of the 1950s and 1960s to the casual, everyday style of modern consumers. Despite these shifts in fashion, the underlying economic lesson remains the same, which is that innovation driven by a clear understanding of consumer needs can yield products that can become timeless.

Moreover, the economic impact of blue jeans extends well beyond their initial market. Levi Strauss & Co. grew from a small dry goods business into a multinational corporation with a global presence. The company not only revolutionized the apparel industry but also became a model for sustainable business practices and corporate responsibility. Its continued success is a direct outcome of the strategic insights that emerged during one of America's most dynamic economic periods.

Conclusion

The California Gold Rush is often remembered as a period of wild dreams and high fortunes. Yet, its true legacy lies in the broader economic transformations that it sparked. Through the lens of entrepreneurship, the Gold Rush reveals how a simple idea of reinforcing work pants with metal rivets could evolve into an innovation that redefined an industry and contributed significantly to economic growth.

Levi Strauss's journey from a dry goods merchant to the creator of blue jeans is a powerful reminder that economic success is not solely about chasing immediate riches. Instead, it is about identifying and meeting a persistent need in a changing market. In an era defined by rapid migration and technological advancements, Strauss's innovation provided a steady foundation for growth. His blue jeans, born from necessity for gold miners of California, have become a timeless symbol of the American dream and a lasting testament to the power of entrepreneurship.

ECONOMIC CROSSROADS: NAVIGATING TUNISIA'S HYBRID TRANSITION

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Tunisia's political landscape exhibits characteristics of a hybrid regime by blending democratic and authoritarian elements. This hybridity is quite evident in various aspects of the political system, including political institutions, media, and civil society.

Voltmer, Selvik, and Høigilt (2021) argued that Tunisia's political system is a hybrid regime wherever the democratic reforms coexist with authoritarian practices; this is particularly evident in the country's political institutions, where democratic reforms have been implemented, but authoritarian legacies within the security sector, continue to shape governance. And the media landscape, while more open than before the revolution, also still faces significant constraints, including political interference and self-censorship (Høigilt & Selvik, 2020).

Keskes and Martin (2018) elaborated on Tunisia's hybrid regime, elucidating the tug between democratic aspirations and authoritarian continuities, arguing that the country's democratization process is a dialectic of continuity and change, where democratic reforms coexist with ever-persisting authoritarian structures. This hybridity questions simplistic narratives of Tunisia's transition as a success story, considering the preservering struggle for full democratization.

The Limits of Democratic Diffusion: Tunisia's Unique Trajectory

The theory of democratic diffusion suggests that democratic norms and practices can spread across countries through processes of external pressure; Goldring and Greitens (2020) argue that democratic diffusion is not a straightforward process, especially in Tunisia, where the local context and regime type significantly influence the potential for democratic change. Tunisia's transition has been influenced by a combination of external pressures from international organizations and foreign governments, as well as internal factors such as the rigor of civil society and the willingness of elites to compromise and concede. However, the country's persisting challenges like political polarization, economic instability, and the ongoing presence of authoritarian structures, brought forth the limits of democratic diffusion. This persistence has irrevocably complicated the idealized narrative of democratic diffusion, demonstrating the meticulous weave of domestic and external factors in shaping the process of democratization.

Study of the Case: Tunisia's Political Transition

Revolution and the Fall of Ben Ali: The Initial Promise of Change

The 2011 revolution in Tunisia, was sparked by the self-immolation of Mohamed Bouazizi, and was a direct response to widespread discontent with the regime of President Zine El Abidine Ben Ali. Ben Ali, had ruled Tunisia for over two decades, and was ousted in lieu of mass protests that mobilized citizens across the country. The revolution was initially seen as a victory of popular mobilization. This signalled the potential for democratic transformation in Tunisia. But unlike in other Arab Spring countries, where authoritarian rulers clung to power through violent repression or international intervention, Ben Ali's regime quickly collapsed, which provided a rare

moment of liberation and hope for democracy in the region.

In the immediate aftermath of the revolution, Tunisia experienced a period of political vacuum and uncertainty; the removal of Ben Ali's regime left a power vacuum that was rapidly filled by political elites and civil society actors. This rapid collapse of authoritarian structures also produced the question of whether Tunisia could build a political system that had the capacity and intent to meet the aspirations of its citizens while avoiding the pitfalls of authoritarian rule.

The Role of Civil Society: Navigating the Transition

One of the star features of Tunisia's transition has been the significant role played by civil society, namely the Tunisian General Labour Union (UGTT), the Tunisian Human Rights League (LTDH), and other grassroots organizations. These groups worked to mediate between competing political entities, while also ensuring that the transition process remained inclusive and non-violent. Civil society organizations were essential in the negotiations that led to the creation of the 2014 Constitution, which solidified democratic principles such as political pluralism, human rights, and gender equality.

This role has been largely praised by academics and international observers. The vitality of Tunisia's civil society organizations has been imperative in fostering dialogue and reducing the potential for violent conflict during the transition process (Hudáková, 2019). Others, however, do caution that the influence of civil society has been calamitously limited by the political and economic realities of the post-revolutionary period. The UGTT for example, played a pivotal role in brokering political agreements, but its political influence also increased harrowing concerns about the growing entanglement of labor unions in political processes, potentially limiting the scope of non-compromisable economic reforms for the country's long-term stability.

Political Elite Dynamics and the Persistence of Authoritarianism

Despite the overthrow of Ben Ali's regime, Tunisia's political transition has been obstructed by continued influence of political elites who were either directly connected to the former regime or were tied to the deep-rooted authoritarian system. The unwavering presence of

these elites has been a crucial challenge to Tunisia's democratization process. While the new democratic framework allowed for free elections in 2011 and 2014, many of the key political figures were former members of the ruling party. And these same elites maintained and cultivated more influence within political institutions, the economy, and the security apparatus.

This continuity of elite power has led to Tunisia's struggle with authoritarian resilience. While the political landscape shifted toward multi-party democracy, actors within the state apparatus including the military and security forces, retained their positions, influence, and social capital. By way of this, security forces, despite their role in suppressing the revolution, continued to wield substantial power in shaping political outcomes. Brooks and White (2022) argue that the persistence of authoritarian institutions—specifically in the security sector—has hindered the full consolidation of democratic government in Tunisia.

In this bargain, the political parties that emerged after the revolution, like Ennahda, have had to balance their ideological positions with the harsh realities of coalition-building in a fragile political system. Ennahda, an Islamist party, found itself in an entangled relationship with secular parties, trying to navigate between its ideological commitment to political Islam and the need to cooperate with the secular factions of the country to maintain political stability. This coalition politics allowed for democratic processes to unfold, but contributed to Tunisia's hybrid regime leaning, where democratic reforms survive within authoritarian legacies.

Economic Challenges and Social Unrest

Even though Tunisia has made impressive strides in terms of political reform, the country's economic challenges have remained a worrying element in its post-revolutionary period. Unemployment, regional disparities, and the lack of economic opportunities for young people are the primal sources of discontent. And these economic grievances frequently coalesce into social unrest, like the protests in 2017 over austerity measures and the high cost of living. Therefore, political elites and civil society have struggled to address these economic challenges in a way that gratifies the population.

The economic difficulties of Tunisia are quite often linked to the lack of nuanced structural reforms, which is in part

a result of the continued ascendancy of former elites in the political and economic sphere. These elites have been able to maintain their economic power despite the democratic reforms, contributing to the country's ongoing social and economic upheaval. The role of the international community, like the European Union and the International Monetary Fund, has been contentious. While these entities do provide significant financial aid and technical assistance, their influence over Tunisia's economic policies has been criticized for exacerbating and exploiting the country's economic problems and limiting the policy space for the Tunisian government (Boubaker & Hassen, 2020).

Analysis of Theory and Case Study

The transition of Tunisia post-Arab Spring offers an important case to test various theories of authoritarian resilience, democratization, and political change. By integrating the theoretical frameworks discussed earlier with the specifics of Tunisia's transition, it becomes possible to assess the validity and limitations of these frameworks and also the overall resilience of the political system.

One of the forefront theoretical debates is the role of political elites in the persistence or downfall of authoritarian regimes. Tunisia's case exemplifies the centrality of elites in shaping the post-revolutionary political landscape. Although the Ben Ali regime was overthrown, many of the political elites that had been complicit in the authoritarian system remained rooted in those political institutions and proceeded to benefit from them even after the revolution. As observed by Hecan and Farhaoui (2021), these elites possess significant influence over economic and political outcomes, even in the establishment of democratization.

Tunisia's elites faced the challenge of managing the transition from an authoritarian system to a democratic one, wherefore the formal structures of authoritarian rule were dismantled, the informal power of elites remained mostly intact and in place. The perseverance of these elites within the military, security forces, and business sectors, contributed to a form of hybrid governance, where democratic institutions coexisted with authoritarian elements. This perfectly captures the theory of authoritarian resilience, which argues that the persistence of authoritarian structures, even after regime change, significantly impacts the prospects for democratization

(Goldring & Greitens, 2020). In Tunisia, despite the revolution and the fall of Ben Ali, the continuation of elite influence restricted the depth of democratic change, compromising the ideal of full democratization.

Essentially, the continuity of certain authoritarian structures, particularly within the security apparatus, hindered Tunisia's transition. The security forces maintained their power and ability to shape political outcomes, despite their initial role in strangling the revolution. This aligns with the concept of authoritarian resilience, where the military and security sectors often act as stabilizers in post-revolutionary contexts, resisting deeper, more authentic changes that might challenge their privileged position (Brooks & White, 2022).

TRANSFORMING PAKISTAN'S TAX SYSTEM: REFORMS, CHALLENGES, AND THE ROAD AHEAD

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Pakistan's tax system has undergone significant changes over the last four years, starting in 2020 and continuing today. These changes were initiated to raise more revenue, boost economic growth, and maintain a strong budget. In addition to these goals, the government aimed to modernize the tax framework to better align with global standards and economic conditions. The reforms included new laws and government actions designed to address economic problems and inefficiencies within the existing tax system. For instance, measures were taken to broaden the tax base and reduce dependency on unpredictable revenue sources, ensuring a more stable fiscal environment. One of the primary objectives of recent tax reforms has been to increase compliance and ensure proper tax payment. The government recognized the inefficiency of relying on a small, spontaneous revenue base and initiated efforts to encourage more individuals and businesses to pay taxes. To achieve this, advanced technology has been employed to improve tax collection processes. This includes integration of databases and the implementation of biometric verification for taxpayers, aimed at reducing tax evasion. Additionally, these technological advancements have enabled better data analysis, allowing tax authorities to identify non-compliant entities more effectively.

Over the last few years, significant efforts have been made to simplify tax procedures and support businesses. This simplification involved eliminating unnecessary regulations and improving the efficiency of taxpayer services. The introduction of online tax websites and automated tax processing systems has facilitated easier interaction with tax authorities, reducing the bureaucratic burden on taxpayers. These digital platforms have also increased transparency and accessibility, fostering greater public trust in the tax system. Furthermore, the streamlining of processes has led to faster resolution of tax-related issues, benefiting both the taxpayers and the tax administration.

The rates and composition of taxes have evolved in response to changing economic conditions and government objectives. Adjustments to personal income taxes, business profit taxes, and excise taxes have been implemented to maintain competitiveness and stimulate investment. For example, tax incentives and exemptions have been introduced in critical sectors such as agriculture, construction, and technology to attract investments and support economic growth. These targeted measures aim to create a favorable business environment, driving development and innovation in key industries. Moreover, by aligning tax policies with economic priorities, the government seeks to achieve sustainable growth and development. Despite the reforms, Pakistan continues to face significant challenges in tax collection. While efforts have been made to broaden the tax base, a substantial portion of the economy remains informal, complicating revenue generation. Many businesses operate outside the legal framework, contributing to tax evasion and undermining the fairness of the tax system. To address these issues, the government must enhance its enforcement mechanisms and improve data collection methods. Public awareness campaigns are also essential to encourage compliance and foster a culture of tax responsibility.

Pakistan's tax regulations and practices are influenced by various external factors and global events. International tax laws, such as the Base Erosion and Profit Shifting (BEPS) initiatives, require countries to adopt uniform tax rules to prevent large corporations from avoiding taxes. In response, Pakistan has been reforming its rules governing cross-border transactions, tax treaties, and anti-avoidance measures. Aligning with these global standards not only helps prevent tax base erosion but also enhances

Pakistan's credibility in the international arena. Such reforms are crucial for attracting foreign investments and ensuring fair competition in the global market.

Looking ahead, Pakistan's tax system will be shaped by domestic demands, economic needs, and international expectations. The primary goals will include generating sustainable revenue, ensuring equitable tax rates, and creating a conducive environment for business growth. The government must strike a balance between maximizing tax revenue and fostering economic development. Continuous reforms and innovations in tax policy and administration will be necessary to address emerging challenges and opportunities. By building a robust tax infrastructure, Pakistan can achieve its long-term development goals and ensure fiscal stability for future generations.

GENDER INEQUALITY IN PAKISTAN: A PERSISTENT CHALLENGE

Moazma Munir Gondal

2060-BS-ECON-22

Pakistan is a country with rich cultural heritage and a population of over 220 million people. Gender inequality is a persistent challenge in Pakistan; due to which women encounter substantial obstacles in their everyday lives, impeding their capacity to engage fully in society. Despite advancements in numerous fields, women still face disparities in many areas such as education, employment, healthcare, and political participation. One of the most crucial challenges faced by women in Pakistan is their access to education despite it being a crucial factor in bridging the gender gap. According to UNESCO, in 2020, the literacy rate for women was 47%, compared to 71% for men. This disparity is even more in rural areas, where the need for education for women is neglected. This gap further widens at secondary level and higher education level, as according to Atlas, only 30% of girls complete secondary while 10% complete higher education.

Women in Pakistan also encounter substantial obstacles to employment. Economic empowerment is limited as according to The World Bank, only a quarter of the workforce comprises women who are confined to low earning jobs. Moreover, women also suffer from workplace discrimination and harassment, experiencing

unequal pay and limited opportunities for promotion. Furthermore, factors such as cultural norms and lack of access to education give a boost to gender inequality in the labor market. In addition to these hurdles, women in Pakistan have disparities in health and sanitation. According to the data of World Health Organization, Pakistan has one of the highest maternal mortality rates in the world, with 140 deaths per 100,000 lives. On top of this, women face barriers in gaining access to reproductive health and family planning services. Moreover, women in Pakistan are vulnerable to harmful traditional practices, notably female genital mutilation which poses several health risks. These practices persist due to societal pressures and lack of awareness.

Political representation stands as another realm where women confront substantial representation crises. According to the National Assembly of Pakistan, women occupy merely 20% of seats in the national parliament, reflecting discrimination in their political mandate. Women also lack participation in decision-making roles within government and politics. The lack of women in politics not only promotes the idea of gender inequality but also means we're missing out on different viewpoints, which are important for making good decisions in government. To tackle the issue of gender inequality, the government of Pakistan has introduced several initiatives towards fostering women empowerment. These include the National Gender Policy 2012, designed for the education, employment, and political representation of women. Moreover, the Women's Protection Bill 2017 stands out, it offers legal action against domestic violence and harassment, enhancing women's safety and rights within the country. In addition to this, the Women's Entrepreneurship Program has been launched by the government to support small scale businesses run by women by providing them education and training.

Despite all the efforts the government is putting in, the issue of gender discrimination persists. This issue can be dealt with by focusing on the root cause of it. To effectively tackle this challenge, it is important to confront the causes of gender inequality, including the social and cultural issues that promote this discrimination.

There are several crucial areas that need attention. To begin with, access to quality of education for women needs severe attention to cater to this issue. This can be done by prioritizing efforts to ensure that girls and women

have equitable access to education, from primary to higher levels. Secondly, focusing on the provision of employment opportunities also plays an important role in the culmination of this discrimination. It is crucial to create a workplace environment where women feel safe and have the same job opportunities and career advancement as men. In addition to this, ensuring adequate healthcare is another field that needs attention. This can be achieved through ensuring this access to healthcare services and addressing the factors that are causing high rates of maternal mortality. Gender inequality cannot be eradicated without ensuring the participation of women in political decision making. This can be accomplished by supporting women's leadership and creating space for women in politics. Moreover, it is necessary to highlight the significance of addressing and putting an end to societal and cultural disparities. This involves engaging the community by reflecting upon the importance of gender equality through education and spreading awareness among people through social media.

The issue of gender inequality persists in Pakistan, but it can be ended by prioritizing efforts in these important areas. Pakistan has the potential to make significant progress through the realization of gender equality. Through the targeted initiatives in education, employment, healthcare, political representation, and addressing societal and cultural disparities, Pakistan can pave the way for a more inclusive and equitable society where all individuals, regardless of gender, have equal opportunities to thrive.

UNIVERSAL BASIC INCOME (UBI): SOLUTION TO POVERTY OR A RISKY GAMBLE?

Ajmaeen Shabbir

2017-BS-ECON-22

The modern global economy is undergoing a significant transformation, driven by technological breakthroughs, automation and changing labor dynamics. As traditional job markets contract and income equality rises, governments and the policymakers are working on the solutions to ensure financial stability for all. Universal Basic Income (UBI) has been thought of as a likely solution to the challenges facing the economy. The concept can be traced back to the early 16th century as in

the thoughts of philosopher Thomas More and later economists such as Milton Friedman, who proposed a negative income tax. As a proposed socio-economic policy providing all citizens with a fixed, unconditional income, regardless of employment status, Universal Basic Income is designed to provide a minimum standard of living, reduce poverty and ensure financial security in this period of speedy technological advancements.

For those who consider it as an impactful solution, UBI ensures a basic income floor that causes a decline in poverty and provides a safety net for the ones undergoing financial struggles. In low-income communities, direct cash transfers have been linked to improved nutrition, healthcare access, and overall quality of life. By supplying money to the economy, UBI can increase consumer spending, developing demand and job opportunities in several sectors. UBI also allows individuals to transition to new career opportunities in automation and continue with creative or volunteer roles that are underappreciated in the traditional labor market. Furthermore, by doing away with the bureaucratic inefficiencies that come with traditional welfare programs, a universal approach to financial support lowers administrative expenses and the possibility of users being stigmatized.

According to the World Economic Forum, automation could relocate up to 85 million jobs globally by 2025, making financial security a serious challenge. To examine the extent of positive influences of Universal Basic Income, different UBI pilot programs have been tested across different regions. In Finland, a two-year experiment (2017-18) provided 2000 unemployed citizens with a monthly stipend. The findings showed less stress and better well-being, but they did not substantially increase employment. A report by the United Nations in 2019 suggested that direct cash transfers, including UBI, are related to improved health outcomes and increased labor participation in developing nations. Furthermore, In 2020, a study conducted by the Roosevelt Institute concluded that a nationwide UBI of \$1000 per month in the U.S. could raise the GDP by 12.56% over eight years. Various localized programs in the U.S., such as the Stockton Economic Empowerment Demonstration (SEED), have exhibited encouraging results in terms of financial stability and psychological health. In another recent experiment in Kenya, the non-profit organization

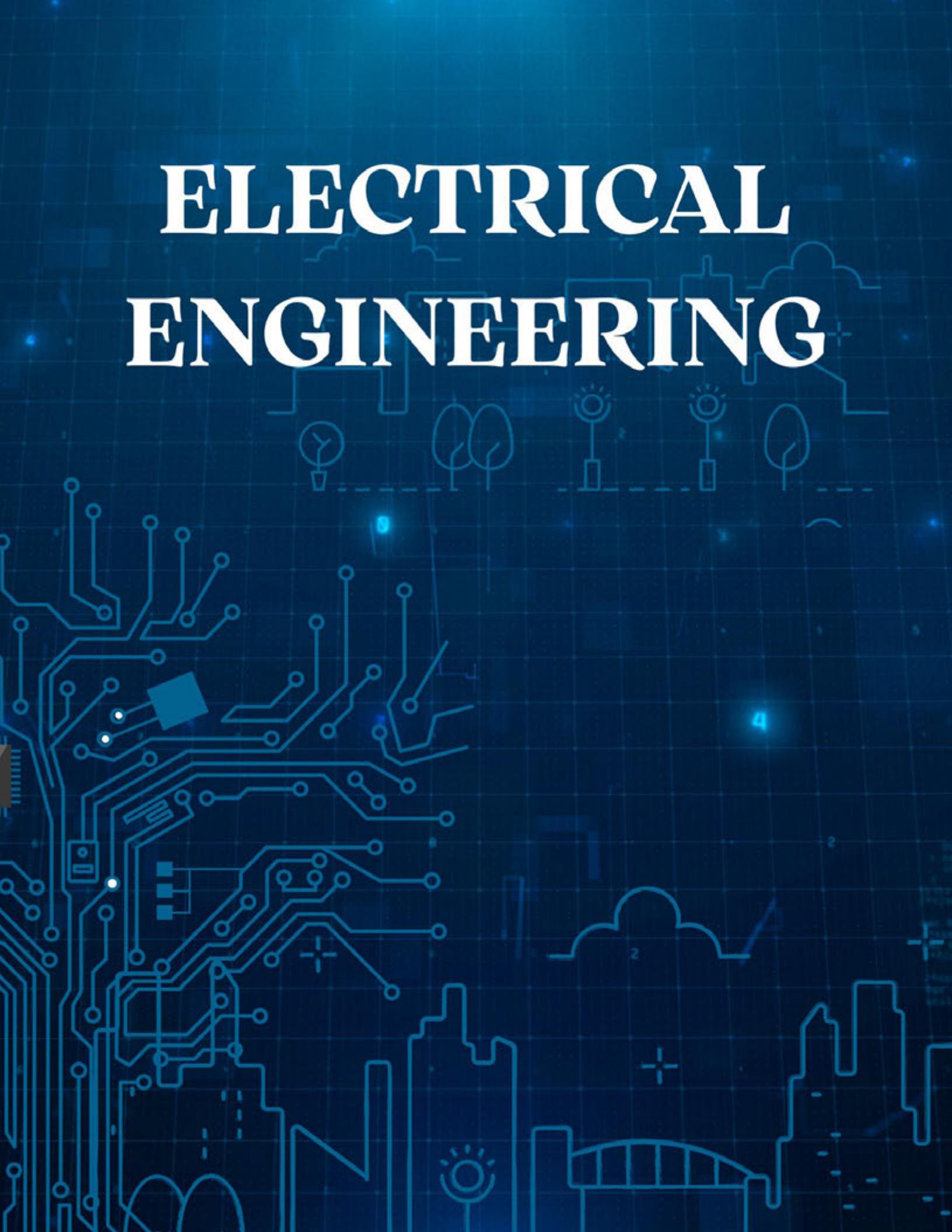
GiveDirectly has given UBI payments to thousands of Kenyan villagers, causing improvement in local economies and an increment in entrepreneurship. These numbers demonstrate how urgent it is to address economic instability and how positively UBI can impact the individuals and national economy as a whole.

However, there are several areas of concern regarding the implementation of Universal Basic Income (UBI) globally. One important challenge is that executing UBI on a large-scale demands large government funding, leading to higher taxation on businesses and the rich and therefore, discouraging economic growth and investment. Critics also fear that guaranteed income might decrease incentive to work, thus reducing labor participation rate and economic output. It is argued that implementing UBI would lead to an increase in disposable income that will cause demand for goods and services to rise, resulting in high inflation. In order to avoid these circumstances, policymakers must carefully design UBI to avoid unintended economic distortions.

Universal Basic Income (UBI) remains one of the most controversial economic policies of the modern world. Despite its outstanding capacity to reduce poverty, stabilize economies and handle technological distortions, issues such as financing, inflation and long-term sustainability need to be resolved. What remains clear is that the future of work is rapidly changing, and traditional welfare systems may be insufficient in resolving the economic insecurities of the 21st century. UBI offers a bold vision for a world where financial security is a right rather than a privilege. However, for it to be implemented successfully, carefully constructed policies, thorough testing and a flexible strategy is needed that takes into account particular economic circumstances of each country.

The debate over universal basic income (UBI) has to shift from ideological arguments to workable solutions as international experiments continue to yield fresh insights. Will universal basic income (UBI) be the economic revolution that changes societies, or will it continue to be a lofty but unfulfilled ideal? How we handle the upcoming economic difficulties will determine the solution.

ELECTRICAL ENGINEERING



2024: YEAR IN REVIEW

Jan

- **Solid-state Battery Technology Advancements:** Researchers have developed solid-state batteries with higher energy density and enhanced safety features, promising longer lifespans and improved performance for electric vehicles.

Feb

- **Ai-driven Smart Grid Optimization:** Artificial intelligence is being integrated into smart grids to facilitate real-time monitoring and management of energy flows, enhancing grid stability and reducing energy losses.

March

- **Wireless Charging Technologies for Electric Vehicles:** Advancements in wireless charging systems are making it more convenient and efficient to charge electric vehicles, supporting the transition to sustainable transportation.

April

- **Ai-powered Smart Home Devices:** The integration of AI into smart home devices enables optimization of energy consumption by learning user behavior and adjusting settings accordingly.

May

- **IoT-enabled Energy Management in Smart Buildings:** The adoption of IoT technologies in buildings allows for real-time monitoring and optimization of energy usage, contributing to increased energy efficiency.

June

- **Quantum Computing in Electrical Simulations:** Quantum computing is being explored to enhance the accuracy and efficiency of electrical system simulations, offering new tools for grid planning and optimization.

July

- **Advancements in Lithium-Sulfur Batteries:** Lithium-sulfur batteries have reached new heights, offering potential benefits such as reduced production costs and avoidance of ethical concerns associated with cobalt mining.

Aug

- **5G Technology's Impact on Smart Grids:** The deployment of 5G networks enhances the capabilities of smart grids, enabling faster, real-time communication for IoT devices and improving grid management.

Sep

- **Energy Harvesting Technologies:** Advancements in energy harvesting, such as piezoelectric and thermoelectric systems, are enabling self-powered devices, reducing the need for battery replacements and promoting sustainability.

Oct

- **Power Electronics Improvements for EVs and Renewable Integration:** Enhancements in power electronics are facilitating more efficient integration of electric vehicles with renewable energy sources, supporting the transition to clean energy.

Nov

- **AI-driven Grid Planning:** AI solutions are being employed to optimize grid planning by analyzing data from various sources, predicting energy demand, and preventing grid overloads.

Dec

- **Cybersecurity Advancements for Smart-grids:** Ongoing efforts are being made to enhance cybersecurity measures for smart grids, protecting critical infrastructure from potential cyber threats.

ELECTRICAL ENGINEERING CAREER DEVELOPMENT

Farooq Ahmad Khan

0009-BSC.ENGG-22

Introduction

Electrical engineering is the branch of engineering that deals with the study and different applications of electricity such as electronics, control system, power system and telecommunication. It is the most evolving field that is playing crucial role in shaping of the modern world. The field of electrical engineering is devoted to the design and analysis of electrical circuits to meet a wide range of uses. Electrical engineers can advance their careers by staying up to date with latest, advance and new industrial skills, trends and specialization.

Emerging Trends in Electrical Engineering:

The field of electrical engineering is becoming more advanced day by day. In this advancement technology has played a vital role. There are new methods being generated for production of electricity. Some trends and technologies that are emerging in field of electrical engineering are such as grids and energy storage, renewable energy sources, electric vehicle, artificial intelligence and machine learning.

Artificial Intelligence and Machine Learning:
Artificial intelligence and machine learning has played an important role in the advancement of this world. In electrical engineering, artificial intelligence is used to perform tasks such as fault detection, maintenance, predicting of instrumental failure, optimization of power system and control system.

Electric Vehicle: Electric vehicle have also played a crucial role in the advancement of field of electrical engineering. Today world is moving towards to field of electric such as bikes and cars running on fossil fuels to the electric bikes and electric cars. Most of the countries are developing their rides to electric which are also environment friendly.

Renewable Energy Sources: Energy sources have played a crucial role in production of electricity. With the passage of time a lot of concerns are arising on these energy sources. Now life has become advanced because

most of the countries has started to take the advantage of sunlight as by production of electricity from solar system. Due to these concerns electrical engineers have started to develop the innovative solutions for the generation of electrical power by using solar, hydro and wind sources.

Career Development Opportunities

Electrical engineers have a wide range of career options from traditional role in power systems to the electronics. Some of these exciting development opportunities in electrical engineering are power system engineer, electronics engineer, renewable energy engineer, research and development engineer.

Power Systems Engineer: In power system engineering, electrical engineers needs to create and improve systems that generate, transmit, and distribute electricity to the consumers.

Electronics Engineer: Electronics is the main part of engineering in which engineer have to design, test, and develop electronic devices, circuits, to the systems. This is difficult because failure of devices or circuit can cause serious problems.

Renewable Energy Engineer: These types of engineers have to develop sustainable energy solutions using solar, wind, and hydro power.

Research and Development Engineer: These types of engineers have to explore new technologies and innovations in electrical engineering, shaping the future of the field according to the modern world.

Specialized Certifications and Training

Electrical engineers can enhance their careers by obtaining specialized certifications and training. These credentials demonstrate expertise and commitment to the field, making engineers more attractive to employers and clients.

Professional Engineer (PE) License: The PE license is a highly regarded qualification that indicates an engineer's expertise and qualifications. To obtain a PE license, engineers must meet educational and experiential requirement and to pass the Fundamentals of Engineering (FE) exam, and complete a principles and practice exam.

Certifications in Emerging Technologies: Certifications in emerging technologies, such as renewable energy and energy storage, demonstrate an engineer's expertise in cutting-edge fields.

Continuing Educational Courses and Workshops: Continuing education courses and workshops help engineers stay up-to-date with industry developments and advancements. These programs can be offered by universities, professional organizations, or private companies.

Soft Skills for Electrical Engineers

Soft-skills in electrical engineering play major roles for the success of electrical engineers in their careers. These soft skills include communication and team work, problem solving and analytical skills, time management, leadership and project management.

Communication and Teamwork: Effective communication and teamwork are crucial for electrical engineers, who often work on complex projects with multidisciplinary teams. Engineers must be able to convey technical information clearly and collaborate with colleagues to achieve project goals.

Problem-Solving and Analytical Skills: Electrical engineers must be able to analyze complex problems, identify solutions, and implement them effectively. Strong problem-solving and analytical skills are essential for designing, developing, and testing electrical systems.

Leadership and Project Management: As electrical engineers progress in their careers, they may take on leadership roles or manage projects. Strong leadership and project management skills are essential for guiding teams, allocating resources, and ensuring project success.

Conclusion

In short, Electrical engineers can advance their careers by staying updated with industry trends, obtaining specialized certifications, and developing essential soft skills, ultimately making a meaningful impact and contributing to the growth of the field.

THE TRANSFORMATIVE IMPACT OF ELECTRICAL ENGINEERING ON MODERN INDUSTRIES

Syed Jalal Haider

0049-BSC.ENGG-22

Electrical engineering stands as one of the most crucial fields contributing to modern technological developments. Its influence is felt across various industries, including healthcare, manufacturing, telecommunications, and energy. With constant technological growth, electrical engineers lead the way in implementing solutions that improve operational efficiency, sustainability, and automation. This article delves into the transformative impact of electrical engineering on different sectors and examines the challenges that professionals in this field must address.

Revolutionizing the Energy Sector

Electrical engineers have been instrumental in reshaping the energy sector, particularly through the transition to renewable sources like solar, wind, and hydroelectric power. Their innovations in energy generation, distribution, and management are reshaping the way power is produced and consumed. The development of smart grids, cutting-edge energy storage solutions, and AI-powered power management systems has significantly increased energy efficiency. These advances allow for a more sustainable and reliable power supply for both homes and industries. Furthermore, the expansion of electric vehicle (EV) infrastructure has prompted engineers to improve battery storage technologies and design more effective charging systems, contributing to a greener energy future.

Electrical Engineering in Healthcare Advancements

In the realm of healthcare, electrical engineering has enabled tremendous advancements in medical technology. Engineers are behind the design of complex diagnostic equipment, such as MRI machines, CT scanners, and life-saving devices like pacemakers and defibrillators. These technologies have played an essential role in enhancing the accuracy of medical diagnoses and improving patient outcomes. The rise of wearable devices, which continuously monitor health metrics, offers individuals the ability to track their health in real-time. Additionally,

AI-based diagnostic tools now assist healthcare professionals by processing vast amounts of medical data, helping detect potential health risks before they become critical. These innovations continue to transform patient care, offering more personalized, proactive, and preventative healthcare solutions.

Boosting Manufacturing through Automation

The manufacturing sector has been revolutionized by the application of electrical engineering through automation, robotics, and control systems. Automated assembly lines and robotic machinery have dramatically increased productivity, reducing the need for human intervention, especially in hazardous environments. Electrical engineers also design systems that integrate AI and the Internet of Things (IoT), further enhancing efficiency. These technologies enable real-time monitoring of production processes, allowing for more precise control, improved quality assurance, and reduced operational costs. Predictive maintenance, facilitated by IoT sensors, minimizes downtime and enhances the longevity of equipment. Additionally, engineers are focused on optimizing energy consumption within manufacturing processes to further reduce costs and support sustainability.

Telecommunications and Networking Innovations

Telecommunications have experienced rapid advancements thanks to the innovations in electrical engineering. The move from 4G to 5G technology, along with ongoing developments in 6G, has enhanced global communication by enabling faster data transfer speeds, reduced latency, and more reliable connectivity. These improvements are essential for the digital economy, supporting everything from remote work to the rise of smart cities. Advances in optical fiber networks, satellite communication, and wireless technologies are continually evolving, meeting the needs of emerging technologies such as autonomous vehicles and the Internet of Things. Engineers continue to develop the infrastructure necessary to ensure uninterrupted connectivity in an increasingly digital world.

Electrical Engineering in Smart Transportation

Electrical engineering has also made significant contributions to the transportation industry. Electric vehicles (EVs), high-speed trains, and autonomous

transportation systems are just a few examples of how electrical engineers are reshaping the way we travel. Innovations in battery technology, regenerative braking systems, and wireless charging infrastructure are making transportation greener and more efficient. Furthermore, electrical engineers are working on optimizing energy use in public transportation systems, such as electric buses and trams, further contributing to reducing the carbon footprint of cities. As autonomous vehicles continue to evolve, engineers are integrating AI and sensor technologies to enhance safety and operational efficiency, ensuring safer and more sustainable transport solutions.

Addressing Challenges and Future Directions

Despite the remarkable progress in electrical engineering, professionals in the field face several challenges. As industries become more interconnected, the risks associated with cyberattacks grow, particularly in sectors like smart grids and IoT-enabled systems. Securing critical infrastructure against cyber threats is becoming a top priority for engineers. Additionally, there is the challenge of making new technologies affordable and accessible to a wider population. Electrical engineers must balance the need for innovation with the practicalities of cost and scalability. The rapid pace of technological advancements also requires engineers to continuously update their skills and knowledge to stay ahead of the curve, ensuring that new solutions are both efficient and sustainable. Collaboration across various sectors, including engineering, policy-making, and industry, will be essential to tackle these challenges and unlock the full potential of electrical engineering.

Conclusion

Electrical engineering is a fundamental force behind industrial evolution, transforming how energy is produced, products are manufactured, communication occurs, and people travel. From optimizing energy systems to pioneering innovations in healthcare, electrical engineers are at the forefront of shaping the future. As they continue to address challenges such as cybersecurity and cost-efficiency, their contributions will remain central to global advancements in technology and development.

INTERNET OF THINGS (IOT) FOR INDUSTRIAL AND BUILDING AUTOMATION

Arooj Abbass

0044-BSC.ENGG-22

Introduction

The Internet of Things has enabled us to connect disparate devices and organizations, forming a network that can be accessed and controlled remotely. In the realm of building automation systems, the integration of IoT has had a significant impact, boosting efficiency, minimizing costs, and optimizing building operations. This article will explore the benefits of IoT in building automation and how it's revolutionizing the industry.

The Rise of IoT in Building Automation

The Internet of Things (IoT) has revolutionized the construction automation industry, enabling new levels of ascendancy, efficiency, and data-driven decision-making. IoT engineering, which connects a vast network of smart, internet-enabled devices, is being increasingly integrated into construction systems, transforming how we manage the performance of our built environments.

In the past, construction automation relied on standalone systems that operated in isolation. But the rise of IoT has ushered in a new era of interconnectivity, where disparate building components can communicate and work together seamlessly. From smart thermostats and lighting control to sensors that monitor indoor air quality and movement patterns, IoT-enabled technologies provide building owners and facility managers with unprecedented insights and control over their properties.

Enhanced Automation with Peck Enable Smart Building

IoT connectivity is at the heart of modern smart buildings, giving facility managers real-time data on all sorts of building operations.

Using IoT sensors and controllers, these systems keep an eye on environmental conditions, track energy use, and manage devices like lights and thermostats, boosting efficiency and lowering costs. For instance, sophisticated HVAC systems can adjust heating and cooling based on

occupancy or even tap into weather data to optimize energy efficiency, reduce operational costs, and shrink carbon emissions. By automating responses to environmental changes, smart buildings enhance occupant comfort while championing sustainability goals.

The impact of IOT on Industrial Automation

The Internet of Things (IoT) is a crucial driving force behind the advancement of industrial automation systems. When combined with computerized automation controllers, IoT helps refine industrial systems and improve data automation, mainly by eliminating human errors and inefficiencies. At the industrial level, this is achieved through multiple layers of interconnected devices. IoT devices, such as sensors from the plant floor, analyzers, actuators, robotics, and more, transmit data to local process control units. These units then relay the data to higher-level Supervisory Control and Data Acquisition (SCADA) software programs. While local machines can operate automatically, human operators can intervene and interact with the system at any level, provided they have the necessary access.

Improved Energy Efficiency and Cost Savings

The incorporation of IoT technology into building automation systems has had a significant impact on energy efficiency and cost savings. By collecting real-time data on energy usage, equipment performance, and occupancy patterns, building owners can implement strategies to reduce their environmental impact and operating costs.

For example, automated HVAC adjustments based on occupancy can dramatically reduce energy consumption by only conditioning spaces that are actively being used. Predictive maintenance, facilitated by IoT sensors, can also extend the lifespan of crucial equipment and prevent expensive breakdowns. Moreover, the data-driven insights provided by IoT-powered building automation systems can help facility managers identify and address energy-wasting problems, further optimizing the building's overall efficiency.

Advantages of IOT Automation

Ability to Scale: The scale of production is achieved by increasing output and improving efficiency, both of which are facilitated and sped up by the digital industrial

revolution. Were it not for the human element, labor forces would be the most straightforward aspect of any production process to eliminate. Consequently, one method to introduce robots into a factory is to have them handle all or some of the operations.

Increased System: The scale of production, as well as uptime, is constrained by human limitations. People require rest, food, a secure work environment, and ethical treatment. In contrast, machines are unaffected by breaks, hunger, and similar needs. It's worth mentioning that many production floors are already quite safe. Often, when automated practices are implemented sensibly, the resulting increase in Overall Equipment Effectiveness (OEE) can actually enhance plant safety.

Improved safety for Workers: While automating tasks might mean fewer line workers (which could make the workplace safer just because there are fewer people around), that same automation can also boost worker safety in real time when combined with data analytics and the Internet of Things (IoT). By gathering and analyzing sensor data, we can get ahead of potential equipment breakdowns and alert maintenance teams proactively.

Disadvantages of IoT

Loss of Great Automation: Unfortunately, while increased connectivity boosts efficiency, it also opens more doors for cyberattacks. Adding more devices means more potential entry points for hackers. IoT security practices are a specialized area focused on tackling this growing concern.

Internet Dependence: IoT and automation rely heavily on the internet to function. While offline systems can be useful, losing internet connection, even briefly, can seriously disrupt production and lead to significant costs.

Complexity Increases Failure Points: More connected equipment also means more potential points of failure, both locally and system-wide, which can be exploited as attack vectors. As IoT automation systems become more complex, the underlying risk of component failures within the system needs careful attention. There are various methods and design principles to mitigate this, such as segmenting the system and incorporating redundancies.

IoT Plan, Building, Management Complications: Simply put, planning, building, and managing IoT automated systems can be quite complex and challenging.

Conclusion

Building automation systems and the Internet of Things (IOT) are revolutionizing how we manage and operate buildings. These sophisticated technologies offer a wealth of advantages, such as improved energy efficiency, enhanced comfort, greater convenience, and increased safety. However, putting these systems in place can come with hurdles, like high upfront costs and the need for specialized expertise. It's crucial to thoughtfully consider the pros and cons before deciding to adopt automation systems and IOT. There are definitely challenges to this, though, as illustrated by the examples in this guide, the potential benefits of these technologies are substantial and can result in long-term cost savings, improved reliability, and better building performance.

Building automation systems and the Internet of Things signify significant technological advancements in the realm of building management and operations.

THE ROLE OF ELECTRICAL ENGINEERING IN AEROSPACE

Ahsan Iqbal

0024-BSC.ENGG-24

Introduction

Electrical engineering plays a vital role in the aerospace industry, driving advancements in avionics, power systems, control mechanisms, and communication networks. From commercial aircraft to space exploration, electrical engineers design and implement such complicated systems that ensure safety, efficiency in air and space travel. This article explores the applications of electrical engineering in aerospace.

Avionics

Avionics, short for aviation electronics, is a primary field of electrical engineering in aerospace. It includes navigation, communication, flight control, and monitoring systems. Some key areas include:

Flight Control Systems: Fly-by-wire (FBW) technology, an advanced control system that replaces traditional mechanical linkages with electronic interfaces, enhances aircraft stability and maneuverability.

Navigation and Communication: GPS, Inertial Navigation Systems (INS), and satellite-based communication ensure precise positioning and real-time connectivity for both pilots and ground control.

Power Systems

Aircraft and spacecraft require complex electrical power systems to support onboard electronics, and life-support mechanisms. It includes some key points such as:

More Electric Aircraft (MEA): It is a kind of electrically powered system which replaces hydraulic and pneumatic systems to improve efficiency.

High-Voltage Power Distribution: Modern aircraft operate on high-voltage DC power (270V DC) for improved power efficiency and weight reduction.

Propulsion Systems

Electrical engineering is revolutionizing aerospace propulsion, leading to efficient solutions.

Electric Propulsion: Hybrid and fully electric aircraft, like those developed by Airbus and NASA, aim to reduce carbon emissions and fuel dependency.

Superconducting Motors: Advances in superconducting materials are paving the way for high-power, lightweight electric propulsion system.

Electromagnetic Interference (EMI) and Shielding

Aircraft and spacecraft operate in environments with high electromagnetic activity. Electrical engineers design shielding techniques and grounding mechanisms to:

- Protect sensitive avionics from external interference.
- Ensure reliable signal transmission.
- Prevent system malfunctions due to electromagnetic exposure.

Artificial Intelligence

Electrical engineers use AI to enhance aerospace capabilities. AI is used in various aspects of life such as

Autonomous drones used for cargo delivery, AI enhances air traffic control and management, This technology also plays a crucial role in space exploration.

Conclusion

Electrical engineering is the backbone of modern aerospace advancements more efficient, and intelligent flight systems. Electrical Engineering has a vast scope in avionics, artificial intelligence, Power system and Electromagnetic Interference . This proves that Electrical Engineering has a demonstrating effect on Aerospace.

ENGINEERING A TECHNOLOGICALLY CONTROLLED SOCIETY

Asma Arshad

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In a world increasingly dominated by technology, the idea of a society governed by artificial intelligence and robotics is no longer science fiction. The anime Psycho-Pass offers a chilling glimpse of a future where a powerful AI system monitors and regulates human behavior, ensuring societal order at the cost of individual freedom. It explores how humanity is unable to separate itself from technology in all aspects, whether it is something as mundane as choosing clothes to choosing jobs, and even food production and justice administration based on data collected from citizens. This dystopian vision, echoed in Westworld and The Matrix, invites us to reflect on life in an AI-controlled world.

In such a future, electrical engineering becomes the hidden force behind autonomous agriculture, smart energy grids, self-repairing robots, and predictive health systems—many of which are already shaping our reality. It concerns all of humanity how these innovations are transforming society while raising new ethical dilemmas.

1. Autonomous Agriculture Systems: Feeding a Tech-Driven Society

Agriculture is evolving into a hub for automation, with smart farms becoming a popular idea.. In Japan, the Spread vertical farm produces over 10,000 heads of lettuce daily using robots that handle planting, watering, and harvesting. Imagine scaling this to entire cities, we

can have vertical farms powered by AI and maintained by drones.

Electrical engineers design sensor networks to monitor plant health, humidity, and nutrients in real time. By integrating renewable energy like solar and wind, these farms could become self-sufficient, maximizing output while minimizing environmental impact. Hydroponic and aeroponic systems, which grow plants without soil, could help solve food shortages by enabling urban farming in even the harshest environments.

In the Netherlands, farms use AI-driven machines and drones to reduce pesticide use and boost yield, offering a model for fully automated food supply chains.

2. Energy Infrastructure: The Lifeblood of Automation

A society reliant on AI and robotics needs an intelligent energy grid. Smart grids, already emerging in South Korea, predict and prevent power outages using microgrids and advanced storage systems to balance supply and demand.

Electrical engineers integrate renewable energy sources, build energy storage solutions like Tesla's Powerwall, and design efficient distribution systems. This decentralized, AI-managed infrastructure could ensure uninterrupted power for a fully automated world—no more blackouts, just clean, reliable energy.

In Germany, over 40% of power comes from renewable sources managed by smart grids that adjust consumption based on real-time resource availability.

3. Robotic Maintenance and Manufacturing: Machines Building Machines

In this tech-driven future, robots won't just "assist humans"—they'll maintain themselves and build their successors. Electrical engineers are developing control systems that allow robots to self-repair and optimize tasks without human input.

Boston Dynamics' robots, like Spot and Atlas, are early versions of what could become an autonomous workforce. Foxconn, Apple's supplier, has replaced thousands of human workers with robots capable of assembling electronics with unmatched precision.

While these advancements promise efficiency, they also force us to confront questions about job displacement and the role of humans in an increasingly automated world.

4. Cyber-Physical Security and AI Governance: Balancing Safety and Freedom

In a society governed by AI, cyber-physical security is critical. Electrical engineers must develop effective systems to protect infrastructure from hackers and malfunctions. Fault-tolerant control systems ensure that AI governance continues even during hardware failures.

However, China's Social Credit System, which monitors and scores citizens based on behavior, hints at how easily these systems could be used for surveillance and control, which can endanger privacy and individual freedom.

5. Health and Nutrition Monitoring: Data-Driven Wellbeing

In this high-tech future, personalized health could be enhanced through wearable technology and sensor networks in food production. Devices like the Apple Watch already track health metrics, but the next wave could monitor nutrient intake, predict illness, and optimize diet in real time.

Electrical engineers would design the sensors and communication systems that make this possible, offering deeper health insights. Imagine an AI assistant recommending meals based on your nutrient needs, sourced from fully automated farms.

Companies like Levels Health are creating glucose-monitoring wearables that help users optimize diet and exercise in real time, pointing to a future where our bodies and technology work seamlessly together.

Final Thoughts: Balancing Innovation and Ethics

The integration of electrical engineering into a tech-controlled society offers incredible opportunities: self-sustaining cities, clean energy, and personalized health care. Yet, as fictional media reminds us, this future demands caution. Without proper checks, technology can become a tool of oppression.

As we stand at the threshold of this new era, it's crucial to ask: How much control should we hand over to machines and at what cost? One thing is certain: electrical engineers

will play a vital role in building this brave new world, and the choices we make today will determine if it's a utopia or dystopia.



ENTREPRENEURSHIP

2024: YEAR IN REVIEW

Jan

- The month of January was all about investment and opportunities for tech startups. Such as the Consumer Electronics Show (CES). The event dates were from 9-12 January. The producers got the opportunity to show off their innovative ventures. Secondly, the IPEM cannes where investors and fundraisers come together to make impactful deals.

Feb

- During this month, the biggest events included the Sharjah Entrepreneurship festival in the United Arab Emirates, it was scheduled for February 3rd and 4th. This event brought many young innovators and entrepreneurs together, offering a platform for workshops and exchange of ideas with likeminded people. Shortly after this event the GoWest conference took place in Sweden.

March

- In March, The SAARC Bazaar and Women's Business Conference will be held in Lahore from MARCH 7 to 9. The main event was organized by the Federation of Pakistan Chambers of Commerce and Industry (FPCCI). It was all about empowering South Asian entrepreneurs, particularly Pakistan's cottage industry.

April

- Spring started with Y Combinator Demo Day, where innovative startups presented their progress to a range of investors. The Techstars Accelerator program also took place, supporting new entrepreneurs in scaling their ventures.

May

- May brings up the highly anticipated Google I/O Developer Conference, offering announcements and chances for entrepreneurs interested in Tech to get involved in Google's latest innovations.

June

- Summers started with the Collision Conference in Toronto, this event is considered the key event for startups and investors to network and collaborate. Startups showcased the progress reports and revenue reports.

July

- Many entrepreneurs pitch their ideas and receive mentorship in the month of July. It occurred in the Techstars Startup Weekend in various locations worldwide. The NEXT FOUNDERS 2024, continued offering intensive training and networking opportunities for selected startups.

Aug

- The month of August was all about the Startup Grind Global Conference in the Silicon Valley, it was a major event that brought together several talented entrepreneurs, stakeholders, investors and change makers around the world. It was all about the exchange of ideas and fostering collaborations.

Sep

- September is highlighted by the International Conference on Leadership, Entrepreneurship, and Business management (ICBM) in various locations including Bhutan, Thimphu and Cyprus. Several ideas of leadership and innovation were discussed.

Oct

- Focal Demo day took place in his month, where startups showcased their progress and revenue models explaining their vision about their venture. It was all about making the innovative ventures more viable and profitable.

Nov

- As we approached November, there was a major Web Summit in Lisbon, Portugal. It was considered the world's largest tech conference happening around the world. It attracted many tech enthusiasts and tech entrepreneurs.

Dec

- The year concluded with the Innovate Slovakia event, which was held in the Slovak Republic. It highlighted innovative startups, and fostered connections among entrepreneurs and stakeholders.

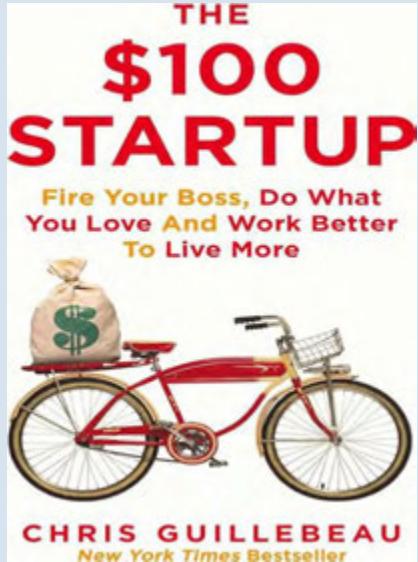
BOOK REVIEWS

THE \$100 STARTUP - CHRIS GUILLEBEAU

Shanzay Umer Khan

3854-BS-ENTR-23

"The 100 Dollar Startup" by Chris Guillebeau is a guide for anyone who wants to start a venture with minimal investment. Whether you are new to the world of entrepreneurship or someone looking for a change provides the ultimate guide to anyone having fewer resources and guidance. Instead of relying on material capital, education, and advanced business plans, the author explains how anyone can transform his passion for business into a profitable and viable venture using just a hundred dollars. The book is a blend of success stories of startups and entrepreneurs and how these ordinary people turned their passions and skills into successful empires. The central theme of the book is based on how by just a hundred dollar bill you can create a legacy of profitable ventures.



Chris Guillebeau has the vision that by providing value or solving problems, customers are forced to pay for something that is solving their problems. The central idea of the book also revolves around the importance of providing value. He also calls out the unnecessary need for a complex business model and how it creates more problems for an entrepreneur. He insists that planning is a necessary and crucial step, but starting small and gaining feedback is all the game. The author suggests simplicity in business models. It is all about finding the right way, a path you are passionate about, and doing something you love.

The major part of the book is about real-life examples and how people with minimal investment have created a viable business. For example, the author shares the story of an entrepreneur who earned more than a thousand dollars every month just by selling vintage maps. Another example is a woman who started selling personalized art and made over sixty thousand dollars monthly. These are crucial examples of how, by low investment, we can earn up to thousands of dollars and provide valuable examples for future entrepreneurs. It is all about understanding the needs of the customers and, most importantly, understanding them. The variety of success stories illustrates the several ways of gaining and achieving your goals. There is also a major concept of solopreneurship. It is all about individuality. There is a problem in this section of the book. Some readers might find it fictional, or this concept does not apply to everyone, especially to someone who wants something big and wants a team with him to help him achieve his desired results.

On the other hand, not everyone is willing to start with minimal investment. Many entrepreneurs have access to capital and finance, which they can invest in and get the desired output.

In conclusion, the 100-dollar startup is a must-read book for readers, especially those thinking of doing something big or solving a problem for customers and filling a gap in the market. The advice in the book is very precious but might not be applicable to all the readers. Some readers don't want to start with a humble investment, and some might want a team to create something massive. The overall message in the book is clear and concise.

ZERO TO ONE: NOTES ON STARTUPS, OR HOW TO BUILD THE FUTURE - PETER THIEL

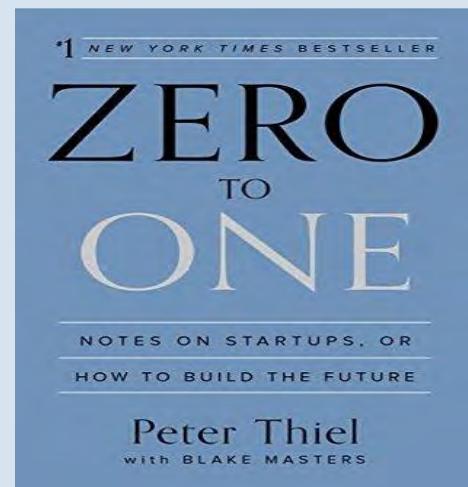
Muhammad Ehsan

3855-BS-ENTR-24

The book Zero to One by Peter Theil is not an ordinary book but a script that gives birth to the ideas of innovation. Zero to one is the phrase that has the essence of moving or taking a step forward. From nothing to something.

The author, Peter Theil, is the co-founder of PayPal and the initial investor of Facebook. His book gives the insights of entrepreneurship and the people who are thinking of innovation and solving a problem. The core idea in this book revolves around the fact that entrepreneurs should not aim for doing something that already exists; instead they should go for inventing new ideas and new technologies that fills gap in the market. There should be monopoly rather than competing in the market. There are several chapters in the book, each section addressing different areas of an emerging venture and discussing the early problems of an entrepreneur.

The first few chapters revolve around the importance of monopolies. The author emphasizes the importance of being the only producer of a particular product in the market. This gives freedom to the producers about innovation and bringing something new to the market. These ideas are crucial for an upcoming entrepreneur and can lead to contribution in overall economic growth. When you are the only producer of a particular product every competitor is after your business model, the author also highlights the importance of gatekeeping the secrets and ideas. The author also encourages the readers on seeking out hidden opportunities', this mindset is extremely important for finding out latest trends and customer demands as well as finding gaps in the market. The last chapters offer practical advices for the emerging entrepreneurs. Theil focuses on the qualities of successful entrepreneurs and the need for technological innovation that is crucial for the overall business culture and upscaling new ventures. The ideas and insights are from his own experiences and researches making them relevant for entrepreneurs.



The negative side of Thiel's is that they give birth to criticisms and controversies, some readers find the idea of monopoly and competition negative. Competition associated with monopoly can create a very uncomfortable situation in the market making the business world a very hard or inflexible as there is no room for repeating the some rules or products. It can also limit consumer choices and can lead to unethical business practices. Some readers also complain the missing practical advices or actionable advice. There are zero steps for the baby steps of creating a monopoly and leveraging innovation. Thus creating confusion for its readers.

Despite these arguments, Zero to One , still remains a must read book for emerging entrepreneur's in the world of business. This book encourages the readers to think differently and innovatively. Creating room for creativity and filling the gaps in the market as well as lisyeneng tp the consumer preferences.

MOVIE REVIEWS

THE SOCIAL NETWORK (2010)

Momina Ali

3814-BS-ENTR-23



The movie The Social Network is a mesmerising movie about the founding of Facebook, which is the biggest social platform for its users today. It is considered one of the most influential tools for the connections among people. The movie is written by Aaron Sorkin and directed by David Fincher. The movie is literally based on the book, the accidental billionaires. The movie characters are Hollywood actors, including Jesse Eisenberg, as Mark Zuckerberg, Andrew Garfield as Eduardo Saverin and Justin Timberlake as Sean Parker.

The starting story is a very stimulating one where Mark Zuckerberg creates a website that is named Facemash which causes him trouble. To prove himself and get out of the problem he created, he collaborates with his friend, Eduardo Saverin, and eventually creates Facebook. It also attracts the attention of Sean Parker, who helps the platform to reach at a top level. The film is all about how ambition can lead you towards success but at the same time how betrayal from your own friend can make a situation a little tougher, and you have to eventually make some hard decisions. In the movie, Mark Zuckerberg has a

conflict with Eduardo as the platform is gaining success, and they go for a battle in the court in terms of ownership of this platform. It creates a suspenseful storyline that captivates the attention of the audience. The movie is not just limited to the rise of Facebook but how such technology affects our daily life and what the changes are made in our lives. It is also about friendships, growth, and betrayal showing the real colors of your loved ones, thus capturing the attention of the audience. The film has a sharp screenplay, and the actors are doing a phenomenal job. This is the most useful movie for entrepreneurs and the individual working on launching their startups. The movie is also about the major factors of entrepreneurship. The risk-taking characteristics of entrepreneurs and how this risk can lead to major changes in the business world can foster economic growth. It also highlights the importance of steadfast behaviour and gaining feedback. At first, his app didn't work but having the resilience to face the hardest moments, Mark Zuckerberg again stood for himself and made history. He brought innovation to the world of tech and business.

In this way, he was also aware of his people and the people who were against him. The movie is thought-provoking and engaged in explaining the complexity of building a successful startup. It also highlights the ups and downs of being an entrepreneur. This movie surely leaves a mark and a lasting impression.

TRUST NO ONE: THE HUNT FOR THE CRYPTO KING

Zaryab Fatima

2652-MSESME-SP-23

An Insight into Crypto Dark Side: With its promises of decentralization, transparency, and rapid wealth accumulation, crypto currency has completely transformed the banking industry. However, the documentary "Trust No one: The Hunt for the Crypto King" on Netflix shows that it is also a field full with dangers, scams, and unsolved issues. The film, which was directed by Luke Swell, explores the tragic and compelling tale of Gerald Cotten, the creator of QuadrigaCX, Canada's biggest crypto currency exchange, whose sudden and unexplained death left thousands of investors in financial devastation.

A Tale of Greed Mystery & Betrayal: Through the perspectives of investigative enthusiasts and deceived investors, the documentary's story is told. It revolves around Cotten's unexplained death in 2018 while on vacation in India, which was purportedly caused by Crohn's illness. The secret keys to QuadrigaCX's cold wallets were taken with him when he mysteriously passed unexpectedly, so preventing the \$250 million in bit coin that was due to 115,000 consumers from being accessed or found. There were several accusations of fraud and conspiracy as a result of the disastrous fallout.

The group of amateur investigators that came together to find the truth is what makes the documentary stand out. The intricacy of the crypto world and the depth of their desperation are both revealed by their unrelenting search, which has been documented in internet forums, Reddit discussions, and private investigations.

An Expose on the Crypto Ecosystem: In addition to its captivating plot, the video serves as a sobering warning of the risks associated with trading crypto currencies. Crypto exchanges, in contrast to traditional institutions, are frequently unregulated, putting investors at the whim of its creators. The movie criticizes the absence of supervision and the possibility of abuse when someone like Cotten have complete power over millions of dollars' worth of assets.

Sewell skillfully illustrates the appeal and dangers of the crypto currency market using vintage video, reenactments, and interviews. The story moves along at a good clip, keeping the reader on edge as it progressively reveals more layers of dishonesty. By providing technical insights to support the investors' emotional testimony, the involvement of specialists in block chain technology and financial security adds depth.

The Ethical Boundaries: Deeply troubling ethical issues are also brought up in the documentary: Can we trust a decentralized system? How can we reconcile the demand for accountability with our freedom from conventional banking systems? The movie hints discreetly that human greed combined with a naïve faith in technology can have unthinkable repercussions.

Verdict: The captivating film "Trust No One: The Hunt for the Crypto King" will appeal to both bit coin newbies and skeptics. It highlights the negative facets of financial innovation and is both an intriguing mystery and a warning story. People want to follow the herd and get wealthy overnight without doing any research. Ambition is admirable, but it is truly crazy to put all of our eggs in one basket without any knowledge. After seeing the film, you will understand that you will always be at a disadvantage if you don't have any reliable information or a thorough background check.



WOMEN ENTREPRENEURSHIP: A DISTANT DREAM COMING TRUE IN PAKISTAN

Zunaira Hussain

1303-MS-ESME-23

Ever since the inception of Pakistan, amidst hue and cry over Pakistan's chaotic political structure; fragile economic framework and fanatical fabrication of culture, women, despite being half of Pakistan's population have barely been bothered for their deprivations in all socio-economic arenas despite their tedious, endless and overwhelmed hustles. Their hardwork has widely been underrepresented since they have informal yet unpaid presence in agricultural sector and house chores, mainly. For instance, women make up around 67 percent of agricultural workforce of Pakistan. The agricultural sector contributes to around 24 percent in overall GDP of Pakistan. Accordingly, women make a huge yet unnoticed participation in country's economy informally. However, the formal presence of women has been minute. Pakistani women's presence in business arena is also quite imperceptible. Undoubtedly, the state of affairs vis-à-vis women entrepreneurship is quite deplorable currently, since only 5 million SMEs are owned by women entrepreneurs that accounts for only 8 percent of overall SMEs count of Pakistan, accordingly to State Bank of Pakistan. Pakistan being a predominantly patriarchal society leaves women entrepreneurial ventures with negligible support and recognition. Women entrepreneurs have to grapple with numerous challenges including difficult accessibility to resources particularly financial ones, being one of the most substantial challenges. Women acquire less control over their financial resources including land and property than their men counterparts. Thus they acquire lesser money to be invested in their businesses. Moreover, education and employment opportunities also become scarce for women owing to lack of decision making power and general empowerment and making them even more deprived and persecuted vis-à-vis their entrepreneurial aspirations owing to lack of awareness, lack of networking and mobility issues, particularly. This leaves women entrepreneurs vulnerable vis-à-vis commencement of their long-dreamed entrepreneurial ventures making women entrepreneurship a distinct and long-held dream for female segment of Pakistan. Despite the in-built social stigma that causes discriminated behaviours towards women refraining them from fulfilment of their dreams of more independent,

autonomous, productive and prosperous lives, there exists a silver lining that depicts that, slowly and gradually, the distant dream of noticeable women entrepreneurs' enterprises is coming true in Pakistan. This positive change has begot by changing societal and political landscape of Pakistan. That has compelled legislative authorities to take more pragmatic measures towards women empowerment. Accordingly, women are able to get more facilitative yet tailored financial services from financial institutions. This undermines women entrepreneurs' vulnerability regarding financial resources to a significant extent. Moreover, government itself incentivises women through certain women friendly policies and schemes along with specialized institutions for women entrepreneurs' training and networking. Besides the described legislative endeavours, women entrepreneurs are being accepted on societal fronts as well. Women do participate in constructive awareness and mentorship campaigns leaving the fellow women more motivated and determined towards their business related hustles. Moreover, women entrepreneurs have managed to acquire more customers and exhibit their offerings to wider target market through an increased access to the Internet. Moreover, Internet has also been more revolutionized. Internet, particularly social media, not only provides a larger audience to Pakistani women entrepreneurs rather it also advertises their products in more economical manner. Women also get easier access to the training modules through Internet and are being more equipped with artisanal skills and expertise. Resultantly, accordingly to SMEDA (Small and Medium Enterprises Development Authority) the percentage of women entrepreneurs has raised from 1 percent to 4 percent across Pakistan. The percentage is expected to be positively raised since a number of women-owned businesses have become inspirationally successful and are motivating other women to take a leaf out of their book and start over with their entrepreneurial dreams. The number of women-owned businesses has also become higher since women entrepreneurs own more than 5 million businesses. Moreover, nearly 65 percent Pakistani females earn their livelihood through their artisanal capabilities in the name of cottage industry as per international labour organization. Significantly and miraculously, women entrepreneurs' ventures are also being internationalized with an increase in globalization oriented business policies and practices and people's increasing inclination towards craft and custom made products. But women artisans of Pakistan's have been

unable to internationalize their products owing to their inability and inaccessibility towards technological modes of internationalization. Now, a few platforms like Vceela, Gear Trust and Hawwa Women Craft Cooperatives etc help women entrepreneurs to connect to international markets and wider local markets. Thus, younger and newer female entrepreneurs are being emerged seeing the success of artisans and other conventional women entrepreneurs. For instance, newer entrepreneurs witness success stories of fashion industry's giants such as Maria B, Elan, Musarrat Misbah etc that are being successfully run by women entrepreneurs both on local and global levels. Accordingly, just a little more determination is required on women entrepreneurs' end and the already defined constructive measures are to be rearticulated on more pragmatic basis to realize the long-held dream of women entrepreneurs to its fullest extent.

EMPOWERING WOMEN THROUGH SOCIAL ENTREPRENEURSHIP: THE STORY OF SHIZA SHAHID

Bakhtawer Anjum

3855-BS-ENTR-23

Shiza Shahid is a prominent figure in Social Entrepreneurship, renowned for her commitment to advocating for girls' education and fostering global change. Her contributions prove how steadfast commitment and innovation can drive social entrepreneurship and bring meaningful alterations.

Shiza Shahid was born and raised in the city of Islamabad. She was aware of the challenges women and girls faced in pursuing education. She came to know about Malala Yousafzai, a social activist who herself was advocating for women's education, and later, she faced oppression by the Taliban.

The change came into her life when she volunteered at a summer camp for Malala and girls from the Swat Valley, the purpose of the camp was the development of leadership skills among young women by educating them and providing them with a safe place. This initiative changed her completely and solidified her commitment to women's education. Malala, a woman who herself was a social activist, was shot by the Taliban for her initiative

for women's education in 2012. Mala and Shiza Shahid started the Malala Fund, which invests in girls' education and organizations around the world. The organization is a non-profit organization. The aim is to break down barriers that prevent women's education, including poverty, gender discrimination, and early marriage.

Malala Fund has been globally impacted as they have advocated for policy changes. Shiza Shahid and the Malala fund team have collaborated with the government, international organizations, and the civil community for the prominence of significant policy changes and weighted investment in women's education. Their efforts have many policies to make substantial changes and ensure increased investment in girls' education in various countries. For example, the Malala Fund played a pivotal role in volunteering for the "Girls Education Act" in Nigeria, ensuring free and compulsory education for girls.

Shiza Shahid's efforts alongside the Malala Fund have earned her international recognition and support. She is highlighted among the major media platforms such as Time, Forbes, and CNN. Her services and dedication have made people around the world advocate for women's education and promote gender equality. Another crucial aspect of Shizas approach is her dedication to collaborations and partnerships. The organization partnered with governments, international organizations, partners of corporations, and local communities to make a strong impact and enhance relations. Through this strategic partnership, the organization can have more resources and more chances of getting accepted and improving the effectiveness of its programs.

Shiza Shahid's success as a social entrepreneur is the result of her inner voice of gratitude towards people in need. The urge to look after unprivileged women, who are helpless and have no one to look after them. It was her inner philosophy that made her dedicated to equality and women's rights. And making them listen to her ideas. She valued empathy, humility, and listening to people in need. Her leadership the collaboration and partnerships by dominant organizations, prioritizing the voices of the communities she serves in the ideation process. Additionally, she believes that her younger generations have the potential to change the world and make changes in the policies. Through her work with the Malala Fund and other initiatives, she has taught and mentored hundreds of unprivileged students who needed a support

system. She has also empowered many young leaders to work themselves and make a positive change in society. Shiza Shahids' continuing legacy as a social entrepreneur is a distinct work of dedication and hard work to education gender equality. Her undertakings have positively impacted thousands of girls towards self-worth and dignity. She has also inspired upcoming organizations working on gender equality and women empowerment to address social challenges and innovative solutions.

Shiza Shahid is continuing her journey as a social entrepreneur, transforming the policies and making the world a better place. Her journey as a social entrepreneur highlights the power of education and the influence of change in social entrepreneurship. Her work with Malala Funds has made a positive change, empowering young women and inspiring others to contribute to a better future. Shiza Shahids' story serves as a light of positivity and hope and demonstrating the potential of individuals and how we can change the world using our voice.

FUTURE OF ENTREPRENEURSHIP: PIONEERING THE NEXT DECADE

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As we look forward to the next decade, the future of entrepreneurship lies with significant transformation. The new emerging industries and the dynamic viewpoint of technology will shape it all. As societies are evolving and we are being introduced to hundreds and thousands of trends, the future of entrepreneurship is all about shaping old patterns.

When we talk about entrepreneurship, we are talking about innovation and changes in the world. Nowadays, the major emerging industry is artificial intelligence (AI). This industry is considered the backbone of innovation. New things will contribute to new developments and productions. During the old patterns of starting a venture, it revolved around hiring a professional and getting paid. But now, with AI, new solutions have been created to create intelligent systems. The latest trend also revolves around sustainability and renewable energy. The future startups will all be about green and healing, which will contribute to the solutions to climate change. Future

entrepreneurs will focus mainly on the manufacturing of renewable energy sources, typically solar, wind, and hydroelectric power. The storage of such a power supply will also be an important part of entrepreneurs' innovations. The companies that will contribute biodegradable stuff and eco-friendly goods will not only contribute to the overall economy but will also find success as people are health conscious and their business will be viable.

Health is the new trend now and for the upcoming future. Biotechnology and health tech are a name that promises to rule after decades. The technology for gene editing and personalized medicine is the beginning of modern and customized world. That will allow future entrepreneurs to create startups like those to fit into the upcoming decades. Since COVID-19, people have been more focused on health care and digital health adoption, and this trend will be continued with innovations created by future entrepreneurs.

Mental health and self-care are also major concerns for the upcoming decades. The problem of mental health will drive the need for innovative startups, which will focus on teletherapy, health care apps, and programs as well as mental health apps. They will look after individuals and contribute to the success of future entrepreneurs.

SpaceX and Blue Origin are one of the major names when it comes to space exploration and commercialization. The future business models will consist of startups mainly about satellites and reusable rockets. These are some of the major and biggest contributions to the modern world. The future of entrepreneurship lies here, and in a decade, the world may become more and more advanced, leading to professionalism. Meanwhile, the traditional banking system will be altered by the fintech sector. The startups will make secure banking systems that will create solutions for potential consumers of such technology to make the system of banking easier to use. The use of digital wallets, lending, and robotic advisors will make financial services more and more efficient.

The new technology has also introduced 5G connectivity. This is a vast improvement in the overall world of technology. With time passing, startups leveraging 5G technology to produce innovative solutions and commodities that will create a very connected world and beyond. It will be a high-density and fixed wireless access that will make emerging ventures more and more viable,

contributing to profits. It will also lead to lower operation costs and increased revenue overall. The suppliers will be connected to customers and solve their problems, which is the main goal of an entrepreneur. The education system is becoming more and more digital. The future demands Edtech, which gives entrepreneurs opportunities to develop business models according to the needs of the people. Future entrepreneurs will create programs and apps that will be the right option for students and professionals seeking digital education. By the use of 5G technology and using it to the fullest, entrepreneurs can gain profit by creating such domains in the upcoming decade. This is the new market demand and it was introduced during the time of Covid-19. When there was no access to the world outside the house. The future of entrepreneurship will be a pinpoint on the creation of diverse products for diverse audiences. We are talking about modern customers who are flexible and make changes according to the changing world.

The next decade is all about emerging industries and future entrepreneurs. It will all be about the new high-end technologies and evolving societal wants. The entrepreneurs who are the most flexible will win through life. Frankly, it is all about the survival of the fittest.

NETWORKING TIPS: BUILDING AND LEVERAGING A STRONG PROFESSIONAL NETWORK

Eishal Wajid

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Networking is all about connecting with people, gaining opportunities, and hustling. It is also about building a strong support system. Building a strong system doesn't only mean to gain business cards of various big business tycoons but actually connecting. It helps us to be visible and create your own personal brand as well as business brands. Connecting with people for entrepreneurs is a big opportunity for motivation, and to keep going, there's emotional support that is essential for venture owners. It also gives the opportunity of connecting with other people as well, hence making a bigger networking circle and gaining more knowledge about the business world. A strong network also increases credibility, thus making everything trustworthy. For a business owner, motivation

plays a vital role in keeping going. Networking really provides those golden opportunities for motivation from big brand owners and creating the one on your own by using networks and even partnerships and collaborations. To build networks it requires a set of strategies that we need to implement to make meaningful connections.

The initial step includes going out and getting exposure. This means to attend seminars, meetings, where we can meet like-minded people and professionals and simply connect with them. Connect to those who have the same goals as you and get knowledge and learn from them. These professional gatherings are the catalysts for personal and professional growth, which not only allows you to expand your industry knowledge and foster collaborations. Some other steps for networking include joining professional associations. A professional association is known as a membership based organization, which is used to promote and advance your profession or advancing what you are doing. There are many benefits of joining a professional association. It includes the setting of professional standards so that you are able to find the difference between low and high in terms of professional development. It also gives the opportunity for networking and connections. An individual can also apply for the completion of his/her education and professional development. We can even address any issues related to our profession and even provide resources for starting your own business. In this modern era where technology has made everything so easier and simpler for humans, networking is also possible while even staying at your home and not going out often. We can leverage social media platforms such as Instagram, Facebook, and Twitter to connect to like-minded people and step up our networking game. That's where the real magic happens. We can engage in conversations with people or organizations that help our business grow. There can be online workshops or conferences where owners can meet and share their life stories or even motivate you to keep going. We can even share content or exchange opinions on various matters of the business world.

The strategies for networking include the urge to look for advice and not favours. That is the best strategy you can use. Using people's opinions to solve your problems and seeing the problems from different perspectives. People are more likely to give advice than help out. Collaboration on different projects is also one of the ways to connect to

different individuals. We need to keep looking for ways and opportunities to exchange ideas and collaborate. This is the best way to strengthen relationships and make mutual benefits. Staying informed and engaged with your targeted ventures is also one of the ways to network and connect and can help to prepare you for the ideas on which perspectives you can connect. One of the real-life examples of successful networking is Oprah Winfrey. Her success is her brilliant talent for connecting and networking, which helped her in the media and entertainment industry. Her connections not only helped her to build a media empire but also erased every obstacle that came between her success. This is her ability to attract top talent and excellence. This is one of the best examples of how networking with people can make your way up to the top.

In the world of entrepreneurship, networking is like a ladder that you use to make your way up to the top and be the best of the best. When you are strong, it makes your life a little easier, and you learn a lot of things early and make fewer blunders. We get motivations and advice from top business tycoons that take you to the top with them. The main strategy is all about observing and looking for opinions instead of getting help. People have a lot to say, so taking opinions is better than asking for help in any of your matters. In the end, it is the most powerful step towards success.

EFFECTIVE MARKETING STRATEGIES FOR STARTUPS

Sukaina Hassan Naqvi

3809-BS-ENTR-24

The start of an entrepreneurial venture is the beginning of your exciting journey. It comes up with its own set of challenges and opportunities. To face challenges and obstacles in your venture requires creativity and having every resource that can help you out of the problem. Effective marketing to be one of the challenges of a viable business venture. The best possible way for effective marketing is to leverage digital marketing, social media, etc. Using these platforms in the best way possible and in the context of marketing is what makes a business successful. Marketing can be considered as the lifeboat of a venture. It is from where the startup is recognized and

the audience reaches out to you out. It creates the levels of who you are and why your venture matters. A lot of creativity and brainstorming techniques can help you out to receive the art of effective marketing. Our goal should not be attracting a large number of customers but to bring together potential customers that can help your venture grow, which not only creates a community, but they also advocate for your brand. Digital marketing is one of the biggest gateways that lead towards growth. It can be considered the backbone of every emerging or existing business. It not only lets you reach out to your target audience but is ideal for getting your customers to reach you out as well.

One of the aspects of digital marketing is the Search Engine Optimization (SEO). It helps you to build high-quality content, optimise your site with relevant words, and help ensure that your content is visible in a fast way. Building blogs and using the right keywords and names can also create traffic.

Pay per click (PPC) is also one of the domains of digital marketing, it is like renting a billboard digitally. You only pay if there is traffic. The process includes the placement of ads on Google or other apps where people can get free trial as well. That's when you pay for advertising. Email marketing is one of the tactics producers use to get recognized. It is the process of sending customized and personalized letters to potential customers in order to create traffic. You can create subscriptions by sending them emails and inviting them to join you. Creating a habit of regular emails can keep the customers engaged and joined, offering insights of any upcoming projects or products so that they are attracted. You can also share your entrepreneurial journey details. Lastly, affiliate marketing is also a win-win strategy where we pay other brands to promote your product in exchange for commission.

Social media marketing is also one of the latest ways to build connections in this digital era. By using social media as the marketing tool, producers can showcase their products as content and show their brands personality. With this, they can connect with their audience and gain feedback. It helps to create a community and creates engagement among producers and potential customers.

Now the question arises on which platform is best for which job. It is very important to choose the right platform. If you are starting something related to fashion,

Instagram is the perfect app to share stunning imagery of your designs. Meanwhile, LinkedIn is a professional platform for a business to business software looking to connect with professionals. The best possible way for successful social media marketing is the making of engaging content that connects with the audience. For example, if you are the owner of a makeup brand, you can create a reel on Instagram where you can use those makeup products and teach them how to use them effectively. Collaboration with other influencers who can use your product can also help you reach a larger number of customers. You can also use Tiktok for marketing.

Customers are used to consistent producers, so posting regularly is very crucial so that your customers can stay in contact. Paid social media ads are also one of the tools influencers use to showcase their products and gain traffic. Such as Facebook ads.

The most successful marketing is the mixture of both digital and social media marketing. It requires a blend of strategies and creativity where a larger number of audience members reach you and promote connections and attract potential customers. Together, these strategies advocate for successful startup ventures. The key is to stay consistent and adapt customers' feedback. And listening to your valuable customers' suggestions and their valuable needs.

ETHICS IN ENTREPRENEURSHIP: A DISCUSSION ON THE IMPORTANCE OF ETHICS IN BUSINESS AND HOW ENTREPRENEURS CAN MAINTAIN INTEGRITY WHILE GROWING THEIR COMPANIES

Zain Shahid

3837-BS-ENTR-24

Ethics can be defined as the way of life in which we are accountable for our actions, and we consider the well-being of others. It includes the awareness of the right and wrong, fair and unfair. All these principles are tooted in societal norms and philosophical teachings. These teachings can interfere in various parts of personal and professional areas, including business, medicine law, and daily affairs of life. In the end it is all about living a good

life and not harming others in any way possible. Ethics and entrepreneurship are closely linked together. An entrepreneur is not a person only looking for earning money and looking for links and networking. But making those decisions that work for the well-being of the citizens of a community. It is all about applying the laws of ethics to decisions that entrepreneurs make. Ethics is more than just principles they are the building blocks upon which trust, credibility, and reputation of anything is built. For entrepreneurs, being in a fast-paced environment and following such standards of ethics can be challenging, but trust me, it's very important, especially if you are ensuring a safer environment for entrepreneurship. Exercising ethics in business fosters trust among stakeholders and is an environment of trust and harmony without harming anyone. When a brand is rich in practicing ethical standards, more and more loyal customers are attracted as the brand demonstrates respect and honesty. In the very same way, the employees also feel safer in such an environment where there is transparency and fulfillment of ethical values. When investors are concerned, they also feel comfortable and easily invest and secure funding.

When a firm does not follow any ethical values and do questionable values, it causes harm to the firm's reputation and can damage the overall brand. We can even lose potential customers and investors. In some cases, there can be legal cases and the collapse of a strong brand. For example, if a company is accused of fraud financially or environmental violations, the government can ban the company, and it can lead to permanent shutdown. It causes unemployment and even damaging some parts of the economy.

Now, we should learn about the common ethical challenges for entrepreneurs. One of the biggest challenges is honesty in advertising. Sometimes, brands showcase something in the ads that are not presented in real life. Misleading customers for gaining customers is fraud. It can lead to customer dissatisfaction and a larger number of negative reviews. Now, if we talk about the work environment within the firm, the most common case of ethics is the mistreatment of employees. Some workers are treated nicely while some are treated like slaves. There is no equality; this act causes a very toxic workplace environment. This is not healthy for a successful firm. Data privacy is also an ethical job of the person responsible. Trust is extremely important in the

workplace so that the employees feel safe and comfortable.

Sustainability is a subset of ethical values, and those companies that don't value the health of the environment and make products that are harming the motherland are the violation of eco-friendly practices. It can lead to climate change, hence harming the health of humans.

There are many steps through which entrepreneurs can maintain integrity in the firm. The first step includes the establishment of clear values and guidelines that are strictly followed by everyone no matter of he/she is the owner. Following the rules is for everyone. This strict attitude can make everyone follow the rules, and no one violates them. Communicating these principles within the employees on a daily basis can make them take action on them and follow them.

Another step can be of the owner itself following and being an example infrastructure of the employees or workers he is with. Prioritizing transparency and sustainability is also one of the steps to gain ethical practices within the firm. There should be no misunderstandings among employees and owners. Admitting mistakes is also good for a healthier environment. Thinking for the safety of the environment can make large-scale protection of the environment and can save many lives, including humans and animals.

Practicing ethical values is a vital step for a firm to make its way to the top. It is not only beneficial for the employees but for the customers and investors as well. Thinking about the environment at the same time can save many lives and make a healthier and safer planet for both humans and animals.

COMPARING GLOBAL AND LOCAL ENTREPRENEURIAL ECOSYSTEMS OF DIFFERENT REGIONS

Muhammad Usman Arif

3815-BS-ENTR-24

Creativity and the thirst of innovation can be found in any region. Entrepreneurship can be found anywhere where there are resources and capital available, and people can come together to exercise innovation. When it comes to

the entrepreneurial activities of different regions, we can see that they shape the overall journey of startups and businesses. The entrepreneurial ecosystem is influenced by a number of factors, including culture, dynamics, and access to meaningful resources in our regions. The global entrepreneurial ecosystem is comprised of a network of innovation, individual talent, and most importantly, investment spread across the countries. Many countries are famous for their minerals or oils that attract entrepreneurs from around the world. Such as Silicon Valley in the United States, Shenzhen in China and Bangalore in India are attractive for entrepreneurs. They are famous for their diversity and high scale cross-border influence. The advantages of international entrepreneurial ecosystems are the availability of diverse and various markets. Entrepreneurs can even have access to international potential customers by operating within these networks. It helps for the international reach of customers to their product and earning profit as well as getting recognized. For example, if you start a business in Berlin, you can sell it in Europe as well as Northern America and Asia. It helps global outreach and diversify revenue streams.

Another opportunity that entrepreneurs can have is the availability of capital, venture capital firms, and angel investors. These are great sources for financing your business venture. This opportunity can give entrepreneurs to innovate in a bold way and have access to cutting edge technology. In the global ecosystems, we are also able to find rich talent that can help us gain feedback from talented entrepreneurs. There are a lot of opportunities for ideas and expertise. By gaining these, we can enhance our startups that can contribute to future success. For example, if we are doing a startup of hardware and electronics manufacturing. This breakthrough is the major breakthrough of products and services. Everything has its cons there. So, the disadvantages of global ecosystems are the factor of intense competition. It is one of the hurdles entrepreneurs face. It creates an atmosphere of pressure, which is not a positive thing. The pressure of outperforming can lead to having the highest forms of innovation so that we can stand out and win in this game of competition.

Additionally, the adaptation of different cultures when you are doing business outside your cultural premises can be complex. For example, a businessman from Bangalore looking to expand in Europe has to face the problem of

cultural differences when doing business with European customers and face the difference in consumer preferences and language barriers. On the other hand, their lies the local entrepreneurial system, these entrepreneurs are limited to the tight geographical region of their region, having intimate networks and strong connections between local markets. For example, Lahore in Pakistan, Helsinki in Finland. They provide unique opportunities for entrepreneurs.

The major advantage of the local entrepreneurial system is the ability to figure out customer preferences and customer tastes. By knowing your customers, you create products that they prefer; hence the customers buy more of your product increasing the revenue and profit. Being so rooted with the local community helps businesses to learn local needs and create something that is needed and filling the gap in the market. As Pakistan's economy is mainly agriculture based, we can make small-scale agri-tech startups that can be a solution for local farmers' problems. Making an impact overall.

Local ecosystems are also famous for the working of stakeholders, entrepreneurs, educational institutions, government, and local investors collaborating. This collaboration can give entrepreneurs access to grants, mentorship, or subsidies to support the local talent. For example, in Lahore, there is Plan9, which is a platform for budding entrepreneurs to bring their ideas to life. Another advantage of local ecosystems is the lower cost of production when compared to international ecosystems such as New York or London. The land, labour, and capital are affordable. The reduced cost acts as an advantage for startups that have a slightly tight budget.

The disadvantages of local ecosystems can be the availability of investors and talent. Some entrepreneurs might want to take higher risks, but there's not enough capital, which is a disadvantage. Entrepreneurs find both local and global ecosystems beneficial. Building roots in both can be beneficial as it opens doors of success and customers reach.

FUNDING OPTIONS FOR STARTUPS

Meerab Jamshaid

3803-BS-ENTR-24

Entrepreneurship is a process of creating and developing a viable business. It requires risk-taking and filling the gaps in the market. Now the question arises in which area is there the possibility of risk.

An entrepreneur takes the financial risk of starting a successful business. It is all about making the investment money work. Startups only work on the financial resources. The money invested provides the fuel for the business to keep going. There are several options for funding a startup. Whether it is attracting seasoned investors or relying on crowdfunding, it all shapes the general tracks of the startup. There are other options as well, including venture capital, angel investors, and crowdfunding. They all come with their set of opportunities and challenges.

The most famous and the best option is venture capital. Venture capital are firms that fund startups that have the potential to grow and promise a high growth rate and profit. In Exchange they have a share in equity, which typically means they have partial ownership of the startup. Venture capital typically invests in tech, healthcare, and problem-solving ventures. They have the most chance of rapid growth. Now, the most important thing about venture capital is that it doesn't only about investing the money but a collaboration and buildup of connections and networks. Venture capital always brings with them mentorship, guidance, and connections to markets and partners. This happens whenever they invest their money in a viable startup. For example, if you are going to start an AI based customer service, the venture capital will introduce you to a number of different tech specialists. This will help you gain further knowledge and lead you towards excellence. The challenges that we face while going for the venture capital option are the number of times we have presented our idea and product, and each time, the pitch should be better than the other. This makes the whole process highly hectic and can cause stress to do better and be able to represent in a more excellent way.

Another negative aspect of venture capital is the involvement of venture capital in the ownership of your startup. By owning some part of your venture, they can

make changes even if you are not willing to do so. The decision-making process becomes complex, and there are chances of conflicts.

Angel invest is another option for funding. These are investors typically supporting entrepreneurs who are passionate about what they are doing. The word Angel is the highlight as it means helping out without the person knowing. Angel investors typically back up those ventures that have the potential to succeed and gain profit. In exchange they have some percent of the equity or even convertible debt. Angel investors are independent without any firm and do the budding part of the startup, which is the starting point of the startup.

The angels are attracted to passionate entrepreneurs as they believe that these entrepreneurs have the potential, and their product or service will succeed in the market. They also provide mentorship and guidance. For example, an angel investor will surely invest in a startup that works for sustainability and eco-friendly products. Angel investors themselves have a lot of experience and can do the mentorship themselves.

The negative side of angel investing is kind of the same as venture capital which is the share in the ownership and decision-making processes.

Crowd funding is also one of the trusting options for funding your business. It is defined by presenting your ideas to the crowd and gaining investors in exchange. There are several platforms where we can do crowdfunding. The common ones include Kickstarter, Indie gogo, and Go fund me. In crowd funding, the entrepreneurs mainly give rewards and equity in exchange for the funding. Reward based crowdfunding includes the offering of free products or early access of the product the entrepreneurs are making. This is the most popular one. The best example can be a mobile phone firm presenting their products first to the crowd funders with a lot of discounts. This leads to community buildup and brand ambassadors. The drawbacks of crowdfunding are the planning and execution. Crafting a pitch and presentation of your idea so that the crowd is impressed.

Funding options are many, and choosing the right options is what the whole game is about. It also depends on at what stage you need investment. If you are in the very early stage, angel and reward based investment is suitable.

If you are in your growth stage, you can go for venture capital and equity crowdfunding.

FROM A KIRYANA STORE TO A RETAIL EMPIRE: THE SUCCESS STORY OF IMTIAZ ABBASI

Mustafa Umer

6999-BS-FINTEC-24

Imtiaz Ali opened a small store in Lahore. Little did he know that this would become the beginning of a vast empire and the founder of Pakistan's largest retail chains. This is a captivating story of how Imtiaz Abbasi modified a small grocery store into a business empire through hard work and commitment to customer satisfaction. Imtiaz Abbasi was born and raised in Karachi. He belonged to a middle-class family, and from a young age, he was surrounded by the market culture of Karachi, his father was the owner of the Kiryana store in Bahudurabad, Karachi.

Customers considered the Bahadurabad store small and congested. During the expansion period, he designed his store to be more spacious and well-organized; the goal was to provide a pleasant hassle-free shopping experience. As far as the variety was concerned, he began to introduce a range of products, including household items, clothing, and tech goods. To make customers' experiences more valuable and to gain potential customers, he decided not to limit the transaction to Rashan only, but rather provide a more fun experience for consumers. Providing quality, variety, and affordability. This was to ensure a full customer experience. He saw this as an opportunity to expand his business. Using this strategic move transformed his small store, attracting a larger number of customers, and proving that his venture was all customer-centric, which made his store a favorite place for customers. Imtiaz Abbasi's commitment to the satisfaction of the customers played a vital role in the growth of his business. He knew that the success of any retail store was dependent on loyal customers and their blind trust, so he made sure he fulfilled those requirements.

Recognizing the potential for further expansion, Imtiaz Abbasi planned to open several branches in various cities

across Pakistan. It was the ultimate move for the prominence and a leading retail chain in the country. This was remarkable growth, and his vision was becoming a reality.

The point to be noted in Imtiaz Abbasi's journey is the concept of a loyal customer base. He achieved that goal by providing discounts and loyalty points. According to him, he gives 30 percent of the profit they earn through discounts on the products he is selling and gains potential customers. There are also times when the inflation rate is high, but there are no price variations, which attracts more customers. This initiative not only boosted sales but also strengthened the consumers' loyalty.

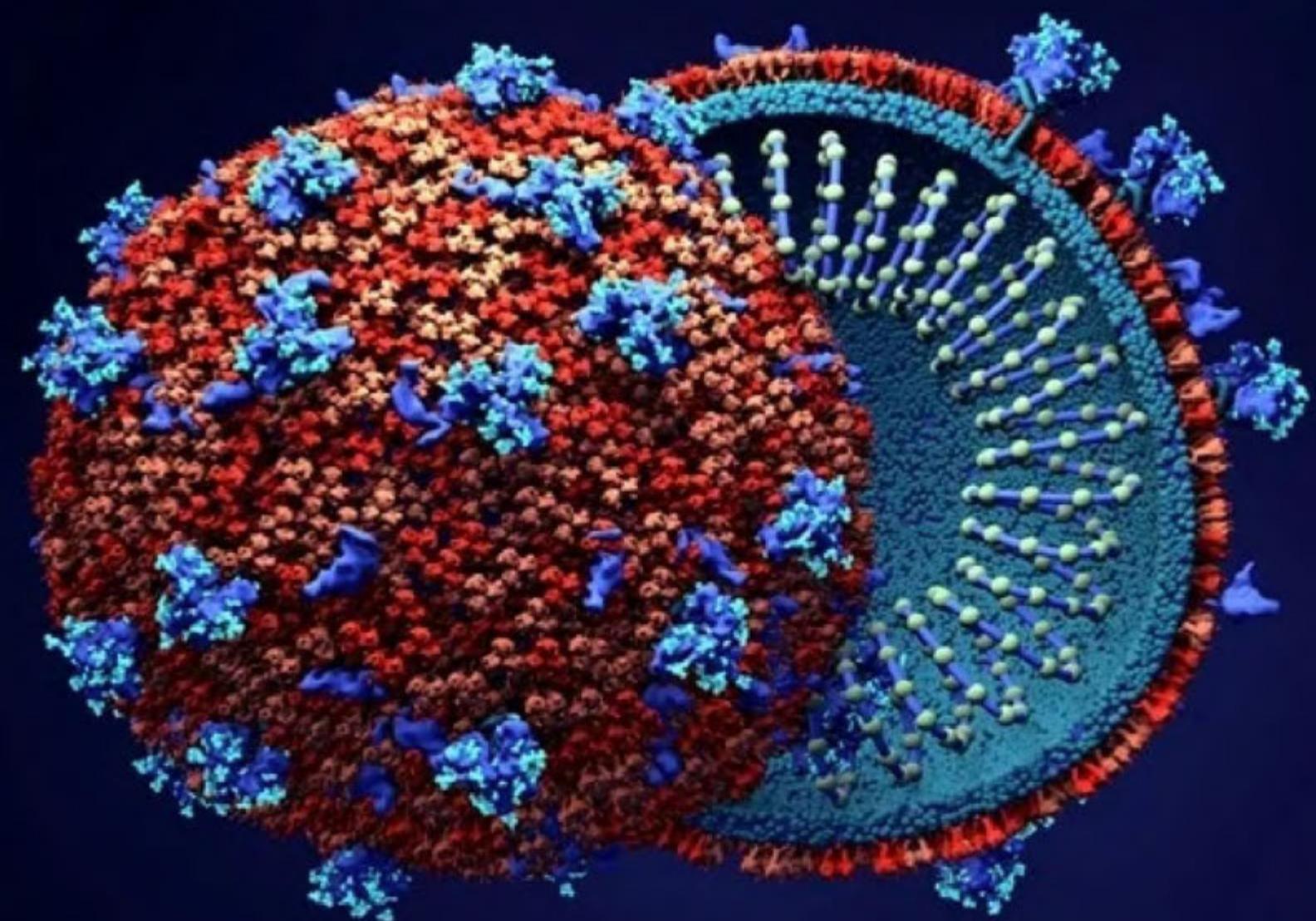
Imtiaz also embraced technology and made the shopping experience better by providing home delivery services through the website. It made it convenient for consumers to shop conveniently by sitting at home. This shift has abolished the need to visit physical stores, saving time and effort to stop by, saving time and effort, and providing a comfortable shopping experience. Imtiaz Abbasi's journey is marked as a success, but not without challenges. Indeed, the retail industry is highly dynamic, and he has had to overcome various obstacles to be the best out there. Changing consumer preferences, economic shifts, and high competition were some of the challenges he had to face along the way.

His journey offers valuable lessons to both current and future entrepreneurs. One of the major lessons is the importance of having a clear vision, tenacity, and resilience and working tirelessly to achieve it. His commitment and his talent for consistency were instrumental in his success. Another important lesson to learn is the significance of customer centricity. He believed that by prioritizing customer needs and delivering exceptional service, he built a strong and potential customer base that contributed to his journey. Furthermore, the ability to adapt and be flexible to the changing dynamics of the market and change according to the technology and customer needs played a crucial role in the growth of the Imtiaz Superstore.

Today, Imtiaz Superstore is one of Pakistan's largest and most successful retail chains, serving thousands of customers in Pakistan. His legacy continues to inspire aspiring entrepreneurs, proving that dreams, no matter how humble they begin, can grow into something vast. This success story of Imtiaz Abbasi is a reflection of the

possibility that lies within each individual. With the right mindset set, consistency, and customer-centric approach, anyone can achieve their entrepreneurial dreams and create a legacy and impact on their industry and community.

MICROBIOLOGY



2024: YEAR IN REVIEW

Jan

- Scientists discovered the new class of life that was being known as Obelisks in the human digestive system, that has an impact on human health.
- The IFSAC reports emphasized that the dairy and produce account for more than 75% of listeria-related illness in the U.S.

Feb

- Scientists discovered new bacterial marine species, including *Santjordia pagesi* and *Vedumodiolus teredinicola*, expanding the knowledge about marine biodiversity.
- Cresomycin, a novel antibiotic, was proved effective against drug resistant bacteria, offering new treatment possibilities.

March

- Researchers developed a method to remove HIV from infected cells that was a breakthrough in potential cure strategies.
- A study proposed ecological strategies for preventing spillovers and reducing future pandemic risks.

April

- Scientists described the mechanism that how tardigrades protect themselves from exposure and damage of radiation at large scale that can be repaired quickly using Dsup protein.
- A nitrogen fixing organelle i.e. **Nitroplast** was identified by the researchers in marine algae advancing the knowledge of organelle evolution.

May

- A study indicated that the Fish Oil omega-3 supplements could increase the risk of Stroke and Atrial fibrillation.
- A selective antibiotic was developed by the scientists that targets the gram negative bacteria but at the same time preserving the gut microbiome.

June

- Group of scientists warned of creating **Mirror Bacteria**” citing potential catastrophic risks globally because it has the ability to evade immune responses.
- The genetic mutations in *Vibrio cholerae* were identified by the researchers that helped in understanding its transmission and severity.

July

- The first mouse model was formed with a complete functional human immune system that enhanced the research capabilities in immunology and disease studies.
- Study revealed that the polymetallic nodules have the ability to produce oxygen without light on the abyssal seafloor.

Aug

- Researchers grew cellulose from *K. hanseii* bacteria on the International Space Station over four weeks. This could enable large scale production in microgravity for use in construction, clothing and energy supply.
- The WHO declared the Monkey-pox as a public health emergency of international concern for the second time.

Sep

- Researchers developed a new method when they merged confocal fluorescence microscopy with microfluidic laminar air flow that had the ability to detect nanoparticles and viruses quickly.
- A systematic analysis predicted that Antimicrobial resistance can cause 39M deaths worldwide between 2025 and 2030.

Oct

- Researchers developed plant based food supplements to protect the brains of bees from neurotoxins.
- Scientists developed the artificial plants with leaves by the use of biological solar cells that can perform respiration, photosynthesis and even generate electricity.

Nov

- Measles cases were reported to have surged across the world, with an estimation of 10.3 M infections, a 20% increase from 2022.
- Northern and central parts of the Great Barrier Reef were reported to have suffered their worst coral bleaching on record, with upto 72% mortality.

Dec

- A new light induced gene therapy method using nanoparticles was introduced to target the mitochondria of the cancerous cells.
- Researchers in South Korea demonstrated a unique way to revert cancer cells back to normal cell, healthy cells, by using simulations to identify master molecular switches involved in the cell differentiation.

MOVIE REVIEWS

CONTAGION (2011)

Sana Muqadus

1292-BS-MB-22

The movie Contagion released in 2011 was filmed by inspiration from the real life virus known as Paramyxoviruses such as Nipah and SARS that spread by the aerosol route. Later this movie resembled the pandemic of Covid-19 and its effects on human and economic health worldwide. As Covid-19 and paramyxoviruses both are said to be spread from the animals especially Pigs and Bats i.e they are zoonotic. This movie shows the rapid spread of deadly fictional virus MEV-1 that kills the person within a few days. At the start of the movie, Beth Emhoff, a woman who comes back from a business trip in Hong Kong doesn't know that she was carrying a new virus. Later on she dies and her husband Mitch Emhoff discovers that this infection is spreading worldwide. As he lost his wife and son, he moved to another place for the safety of his daughter. Then this movie shows the scientists from Centres of Disease Control and Prevention (CDC) and World Health organization (WHO) working to find the treatment for the viral disease. Meanwhile a blogger tries to spread false information regarding the MEV-1 virus and its cure. One of the most amazing and remarkable aspects of this movie is its scientific accuracy regarding the methods and development of vaccines based on real life medical research and practices. Moreover, it shows the spread of virus by the fomites - contaminated surfaces that are frequently touched by the people and are the potential sources for the interaction and spread of the virus. Beyond its scientific depth, it portrayed a psychological and societal impact of the pandemic in which the people were under stress of great fear and were panicked. People started to buy and stock food items and medicines, causing social unrest and lack of trust in authorities. This movie also marked the importance of precautionary measures. At the same time, the movie also represented the doctors, scientists and nurses as a symbol of heroism working tirelessly for the people and putting their lives at risk for the sake of humanity. Dr. Erin Mears, a dedicated and hardworking epidemiologist dies while looking for the pattern and cause of infection as she suffered from the same infection she was studying. Overall this movie is masterfully crafted in a way that combines scientific accuracy with intense storytelling. Due to strong performances and that much accuracy regarding science and the techniques used in it, this movie can be of great attention for the people interested in both science and arts. The blend of reality and fiction of it has made it one of the most impactful films in the genre.



OUTBREAK (1995)

Syeda Dua e Fatima

1267-BS-MB-22

A world that is being destroyed by a little virus about a size of a few nanometers sounds terrifying and somewhat unbelievable; this movie depicts exactly the same terrifying situation that has prevailed worldwide. "The outbreak" is directed by Wolfgang Peterson starring Dustin Hoffman, Rene Russo, Morgan Freeman, Kevin Spacey is an exciting thriller that has captured the audience through the terrifying experience of pandemic. Released in 1995 this movie has been able to keep its viewers on edge. This film is a perfect blend of action, thrill and suspense.

The film centers on Colonel Sam Daniels, a talented epidemiologist who is working against the clock to prevent a deadly virus from destroying civilization. A small town is the beginning of the outbreak, which swiftly spreads and causes chaos and fear. A team of doctors, scientists, and survivors come together to try to find a cure while governments struggle to control it. Tensions between the desperate survivors attempting to flee and the infected increase in the meantime. The narrative is more than just a straightforward disaster movie because it is full of poignant scenes, fast-paced action, and moral quandaries.

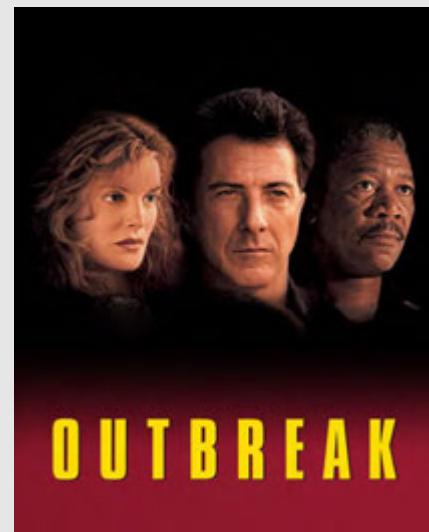
The direction of movie makes it more exceptional. The pace of this movie is fast which creates an environment of pure horror and impatience which makes the exact scenario of how a pandemic feels. This screenplay makes the views hooked to the screen as if they are themselves experiencing it. With powerful dialogue that gives the characters nuance instead of making them seem like stereotypical disaster movie clichés, the screenplay is captivating.

Particularly Dr. Roberta, who portrays the resolute doctor, gives strong performances. They convey fear, frustration, and hope in a way that seems real. Particularly in scenes with a lot of emotion and stakes, the supporting cast, which includes Colonel Sam Daniels, Major Casey Schuler, General Billy Ford, General Donald McClintock, Jimbo Scott, Dr. Benjamin Iwabi and Major Salt excels. Some of the supporting characters, though, feel like they are there merely to participate in the chaos, so they could have been given more depth.

The Outbreak examines themes of fear, selflessness, and human resiliency in addition to action and suspense. It calls into question the authority of the government, moral judgments during emergencies, and the ways in which individuals respond to stress. It's a commentary on contemporary issues as well as a thriller.

The Outbreak is a gripping film that captivates you from beginning to end. It's powerful, thought-provoking, and visually stunning. You can relate to the characters because the actors give the story genuine emotion. Even though a few scenes are predictable and some characters could have used more development, these are minor complaints in light of the film's overall high level of interest. This is unquestionably worth seeing if you like disaster thrillers like World War Z or Contagion. You won't forget this thrilling and tense ride.

The Outbreak is a masterfully written pandemic thriller with a gripping plot, excellent acting, and tension. It's about human nature in times of crisis, not just about surviving. This film is worth seeing regardless of your preference for realistic thrillers or action-packed dramas. Four out of five stars.



MYCO-ARCHITECTURE: A SUSTAINABLE APPROACH FOR MARS COLONIZATION

Dr. Saba Sana

**Department of Microbiology, Dr. Ikram Ul Haq
Institute of Industrial Biotechnology, GCU Lahore**

Mars, the mysterious red planet is calling and humanity is ready to answer. IS LIFE REALLY POSSIBLE ON MARS? Maybe? The Red Planet" (MARS) is a neighbouring planet of Earth and at an average distance of 142 million miles from sun. Sun light travels 13 minutes to strike the MARS surface. Because of thin atmosphere this planet fails to retain heat making planet environment super cold. The average range of temperature is from 20 C to -153C. Dust storms are frequent on MARS surface which results in suspension of particles in atmosphere for several months and colors Martian skies tan in photos. So, it is like a desert and blasted by radiations from sun. Beside of neighborhood a huge difference exists between earth and Mars atmosphere. Earth atmosphere have nitrogen (78%), oxygen (21%), argon (1%), carbon dioxide (0.04%) and traces of other gases. This combination supports life on Earth. However, on Mars carbon dioxide is prevalent gas (95%) followed by nitrogen (3%), argon (1.6%) and traces of oxygen, water, carbon mono oxide and other gases. Other variable between two planets is atmospheric pressure (1013 millibar on Earth and 6-7 millibar on Mars). Water the basic indicator of life abundantly covers earth in liquid form (oceans) and in permanently frozen form called Permafrost in Arctic and Antarctic regions. According to reports underground water exists on Mars, which is 1.5 miles near equator and 04 miles in polar region. This frozen water is termed as Cryosphere. Above facts indicates that it is extremely difficult for most known life forms to survive on extreme condition of Mars. Some researchers have analyzed images from Mars Preserverance rover and claimed to have found an evidence of fungus-like organisms similar to Puffballs (Basidiomycota). These structures appear to grow up-to 300 meters resembling mycelia (thread like structures in fungus). This claim was criticized by scientific community. However, the more research and exploration is needed to rule out the possibility of fungal life on Mars. However, the resilience nature of certain fungi to extreme temperatures and radiations supports the possibility of fungal survival in extreme condition. This makes fungi an

ideal candidate for growing habitat on Mars. Three approaches can be used for habitat on Mars. First approach is to construct habitat by supplying the construction material from Earth. Which demands a high cost (launch of one kg material requires 10,000 US dollars). Second to construct what already have on planet (regolith), it requires heavy machinery to launch. Third approach is to grow habitat rather than construction. The Myco-architecture project of NASA is based upon third approach and is working on prototype technologies to grow habitat on Mars. The main component of fungi is mycelia. These mycelia will help not only to build a viable home for astronauts but also to meet their basic needs on distant world. The mycelial will built a home rather than a shell which will have its own ecosystem. But astronauts and fungal mycelia needs food and oxygen (trace amount on Mars). Here comes in Cyanobacteria for support which can convert water and carbon dioxide into oxygen and food.

So, the concept of Myco-architecture is an elegant habitat with three layered dome as home. The outer layer is made up of frozen ice followed by second layer of Cyanobacteria and third layer of fungal mycelia. The water will give protection from radiation and trickle down on second layer (Cyanobacteria). Cyanobacteria will use water and light reflects on icy layer for photosynthesis and liberate oxygen for astronauts and food for fungi (3rd layer). Now the question is, how the mycelia are converted into building material for third layer? The third layer material will be prepared by coating the dehydrated fungal spores on a basic framework (lightweight and will be launched from Earth) like a turtle (carrying home on back) and activation by water using rovers on surface. During this process mycelia will grow and penetrate/entangles into basic framework to form a compact home on basic framework. This material will be backed to kill mycelial life so that these may not contaminate Mars environment. Other than buildings/homes communities will need their own food sources to survive on Mars. Again, fungi are there for their help. The diverse enzyme profile particularly degrading enzymes of fungi will help to dissolve the carbon rich asteroids and convert them into soil where astronauts / communities can cultivate crops for food. Fungus can be used for mining minerals from sewage water.

So, it is concluded that human colonization on Mars is no more a science fiction. Long term efforts with significant advancements in technologies can help to achieve this goal.



Image: Bricks produced using fungal mycelia, yard waste and wood chips as a part of the Myco-architecture project

(Credits: NASA)

THE ALARMING RISE OF HIV/AIDS IN PAKISTAN: CHALLENGES AND THE WAY FORWARD

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Human Immunodeficiency virus (HIV) is a member of the family *Retroviridae* that primarily infects CD4⁺ immune cells. There are two major strains of the virus, named as HIV-1 and HIV-2, where HIV-1 being the most prevalent. The mode of the virus transmission is through exchange of body fluids such as blood, semen, and breast milk. In the chronic stage, HIV leads to Acquired immunodeficiency (AIDS). The symptoms of AIDS are nonspecific and diverse, depending upon the stage of infection, which includes fatigue, loss of body weight, skin rashes, diarrhoea, and enlarged lymph nodes. The neurological symptoms may include dementia,

neuropathy, and seizures as the virus affects the nervous system. In Pakistan, since the first HIV case reported in 1987, the virus has spread rapidly, as of now, 210000 people are infected with the virus, while this number is said to be quite low as compared to actual cases due to the social stigma and cultural pressure. The national AIDS control program reports that Punjab (75000) and Sindh (60.000) are home to the majority of people living with HIV, while Punjab is at the top. Rest of the percentage of vulnerable population where the HIV epidemic in Pakistan is concentrated are: 38.4% in people who inject drugs, 7.5% in transgender sex workers, 5.6% in male sex workers, 5.4% in men who have sex with men, 2.2% in female sex workers.

Several factors contribute to the spread of HIV/AIDS in the regions, including low literacy rates, poverty, and a lack of awareness about the disease. The Pakistan healthcare system is fragile and facing many challenges in combating HIV/AIDS. The social stigma, lack of concrete prevention programs, poor surveillance. The improper disposal of the medical waste specially infectious waste constituting 10-25% of the hospital waste, is posing significant risk of virus transmission and spread. Alarmingly, most of the hospital waste is being dumped at community sites or sold to dealers exposing scavengers and the population is exposed to the material. To combat the HIV/AIDS epidemic in Pakistan, the National AIDS Control Program has started a number of projects. Priorities for successfully managing the pandemic are outlined in the National Strategic Framework for HIV/AIDS, which was also created by the government. These consist of free HIV testing and treatment, mobile testing vans, and community-based organisations. Improving testing and treatment facilities, raising awareness and education, bolstering surveillance and monitoring, and increasing financing and support are all critical to addressing Pakistan's growing HIV infection rate. To put these policies into effect and give HIV prevention and treatment programs top priority, the government, medical community, and local communities must collaborate. To encourage self-testing among medical professionals, privacy and confidentiality issues related to HIV testing should be resolved.

HIV transmission knowledge varies significantly among individuals. A study conducted in Lahore among the youth revealed that while 95.2% of males and 76.9% of females were aware of HIV/AIDS, understanding of its

transmission modes was incomplete. Nonetheless, there were still misconceptions about ear piercing (erroneously perceived as a transmission mode by some females), sharing utensils (perceived by some females as a transmission mode), and casual contact like touching or handshaking (erroneously identified as a transmission mode by some females). Compared to women, men showed noticeably greater understanding of HIV transmission mechanisms. The AIDS epidemic requires immediate action. By implementing attentive intermediation, it is possible to decrease the HIV prevalence and improve the life for those who are infected by it. Long-term measures dealing the underlying economic and social problems are also essential to controlling the transmission of HIV/AIDS in Pakistan. The government, healthcare professionals, and local communities must work together to address this growing public health concern.

MYCOTOXINS: A HIDDEN AND SILENT POISON CREEPING FROM CROPS TO CUISINE

Memoona Sajid

1278-BS-MB-21

Imagine you are eating your favorite food, and someone told you that you are eating poison instead of food. What will you respond to???

Yes, we have read this right. We eat poisons in the form of food.

Introduction

Every organism that is living on this planet earth is producing something that is not only beneficial for us but has some hazardous effects on us, and the effects of toxins are one of them. Toxins are basically those substances that are produced by different organisms such as plants that produce toxic metabolites called **phytotoxins**. Exactly like these organisms fungus which is a microorganism produces toxins that are called **-mycotoxins**. The respective fungi that produce mycotoxins are called toxigenic fungi. These toxigenic fungi have the ability to **colonize crops**, gather **bioactive** compounds in their products, and **infect** them. According to the food and **agriculture organization**,

25% of the total food and crops produced worldwide are **contaminated** by mycotoxins. Mycotoxins are secondary metabolites secreted by filamentous fungi. Research has shown that these metabolites might act as virulence factors, increase the ability of fungal survival, increase pathogenicity of the plants or act as chemical signals among fungal species. Mycotoxins are also found in animal diets. There are **200** species of **molds** that produce mycotoxins, and the effects of these mycotoxins on food are **acute**. The main and most problematic issue regarding these Mycotoxins is that they not only have hazardous effects but are also difficult to **avoid** and **eliminate**.

Various Fungi and Mycotoxins

Several classes of fungi produce mycotoxins in different crops, including *Fusarium*, *Aspergillus* and *Penicillium*. *Aspergillus* produces **Aflatoxins B1 (AFB1)**. *Fusarium* produces three important classes of mycotoxins: trichothecenes, fumonisins, zearalenone (ZEA) likewise *Penicillium* which produces a variety of mycotoxins, including Ochratoxin A and patulin. *Alternaria* produces mycotoxins such as; altenuene (ALT), alternariol (AOH), tenuazonic acid (TeA), and tentoxin. Among them Ochratoxin, patulin, aflatoxin and zearalenone are agriculturally important. *Cercospora* is a unique type of fungi that produces toxins when exposed to light. *Cercospora* produces photosensitizer toxins that are called **Cercosporin**. These toxins are activated by light and produce reactive intermediates of oxygen.

Factors Alleviating Mycotoxin Production

Several elements contribute to the production of mycotoxins in food crops, such as environmental conditions which include various factors including temperature, humidity, rainfall, changes in the climate. Agricultural Practices such as methods of crop rotation, irrigation, and harvesting as well as conditions of storage, genetics of plants, and susceptibility.

Foods / Crops Susceptible to Mycotoxins

In a **three year study** the most susceptible or sensitive food items determined in which mycotoxins can build up are ripening corn, cereals, soybeans, sorghum and peanuts wheat and dried distiller grains .The identification of mycotoxin in finished feed samples from the regions of Americas, Europe and Asia were done by surveyed them, which revealed the presence of various mycotoxins

weighing different percentage concentration such as fumonisins (FUM) (64%), deoxynivalenol (DON) (59%), zearalenone (ZEA) (45%), aflatoxins (AF) (33%), and ochratoxins (OT) (28%).

Mycotoxins VS Economy

Every year this mycotoxins contamination in crops and feed causes destruction at magnificent levels such as reduction in crop yield, loss of billions of dollars worldwide, livestock illnesses, and adverse effects on human health. According to estimation, the economic loss of mycotoxin-contaminated animal feed and livestock is **243 million** dollars in the US.

Mycotoxins VS Health

Recent research on the effects of mycotoxins showed that the ingestion of these mycotoxins from crop or animal feed causes massive destruction of health. According to previous studies, ingestion of chronic **aflatoxin** causes **liver cancer** and the consumption of **zearalenone** (ZEA) causes excessive **estrogen** hormone excretion in the body, the exposure to **deoxynivalenol** (DON) causes **inflammation** in the **stomach** and **gastrointestinal tract**, which results in **infectious diarrhea** and immunotoxicity. The ingestion of Ochratoxin A causes kidney disease or damage to kidney tissues. The ingestion of chronic fumonisins (FUM) causes cancer of the food pipe or in other words, **esophageal cancer** and birth defects such as neural tube defects.

Summary

The removal of detoxification of these mycotoxins is necessary as it targets the two main components; the economy or health. In particular, countries whose GDP depends on agriculture. Mycotoxins cause contamination of crops which results in destruction of agriculture resulting economic loss in economy. By ingesting these contaminated crop based food items, disastrous health issues can occur.

MICROBIAL FORENSICS: SOLVING MYSTERIES WITH MICROORGANISMS

Naira Kashif

1203-BS-MB-21

Introduction

Anthrax spores surfaced in a series of letters sent to media offices and government buildings at the turn of the year 2001; these attacks culminated into five deaths and sent terror across America. The foundation of the later investigation was ruthless scientific theory: microbial forensics, a new yet fundamental field applied to identify the strain of the anthrax to its origin. Its potential in applying microorganisms are the power this new field reveals in forensic science.

Fingerprinting and DNA profiling were methods used to assist in the solving of crimes and forensic science has always had a place. Recently, however, a new frontier has developed: microbial forensics, which examines microorganisms in order to help solve crimes, evaluate the environment, and detect bioterrorism. This article discusses the scientific principles, technology applications, case studies, and future prospects of the discipline of microbial forensics.

The Science behind Microbial Forensics

Microorganisms include bacteria, viruses, fungi, and archaea. These, type of organisms are found on humans, within soil, water, and in the air. Their presence alone and the things surrounding them are enough reason to conduct microbial forensics.

Every environment contains a specific community of microbes that depend on variables like temperature, humidity, and human activities. A person leaves a microbial signature in the form of particular microbes on their body and those exhaled with their breath when they walk through a particular area. Furthermore, different kinds of microorganisms found in forensic specimens under examination, such as soil, water, or even biological fluids, may be able to connect the sample to a specific location or even a specific individual. In order to establish connections between a suspect, victim, and crime scene forensic scientists utilize microbial profiles from different sources. Metagenomics

is the branch of science that deals with the techniques of producing metagenomic evidence which is defined as a sample of DNA from a certain environment. Through the use of PCR, microbial DNA can be amplified and hooked up to a specific forensic case.

Applications of Microbial Forensics

Forensic microbiology is helpful in a lot of domains, such as food safety, environmental protection, bioterrorism, and even criminal investigations.

Investigation of Crime Scenes: Microbes assist in establishing the time of death, tracking specific persons and even setting up a homicide. The human microbiota which included the appertaining microbes located on the skin and region of a body changes post death to some degree. We are able to build the sequence of microbes in corpses throughout their decomposition. Furthermore, certain microbes which exist in soils or waters can on their own or together be utilized to strategically locate a crime scene.

Identification of Biological Hazards: Bioterrorism circumvention requires forensic microbiology techniques. This is critical for microbiologic agents such as anthrax, smallpox, and botulinum where pathogenic damage can be done on mass scales. The death by anthrax in 2001 revealed the protective forensics outlook of microbes to the country.

Safe Food Assurance: The protection of food from contamination and the guarantee of its safety is a difficult endeavor.

Case Studies and Examples

The 2001 Anthrax Attacks: After the anthrax letter attacks, microbial forensic specialists sequenced the strains of *Bacillus anthracis* involved in the attacks against laboratory strains, which ultimately led them to a biodefense scientist. They were able to provide a list of primary suspects and solidify the role forensic microbes could play in the security of a nation.

Foodborne Illness Outbreaks: In 2011, Europe was overtaken by an *E. coli* outbreak. Microbial forensic techniques were executed in the detection of the source of infection and absolutely prevented the cases from spreading any further because of contaminated fenugreek

seeds that were located. This heightened the level of safety concerning food hygiene.

Environmental Crime Investigations: With the use of microbial forensics, particular strains that hydrolyze the hydrocarbons present in oil have helped identify the source of contamination in oil spills. The bacterial signature diversity allows for easy identification of the origin of the oil spill. This approach was used in tracing oil contamination after the occurrence of the Deepwater Horizon disaster in 2010.

Challenges and Future Directions

- In microbial forensic examinations, consistency and reliability is difficult due to lack of standardized protocols.
- The interpretation of results is particularly difficult due to the great level of dynamics of microbial communities. In legal cases, communicating these findings presents further complications.
- Inquiries regarding the case will benefit from the integration of microbial forensics and other forensic disciplines, including molecular biology, DNA forensics, and forensic toxicology.

The integration of machine learning as well as artificial intelligence, in addition to new sequencing technologies, will facilitate the developing of forensic biology methods making them even quicker and more accurate. As a result, the world will be able to enjoy wider applications in criminology, national defense, and ecologic system contamination mitigation.

Conclusion

Microbial analysis is substantially transforming forensic science, whether it be through detecting environmental offenses or aiding in criminal investigations. With time, microbial forensics will be more and more important in enabling the world to maintain public health, national security, and resolving offenses.

QUORUM SENSING: THE SECRET LANGUAGE OF BACTERIA

Irum Sughara Dar

1223-BS-MB-22

Introduction

Imagine a world without voices where people have code signals for communicating with each other. You might be wondering what type of organisms communicate without voices and words as it is the basic need of communication. But humans' communication pales in comparison with bacterial communication. Bacteria use a sophisticated system of invisible signals to communicate with their kind. This is more like a secret language that aids them in carrying out their life processes. By diving deep into this language, we might be able to discover new strategies in the field of microbiology and biotechnology.

The Mechanism of Bacterial Speech

Quorum sensing is not present in all bacteria. It is mostly used by pathogenic bacteria while non-pathogenic bacteria may use other forms of communication. Quorum sensing bacteria use specific chemical signals to speak, listen to their surroundings and make decision. There can be various systems involved in quorum sensing. In this neighbor communication, bacteria release and sense chemical signals called auto inducers to process cell to cell communication which enables them to coordinate. These signals are termed as the "language" of bacteria. The amount of released auto-inducers is directly proportional to the numbers of growing bacteria i.e. cell density. Once a certain amount of auto-inducers has been released, it acts as a threshold stimulus for bacteria to adjust gene expression accordingly. Thus bacteria cannot interact or produce auto-inducers when the cell density is below the threshold. Bacteria release these signals into extracellular matrix and their accumulation is sensed by specialized bacterial receptors. These auto-inducers specifically work by activating the transcription factors which causes the turning on of a particular gene by whole population. Quorum sensing is a collective decision making process leading towards more accuracy as compared to the accuracy acquired by individual assessment. To understand this collective influence, let's take an example of social media trends. When an event happens, many individuals start talking about the same

event at the same time. Soon the event gains fame and becomes trending on social media platforms. This is how accumulation of individual actions may lead to collective outcome. Similarly, bacteria assess their environment individually and share their information by releasing and sensing auto-inducers. When the amount of auto-inducers reaches the threshold point, they know its perfect time to take collective action.

Biological Significance

Quorum sensing is valuable for its role in various processes involving bioluminescence, enabling access to nutrient rich environments, competing non biofilm producing bacteria by aiding in biofilm production, production of spores, conjugation, antibiotic resistance, and virulence factor secretion for inducing pathogenicity. *Aliivibrio fischeri* was the first bacterium that showed the role of quorum sensing in bioluminescence. *Staphylococcus aureus* uses Agr (accessory gene regulation) i.e. a type of quorum sensing to increase the inflammation in humans' gut in order to breach nutrient rich sites. This system regulates and produces virulence factors in *Staphylococcus aureus*. In mostly gram negative bacteria the major group of auto-inducers involves acylated homoserine lactones (AHLs). *Burkholderia cepacia* and *Pseudomonas aeruginosa* are involved in the formation of biofilm in the lungs of patients suffering from cystic fibrosis. This biofilm production is induced when these two species communicate by using acylated homoserine lactone auto-inducers for communication. It is also an example of interspecies communication. In gram positive bacteria mostly used auto-inducers are autoinducing peptides (AIPs). *Bacillus cereus* uses this quorum sensing system to activate expression of genes that are responsible for production of enterotoxins.

Applications

Quorum sensing has various applications in the field of biotechnology. As it triggers many life processes and the activation of gene expression in bacteria so it can be a great target for antibiotics leading to infection control. Quorum sensing system of bacteria can be modified via genetic modification to produce biosensor bacteria. These are then used in anti-cancer treatments by injecting cancer destroying modules to them. Amplification circuits are produced that use amplified quorum sensing and can detect a small amount of quorum sensing bacteria i.e.

pathogenic bacteria even in smaller amounts. It helps detection of contamination in dairy or meat products. Various quorum sensing inhibitors and antibiotics are targeting quorum sensing mechanisms of bacteria to mitigate their negative impacts decreasing the severity of infections. Emergence of antibiotic resistance has enabled humans to explore new ways to control disease development so another useful strategy used in the field of biotechnology is quorum quenching i.e. naturally occurring mechanisms that compete with quorum sensing pathogens and halting disease development. This strategy doesn't kill bacteria but disrupts their virulence, sporulation or biofilm production.

Conclusion

To sum up, quorum sensing is the secret voiceless language of bacteria that enables them to coordinate with their neighbors, sharing information about the environment and taking collective actions that may lead to infection and disease development. Quorum sensing is targeted in many therapeutic roles to prevent infections and diseases.

HUMAN METAPNEUMOVIRUS

Sana Muqadus

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HMPV is a paramyxovirus that was discovered in 2001. It causes upper and lower respiratory tract infection in elderly people, young children and immunocompromised individuals. About 10-12% respiratory illness in young children is due to HMPV. It can cause severe illness in children between the ages of 6 to 12 months-14 years.

Symptoms

- Cough
- Stuffy nose
- Fever
- Short breath
- Sore throat
- Wheezing

- Rash

Disease

It can cause viral pneumonia that requires urgent hospitalization and proper care. Moreover, it can cause difficulty in breathing by blocking and inflammation of the airways in young infants and elderly people causing **Bronchiolitis**. Not only this, it can make conditions like asthma and COPD even worse. Also it can lead to secondary bacterial infections i.e. bacterial pneumonia due to the weakened immune system.

Epidemiology

China's surge in HMPV cases: By the end of 2024, HMPV accounted for 6.2% respiratory illness cases and 5.4% of hospitalizations exceeding adenovirus, Covid -19 and rhinovirus. This surge raised the main concern about the hospital capacities.

Cases in Hong Kong and Malaysia: In Malaysia, cases exceeded from 225 in 2023 to 327 in 2024 which raised the concerns regarding the health and use of precautionary and preventive measures. As compared to Malaysia, the cases were reported in Hong Kong but spreading at a slow rate.

Recent Seasonal outbreak in China 2024: In late 2024 and early 2025 China faced an increase in the acute respiratory infections. According to a report it was the attack of multiple viruses including seasonal influenza, respiratory syncytial virus (RSV), rhinovirus and HMPV. This increased attack was particularly noticed in the northern provinces of China. The spike led to the overcrowded hospitals in some areas raising concerns. Many hospitals there are still struggling to cope with this emergency but now it is under control.

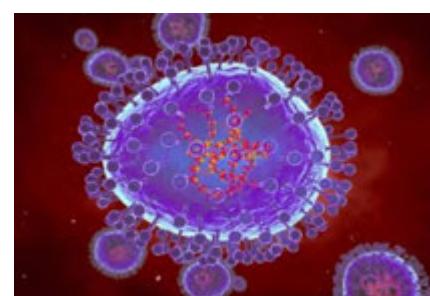


Figure: Human Metapneumovirus

(Credits: www.clinicaladvisor.com)

Diagnosis

Its diagnosis can be done by the following techniques:

1-Real-Time PCR: It is a sensitive test for the detection of HMPV that gives quick results and can measure how much virus is present in the body which will help to assess the severity of infection.

2-Virus Isolation: It is a method most frequently used to study the viruses, as it helps in making the vaccines and understanding how the virus works. But it needs skilled workers; it is a costly and slow method that has low success rates.

3-LAMP: Loop Mediated Isothermal Amplification is another method used to detect viruses. Unlike PCR, it does not need temperature change, making it simpler. The results of it can be seen with the naked eye but it is more expensive than PCR tests.

4-X- Ray and Bronchoscopy: These techniques are also used to observe changes and pneumonia in the airways.

Prevention

- Wash your hands with soap frequently.
- Use Alcohol based Hand Sanitizers when soap and water are unavailable.
- When you are sick avoid meeting others, stay at home and use medicines and different effective remedies.
- Try to use tissue paper/handkerchief or cover your mouth with your elbow while sneezing and coughing.
- Do not touch your face, mouth and nose frequently.
- If you feel that you are sick and can't avoid meeting people, wear a mask and keep sanitizing your hands after a few intervals.

Future Perspectives and Research Direction

1-Vaccine Development: It is a top priority with ongoing research into the live attenuated and protein based vaccines. mRNA vaccine technology , similar to COVID-19 vaccines, is also being explored for HMPV .

2-Improved Diagnostic Methods: Advances in PCR and CRISPER based diagnostics could enable faster detection and better outbreak control. Scientists and Researchers are using these methods to differentiate HMPV from similar respiratory infections.

Conclusions

HMPV is a significant respiratory pathogen that affects both young and elderly people and also in the immunocompromised individuals. While its symptoms range from mild cold to severe pneumonia. Moreover, the lack of vaccines and specific antiviral treatments still remain a challenge. Well scientists are working on the development of its vaccines till that strengthening global surveillance and public awareness will be essential in mitigating its spread and reducing hospitalisation rates.

BRAIN EATING AMOEBA: THE SILENT KILLER WITH NO CURE

Rabia Ali

1287-BS-MB-22

—Brain eating amoeba is deadliest human parasite known with mortality rate more than 97%.”

Causative Agent: *Naegleria fowleri*

Disease Caused: Primary Amoebic Meningoencephalitis (PAM)

Size

Depending on its environment and life stage, *Naegleria fowleri* can range in size from 8-15 micrometers. A hair in contrast is 40-50 micrometers broad.

History

Following deadly brain infections in Australian youngsters who had been swimming, the brain eating amoeba was discovered for the first time in the 1960s. According to Dr. Malcolm Fowler, it enters through the nose, attacks the brain and causes PAM, a disease associated with warm water that is almost always fatal. As its habitat grows due to climate change, incidences have been observed globally throughout time raising worries.

Despite being fatal, there is hope because of early identification and the experimental medication miltefosine, as demonstrated by rare survivors like Sebastian Deleon (2016) and Kali Hardig (2013). Researchers are trying to improve public awareness, speed up detection, and improve treatments because infections are becoming more common in warmer climates. *Naegleria fowleri* is still one of the most enigmatic and lethal microorganisms known despite its rarity.



Figure: *Naegleria fowleri*

Location

- Hot springs
- Lakes
- Rivers
- Moist soils
- Thermally polluted water

Structure

Brain eating amoeba has three different morphological stages:

a) Cyst stage: *Naegleria fowleri* develops a cyst stage, a spherical single layered structure that varies in diameter from 7 to 15 micrometers when environmental conditions are poor. By acting as a protective capsule, this cyst helps the amoeba endure harsh conditions. The amoeba may come out of the

cyst and resume its activity when the situation improves.

b) Trophozoite stage: The trophozoite *Naegleria fowleri* is active, feeding and reproducing stage. The trophozoite which is actually 10-25 micrometers long has a nucleus encased in a flexible membrane and moves by use of pseudopodia. The pathogenic consequences seen in infected individuals are caused by this stage.

c) Flagellate stage: Trophozoites can temporarily transition into pear shaped flagellate may be sucked into the nasal cavity, where it may then transform back into the trophozoite stage to cause infections in humans.

Operating mechanism

Initiation of infection takes place when water contaminated with brain eating amoeba gains entry into the body through the nose during activities like swimming. After attachment to olfactory nerves, go through the cribriform plate (bone responsible for separating nasal cavity and brain) to reach the brain. When reached the brain results in destruction of neural tissues, which results in swelling of the brain similar to meningitis. It also has its own way to infest the host human system, minimizing host stamina of striving against infections.

Early Symptoms

- Headache
- Fever
- Nausea
- Vomiting

Later Symptoms

- Stiff neck
- Seizures
- Coma
- Hallucinations

Diagnosis

The clinical examination signs and symptoms and medical history are used to make the diagnosis. Cerebrospinal fluid samples may be required for microscopy and further referral testing. Roughly 75% of the diagnoses are made after the patient has passed away due to the infection's rarity and difficulty in being identified early.

In the lab, the following characteristics of the CSF, biopsy or tissue samples are used to diagnose a *Naegleria fowleri* infection:

- Amoeba *Naegleria fowleri*
- The nucleic acid of *Naegleria fowleri*
- The antigen of *Naegleria fowleri*

Treatment

Several medicines are effective against this medicine in the lab. Their effectiveness is questionable, though, as almost all infections have proven fatal, even when patients received comparable drug regimens. The likelihood of survival may be improved by an early diagnosis and intensive supportive care.

- Drugs that can aid in the treatment of this infection includes:
- Amphotericin B
- Corticosteroid
- Fluconazole with Rifampicin
- Miltefosine with Azithromycin

It has been recently shown that Miltefosine is the most effective against *Naegleria fowleri* yet.

Cure

Amphotericin B alone is no longer the treatment for this infection; instead a combined therapy strategy involving azithromycin, Fluconazole and miltefosine is used to reduce brain swelling. Although the chances of survival somewhat increased due to these developments, the disease is still very deadly. Since even a few hours of delay might be fatal. Prompt diagnosis and strong actions are essential.

Survivor's State Following Recovery

Only 8 people have survived as of 2024, with the most recent survivor being a 22 year old Pakistani. Survivors frequently deal with serious long term health issues. One of the rare survivors Kali hardig for example suffers from periodic blurred vision as a long term consequence of the virus. These incidents highlight the vital significance of vigorous treatment and early detection, as well as the necessity of continued research to enhance results and handle the survival of chronic health concerns.

Prevention Strategies

- Steer away from swimming or jumping in warm freshwater, particularly during summer.
- To stop water from getting into nasal passages use nose clips.
- Make sure the pools are properly chlorinated.
- Raising public awareness through educational initiatives and health campaigns.
- Restrict water related activities in warm, untreated water

SPACE STATION SQUATTERS: MICROBES THRIVE ON ISS

Dua Hussain

1267-BS-MB-22

The International Space station that is often referred to as ISS is a large spacecraft that orbits the earth; it basically provides a research laboratory for scientists and astronauts. It has a space environment that may become host to microbial life. The spacecraft has a closed environment as the microbes are present in it, which can lead to various issues such as the astronaut health can be at risk.

Understanding the presence of microbes on ISS is not only crucial for the health risks it causes, it is also important in order to recognize the potential threats of microbes to the equipment present in the ISS. We can say that there are certain microbes that can degrade metal,

plastic and rubber therefore if such microbes are present in the ISS then they could be a threat to ISS.



Image: International Space Station (**Credits:** NASA)

Source of Microbes on the ISS

The microbes that are found on the ISS surely have sources through which they enter the space craft. We can say that there is not a single source of entry of microbes but there are multiple sources such as humans, cargo and shipment, and spacecraft materials and components.

Human Contributions

Humans are a major source of entry of microbes on the ISS. When humans cough, sneeze or if they are suffering from any sort of infections they can easily spread microbes on ISS. Astronauts alone carry millions of microbes on their skin and even passing through certain sterility tests they still can act as a source of microbes present on the ISS. Some microbes that are a part of ISS and are spread through humans are *Staphylococcus aureus*, *Corynebacterium* and *Penicillium* and *candida*.

Cargo and Supplies

The food supplies are delivered every day to the astronauts and researchers in the ISS through cargo spacecraft and although the food supplies have passed through various sterility tests they still have the microbes present on them these microbes then enter in the ISS and thus the cargo and supplies act as a source of microbes present on the ISS.

Contamination sources include:

- Materials for packaging (fabric, metal, and plastic)

- Food products, particularly fresh produce
- Biological sample-based scientific experiments
- Equipment for extravehicular activities (EVAs) and space suits.

Types of Microbes Found on ISS

There are various kinds of microbes in general, some of them are bacteria, some are viruses and some are fungi. These microbes are present everywhere in our environment. However there are different kinds of species of these microbes that inhabit different habitats. For e.g. some bacteria are found in soil only whereas some are found on food. Similarly these bacteria, fungi and viruses have certain species that are also present on the international space station; these microbes possess different characteristics that enable them to adapt to the space conditions. Let's discuss them below:

1. Bacteria

Bacteria are the most common microorganisms that inhabit the ISS. Some of these bacteria do not possess any threat whereas some can be harmful to astronaut's health and the material of spacecraft.

- ***Staphylococcus aureus*:** Human skin and the respiratory system are home to *Staphylococcus aureus*, which can lead to infections.
- ***Staphylococcus epidermidis*:** One common skin bacteria that is known to create biofilms on surfaces is *Staphylococcus epidermidis*.
- ***Pseudomonas aeruginosa*:** *Pseudomonas aeruginosa* is an opportunistic pathogen that can withstand antibiotics and grows well in moist conditions.
- ***Enterobacter*:** Some strains of *Enterobacter* species are associated with hospital-acquired infections and exhibit antibiotic resistance.
- ***Bacillus species*:** *Bacillus* species are spore-forming bacteria that are resistant to harsh environments.
- ***Actinobacteria*:** Species of *Acinetobacter* are well-known for their hardiness and capacity to endure on surfaces.

Bacterial Adaptations in Space:

- Bacterial adaptations in space include heightened antibiotic resistance.
- Increased production of biofilm, which can harm the surfaces of spacecraft.
- Genetic alterations brought on by exposure to microgravity.

2. Fungi

Another class of microbes frequently discovered on the ISS are fungi, which are mostly brought in via food, human skin, and cargo shipments. While certain fungi contribute to material breakdown, others can cause allergies and illnesses.

- ***Aspergillus* species:** An opportunistic mold that can lead to respiratory illnesses is *Aspergillus* species.
- ***Penicillium* species:** Known to produce antibiotics, *Penicillium* species can also trigger allergic reactions.
- ***Cladosporium* species:** May cause allergies and inflammation of the lungs.
- ***Candida* species:** it is a type of yeast that is naturally present in the human body but can cause infections in those with weakened immune systems.

Fungal Challenges in Space:

- Capable of producing spores that endure harsh environments.
- Certain species cause structural harm by breaking down manmade materials.
- Astronauts may be at risk for respiratory illnesses.

3. Other Microbes Found on the ISS:

Other microorganisms, including viruses and archaea, have also been investigated on board the ISS in addition to bacteria and fungi.

- **Archaea:** Although less often, archaea have been found in water recycling systems. Biogeochemical processes involve them.

- **Viruses:** Common human viruses such as herpesviruses (e.g., Epstein-Barr virus, cytomegalovirus) can reactivate in astronauts due to space-induced immune suppression, even though no special space-adapted viruses have been found.

Conclusion

Because of the spacecraft environment, supplies, and human living, microbial existence on the ISS is an unavoidable challenge. Even with rigorous sterilization procedures, bacteria and fungus persist, with some developing special adaptations to microgravity. Long-duration mission success, spacecraft material degradation, and astronaut health are all impacted by these bacteria.

Through a variety of investigations and tests, scientists have learned important things about the behavior of microorganisms in space. By identifying bacterial and fungal species on board the ISS, NASA's Microbial Tracking-1 and 2 investigations have shed light on how microbes change in space. Research on antibiotic resistance and biofilm formation has yielded important information about microbial adaptation, which has influenced the creation of more effective defenses. With potential uses in astrobiology and planetary exploration, the "Extreme Microbiome Project" has also investigated how some microorganisms endure and flourish in the harsh environment of the International Space Station.

In addition to protecting astronaut health, researchers on the ISS are advancing our understanding of microbial survival in harsh conditions, which will help deep-space exploration succeed.

NECROTISING FASCIITIS: FLESH-EATING BACTERIA; THE ROLE OF IMMUNE SYSTEM AND WHY SOME ARE MORE SUSCEPTIBLE?

Amna Iqbal

1211-BS-MB-23

Did your skin have a scar, simple cut, or a scrape today? Well, this may not be that simple — you're likely to experience Necrotising Fasciitis, a condition where bacteria can eat your flesh. But why may your immune system be or not be able to overcome this rare condition?

Introduction

Necrotising Fasciitis (NF) is a rare but life-threatening bacterial infection that causes the necrosis, death of premature cells, of underlying skin soft tissues and fascia, a layer of connective tissues that surrounds the nerves, muscles, and blood vessels. Limbs are the most susceptible body parts for this infection, where prolonged infection can lead to amputation or death if left untreated. A compromised immune system may increase an individual's susceptibility to have NF when, in fact, a healthy immune system works to eliminate and engulf the bacteria. The overall average annual incidence of NF claims to be every 4 out of 100,000 individuals.

Etiology of NF

NF is an acute infection that develops rapidly over a few days. *Streptococci* group A, *Escherichia coli*, and MRSA are responsible for single -sited infections. Poly-microbial infections are caused by bacteria such as *Pseudomonas*, *Staphylococcus*, *Actinobacter*, and multiple organisms.

Microbiology of NF

Microbiological cultures classified the two types of infections based on results obtained from isolation techniques and tissue culture detriments obtained from patients. Type-I aerobic poly-microbial infections require less surgical repetition than Type-II infections caused by anaerobic *Streptococcus* or its combination with other bacteria such as MRSA or *Staphylococcus*. Type-III infections caused by Gram-negative rods are less common.

Pathology of NF

The infection usually starts with a cut, abrasion, or scrape of skin. The affected area appears as a blister. Inside the blister, the bacteria travel towards fascia and from there laterally towards the subcutaneous tissues. Type-I and Type-III infections can be characterised by pus-filled blister, whereas Type-II infections do not produce pus. The blister becomes bluish-purple to reddish-gray like a bruise, warm, swollen, and painful. Physical findings of the inside of the blister reveal the necrosis of fat, skin glands, as well as the nerves and blood vessels, and a cluster of neutrophils. The infection spreads rapidly within hours to a few days, requiring immediate surgical procedures.

Role of Immune System against NF

Innate Immune System

- Early Response:** Dendritic cells and macrophages are activated towards the infection site to detect the bacterial cells. Cytokines are released to direct neutrophils towards the infection site.
- Neutrophils take over the infection site:** Neutrophils at the infection site try to eliminate and engulf bacterial cells by phagocytosis but usually fail due to bacterial mechanisms.

Adaptive Immune System

- Delayed response:** Dissimilar to the innate immune system, the adaptive immune system shows delayed action while preparing specific antibodies.
- T cells activation:** T cells try to directly kill the bacterial cells.
- B cells activation:** B cells produce specific antibodies against the bacterial cells.

Despite all these attempts of Immune System against NF bacteria, the bacteria progressively overcome all the attempts and move laterally towards the subcutaneous tissues.

Susceptibility Factors for NF

- Diabetes:** The majority of patients have diabetes mellitus.
- Alcoholism:** People with a habit of heavy alcohol drinking.
- Age:** People with age 50-60 or 60+.
- Obesity:** Obese people with unhealthy lifestyles.
- Chronic diseases:** patients with liver cirrhosis, heart valve diseases, and chronic kidney diseases.
- Intravenous drug abuse:** People who inject drugs intravenously.
- Immunosuppression:** Patients having diseases like HIV, cancer, or other conditions in which the probability of secondary infections is high.

Treatment Options for NF

- Hyperbaric oxygen therapy:**

Pressurised oxygen is used to heal wounds.

2. Antibiotic therapy

Broad spectrum antibiotics: antibiotics that work against numerous bacterial infections such as gram-negative and anaerobic, etc.

Combination antibiotic therapy: A specific combination of antibiotics for a patient can be prescribed.

3. Surgery

Amputation: If the infection spreads widely in a certain body part, then that part can be cut off to avoid infection spread in the body.

Debridement: Infection sites and dead tissues can be removed to control the infection.

Site-surgical procedures: Surgical removal of some infection sites to treat wounds.

Conclusion

Necrotising Fasciitis is initiated as an acute infection from a cut, scar, or scrape of skin but develops rapidly destroying tissues and its components. The etiology of this infection varies from a single bacterium such as *Streptococcus* to multiple bacteria or a rare infection caused by Gram-negative rods. The intensifying nature of bacteria can overcome the immune system, and the susceptibility factors in the host make it a no sweat. The infection can be fatal regardless of antibiotic therapy or surgical treatments, although early detection can reduce risk.

THE MICROBIOME AND MENTAL HEALTH

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Introduction

Did you know your mood can be influence by your microbiomes in your gut and other parts of body? In recent research the connection between gut and brain has been subject of growing research which lead to fascinating discoveries about how our influence our mental well-being. The microorganism in gut can affect our behavior mood and conditions like anxiety and

depression by communicating with our brain. Some scientists believe that the care of microbiomes is one way to improve mental health because the connection between microbiomes and brain is strong.

Microbiomes

The microorganisms that live in and on our body that **can't harm in normal circumstances** are called microbiomes. Trillions of fungi and bacteria are microbiomes. Microbiome in gut helps in digestion, immune system and production of vitamins. They play an important role in maintaining our health as these are not just passive inhabitants.

These microflora have direct link with brain functioning. The gut microbiomes send signals to the brain through a network of pathway. In turn the microbiome can be affected by brain by influencing the digestion and gut motility.

Gut-Brain Axis

In a complex feedback loop gut microbiomes and brain communicate with each other. Our gut can be negatively affected when we experienced stress, anxiety and depression by causing discomfort and digestive problems. Gut microbiomes can send signals to the brain that can lead to worse mental health when it is out of balance. Research on how gut microbiomes influence mood and emotions has been increased recently. People with imbalances in their gut microbiomes can lead high level of stress, depression anxiety and mood issues reveal by recent research. On other hand if we improve our gut health with diet we improve our mental health.

Microbiome Affects Mental Health

Microbiome affects mental health through **inflammation** which is cause by imbalances of microbiomes at particular places in body. If the inflammation is chronic then it can lead to variety of mental issues like depression most of the time. Recent research shows that people have higher levels of inflammatory markers in their blood experience. Important **neurotransmitters** (e.g. serotonin) are produced by gut microbiomes. Serotonin neurotransmitter that regulates mood sleep and appetite, 90% of it is made in gut. Again imbalances in gut microbiomes effect the production of serotonin and other neurotransmitter which in turn affect the mental health.

Stress Response

The gut microbiomes also involved in how we response in stress. Our body release stress hormones like **cortisol** when we are in stress. The body central stress control system particular hypothalamic pituitary adrenal (HPA) and gut microbiomes are interconnected. **Gut permeability** is also increased by stress which can lead to leaky gut where harmful substances leak into blood stream and cause systematic inflammation which in turn affect brain. If the number of microbiomes in gut is in balance then they maintain the integrity of gut lining reducing the risk. In stress the production of neurotransmitter by gut microbiomes also affected.

Microbiomes Support Mental Well Being

Healthy microbiome is promoted by a diet rich in fiber, fruits, vegetables and whole grains. Eating a variety of plants based can encourage diverse gut microbiomes as different types of fiber need different types of bacteria which are associated with better mental health. Beneficial bacteria that can help to restore balance of the gut microbiomes are **probiotics**. Food rich in probiotics are fermented foods like yogurt, kefir, kimchi and kombucha. The growth of harmful bacteria in gut is promoted by highly processed food and excessive sugar intake which contribute to the inflammation and mood disturbance. So it is important to limit **processed food and excessive sugar**. The improvement in gut microbiomes is also done by **physical activity**. The diversity of gut microbiomes can be improved by regular exercise is shown in recent research. Practices that can help lower stress level and support a healthier gut brain connection are yoga, meditation, deep breathing exercises and mindfulness.

Conclusion

In our mental health microbiomes play a crucial role. We may be able to reduce the risk of mental health disorder (e.g. anxiety, depression and stress) by understanding the microbiome and brain connection and making a effort to support a healthy microbiomes. A long way in improving both gut health and mental well-being is simple lifestyle changes like eating a balanced diet, taking probiotics and managing stress. Taking care of our gut could be one of the most important steps in improving our overall health both mentally and physically according to the recent research.

NANOPARTICLES IN MICROBIAL INHIBITION AND DRUG DELIVERY

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Nanoparticles (NPs) are very small particles, with their sizes in nanometres (usually between 1 to 100 nm), that possess a variety of applications. These triple layered particles are made using different approaches such as chemical vapor deposition (CVD), spinning, laser pyrolysis or laser ablation. Nanoparticles exhibit unique optical, thermal, mechanical and magnetic properties which make them an important area of scientific interest.

Antibiotic resistance in bacteria has resulted in a quest to find alternate treatment against microbes. The use of nanoparticles for effective penetration into living systems has no more remained uncommon. Using nanoparticles is rapid, cost effective as well as environmentally safe when compared with other physical and chemical methods. Metal based nanoparticles make it harder for the bacteria to develop antibiotic resistance and have broad spectrum antimicrobial activity. These particles can effectively penetrate into the matrix of bacterial biofilms and inhibit bacterial growth. Biofilms which adhere to living and nonliving surfaces are known to cause many chronic diseases. Nanoparticles target the quorum sensing gene cascade and thus silence the communication between cells present in a biofilm. Another important factor which makes nanoparticles effective antimicrobial agents is their large surface area to volume ratio. Silver nanoparticles produced using the extracts of the fungi, *Trichoderma harzianum* and *Ganoderma sessile* have shown remarkable results against bacterial species such as *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. Moreover, it has been determined that silver based nanoparticles had their antimicrobial properties preserved for more than a year. The usage of silver and copper nanoparticles individually or in combination can inhibit the biofilms produced by pathogens of bovine mastitis which is a common disease in cattle. *Candida albicans* is an important fungal specie best known for causing the opportunistic disease, Candidiasis. The conventional treatment methods involving antifungals have their own potential drawbacks such as high cost, antifungal resistance and toxicity. However, silver, gold and iron nanoparticles have shown

effective antifungal activity against *C. albicans*. Silver nanoparticles have also exhibited their potential as antiviral agents. Designing a drug which selectively destroys a virus is quite complex as viruses reside in host cell for replication. Other nanoparticles such as gold nanoparticles, quantum dots, carbon dots and zinc oxide nanoparticles have also shown remarkable results when used against a variety of viruses.

In the last few years, nanoparticles have revolutionized drug delivery by offering numerous clinical applications. The advancements in designing nanoparticles have started a new era involving precision medicine. Engineered nanoparticles are employed for targeted delivery at specific areas of the body. The use of nanomedicine to cure diseases such as cancers, cardiovascular diseases, bacterial and viral infections has rapidly grown. Nanoparticles used in drug delivery offer a number of advantages such as improved time for drug absorption time, improved bioavailability of drug, reduced release time, increased solubility of drug in the blood and no drug aggregation. The use of polymeric nanoparticles for drug delivery has been more pronounced due to their unique physiochemical properties and their ability to cross different biological barriers. The conventional therapeutics has a number of limitations such as low therapeutic index, systemic toxicity, poor water solubility and non-specific distribution. It has been found that nanoparticles are a promising alternate which can be used in delivery of hydrophilic drugs. Nanoparticles allow controlled release when drug molecules are placed inside or on its surface. Drug delivery involving use of microfluidic nanoparticles has also been explored and the development of mRNA vaccine from it is a successful example. Microfluidic nanoparticles have been used widely to deliver drugs such as coenzyme Q10, efavirenz, Mithramycin A, metformin hydrochloride, streptokinase and hydromorphone for ischemic diseases, HIV, hematological diseases, diabetes, thrombolysis, and pain relief respectively. Many COVID-19 vaccines use nanoparticles which increase the immunogenicity and efficacy of the vaccine. Nanoantibiotics have been created as well which are a combination of antimicrobial compounds and nanoparticles. Bacteria develop resistance at a considerably slower rate against nanoscale conjugates. Chitosan and silver nanoparticles are known to have antibacterial, antifungal as well as antiviral properties. Nanoantibiotics have lesser side effects in addition to enhanced drug delivery.

The use of nanoparticles also has some challenges which the scientific community needs to address. Metal based nanoparticles pose toxic threats to humans which can be dealt by better understanding of the mechanism of toxicity and more research in nanotoxicity. Nanoparticle development also faces similar problems such as limited administration routes, degradation and difficulties in scaling up production. However, once these obstacles associated with nanoparticle use gets addressed; the use of nanoparticles shall become safer.

THE GUT-BREAST AXIS: UNCOVERING THE ROLE OF MICROBIOTA IN BREAST CANCER DEVELOPMENT AND TREATMENT

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Introduction and Background

Breast cancer has become the most frequent and second most common non-skin cancer in females throughout the world. It makes up **10.4%** of all other cancer incidences and has become the **5th most common** cancer that leads to death. **Gut microbiota** are the residue of the intestine and form a symbiotic relationship with the host. In the gut, trillions of microorganisms are present including bacteria such as *Lactobacillus* sp., *Streptococcus* sp., *Thermophilus*, *Clostridium* sp.; fungi like *Candida*; and some viruses.

A bidirectional communication network between the breast and gut is the **gut-breast axis**. When the gut microbiota starts functioning abnormally, it leads to dysbiosis, which not only leads to acute but also chronic infections. The gastrointestinal microbiome plays an important role in the regulation of the immune system, metabolism of endogenous and exogenous substances, weight gain, and other factors involved in the development of breast cancer.

The Role of Dysbiosis in Breast Cancer

Dysbiosis has been identified as a key contributing factor to the development of breast cancer. A complex microenvironment that is favorable to carcinogenesis is

created by microbial imbalance, which essentially modifies inflammatory and immunological responses. **Pro-inflammatory cytokines** including interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- α) are released when the microbial composition is disrupted, and they play a key role in fostering inflammatory cascades linked to the advancement of cancer.

Certain bacterial species have been found to significantly increase the risk of cancer, including *Enterococcus* and *Fusobacterium*. These microbes have special molecular processes that might trigger **inflammatory pathways**, which may be the first step in the development of breast cancer. Chronic inflammatory conditions brought on by microbial dysbiosis can result in important cellular alterations such as angiogenesis, DNA damage, and abnormal cell division, all of which are essential steps in the development and spread of cancer.

Role of Other Factors

- Metabolites from the gut microbiota impact several physiological pathways and serve as a crucial link between microbial ecology and cancer development.
- Inflammatory reactions, metabolic processes, and hormonal regulation are all involved in the complex link between gut microbiota and breast cancer. The gut microbiota is critical in regulating immune responses and inflammation, intricately linked to breast cancer progression.

Therapeutic Implications of Targeting Gut Microbiota

- Prebiotics and probiotics** are essential components that contribute to maintaining a healthy gut microbiome. Probiotics and prebiotics represent some of the most extensively studied approaches for regulating gut microbiota to enhance health. They primarily restore microbial balance, enhance gut barrier function, and modulate the immune response.
- Emerging research suggests that **FMT** (Fecal microbiota transplantation) may also have a role in cancer treatment.

Emerging Research and Future Directions

Gut microbiota secretes the **metabolites** such as cadaverine, indoxusulfate, and lithocholic acid that suppress BC progression. Other studies have shown that gut microbiota also produce certain types of **enzymes** that

help in the deconjugation of conjugated estrogen metabolites, hinder their secretions, and prevent the metastasis of BC. Multiple strains of bacteria also produce **estrogen mimics** like seasmin, enterolactone, and enterodiol by dissimilation of dietary lignans.

It has also been studied that *Bacteroides* species increase the anti-tumor efficacy of CTL-4. Bacterial **genotoxin** plays a huge role in promoting cancer. However, some bacterial toxins act as anticancer agents. **Clostridium Perfringens enterotoxin (CPE)** is known as a causative agent of food poisoning, it is also reported as a tumor suppressive agent against breast, prostate, and colon cancer as it blocks the transmembrane junction proteins Claudin-3 and Claudin-4. Mechanistically, when CPE binds with Claudin, a pore complex in the cell membranes, it results in the loss of osmotic balance between intracellular and extracellular fluid and ultimate cell death. Other bacteria that have been characterized as anti-cancerous microbes are *Pseudomonas aeruginosa*, *Salmonella typhimurium*, and *Clostridium difficile*

Breast cancer treatments are usually determined based on cell surface receptors such as ER, PR, and Her2. Patients with **Triple-negative breast cancer (TNBC)** are more prone to death because of limited targeted therapies. The gut microbiota can influence the **pharmacokinetics** and **pharmacodynamics** of anti-cancer therapy.

Surgery, radiotherapy, and chemotherapy have been used as **conventional treatments**. Still, they are not effective in all molecular subtypes of BC, as every type of BC responds differently to radiotherapy or adjuvant and Neo adjuvant chemotherapy. Therefore, most of the research is focused on personalized medicinal treatments like endocrine therapy, Aromatase inhibitors (AIS), SERDs, Antibodies targeting HER 2, epidermal growth factor receptor (EGFR) and Vascular Endothelial growth factor (VEGF).

Hence, the relationship between gut microbiota and breast cancer is undeniably complex, encompassing critical factors such as immune modulation, inflammation, and microbial translocation

MICROBIAL BIOREMEDIATION OF SMOG: TRENDS AND FUTURE DIRECTION

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One of the biggest environmental troubles of current times is air pollutants, and smog is a large contributor to terrible air. Smog, a thick fog of air pollutants inclusive of particulate matter (PM), unstable organic compounds (VOCs), nitrogen oxides (NOx), and sulfur oxides (SOx), has critical implications for human fitness, ecosystems, and climate balance. Whereas traditional mitigation technique has intention to lower emissions through technological controls and regulatory guidelines, microbial bioremediation is being developed as a viable opportunity for the degradation of airborne pollutants and enhancing air quality. This article discusses current tendencies in microbial bioremediation of smog, the possible mechanisms involved, and future potentialities for the utilization of microbial interest to combat air pollution.

Understanding Microbial Bioremediation of Smog

Microbial bioremediation is the utility of microorganisms, including microorganism, fungi, and archaea, to degrade or detoxify environmental pollutants. This has been used conventionally to clean up soil and water contaminants and researched for cleansing up airborne contaminants of smog. Some microbes were found to be able to metabolize poisonous pollutants and convert them into much less toxic components by the enzymatic approach.

Microbial bioremediation of smog may be performed either in natural settings or in man-made systems like biofilters and bioreactors. These are structures that use microbial populations to break down pollutants disposed of into the air. Using microbial metabolism, researchers wish to create bio-based solutions for alleviating air pollutants in city and business settings.

Microorganisms Involved in Smog Bioremediation

A variety of agencies of microorganisms had been proven to interrupt down smog-forming pollutants.

1. Bacteria

Pseudomonas spp.: They are powerful VOC, hydrocarbon degraders and are critical in decomposing industrial wastes.

Bacillus spp.: They can utilize NOx and SOx as substrates and hence lower the atmospheric pollutants.

Methylo trophic bacteria (e.g. *Methylobacterium spp.*): Effective in degrading methane and different quick-chain carbon compounds liable for smog formation.

2. Fungi

Aspergillus and *Penicillium spp.*: Both can degrade VOCs, which includes benzene and toluene, by enzymatic oxidation.

White-rot fungi (e.g., *Phanerochaete chrysosporium*): Secrete ligninolytic enzymes that degrade polycyclic aromatic hydrocarbons (PAHs), a main smog factor.

3. Algae and Cyanobacteria

Chlorella and *Spirulina spp.*: CO2-absorbing photosynthetic microorganisms, which reduce the awareness of carbon-based smog pollution in the surroundings

Anabaena spp.: They have the ability to restore nitrogen, which might help in lowering NOx pollutants.

Microorganisms play a role in lowering the level of smog by metabolism of smog pollutants into harmless merchandise like water, carbon dioxide, and biomass that may be reused in ecological cycles.

Mechanisms of Microbial Degradation of Smog Pollutants

There are diverse mechanisms via which smog pollutants go through microbial degradation:

1. Enzymatic Degradation

Microbes synthesize particular enzymes that catalyze the degradation of smog pollution. For instance:

Monoxygenases and dioxygenases cleave aromatic hydrocarbons in VOCs.

Nitrate reduces NOx to nitrogen gasoline.

Sulfur oxidases convert SO_x to sulfate, minimizing acid rain formation.

2. Biosorption and Bioaccumulation

Some microbes absorb and lure airborne pollutants. Biofilms evolved with the aid of microorganism and fungi to lure particulate count and heavy metals and prevent their dispersal into the environment.

3. Biotransformation

Microbes are capable of converting toxic pollution into less toxic forms of biodegradable materials. As an example, methanotrophic bacteria break down methane to CO₂ and water, for that reason minimizing its significance as a greenhouse fuel.

Trends in Present Microbial Smog Bioremediation

1. Genetically Engineered Microorganisms (GEMs): Genetic engineering has allowed researchers to enhance the pollutant-degrading ability of microorganisms. Engineered cyanobacteria boost the performance of CO₂ capture, thereby decreasing greenhouse gas contributions to smog. Synthetic biology processes allow the layout of microbial consortia optimized for smog remediation.

2. Microbial Consortia for Enhanced Biodegradation

Instead of the usage of man or woman microbial species, scientists are creating mixed microbial cultures that act synergistically to interrupt pollution. These consortia can modify pollutant hundreds and environmental conditions and therefore show more beneficial in real area applications.

3. Algal-Based Air Purification Systems

Bioreactors with algae are being researched as herbal air filters. Algae-based total structures now not most effectively lure CO₂ but additionally soak up different smog constituents, leading to the improvement of urban air excellent. Certain experimental setups include algal panels in buildings, designing bioactive facades that purify pollutants from surrounding air.

Future Outlook and Challenges

The majority of the existing research on microbial air pollutant degradation is confined to pilot-scale or laboratory experiments. Urban and business scale-up of

such technology necessitates fee-powerful engineering solutions and regulatory clearance. Microbial consortia or genetically engineered organisms brought into urban settings pose the question of ecological outcomes. Care has to be taken to save you from disruption of installed microbial communities or poisonous byproduct formation through bioremediation microbes.

Microbial bioremediation needs to be integrated with current air pollution managing technologies, e.g., catalytic converters and commercial scrubbers. Blended strategies based totally on aggregate of biological and chemical remediation strategies doubtlessly increase basic performance. Large-scale applications of microbial bioremediation technology will contain public consciousness, coverage help, and regulatory surroundings favoring research, development, and alertness. Governments and groups of the environment want to understand the potential for microbial answers for air exceptional management.

Conclusion

Microbial bioremediation provides a new and sustainable option for smog mitigation via exploitation of the innate pollutant-degrading capability of microorganisms. Technological advancements in microbial biotechnology, synthetic biology, and bioengineering are commencing the door to more efficient and scalable solutions. Although demanding situations exist, the convergence of microbial-based techniques with traditional air pollutants manipulation technologies could be very promising for enhancing air satisfaction in urban and commercial regions. As studies continue to advance, microbial bioremediation can be an essential part of future environmental management practices, mainly to purify air and a fit international environment.

FASHIONED BY MICROBES: MICROBIAL REVOLUTION IN FASHION INDUSTRY

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Fashion is how we introduce ourselves to the world, however, it also introduces massive pollution to the world, second only to the petroleum industry. Obviously, the fashion industry is indispensable but its pollution is

undeniable. Toxicity of synthetic dyes, microplastic shedding of synthetic fabrics, air pollution, landfill overflow from fashion waste and water pollution are just a few of the many harmful impacts of the fashion industry. At the same time, the significance and people's fascination of fashion industry are indisputable and need no lengthy explanation. To overcome this predicament, microorganisms and their products can be used in fashion industry with different aspects. Simply put, microorganisms have started to revolutionize the fashion industry. Their uprising in fashion industry is explored in this article.

Color is the first & most attractive thing that we see in an object. In order to obtain the color in fabric, there are lot of synthetic colors used in fashion industry. Owing to their petroleum-based origin and other reasons, synthetic dyes cause several negative outcomes. The hazardous nature, carcinogenicity, and toxicity of them create direct disturbances to the human body. On the other hand, they emerge environmental & economic problems as well.

Interestingly, microbial bio pigments bring solutions for almost all bad impacts of synthetic dyes. As a result of their natural origin & eco-friendly behavior, biodegradable bio pigments do not cause environmental pollution. From a human health perspective, bio pigments are safer to use in textile industry as compare to the synthetic dyes. Some bio pigments such as carotenoids & flavins have antioxidant, antimicrobial and anticancer properties as well. Adding more, the green processing of bio pigments from microorganisms is economically favorable as well as the process does not require harmful chemicals as synthetic dyes do. Bacteria and fungi play major role in microbial bio pigment production.

The red color pigment of *Serratia marcescens*, brown color melanin pigment of *Streptomyces virginiae* are important bacterial bio pigments and the yellow color Ankaflavin pigment of *Monascus* sp. is an important fungal pigment. Apart from them, there are number of different microbial bio pigments with variety of colors.

The next significant involvement of microbes in fashion industry is the use of their enzymes. These enzymes are used several important steps in the fabric production called desizing, bio-polishing, softening, biostoning, bio-bleaching and bio-washing. Desizing is the removal of starch-based protective layer of fabrics which was previously done by using inorganic acids. Amylase

enzyme acts as an important alternative to inorganic acids, providing controlled and highly specific removal of fabric's protective layer.

In bio-scouring step, microbial enzymes like cellulase, pectinase, protease and cutinase selectively remove the impurities such as pectin and waxes from cotton fabric, thereby enhancing the quality of textiles. Moreover, enzymes like laccase and cellulase involve in bio-washing of denims instead of traditional chemicals and pumice stones, to remove indigo dye, reducing fabric damage and environmental impact.

The post-consumer textile waste (PCTW) refers to the discarded textile products by consumers after use. Recycling or landfilling are two common fates for PCTWs. However, they triggered a series of difficulties such as landfilling issues, complexity of separation, low-quality recycled products, high recycling costs and logistical challenges. Problem-solving microorganisms offer different solutions for these challenges as well.

They decompose biodegradable fabrics via three phases of biodegradation process, called biodeterioration, assimilation and mineralization. In biodeterioration, they degrade textile fibers into small fragments which are absorbed as low-molecular weight compounds through cell walls during assimilation. Adding more, organic fibers can be converted into CO₂, water or biomass by microorganisms during the mineralization phase. Beyond these steps, microorganisms help to produce enzymes to degrade used fibers and their synthetic colors in textile recycling processes, lowering the PCTW treatment costs.

Nowadays, a growing trend is shifting towards bacterial cellulose other than plant-based cellulose. Although, we have been using plant-based cellulose (cotton) for centuries, its composition includes lignin, hemicellulose, and pectin, leading to impurity challenges. Moreover, plant cellulose is in micrometer-scale, therefore it badly affects to the texture and flexibility. Surprisingly, the bacterial cellulose, produced by microorganisms like *Gluconacetobacter* and *Azobacter* has high purity having no lignin and other impurities.

Bacterial cellulose is in nanometer scale that enhances the better texture, flexibility and mechanical resistance of textiles. In addition, bacterial cellulose is more eco-friendly compared to plant-based cellulose. *Moraxella*, *Pseudomonas* and other odor-forming bacteria convert the

skin secretions like sweat and sebum into volatile compounds therefore, unpleasant odor will be emerged from clothes. Synthetic antimicrobial compounds have been prepared to control this odor in textiles. However, their toxicity, less specificity and cost, limit their uses in textiles. Surprisingly, there are some important microorganisms can serve as alternatives to synthetic antimicrobial agents to control the odor of textiles.

Microorganisms like *Lactobacillus*, *Bacillus*, *Streptococcus*, *Nitrosomonas* are used in textiles and related materials such as carpets, pillows, towels and footwear to control the odor by decomposing organic compounds like sweat, sebum and blood. Also, Chitosan which is derived from fungal cell wall is used in the textile industry to kill odor-forming bacteria by destroying their bacterial cells walls. Finally, some studies have shown that incorporation of probiotics (microorganisms) into textiles can reduce the hospital acquired pathogens as well.

Future research must also identify new bio-based colors and further microbial advantage to the world of fashion. Further researches will not only increase the sustainability of fashion industry but also provide breakthroughs in terms of innovative eco-friendly fashioning.

FROM FARM TO FORK; ROLE OF MICROBES IN FOOD SAFETY FOR SUSTAINABLE FOOD SECURITY

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Food is the necessity of not only humans but for all the living beings. United Nations in its 17 Sustainable development goals (SDGs) also includes no hunger, which focuses on the providence of food to each human irrespective of its race, religion and social class. Every government struggles to delve the solutions that may leads to the efficient food security. However, here a question arises, is it possible to achieve food security without ensuring food safety? To get an appropriate answer to this one must know the difference between food safety and food security. Commonly there is a confusion regarding the terms of food safety and food security. People often misunderstood them. No doubt, that they are both different terms and considered as

individual challenges but still they are correlated. Food safety can be defined as the safe and contamination free feed which on ingestion does not leads to food borne illness while food security refers to the development of such sustainable system that could provide food to all people without any discrimination. A variety of factors can affect the food security in which food safety is one of the most important elements that ensures not only health benefits but also minimize the wastage of food. From harvesting to supply and transportation of food, microbes play a vital role in spoilage and wastage of food. Microbes can also aid in the taste and nutritional value of food so to better understand the food safety for sustainable food security we must understand the role of microbes in food safety.

This subject is of great concern due to the ability of large variety of pathogenic organisms to metabolize in different foods. The threat posed by contaminants such as microbial entities can be food poisoning, food wastage and food borne outbreaks. This food safety issue adversely affects the food security. Let's focus on the food safety hazards posed by different microbes.

In microbes, bacteria are generally and widely associated with these types of outbreaks. These illnesses by food contamination can leads to economic devastation too. Studies of cost of illness (COI) reveals the actual economic burden societies are bearing due to foodborne outbreaks and policies must be made accordingly.

Studies showed the COI in New Zealand due to foodborne diseases i.e. by salmonellosis, listeriosis, campylobacteriosis etc. is around \$86 annually. Sweden yearly expenditures due to foodborne illnesses are approximately \$171 million. Many International organizations like Food & Agricultural Organization (FAO) and World Health Organization (WHO) are collaboratively putting their efforts to tackle this menace by doing risk assessment studies of variety of pathogenic organisms in food products for better health that leads to strong economy. The strong economy will definitely pave the way towards food security by ensuring enough funds for the providence of food to every citizen.

Species of bacteria, *Salmonella* is majorly involved in foodborne outbreaks globally. This bacterial specie spread through food from animal sources i.e. chicken, meat and pork. It can easily contaminate the food due to unhygienic practices during production and handling. Economically it

cost \$2.4 billion to USA when in 2014 *Salmonella* infections prevailed.

When it comes to food poisoning, *Campylobacter* takes lead. Poultry related products are the main career of it. USA annually suffers a loss of more than \$1.3 billion due to 0.6 million *Campylobacter* illnesses. Netherland suffering from the same dilemma due to poultry associated *Campylobacter* illnesses and bear huge burden of 21 million euros per year. A data of 2012 regarding New Zealand indicates that campylobacteriosis cost \$1.184 million to economy.

E.coli is a bacterial specie that is part of the gut normal flora in many organisms but it can be pathogenic too especially Shiga toxic producing species are involved in foodborne outbreaks. This contaminate the food due to poor handling while slaughtering and spread through beef and minces meat. Illness by *E. coli* annually cost about \$280 million to USA while UK, Germany and New Zealand also suffer similar economic burdens.

Listeria monocytogenes is of greatly concerned pathogen in food industry due to its high fatality rate about 20-30%. It targets mainly through dairy products and adversely affects the elderly and infants. USA suffered from economic loss of \$2.6 billion and Australia experiences \$1.2 billion loss per year due to *L. monocytogenes* cases.

Developed countries like USA, UK, New Zealand etc. have strong data collection regarding foodborne illnesses but if we talk about third world countries like Pakistan then we underestimate the economic losses due to such outbreaks, this is also because there are no or less reports of such outbreaks and less than actual records to access. The available data reveals that the bacteria are an important threat to food safety and ultimately to food security due to heavy economic losses as they are involved in a great number of foodborne outbreaks.

Safe supply chain plays a vital role in ensuring safety of food, if supply chain at some point is compromised then it would definitely cause loss of food and threatens the food security. FAO claimed that we have enough production of food that is sufficient for everyone. Here question arises if we really do have that much then why we are threatened by food insecurity. Answer lies here, 1/3 of total produced food is lost or wasted and no one is able to consume them leaving us with scarcity of food. Food supply chain (FSC) is the process of supplying food from farm to fork and it

includes every step from sowing, harvesting on farm or slaughtering to storage and distribution until it reaches the table of consumer. Food waste can be occurred at any stage of FSC due to poor planning and inefficiency in design. The major cause of food lost is microbial contamination and spoilage that makes food imperfect for human intake and hence wasted. Farmers, distributors or customers due to poor handling can introduce different microbes in food during supply. Food wastage due to this is not exactly recorded or we don't know the exact digit that how much food is lost due to microbial contamination but one can evaluate the seriousness of issue from the prevalent cases of food borne illness by pathogenic microbes that cause billion dollars to world economy. This shows the link between microbial associated outbreaks and food loss.

Technical point is how food safety is linked to food security which is essential element of sustainable development. Food insecurity generates when food safety is threatened or compromised that retards the food supply to consumer. Proper planning and strategy of supply chain eliminates all food safety related concerns either arise from poor transport condition or unhygienic handling while distribution. While making action plan for food safety the policies must be designed in such a manner that it reduces the risk of delivering any contaminated or unsafe product. This will definitely eradicate the probability of food loss. Uncertainty in the food service sectors in the FSC and limited knowledge of food safety strategies can negatively affect food safety control during production and handling which directly impacts the quality and quantity of food. An investigative study indicates the occurrence of *L. monocytogenes* in European market, highlighting 12 meat and dairy specimens from small-scale marketers. This showed the cross contamination in food due to poor environmental conditions which leads to food wastage. This directly or indirectly pose a threat to food security.

To ensure the safety and quality of food we need to develop a proper food safety management system. These kinds of measures can save food from microbial contamination in FSC ultimately ensuring food security. It is essentially to fathom how to make a proper plan to best manage the FSC, which leads to the microbiological food safety. World is focusing on achieving food security by implementing food safety measures and lowering the tons of edible food that lost in FSC. A sustainable system can

only developed by keeping in view the microbiological hazards and their scientific remedies.

I observe that in Pakistan we are not considering it a major threat to our sustainable development due to no legislation and implementable policies. We do not have proper data to build an analysis, also lacking research in this field. This can severely damage us on world forums. I

suggest that government policy making bodies must include food microbiologists to make sure the elimination of this risk by inducing some science oriented solutions. One cannot solve a pure scientific problem with ignorant, illogical or I must say by nonscientific ways. Research centers must be established to empower youth under the supervision of experts where a proper research may leads us towards the key solutions.

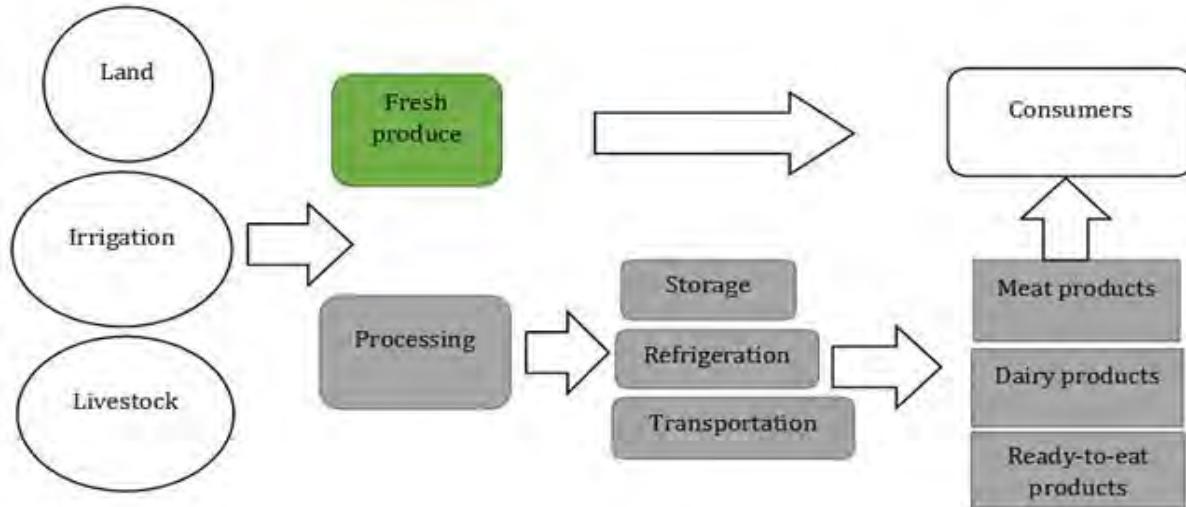
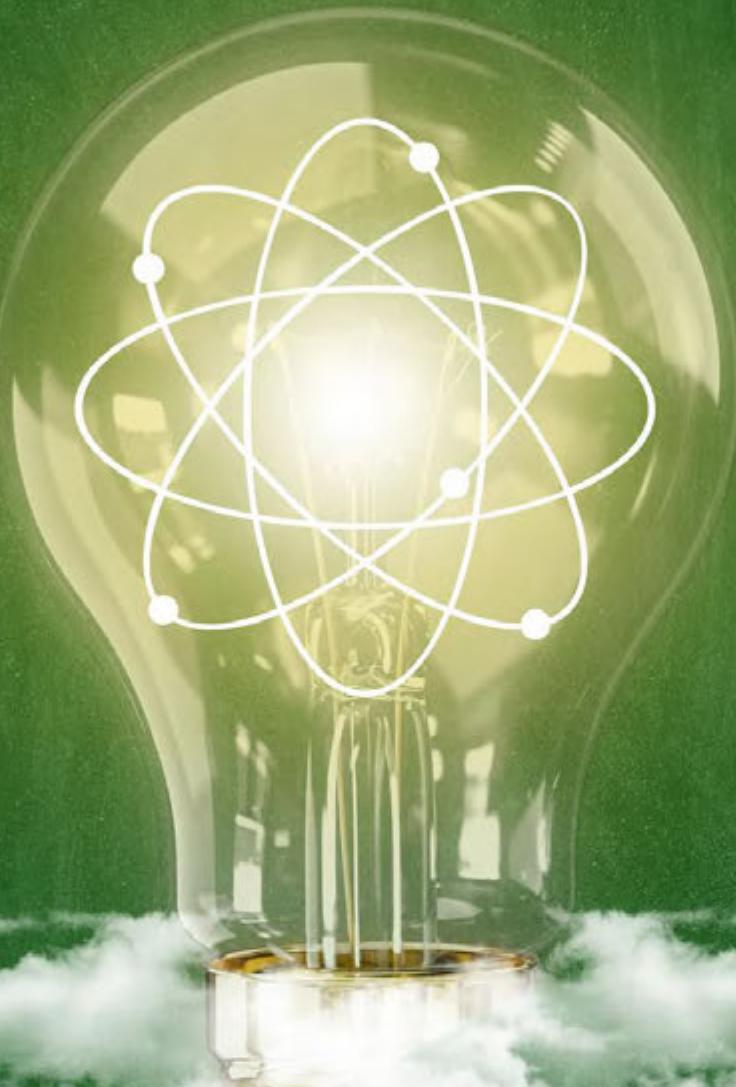


Figure: Stages of FSC where microbial contaminations can occur



PHYSICS

2024: YEAR IN REVIEW

Jan

- The Event Horizon Telescope (EHT) collaboration released new images of M87* from the observations taken in April 2018. The observation revealed that the brightest pinnacle of the ring has shifted by about 30° compared to the observations taken in 2017.

Feb

- A Los Alamos National Laboratory research team designed and fabricated irregular nanosized gold structures on an atomically thin graphene layer. They aimed to harness the light-powered nanoscale electrical currents to actuate upcoming technologies.

March

- The Perimeter researchers, parallel to the Event Horizon Telescope collaboration (EHT), revealed revolutionary shots of Sagitarius A*. The images showed the plasma ring and the magnetic field lines of the supermassive blackhole.

April

- On April 8, a rare total solar eclipse was seen across North America, passing over Mexico, the United States, and Canada.
- The Dark Energy Spectroscopic Instrument (DESI), which maps millions of galaxies in space and time, hints that the universe's expansion rate is slowing.

May

- The ESA's Euclid science mission unveiled five exceptional views of the universe. It shows the mission's first scientific data gathered from nearby clouds of gas and dust to a far-off cluster of galaxies.

June

- The 56 qubit H2-1 quantum computer at Quantinuum broke the record set by Google's Sycamore machine. The H2-1 computer secured the linear cross entropy benchmark (XEB) of 0.35, which means it can produce results without producing an error of 35%.

July

- With the help of advanced imaging techniques, scanning tunneling microscopy (STM) and scanning tunneling spectroscopy (STS) researchers delineated the electrochemical surface topography of the titanium carbide MXene.

Aug

- In 1973, Stephen Hawking, James Barden, and Brandon Carter hypothesized that extremal black holes cannot exist. However, papers published by two mathematicians, Cristoph Kehle and Ryan Unger, proved Stephen Hawking and his colleagues wrong.

Sep

- On September 4, Nature published an article on the nuclear clock, which utilizes thorium-229 nuclei. Because the nucleus is smaller than the electron shell, it is less affected by external disturbances, making it a more precise timekeeper than atomic clocks.

Oct

- On 8 October, John J. Hopfield and Geoffrey Hinton shared the Nobel Prize in physics for foundational discoveries and inventions that enable machine learning with artificial neural networks.

Nov

- A team in Innsbruck successfully created a long-anticipated state of matter known as a supersolid, capturing images of the distinct “quantum tornadoes” that emerged from stirring a rigid crystal of dysprosium atoms.

Dec

- European Southern Observatory's Very Large Telescope (ESO's VLT) detected a binary star orbiting close to Sagittarius A*. The observations shed light on the sustainability of stars around the destructive conditions of a black hole.

BOOK REVIEW

THE ELEGANT UNIVERSE: UNDERSTANDING THE COSMOS SIMPLY - BRIAN GREENE

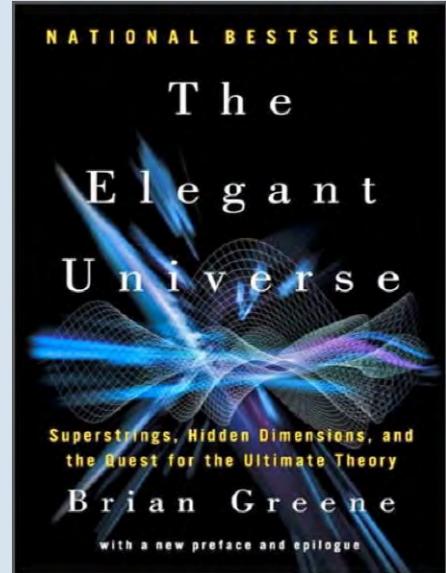
Rafia Eman

1439-BS-PHY-24

The Elegant Universe by Brian Greene explores the fascinating world of string theory. This theory suggests that everything in the universe is made up of tiny, vibrating strings.

Greene explains these complex ideas in a captivating way, making it easy for readers to understand the mysteries of space, time, and reality. The book takes you on a journey through the wonders of the universe, whether you are a science expert or just curious about how things work. He explains how the discussed theories were successful in explaining the world at large scales but break down when applied to the subatomic level.

Classical Physics and its Limitations: Brian Greene explains the limits of classical physics by showing how it fails to describe the complicated conditions of the universe. The Classical Theory, based on Newton's laws and Maxwell's Electromagnetism, describes the everyday planetary motions and objects. He also describes how this theory breaks down at large scale (gravity), small scale (quantum), and also at very fast speed (near the speed of light).



At the atomic level, quantum mechanics takes over, elaborating that the particles behave unpredictably. He shows how the classical theory holds well for big objects but not for the extremely small and fast entities.

Quantum Mechanics: This book also explains the principles of quantum mechanics, which govern the behavior of particles at the atomic and subatomic levels. Electrons can behave both as particles and waves; this means that they can be in multiple places at once due to their behavior of duality. Greene also explains the Uncertainty Principle: the more accurately you know the position, the less accurately you know the momentum; this gives the particle superposition. He further adds that when some particles become entangled, the state of one element is connected to the other. He highlights the nature and the formation of quantum physics from the limitations of classical physics.

String Theory as a Solution: Greene introduces String Theory to solve the conflict. This theory says that the fundamental building blocks of the universe are not tiny particles but extremely small vibrating elements. The way these strings vibrate determines the properties of the particles, such as mass and charge. This theory needs extra dimensions beyond the familiar three dimensions of space and time.

Extra Dimensions: These extra dimensions work as the unifying forces; they combine all the forces of nature (gravity, electromagnetism & nuclear forces) into a conjugate theory. Extra dimensions are the additional spatial dimensions that we cannot experience in daily life. These dimensions are thought to be "curled up" in a way that we cannot experience them. This theory suggests that there are "10 to 11 dimensions" in total (three regular dimensions, one time dimension, and six to seven extra dimensions).

M-Theory: Greene also talks about the advanced idea in string theory, which is known as "M-Theory". It tells that there are not only quantum vibrating strings but also "membranes" or "branes". These branes can exist in multiple dimensions, like the

11 dimensions (10 spatial dimensions with a time dimension). This makes a candidate for the ‘Theory of Everything’ a theory that unites all the related theories and explains all the physical phenomena of the universe.

Unification and the Future of Physics: In this book, the writer Brian Greene concludes his book in the chapter ‘Unification in the Twenty-First Century’. In this chapter, he covers all the prospects of the String Theory in the twenty-first century. This describes what Greene and the other string theorists hope to make in unveiling a single theory to explain the entire universe.

Conclusion: In this book, The Elegant Universe, the writer Brian Greene wants to elaborate the Universe to the reader at the most fundamental level. He talks about String Theory, which says that tiny, vibrating strings are the most basic building blocks of everything. Despite challenges due to a lack of experimental proof, this theory suggests a beautiful, interconnected universe.

BLACK HOLES: THE UNIVERSE'S GREATEST PARADOX

Noor Shakeel

1435-BS-PHY-24

Is there a place in the universe where the boundary between the possible and the impossible blurs? A region where light itself is trapped in an endless loop, where time stretches to infinity, and the very fabric of reality twists upon itself? In the depths of space, hidden from view yet shaping the cosmos with their immense gravity, black holes exist as nature's ultimate paradoxes. About a hundred years ago, no one even knew black holes existed. Then came Einstein's theory of relativity, changing everything.

He proposed that gravity, like speed, affects the fabric of space-time. The stronger the gravitational force, the slower time passes. To explain this, Einstein asked us to imagine space as a mesh, with planets and stars placed on it. The heavier the object, the more it bends the mesh. This bending not only attracts physical objects but also dilates time and pulls in all forms of energy, including light.

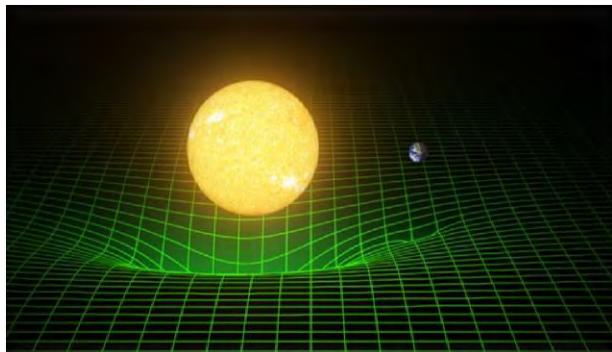


Figure: Visualizing Einstein's Fabric of Space-time

That raised an interesting idea—if there were objects with gravitational forces so intense that they could absorb even light, leaving no trace of it, wouldn't that mean they were completely black? And if they were black, how could we ever see them? Yet, if such objects existed, their presence would still be felt through their immense gravitational pull. These are black holes. But at that time, black holes were nothing more than a theoretical prediction. Even Einstein himself wasn't convinced they existed outside of

equations. The term "black hole" was not coined until after he passed away. It wasn't until the 1960s that scientists began agreeing that we would eventually find evidence of them. The phrase "black hole" first appeared in a magazine named *Science News Letter* in 1964 but didn't gain popularity until 1967. As research on general relativity progressed, it became clear that black holes weren't just theoretical; they were real, waiting to be discovered.

A black hole is not a hole. It forms from the collapse of a massive star. Every star has a fuel source, primarily hydrogen and helium that powers it through nuclear fusion, balancing the inward pull of gravity with the outward force of energy. As long as this fuel lasts, the star exists in a delicate equilibrium. But when the fuel runs out, gravity wins. The star collapses in on itself, and if it's massive enough, it compresses into a singularity, a point of infinite density, creating a black hole. For example, if the Sun were to become a black hole, it would shrink to a mere 50 km in diameter. That's how dense black holes are. But in reality, the Sun doesn't have enough mass to undergo this transformation. Only the most massive stars, far greater in size than the Sun, can become black holes.

There are different types of black holes. Stellar black holes form from collapsing stars, while supermassive black holes, like the one at the center of our Milky Way, Sagittarius A*, are millions to billions of times more massive than the Sun. These cosmic giants likely formed from the merging of countless smaller black holes and an accumulation of vast amounts of matter over billions of years. Then there are intermediate black holes, a mysterious middle ground that scientists are still trying to understand.

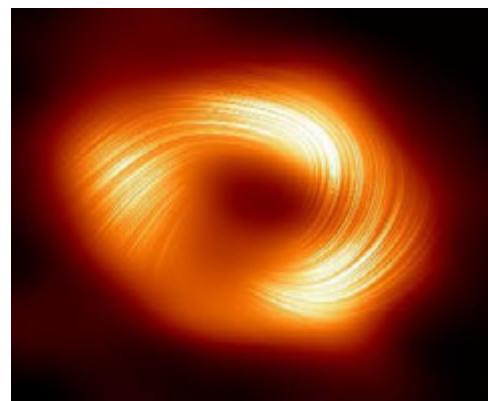


Figure: Sagittarius A*

In 2019, we finally saw the first-ever image of a black hole. Using a network of telescopes across the globe, the Event Horizon Telescope captured the glowing ring surrounding the supermassive black hole at the heart of the M87 galaxy. But if black holes are black, then how did we see them? The answer lies in the glowing disk of material around them, known as the accretion disk. Matter swirling around a black hole is heated to extreme temperatures, emitting radiation in the form of X-rays. Though the disk itself isn't visible in normal light, scientists represent it with a yellowish-orange hue to make it comprehensible.

Then comes the photon sphere, a region where gravity is so strong that light itself begins orbiting the black hole. Theoretically, if you made it to this area and looked forward, you might see the back of your head, as light from behind you could loop around the black hole and return to your eyes. Beyond this lies the event horizon, the true point of no return. Anything crossing this boundary, even light, is trapped forever. The blackness beyond the event horizon is the singularity itself, where space-time is warped to infinity. Time slows to a crawl, stretching endlessly.

If someone were to enter a black hole and somehow escape, a theoretical impossibility, they would find themselves in a universe where billions of years had passed in mere moments for them. Would the world they knew still exist? Would time itself still function the same way? That's still a mystery.

EXPLORING BINARY STARS SYSTEMS

Aleena Khan

2108-BS-PHY-22

Have you ever looked at the night sky and seen a star shining brightly in the constellation Canis Major? It is known as Sirius, the prominent star that Greeks used to navigate the year. But did you know that Sirius is a binary star? Now, what is a binary star? Let's find out by diving deep into the realm of stars.

The word binary originates from *bini*, a Latin phrase that translates to two by two. A binary star is a type of multiple-star system in which a pair of stars orbit around a

common center of mass; the stars orbit around each other. John Michel was the first person who demonstrated in 1767 in a paper that many double stars, which appear to consist of two stars placed together, must be in close physical proximity. He focused his research on the Pleiades cluster. He calculated that the possibility of finding such a close grouping of stars was one in half a million, concluding that stars in these double star systems might be drawn to one another. William Herschel started observing double stars in 1779, and in 1803, after observing hundreds of double stars; he discovered the first binary star, Castor in Gemini.



Figure: Sirius

At this point, an intriguing question arises: How do these star systems form? To delve into the answer to this question, let's first discuss the star formation process. A star forms inside an interstellar cloud that contains a large quantity of hydrogen and helium along with dust and primeval remnants. The gas and dust inside the clouds reach a critical mass and collapse under its gravity. This happens due to random fluctuation of density within the cloud or due to other factors like collision with a supernova or shockwaves from a blackhole. The gas and dust are compressed to a point where it possesses enough gravity to collect more material onto itself. At this stage, a protostar is formed. The protostar, after a series of events, transforms into a star. Now, there are different hypotheses on the formation of binary stars. One of them states that, sometimes, the cloud might detach into distinct clumps, each forming a new star. These clumps can then form multiple star systems depending on their proximity.

Types of Binary Stars

1. Visual binaries: A large quantity, about one-half of the stars in the Milky Way galaxy, are binaries or belong to

more complex multiple-star systems. The binaries that can be seen separately from a telescope are known as visual binaries. The bright component of the star is assigned suffix A and the dim component the suffix B. Sirius is a visual binary star, whose bright component (Sirius A) is 25.4 times more luminous than the Sun. Sirius B is as radiant as the Sun and was the first white dwarf star to be discovered.

2. Spectroscopic binaries: When the binaries cannot be seen with a telescope, astrophysicists use the spectrometer to observe them. They are known as spectroscopic binaries.

3. Eclipsing binaries: Some binaries are oriented in a way, from the earth, that one periodically blocks the light of the other. They are called eclipsing binaries. An example of an eclipsing binary is Algol (Beta Persei), which has a period of eclipse of 2.9 days.

Cygnus X-1

Till now, I have only discussed stars in a binary star system. However, some cases involve a star and a black hole companion. Yes, you read it right. But how can black holes, the giants that eat up everything in their vicinity, be companions? This system is formed when the massive star in the binary star system collapses into a black hole, leaving the other star in orbit with it. Cygnus X-1, shortened to Cyg X-1 – an example of a binary star system with a star and a black hole companion – is located in the constellation Cygnus, 7000 light years away from the earth. The supergiant star, HDE226868, revolves around an unseen celestial object with a period of 5.6 days. Scientists assume that the companion is a black hole, and evidence hints at the existence of a black hole. It is one of the brightest X-ray sources observed from the Earth, which corroborates the presence of a black hole.

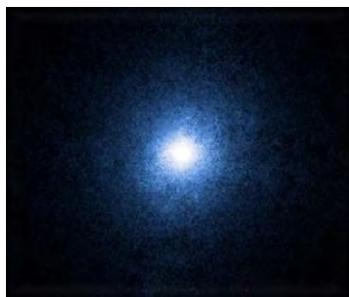


Figure: Chandra X-ray of Cyg X-1

There are numerous, fascinating yet perplexing wonders in the cosmos waiting to be unveiled. A hundred years back, maybe someone would have thought that, like planets, stars also revolved around each other. Now we know they do. Perhaps the ideas or thoughts that occupy our minds may one day become our ultimate reality.

GALACTIC FORMATION AND EVOLUTION

Bakhtawar Alam

1431-BS-PHY-24

Introduction

Whenever we look up at the sky, the mysteries of this universe always spark our curiosity. We feel a deep connection with this infinite, never-ending cosmos. This curiosity has led humans to understand the laws of nature and to develop scientific theories to deeply analyze the magnificent universe we inhabit.

Galaxies are among the most fascinating structures in our universe, attracting almost everyone to admire their breathtaking views and mind-boggling structures. A galaxy is a collection of different types of stars, interstellar gas and dust, stellar systems, planetary nebulae, and often a blackhole at the center. The observable universe contains around two trillion galaxies.

Formation of Galaxies

The galaxies are some of the oldest structures in the cosmos. They are massive (across hundreds to millions of light years) and bright, shining gloriously in the vastness of dark space. They have their roots in the early universe.



Figure: The image represents an awe inspiring structure of one of the trillions of galaxies in our universe

Our universe originated from the Big Bang, which began from an extremely hot and dense state. When the singularity expanded, space and time came into existence simultaneously. After the universe's formation, it was filled with a hot, dense soup of subatomic particles. As the universe evolved, subatomic particles combined to form atoms. Over time, atoms formed molecules, and elements emerged through nuclear fusion in stars. Eventually, stars formed and gathered into specific structures, giving rise to galaxies.

Early galaxies were formed when matter clumped together due to strong gravitational forces. Some regions in the space were denser than others, leading to the accumulation of matter and formation of stellar structures. The interstellar gas, primarily hydrogen and helium, provided the raw material for star formation. Through nuclear fusion, these were converted to heavier elements to form massive Stars. The evolution of these stellar systems governs the large-scale evolution of galaxies. These stars cluster together, eventually shaping the galaxy. They orbit around the center of mass of a galaxy, which is usually a supermassive blackhole.

Evolution of Galaxies

Galaxies exist in many shapes, depending on the type of stellar evolution occurring in them. The earliest stage in the evolution of a galaxy is the formation of a disk, characterized by spiral-like arm structures. As supernovae and stellar nucleosynthesis occur, heavier elements are produced, enriching the galaxy. Galaxies can collide with neighboring galaxies to form even larger structures. Galactic mergers, though rare events on human timescales, can be observed with powerful telescopes.

Types of Galaxies

Now, let's have a look at the types of galaxies. The galaxies are classified into three major types. These include spiral galaxies, elliptical galaxies, and irregular galaxies. Spiral galaxies have distinct spiral arms, comprising young stars and interstellar gas and dust, extending from a central bulge. The central bulge contains older stars and often a blackhole around which the galaxy rotates. The Milky Way galaxy is a spiral galaxy. It contains hundreds of billions of stars. Some regions of the Milky Way with dense stellar systems can be observed with the naked eye. The next type is elliptical galaxies. These are oval-shaped galaxies, usually consisting of old

stars. These are not very active in star formation. Their stars move randomly instead of having a well-defined structure. The third type is the irregular galaxies. As the name suggests, they also don't have a well-defined shape or structure. Typically, these galaxies are home to both young, bright stars and older, stellar populations.

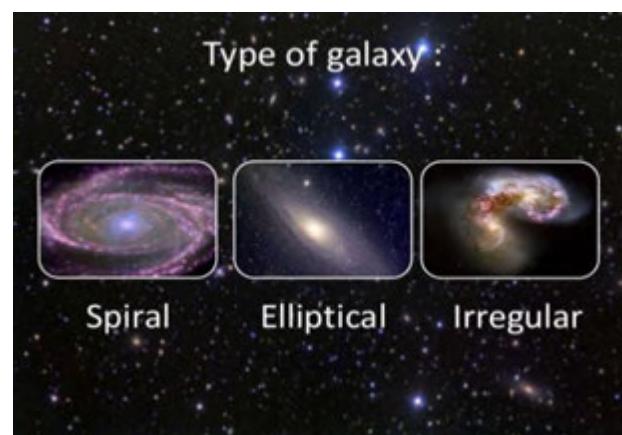


Figure: Major types of galaxies and their shapes, showcasing the incredible diversity of the universe

Redshift of Galaxies

The universe has been expanding since the Big Bang. This expansion affects the motion of galaxies, causing them to move away from us. This phenomenon, known as cosmological redshift, occurs because the expansion of space stretches the wavelength of light, shifting it toward the red end of the spectrum. This means that galaxies with a greater redshift are farther away from us and receding faster. Studying galactic evolution in this context leads to intriguing theories about the universe's history and structure.

Galactic Structures

To understand the grand structure of the universe, it is essential to examine galactic structures. Galaxies group to form clusters, with each cluster containing hundreds of galaxies. There are millions of galactic clusters in the universe. The local cluster in which the Milky Way resides is the Virgo Cluster. Beyond clusters are superclusters, each containing numerous local clusters. Our local cluster is part of the Laniakea Supercluster. These clusters and superclusters are interconnected within the cosmic web—the largest known structure in the observable universe—spanning trillions of galaxies.

Conclusion

Galactic Formation and Evolution is the most crucial topic in astrophysics. It always intrigues physicists to understand what's going on beyond the limits of the visible blue sky. If we point a telescope in any corner of the night sky and focus it there, we can see thousands of galaxies. These are considered the most prominent structures in the cosmos. Galaxies always captivate our curiosity and force us to understand our magnificent universe more deeply.

MICROSOFT'S MAJORANA 1 SETS A NEW MILESTONE IN QUANTUM COMPUTING

Fatima Zahra

1421-BS-PHY-22

In this century, almost everything we do requires some degree of automation or the use of a computer. Be it checking the weather on your phone, booking a flight, or ordering groceries, you are always leveraging the intricate infrastructure of digitalization. While the list of tasks that a computer can perform is ever-expanding due to rising productivity and innovation in computing, it still warrants a fundamental question: What is the **basic unit of information** in a computer, or how does the computer perform these nuanced functions?

In the world of computing, **bits** serve as the most fundamental unit of information. A bit can have only two values, either a one or a zero. This foundation value provides the stage for performing calculations and representing all types of data we're familiar with, such as images, text, sounds, etc. For instance, images on computers are represented by using a combination of bits. Each pixel in an image is represented by a unique combination of bits. In the same manner, sound waves are converted into digital signals that are uniquely defined by bits. But what about complex tasks that require much more sophisticated modeling and problem analysis? The binary system used by classical computers restricts their ability to solve complex problems efficiently. They usually struggle with tasks that require simultaneous exploring of vast solution spaces.

But on the other hand, quantum computers are a game changer in the computing landscape. Quantum computers

leverage quantum bits or “**qubits**” that can exist in multiple states all at once, in sharp contrast to the binary system of zeroes and ones! That they can process multiple states at once renders them the perfect prototype for innovation in various fields such as cryptanalysis and optimization problems. However, in just the month of February 2025, a recent breakthrough in this frontier has left the scientific community in awe.

On February 19th, 2025, Microsoft announced the release of **Majorana 1**, the world's first quantum chip that is based on a topoconductor. But before delving into the science of this quantum chip, its scope and its scale, it is essential to step back and put this breakthrough into context. Topoconductors are a new category of materials that are rigorously being scrutinized to test their applicability in quantum systems. In much the same way that semiconductors have thoroughly revolutionized the current technology, including smartphones and computers, **topoconductors** are a class of materials that exhibit excellent conductivity and protection against perturbations. Majorana 1 is the first quantum chip that leverages the world's first topoconductor!

This quantum chip, powered by this novel topological architecture, is claimed to be able to solve industrial-scale problems at an unprecedented scale. This material in Majorana 1 can harness Majorana 1 to produce more reliable qubits which are the foundation of quantum computers. The way this material achieves this task is by offering a clear route to fit almost **one million qubits** on a single chip! This million qubit is the theoretical threshold needed to deliver real-world, transformative solutions. This includes, but is not exclusive to, solutions such as the invention of self-healing materials for healthcare and construction. The computing power of a single one-million qubits quantum computer far surpasses the computational prowess of all the classical computers in the world combined!

This exotic material, called either a topoconductor or a topological conductor, is a new and very specialized type of material. It is not solid, liquid, gas, or even plasma! This entirely new state of matter is actually a **topological state**. This unique phenomenon is exploited to produce qubits that are faster, smaller, and more stable. These properties allow them to be digitally controlled more effectively without really relying on any tradeoffs that are

necessary for typical computer systems. This is an essential step in practical quantum computing.

Microsoft's technical fellow Chetan Nayak remarks on the importance of this one-million qubit threshold in quantum computing and how Majorana 1 offers a pathway to this value. This exciting milestone in quantum computing validates the decision of Microsoft to pursue the design of a topological qubit years ago. Although the idea was high risk, this engineering step is now paying off as Microsoft has now placed 8 topological qubits on the chip to scale up to one million.

LUNAR MOTION

Musaddiq Meeran Ahmed

1401-BS-PHY-24

Introduction

In Physics, the term —~~otion~~” has very importance. We study different types of motion in physics, like the motion of charged particles, the motion of freely falling objects, and the motion of particles in different fields (electric and magnetic). In this article, you shall be introduced to the motion of the moon around the earth, which is scientifically referred to as the —~~unar~~ motion”.

What is Lunar Motion?

The revolution of the moon around the Earth in a particular orbit is called lunar motion. The moon takes about 27.3 days to complete one revolution around the Earth. It passes through different positions in the sky during its revolution each day. Sometimes, it is in the very north of the sky; other times, it is in the very south of the sky.

Phases of the Moon during Its Revolution Around the Earth:

The moon passes through eight different phases of its complete cycle around the Earth. These phases of the moon are as follows:

1. New Moon
2. Waxing Crescent
3. First Quarter

4. Waxing Gibbous
5. Full Moon
6. Waning Gibbous
7. Third / Last Quarter
8. Waning Crescent

1. New Moon: During a New Moon, the moon is between the sun and the earth. It almost lies very near to the sun in the sky. During this phase, the moon is completely invisible from the earth, but it is present in the sky. It rises with the sun. When the sun sets, the New Moon sets. It's almost the 29th date of the Islamic month on a New Moon day. The next day, a new crescent appears after sunset in the sky.

2. Waxing Crescent: Waxing means increasing. The crescent moon, which is increasing, i.e., becoming brighter day by day, is called waxing crescent. It rises almost 2 to 4 hours after sunrise and sets 2 to 4 hours after sunset.

3. First Quarter: Half-moon is called quarter moon. There are two half-moons in the complete cycle of the moon. When the moon phase increases and it reaches a stage where about 50% of the total moon is luminous, it is called the first quarter moon. The first quarter moon rises mostly at noon and sets at midnight.

4. Waxing Gibbous Moon: The phase of Moon when it is more than 50% luminous is called gibbous. Gibbous means more than half. If the gibbous moon phase is increasing that is its brightness increasing day by day then it is called waxing gibbous stage of moon. It rises mostly in the afternoon and sets a few hours before sunrise.

5. Full Moon: A full moon occurs when the moon is completely or 100% luminous. A full moon is always opposite to the New Moon. When the sun sets, the full moon rises from the east, and when the sunrise, full moon sets in the west.

6. Waning Gibbous: It is opposite to waxing gibbous. Waning means decreasing. The stage of the moon during which it is more than 50% luminous but its brightness is decreasing day by day is known as the waning gibbous phase of the moon.

7. Third or Last Quarter: It is the last half moon of the complete cycle and is opposite to the first quarter.

8. Waning Crescent: Before a New Moon, it is the final stage of the moon's complete orbit around the earth. It rises early in the morning and sets before sunset.

Conclusion

Everything in the sky rises and sets like the sun. Moon rising and setting is not to be confused. Many people have developed a wrong concept about the moon, which is that the moon doesn't set and remains 24 hours in the sky. There is also another wrong concept that the moon rises from the west, which should be disregarded. Like the sun, the moon also rises from the east and sets in the west. The moon completes its one revolution around the earth by passing through eight different phases. The study of lunar motion enables us to find the New Moon of the new Islamic month. Science and technology experts predict the date of Ramadan, Eids, etc., after studying lunar motion.

QUANTUM FIELDS: THE FOUNDATION OF MODERN PHYSICS

Abdul Ahad Afzal

1409-BS-PHY-22

To understand the quantum field, we must understand its pre-requisite. Let us build our way to this. It is difficult to construct an understanding of this in one simple article because if I am given a chance, I can speak for hours on this topic. Let us start with a considerably basic and familiar concept. The Wave.

Let us say, what is a wave? "In basic physics, we define a wave as a propagating disturbance that transfers energy and information." But if I say in simple words, "Waves are disturbances." But the disturbance of what? The simplest answer is the disturbance of medium, like when we throw a pebble in water, it disturbs the water, and at least a wave originates.

So, now what about the case of electromagnetic waves like light? how can these propagate without any medium? The electromagnetic waves are the oscillations of electric and magnetic fields in some certain directions, but more simply electromagnetic waves are the disturbances in the

electromagnetic fields i.e. Electric field and Magnetic field (not a disturbance of a medium like we discussed in case of mechanical waves). The important thing here is that "wave is the disturbance of the field" (to apply this theory on mechanical waves I need a lot of time and much more words, so let us skip this topic for now).

Now, let us move forward towards our next milestone. Quantum mechanics says that every particle (entity is more suitable, but for simplicity I will use particle) has its wave function. The function can describe that particle. The wave function is so important, but the question is, what is a wave function? As Most of you think of wave function as a function that describes a wave that we can see or feel, but sadly, that is not possible because of the imaginary number $-i$ (the number that exists in some imaginary dimensions that we cannot see, a mathematical dimension). The wave function is a mathematical wave, the wave of probabilities for a particle. The wave function describes the probability distribution of a particle's properties, not a physical wave in space.

So, if we say particles have wavefunctions, then the particles are also the waves. Pretty obvious, right? In a way, yes. Particles have a dual nature. The particles sometimes show particle behaviour and sometimes show wave nature (it is also proven by different experiments and obviously, there are certain conditions for particles to change their nature that I am not going to touch today).

So, the million-dollar question is that "the particles are waves, then these waves are the disturbance of which thing, which field." And here come the quantum fields. The quantum field is not a physical object like air or water but a mathematical framework that assigns values to every point in space. When these fields fluctuate, it produces a pair of its respective particle and anti-particle like electron field produces electrons and positrons. We can measure these fields by some direct or indirect methods. These fluctuations are known as quantum fluctuations. By the saying of quantum fluctuations, I mean spontaneous, unpredictable changes in a field's energy due to the inherent uncertainty of quantum mechanics. In simpler words, the waves of particles are the disturbances of quantum fields. Imagine a pond filled with crystal clear water, so crystal clear that it is invisible, and someone randomly throwing pebbles in the pond. As a result, ripples are formed. Now, let water be a quantum field, pebbles are disturbances, and the ripples are the

quantum fluctuations that are responsible for pair production.

For example, electrons are the disturbance of the electron field (the electron field is a quantum field). To accurately say electrons and positrons are produced due to the quantum fluctuations in the electron field. So, what are the fluctuations? You already know the answer in very comprehensive and simple words: Fluctuations are disturbances due to any unclear cause or source of it. It just happens randomly (the beauty of quantum mechanics).

Until now, I hope, I have given you an understanding of the quantum fields. Now, I am jumping to the second part of the question. That is, —Are the quantum fields fundamental?"

In physics history, the fundamentals kept changing from time to time as our understanding of the universe expanded. Like atoms were fundamental in the past. Then, we became capable of seeing inside the atom. We saw (not literally) protons, neutrons, and electrons inside the atom and became fundamentals. Then we discovered quarks inside the protons and neutrons, and they became fundamental beside electrons. Then, we humans discovered the process of their production (how they are made). These particles are formed due to the quantum fluctuations in their respective quantum fields.

So, we can say with some confidence that quantum fields are fundamental. But only for now, until we discover something more exciting, fascinating, and fundamental someday, maybe. Speaking of this, there arises a billion-dollar question, and the question is —How do these quantum fields originate?" I hope someday I will be able to draft another article on the answer to this question, or maybe someone else will do this earlier than me. who knows.

QUANTUM TELEPORTATION: SCIENCE FICTION OR FUTURE REALITY?

Maham Mumtaz

1403-BS-PHY-22

In modern physics, the apparently sci-fi idea of quantum teleportation is starting to become a fascinating reality.

The scientific method of quantum teleportation is a well-established phenomenon in quantum mechanics, but the idea of quickly moving objects or people from one place to another is still limited to literature and movies. But what does it mean, and how close are we to practical applications?

Quantum Teleportation

Quantum teleportation is the use of entanglement to move quantum information from one place to another, not the movement of matter. The phenomenon known as quantum entanglement occurs when two or more particles, regardless of their distance from one another, get intertwined in such a way that the state of one immediately affects the state of the other.

Three main steps are involved in the quantum teleportation process:

Entanglement: The states of two particles (A and B) are inherently connected when they are entangled.

Measurement: The state of one of the entangled particles (A) is transferred by interaction with a third particle (C), which has the information to be transported.

Classical Communication & Reconstruction: The recipient receives the measurement results by classical communication and then reconstructs the initial quantum state of C using the entangled counterpart (B). This method enables the transmission of a particle's quantum state without actually delivering the particle.

New Developments in Quantum Teleportation

Scientists have effectively demonstrated quantum teleportation over longer distances in recent decades.

- The first time quantum teleportation was accomplished with photons was in 1997 by physicists at the University of Innsbruck.
- Researchers at the University of Science and Technology of China used free-space optics to expand teleportation more than 100 kilometers in 2012.
- China's Micius satellite set a new milestone in 2017 when it was able to transport quantum states from Earth to space.

These developments imply that, in the kingdom of quantum communications, quantum teleportation is now a genuine possibility rather than just a theoretical one.

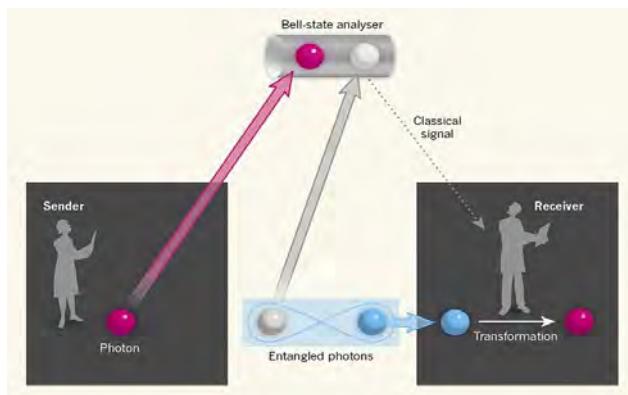


Figure: Quantum Teleportation experiment

Possible Uses

Quantum teleportation has important technological consequences, even though human teleportation is yet unattainable. These include:

Quantum Computing: The development of quantum networks, which enable safe and effective communication between quantum computers, depends on quantum teleportation.

Quantum teleportation provides a basis for extremely strong encryption techniques that are impenetrable due to the inability to replicate quantum states.

Advanced Communication Systems: Global communication could be revolutionized via quantum teleportation, which would allow for instantaneous, safe data transmission over great distances.

Obstacles for the Future

Quantum teleportation has a number of obstacles in spite of its potential:

DE coherence: Stable teleportation is challenging because quantum states are brittle and readily disturbed by outside noise.

Need for Classical Communication: Despite the instantaneous nature of teleportation, actual "instantaneous" transmission is limited since it still requires classical signals, which move at the speed of light.

Scalability: One of the biggest obstacles to the widespread use of quantum teleportation is its large-scale implementation. Researchers are still looking for methods to improve the scalability, dependability, and efficiency. Given the speed at which quantum technology is developing, useful applications might appear in the ensuing decades.

The Role of Quantum Teleportation in the Future of Science

It is anticipated that quantum teleportation will be essential to the development of quantum technologies as research continues. Researchers are investigating its potential integration into quantum networks, which could lead to advances in distributed computing, secure communication, and quantum-enhanced sensing. Artificial intelligence and space exploration may change as a result of the capacity to transport quantum states over great distances.

Public Perception and Misconceptions

Despite its scientific keystones, the general public frequently has misconceptions about quantum teleportation. It's more often linked to the teleportation of touchable items in science fiction than to the transmission of quantum information. To promote a greater awareness of its practical implications and opportunities, it will be crucial to close this gap via outreach and education.

Conclusion

Quantum teleportation is a genuine and quickly evolving technology with significant implications for communication and computing, even though it is not the instantaneous transport of physical objects portrayed in science fiction. The goal of using teleportation for useful purposes might one day come true as scientists continue to push the limits of quantum mechanics. Although the future remains uncertain, researchers are still looking for ways to improve the scalability, efficiency, and dependability. Given the speed at which quantum technology is developing, useful applications might appear in the ensuing decades.

FROM EQUATIONS TO SIMULATIONS: THE ROLE OF COMPUTATION IN MODERN PHYSICS

Ahad Raza

1459-BS-PHY-22

Introduction: The Rise of Computational Physics

Computational physics is the study and application of numerical analysis to physics problems that already have a quantitative theory; it combines applied mathematics, physics, and computer science to provide scientific answers to difficult questions. It is difficult to investigate many elements of physics, particularly theoretical physics, without computer simulations of models. Researchers use a range of strategies to solve problems in complex dynamics, particle physics, quantum field theory, and other domains, such as statistical analysis, visual/graphical representation, and numerical approximation. Even experimental physicists utilize software to measure and investigate the atomic structure of condensed materials, such as semiconductors and topological insulators. Computers are usually used in physics and related sciences nowadays. In addition to being used in numerical analysis, simulations, data collection and analysis, and symbolic manipulation, computational physics has become a third approach to physics, and almost all undergraduate students who take physics courses will eventually use computational tools, even if they do not decide to become practicing physicists.

Why Computational Physics Matters

Deep Understanding of Physics: Computational physics allows us to simulate complex models of physical processes that are difficult to study empirically. As a result, it facilitates the exploration of new study areas and improves our understanding of physics.

Improve Problem-Solving Ability: Because computational physics requires the construction of algorithms to address complex physical problems, it contributes to the development of human problem-solving skills. Before we can utilise computer technologies to conduct experiments and solve problems in a virtual physical system.

Career Opportunities: Because computational physics is a fast growing field, there is a high demand for qualified computational physicists in a variety of industries, including research, technology, and academia.

Applications across disciplines: Computational physics is widely used in research spanning disciplines such as biophysics, materials science, geophysics, plasma physics, meteorology, and many more. Learning computational physics may provide up opportunities to work on these transdisciplinary initiatives.

Additionally, it might offer chances to collaborate with and gain knowledge from other researchers and experts in the field.

Features of Computational Physics

Algorithm development: Computational physicists develop new algorithms and numerical methods to solve complex physical problems. Computational physicists study and predict the behavior of physical systems using numerical simulations and statistical analysis. Computational physicists employ mathematical models to describe physical systems and events.

High-performance computing: Computational physics demands high-performance computing resources to execute simulations and solve complicated issues. Computational physicists use sophisticated data analysis and visualisation techniques to investigate simulation and experimental results.

Multidisciplinary collaboration: Computational physicists commonly work closely with mathematicians, computer scientists, experimental physicists, and engineers to solve complex physical problems.

Applications of Computational Physics

Computational physics has immense potential to change the world. It is already doing wonders in various fields of science and technology, and soon, its impact on human civilization will surely be increased manyfold. Some of its uses are described below:

Cosmology and astrophysics: Computer simulations are used to model the behavior of celestial objects, such as planets, stars, galaxies, and even black holes.

High-energy physics: Computational simulations are used to explain the behavior of subatomic particles in particle accelerators and to understand the properties of the fundamental forces of nature.

Condensed matter physics: To study the properties of materials, forecast their behaviour at the atomic and molecular level, and develop new materials, computational simulations are employed.

Climate modeling: Computational simulations are used to model the behavior of the Earth's climate system, predict future climate change, and comprehend how human activity impacts the climate.

Fluid dynamics, structural mechanics, and electromagnetic simulations are just a few of the many engineering and technological applications that make use of computational simulations.

Programming Languages Used for Computational Physics

Since each programming language has advantages and disadvantages based on the needs of a project, no one programming language is utilized only for computational physics. Nonetheless, the following are a few of the languages that are often used in computational physics:

- **Python.**
- **C++.**
- **Fortran.**
- **MATLAB.**
- **Julia.**

Challenges in Computational Physics

Despite the many advantages of computational physics, there are also several challenges associated with this field.

Simulation accuracy and reliability: One of the main goals is to increase simulation accuracy and reliability. Even little errors in the beginning conditions or numerical methods could result in significant differences in the simulation results.

Resources for computation: Numerical simulations sometimes require computing resources such as large-scale data storage, specialised equipment, and clusters of high-performance computers. It could be challenging to access these resources, especially for researchers in developing countries or at small universities.

The model's complexity: Many physical problems require complex models that are difficult to replicate accurately. These models often require extremely complex computing techniques and a full understanding of the physics involved.

Software development: Developing software for numerical simulations is a time-consuming and labor-intensive process. It requires an understanding of software engineering, physics, and numerical methods. Moreover, the software may be challenging to maintain and update.

BEYOND THE LAB: COLLABORATION BETWEEN PHYSICS ACADEMIA AND INDUSTRY

Muhammad Kashif Raza

1428 BS PHY 21

As a basic subject, physics has always been essential to the invention of cutting-edge technologies. However, partnership between industries and universities is important for the transfer of research findings from academic institutions to real-life scenarios. Considering notable advancements in scientific research, the capacity of Pakistan to use physics for technological and economic advancement is constrained by the broad gap separating the higher education and industry sectors.



Figure: Depiction for bridging Academia and Industry as a collaborative model for contributing to startups and at the same time for human development

The groundwork for discoveries in science is academic institutions. Research laboratories and universities engage in experimental and computational physics, yielding novel ideas that serve as the foundation for breakthroughs in science. Many universities in Pakistan are engaged in state-of-the-art physics research, such as the Government College University Lahore, the National Center for Physics, Quaid-i-Azam University, and other private sector institutes like LUMS, NUST, PIEAS, and GIKI, etc. Awareness in subfields of Physics like nanotechnology, quantum mechanics, and renewable energy has grown. The challenge, however, is the lack of practical application of these developments in science.

To turn our theoretical findings into valuable applications in the industry, certain efforts are required. To translate lab findings into commercial goods, sectors such as semiconductor physics, material research, and photon science need to work closely together with companies. The industry in Pakistan has not completely profited from research conducted by universities, especially in areas like manufacturing, electricity, and transportation. Companies cannot adopt the most advanced physics-based ideas due to a lack of funds, old equipment, and weak research opportunities. Dr. Pervez Hoodbhoy discusses this particular issue as, —Without science, there is no future. A country that does not invest in education and research cannot progress.”

The colleges and universities of Pakistan have little government funds and little industrial investment in research and development, making it difficult to reduce the distinction between academia and industry. Industrialization is additionally hindered by the absence of coordinated partnerships and transferable technology companies. The local academic sector experiences a brain drain, and innovation is limited by outdated manufacturing processes. Furthermore, graduates are unfit for the demands of employers due to educational gaps and skill inadequacies. More powerful collaborations, more investment, and modifications to the curriculum that match academic research with business demands are all essential to meet such challenges.

Consider an authentic example from the educational sector of Pakistan: a PhD researcher is working in a Physics research lab, thinking about his family expenses needs, and financing his research results at the same

time. Would he work efficiently with all these difficulties? The answer must be —absolutely not!”. He can't focus on his scientific work properly. Now, do you think he can contribute to society in this situation where he didn't get enough funding and resources to meet his daily life needs? Consequently, researchers lose interest in their work and quit, or they adopt a —go with the flow” trend. What I believe is, even undergrads and master's students should be funded by Higher Education Commission (HEC) and companies so they get finances for their research projects.



Figure: Despite the efforts of prestigious higher education institutions, employers still find it difficult to attract graduates who have the necessary skills for the job market, underlining the widely recognized gap between educators and companies

In a talk, Dr. Sabieh Anwar Siddiqui (LUMS) and Dr. Sajid Ali (GCU) said that the same aspect that we have zero collaboration between academicians and the industry sector in Pakistan. We are just focusing on paper mills, and there is no contribution and outcome from these articles as they don't have support from companies. Academia and educational labs are like software, and the industrial sector is like hardware. So, concluding the whole discussion, we can say that academia provides the backbone to an industry work. If there is no industry, academia is useless because people are not getting any kind of benefits from their research, and there is no exceptional contribution to the economy as well. The World Bank reported that the Pakistani government increased its education budget from 1.69% of GDP in 2021 to 1.9% in 2023. Still, Pakistan needs to enhance its educational finances in the years ahead if we want to survive in the energy sector, climate change, and other crises like those in developing countries.

To cope with these challenges in Pakistan, authorities must work on the development of industrial zones in our country and support these sectors. As a result, researchers, research labs, research and development academic institutes, the industrial sector, and ultimately the economy of Pakistan will grow. Also, the Higher Education Commission (HEC) needs to modify the courses that were designed decades ago in our educational institutes. HEC should provide a project to each master's research student in physics and expect a great contribution from their graduations. Then, it is essential to implement these scientific project findings and outcomes in industrial sectors to stimulate innovation and practical advancements.

MEDICAL PHYSICS: BRIDGING SCIENCE AND HEALTHCARE

Ayesha Tanveer

1411-BS-PHY-22

Medical physics is the application of physics concepts and methods to prevent, diagnose, and treat human diseases in order to improve our health and well-being. It has also been considered a medical profession since 2008 by the International Standards Classification of Occupation of the International Labour Organization.

Medical physics is sometimes called biomedicine, applied physics in medicine, or hospital radio physics. It's all the same field. Medical physicists, like most physicists, can work in specialties such as radiation oncology (e.g., radiotherapy), diagnostic and interventional radiation (e.g., medical imaging), core medicine, and radiation protection.

In radiation therapy, they work with dosimetry, linear accelerator (LINAC) quality assurance, and brachytherapy. In diagnostic and interventional radiology, techniques include MRI, ultrasound, CT scans, and X-rays. Core medicine works with advanced techniques such as positron emission tomography and radio nuclear therapy.

However, medical physicists also work in physiological monitoring, audiology, neurology, neurophysiology, and cardiology, among other areas. There are two types of

university programs in medical physics. One type is designed to prepare students for hospital careers as physicians; it stresses research that improves clinical practice. The other type—which is often called "biomedical"—is more general, covering all medical applications of physics and even taking in nanomedicine by studying biomolecular structures.

Key Areas of Medical Physics

1. Diagnostic Imaging: Diagnostic imaging is one of the most prominent applications of medical physics. Radiologic imaging (ie, X-rays, computed tomography [CT], MRI, positron emission tomography [PET], ultrasound) enables physicians to visualize the internal structures of the body without invasive procedures. They assist in identifying diseases while still in the early stages, allowing for prompt interventions.

2. Radiation Therapy: Radiation therapy is a cornerstone treatment for many cancers. Involves delivering precise doses of ionizing radiation to targeted areas to kill cancerous cells with minimal impact to surrounding healthy tissue. Individuals in this field work alongside oncologists and radiotherapists in the development of treatment plans in a manner that aims to provide the most precise and safe delivery of radiation to patients.

3. The field of nuclear medicine: Both in nuclear medicine radioactive tracers for diagnosis and in treatment procedures like PET scans and single-photon emission computed tomography (SPECT) can be used to view organ function for early diagnosis of diseases such as cancer, heart disease, and neurodegenerative or metabolic disorders. Targeted radionuclide therapy (directed radiation to the tumor for specific forms of cancer)

4. Safety and Protection against Radiation: Medical physics: As there are medical applications of ionizing radiation, medical physicists must ensure that patients and health care workers are guarded. They calibrate instruments, make safety protocols, and stick to global standards. Routine quality control verifications reduce the associated risks of radiation-based activities.

5. Research and Biomedical Engineering: Proton therapy, AI-based imaging systems, and customized treatment planning, among others, are some advanced medical technologies developed because of medical

physicists. Working with researchers, doctors, and engineers to enhance therapies and methods of diagnosis. Lastly, this is to benefit patients.

Medical Physicists' Role

Medical physicists are widely found in academic programs, industries, hospitals, and facilities. Their duties include:

Quality assurance: Making sure radiation therapy and medical imaging equipment operates at its best

Treatment planning: Specialized radiation therapy protocols with fellow oncologists.

Research and development: Induction of novel radiation, imaging, and safety measures.

Compliance with regulation: Ensuring compliance of OSH practices to prevent radiation-related injuries. .

Prospects for Medical Physics in the Future

Technology evolves; so does medical physics. Among the new trends include:

Artificial intelligence (AI) in medical imaging: AI drives algorithms for increased proficiency of the analysis, improving efficiency and accuracy despite being misbegotten tasks.

Proton therapy: An advanced quality radiation treatment based on reducing tissue destruction.

Personalized medicine: Medical physics developments that develop individualized treatment plans based on biological and genetic associations.

Non-ionizing imaging: The use of ultrasound, MRI, etc, to de-emphasize the use of ionizing radiation while preserving critical diagnostic information at highest fidelity.

Conclusion

Modern healthcare is not complete without its medical physics — which is where physics meets medicine for the promotion of patient safety and diagnostic and therapeutic accuracy. Medical physicists are critical to maintaining the path of progress in healthcare technology and ensuring that safe, efficient medical performance is carried

forward. In the future, as this field develops, more precise and personalized solutions for medicine may be created that will positively impact patient care all over the world.

UNVEILING THE MILKY WAY'S SECRETS WITH GHOST PARTICLES

Sidra Razzaq

1525-BS-SP-PHY-23

Introduction

For many years, astronomers have used telescopes that capture visible light, radio waves, and X-rays to study the Milky Way galaxy. However, it is challenging because the space is filled with dust and gas particles, which makes it difficult to observe the galaxy using traditional methods. It's like trying to look through thick fog by using a weak flashlight. Fortunately, scientists have overcome this challenge by using something entirely different called Neutrinos to map our galaxy.

Neutrino, a Ghost Particle

Imagine a particle so small that it can easily pass through entire planets without slowing down. Yes, these are Neutrinos. They are teeny, tiny, almost massless particles that travel near the speed of light. Unlike many other subatomic particles, they have no electric charge, which means that they are difficult to capture using electric or magnetic fields. Physicists call them "ghost particles". They originate from some of the most powerful cosmic events like exploding stars, black holes, and gamma ray bursts. They are the most abundant particles in the universe and can move as easily through lead as we move through the air. Unlike light, which can be blocked or bent, neutrinos move through galaxies as if they weren't even there. Because of that, it provides unique ways to study hidden cosmic phenomena.

Exploring the Types of Neutrinos

As the most abundant particles in the universe, they are produced in a multitude of different processes, but the scientists hunting for them focus on two key types:

Ultra-high-energy neutrinos: As matter spirals into the black hole, it releases intense radiation and high-energy

particles; some of these particles decay into neutrinos. In the case of Gamma-Ray Bursts, an enormous amount of energy is released in a short time. This energy creates shock waves where protons collide, creating pions that eventually decay into ultra-high-energy neutrinos. By studying these cosmic events, physicists aim to uncover how ultra-high-energy neutrinos are generated and what secrets they hold about the universe's most extreme environments.

Friedland says: "Neutrinos give you a different eye to look at the universe and a unique probe of new physics,"

Low-energy neutrinos: The low-energy neutrinos are hard to detect. This is why the cosmic neutrino background is still somewhat out of reach. But with the advancement in the detector's sensitivity, researchers may finally confirm the existence of a "sterile neutrino," hypothetical particles that might play a role in dark matter, the unseen mass that makes up most of the universe.



Figure: The Ice-Cube Neutrino Observatory, founded in a cubic kilometer of Antarctic ice, searches for neutrinos and captures them at different energy levels

Mapping the Milky Way with Neutrinos

Back in 2015, Kurahashi Neilson proposed the idea of using cascade neutrinos to map the Milky Way galaxy. After eight years of research and development, her vision is now a reality. Deep under the ice in Antarctica, there's a giant telescope called the IceCube Neutrino Observatory. Instead of using glass lenses, it detects neutrinos when they interact with ice. The IceCube Collaboration, a research group that includes the Drexel University Physicist, has shared the first map of neutrino emission from our Galaxy.

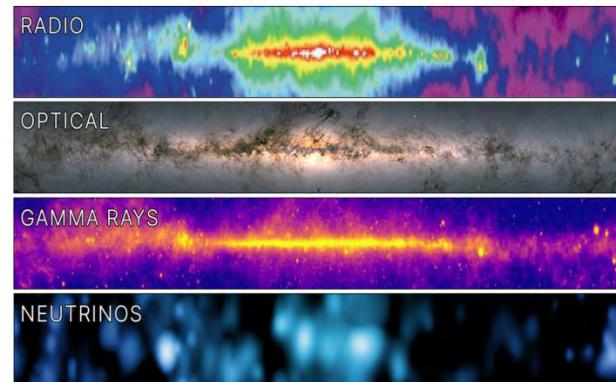


Figure: Four different views of our Galaxy: The first three images show light detected at different wavelengths (radio, visible, and gamma rays) and the last image shows the first map of the Milky Way in neutrinos

Scientific Impact of Neutrino Mapping

This discovery changes how we study space. Here's why:

- A new lens on the universe – Instead of relying only on light, we can now use neutrinos to explore space.
- Locating galactic powerhouses – The map verifies the locations of high-energy occurrences like black holes and exploding stars.
- A step toward multi-messenger astronomy – Scientists combine different cosmic signals, for instance, light, neutrinos, and even gravitational waves, to get a fuller picture of space.

Future Prospects: Neutrino Astronomy

Research in neutrino astronomy continues to advance with larger and more sensitive detectors like IceCube-Gen2 and KM3NeT, which will help scientists find even more hidden cosmic wonders. These future discoveries could:

- Shows new types of galactic explosions and high-energy events.
- Explains where mysterious cosmic rays come from.
- Unveil parts of the universe we've never observed before.
- By the mid-2020s and beyond, an increasing number of neutrino sources have been identified, eventually answering the question about the origin of cosmic rays.

Conclusion

Neutrino experiments are essential for both physics and astronomy. Scientific history has taught us that using a variety of experiments is the best way to confirm discoveries and minimize uncertainties. This breakthrough gives us a brand-new tool for uncovering the hidden universe.



PSYCHOLOGY

2024: YEAR IN REVIEW

Jan

- Researchers from Universities of Bath and Bristol conducted a qualitative research to highlight social and cognitive challenges in response to withdrawal from SSRI antidepressants. Themes such as managing the return of emotions, cognitive clarity with negative impacts on relationships and social interactions were prevalent in the participants.

Feb

- An experimental study in Consciousness and Cognition, investigated that how individuals with phantasies, those unable to form mental images, experience storytelling. Aphantasics were less likely to be engaged and absorbed in the content, and experienced reduced emotional engagement with the characters as compared to the controls.

March

- Researchers at University College London (UCL) developed a Mental Health Intervention for Children with Epilepsy (MICE), showing significant improvements in 334 participants receiving it. This modular approach treats multiple conditions like anxiety and depression within epilepsy care.

April

- A longitudinal cohort study in Nature found that first-trimester Prenatal Alcohol Exposure may alter visual neurodevelopmental timing in early infancy. Using high-density EEG during a visual-evoked potential (VEP) task, researchers observed abnormal VEP timing in infants aged 8-52 weeks, indicating disrupted electrical brain signals.

May

- From May 23rd to 26th, 36th Annual Convention of APS took place in San Francisco. It attracted leading professionals, researchers and students who presented cutting-edge researches. Special symposia included sessions on ethical implications of AI and advancements in psychometric tools.

June

- A groundbreaking study in Brain identified key brain regions linked to stuttering by analyzing brain lesions using lesion-symptom mapping. Damage to the left insula, supplementary motor area, and basal ganglia was found to disrupt speech fluency.

July

- A novel study explored the use of AI to generate psychological hypotheses by combining large language models (LLMs) and causal graphs. The study involved analyzing over 43,000 psychology articles and generated 130 new hypotheses on well-being related to causal relationships between psychological variables.

Aug

- On August 9th, the FDA rejected approval for MDMA-assisted PTSD therapy, marking the first psychedelic drug rejection. Citing issues like functional unbinding, psychotherapy protocols, ethics, and abuse potential, the decision disappointed advocates and impacted industry stocks.

Sep

- Vistagen launched the PALISADE-4 Phase 3 study to assess the efficacy, safety, and tolerability of fasedienol, an investigational nasal spray for Social Anxiety Disorder. Designed to activate olfactory-amygdala circuits, it stimulates nasal chemosensory receptors rapidly lowering autonomic nervous system responses linked to anxiety.

Oct

- A University of Pennsylvania study found that omega-3 supplementation can significantly reduce aggression. Analyzing 28 Randomized Controlled Trials with 3,918 participants, researchers observed a potential 28% decrease in proactive and reactive aggression.

Nov

- The 10th International Congress of Clinical and Health Psychology in Children and Adolescents, was held from November 21st to 23rd in Spain. 600 experts from 35 countries examined the impact of pornography, self-harm behaviors, and importance of collaborative approach to therapeutic practices involving adolescents.

Dec

- In a study published in *Nature*, researchers from MIT and Stanford analyzed the browsing histories of over 1,000 participants. Findings suggested that exposure to negative online content led to increased consumption of similar content. This pattern indicated that online behavior can reinforce emotional distress rather than alleviate it.

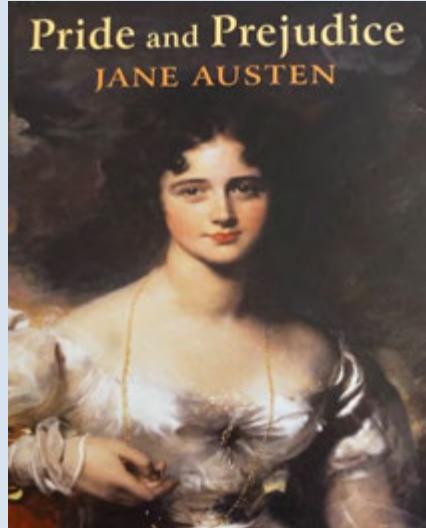
BOOK REVIEWS

PRIDE AND PREJUDICE - JANE AUSTEN

Amna Tahir

2993-BS-PSY-21

Pride and Prejudice, originally penned by Jane Austen in 1813, is a timeless classic that has many adaptations in films and television, with the 2005 film directed by Joe Wright being one of the most popular. This romantic drama explores the complexities of love, social class, and the quest for personal happiness in early 19th century England. The story revolves around Elizabeth Bennet, a strong-willed and intelligent young woman, and her developing relationship with the enigmatic Mr. Darcy. Set against the backdrop of the strict social structure of the time, this story delves into themes of prejudice, pride and importance of self-awareness. The plot follows Elizabeth as she navigates societal expectations and family pressures, particularly regarding marriage and social status. The Bennet family, with their five daughters, faces the pressing need to secure advantageous marriages. Elizabeth's initial dislike for Mr. Darcy, stemming from perceived arrogance, gradually evolves into a deeper understanding of his character. As the story unfolds, Elizabeth learns to look past first impressions and societal judgments, ultimately leading to her personal growth and self-acceptance. The story effectively portrays the tension between individual desires and societal norms, making it a rich subject for psychological analysis.



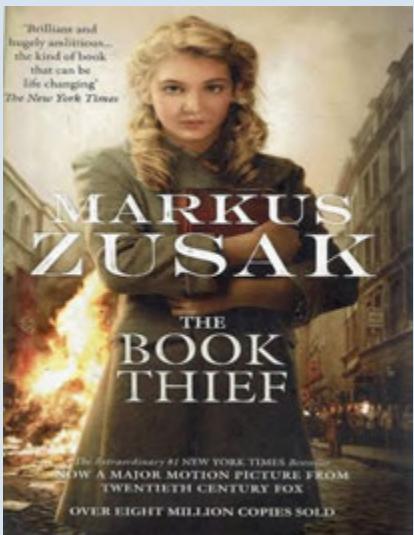
By examining Pride and Prejudice through the lens of Erik Erickson's psychosocial stage of identity versus role confusion, we can gain a deeper understanding of the characters' development, particularly Elizabeth and Darcy. This stage which usually occurs during adolescence, involves the struggle of forming personal identity while dealing with societal expectations and roles. Elizabeth's journey illustrates this conflict as she navigates her sense of self in a society that dictates her worth based on marital prospects. Another significant moment occurs when Elizabeth learns about Darcy's involvement in saving her family's disgrace. This revelation forces her to reevaluate her prejudices and misconceptions about him. This moment marks a crucial turning point in both characters' paths toward self-acceptance and understanding. Additionally, other stages of Erickson's theory are also evident, particularly intimacy versus isolation. This stage highlights the importance of forming deep emotional bonds with others. Elizabeth and Darcy's relationship transforms from initial misunderstandings and biases to mutual love and respect. Their journey depicts how surmounting personal obstacles and societal expectations can foster significant intimacy, which is essential for achieving personal fulfillment. Moreover, themes of competence and achievement emerge as characters deal with their social roles. For instance, characters such as Mr. Collins and Lady Catherine de Bourgh embody societal norms, whereas Elizabeth challenges these expectations. This struggle illustrates the stage of industry versus inferiority, where individuals strive to demonstrate their worth and capabilities within their social framework.

In conclusion, Pride and Prejudice serves as a fascinating exploration of identity and the complexities of human relationships. By applying Erik Erickson's theory of psychosocial development, we gain an insight into the characters' struggles as they navigate societal pressures and personal desires. The journey of Elizabeth and Darcy highlights the significance of self-awareness and the bravery to defy societal norms in the quest for genuine happiness. This classic narrative not only provides entertainment to the readers but also encourages them to reflect on their own identities and the roles they fulfill in the society.

THE BOOK THIEF - MARKUS ZUSAK

Arooj Yasir

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The Book Thief is a historical novel set in the time of Nazi Germany during the World War II. The story distinctively explores humanity through the lens of death. Death provides the reflective yet emotional commentary on the life of a young girl, Liesel Meminger, who struggles with the loss, love and horrors of war while finding peace and life in the power of words. Along the way, Liesel lives with her foster parents in a fictional town of Molching where she steals books to quench her thirst for reading. One of the most fascinating aspects of the book is its narrator, Death. Not only its cold and detached nature is depicted, but death is portrayed as a compassionate observer with the tint of sarcastic remarks about human nature. Zusak captured the childlike details with profound philosophical musings through the lens of death. The distinct rhythm of the novel is specified by the exclamations of death adorned with disdainfully ironic humor. The book revolves around the themes of loss, love and resilience through the relationships Liesel forms; with her loving foster father Hans, her strong foster mother Rosa, her best friend Rudy, and Max, the Jewish man hiding in their basement. Zusak highlights the altering power of words and stories, and how these can be a source of comfort, rebellion, and connection. Death contributes in emphasizing these themes by the significance of stories it encounters, serving as both a witness and a storyteller.

Liesel is a down to earth and likeable girl with balanced personality whose character development throughout the story feels organic. Particularly, her growing relationship with Rudy and Hans Hubermann leaves a lasting impression. Max's struggle for survival and his friendship with Liesel are both heart-wrenching and powerful. The novel's depth goes beyond its literary refinement, inviting readers to explore its psychological layers. The humanistic ideals of self-actualization and power of free will are reflected through the growth of Liesel's character. Her passion for words and love for her relationships illustrate how hope can be found in the darkest of times. Death respects humanity's capacity for kindness and courage. Death's narration evokes existential themes into the spotlight as it constantly ponders on the unpredictability of life and inevitability of mortality. The story dominates with questions about the meaning of life and value of human actions in the face of suffering. Liesel's persistence on finding meaning and beauty in the words is an existential act of rebellion; a struggle to explore meaning in a chaotic and destructive world. The novel captures the psychological phenomenon i.e., conformity under Nazi rule and how it duels with the moral values of characters like Hans Hubermann and Liesel. It also examines the importance of social bonds and how these foster strength and resilience even in harshest circumstances.

The Book Thief is a story about war and human nature blending with psychological depth. It speaks to the heart and mind. The contrast of beauty and horror, life and death, kindness and cruelty, makes it standout in historical fiction. It is highly recommended for readers who appreciate historical fiction layered with literary artistry and psychological insight. It offers a memorable experience with the enduring power of words to transform, heal and connect us all.

MOVIE REVIEWS

THE GOOD DOCTOR (2017)

Amna Tahir

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The Good Doctor (2017) is a captivating medical drama that digs into the complexities of human psychology from the perspective of its protagonist, Dr Shaun Murphy, a young surgical resident with Autism and Savant syndrome. The show not only features the challenges encountered by the individuals with autism but it also emphasizes the significance of compassion, empathy, understanding, and acceptance in both personal and professional spheres. As Shaun maneuvers through the intense environment of a hospital, viewers can witness a unique perspective on the amalgamation of psychology and medicine, representing how mental health and emotional intelligence play integral roles in patient care and teamwork. One of the most impressive characteristics of the show is its depiction of Shaun's experiences with social interactions and communication. The show beautifully captures the subtleties of autism, showing how Shaun's mind works differently,



allowing him to note patterns and details that others might somehow overlook or ignore. This distinct cognitive style is portrayed as both strength and a challenge as Shaun has difficulty with social cues and expressing emotions. The series does a brilliant job in humanizing Shaun, allowing the audience to put themselves in his shoes while also confronting the stigma surrounding disabilities. By demonstrating Shaun's vulnerabilities and triumphs, the show fosters a deeper understanding of the psychological complexities that individuals with autism face daily. The relationship Shaun develops with his colleagues further deepens the narrative, as they offer varying forms of support and acceptance within the medical community. Characters like Dr. Aaron Glassman, Shaun's mentor, and Dr. Claire Browne, his friend and ally, serve as important sources of encouragement, helping Shaun to explore the complex world of medicine. Their interactions highlight the importance of emotional support and mentorship in fostering a positive work environment, particularly for those who feel marginalized or misunderstood. The show also addresses the challenges of joint effort, focusing on the need for open and healthy communication in high-stress situations, which can be specifically beneficial in understanding teamwork from a psychological perspective.

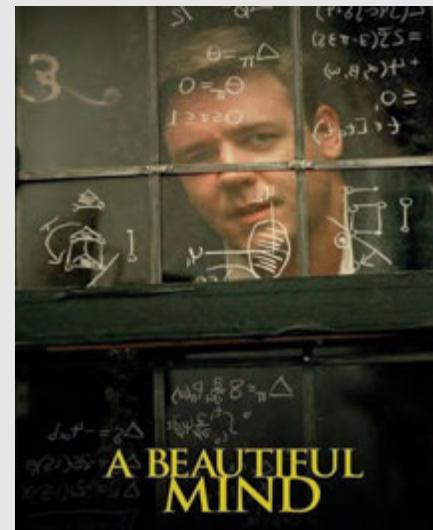
Furthermore, the show not only explores individual experiences but also raises critical questions about the healthcare system and how it deals with mental health. It addresses how stigma and misunderstanding can be an obstacle in the treatment. By integrating these themes into the storyline, the series inspires viewers to consider the broader implications of mental health in medicine, promoting a more compassionate and holistic approach to patient care. This emphasis on mental health is especially important in today's society, where discussions about psychological well-being are gaining importance. Overall, The Good Doctor is a thought-provoking series that effectively merges medical drama with psychological exploration. Through its nuanced portrayal of autism and the intricacies of human connections, the show not only entertains but also teaches the audience. By questioning societal perceptions of disabilities and promoting awareness of mental health, it serves as a powerful reminder of the great impact that psychological factors can have on both individuals and the healthcare system as a whole. Its insightful storyline and compelling characters make it a must-watch for anyone who is curious about the crossroads of psychology and medicine.

A BEAUTIFUL MIND (2001)

Asmah Jamil

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A Beautiful Mind (2001), directed by Ron Howard, is a biographical drama that has served as a poignant reminder of the thin line between brilliance and vulnerability. It is based on the life of a genius mathematician and his battle with schizophrenia which showcases how illness impacts both personal and professional lives. The film effectively illustrates common schizophrenia symptoms like paranoia, auditory hallucinations, and distorted perceptions. In this movie, John Nash is introduced as an intellectually gifted mathematician studying at Princeton University. His groundbreaking work in game theory helped him earn widespread recognition but over time, he began experiencing delusions and hallucinations, leading to false self-beliefs that he was a part of government plots; working as a cryptographer for a secret government agency. While chatting with Charles who only exists inside John's head, he yells off the balcony to the graduate students at Princeton University and voices, "I cannot waste time with these classes and books, memorizing the weak assumptions of lesser mortals." People responded by laughing, as it appeared that he was only talking to himself. This scene was significant as it underlined the idea that delusions of grandeur can create a social barrier between the affected and unaffected individuals, along with experiencing disconnect from reality. Characters like Charles, his imagined roommate, and Parcher, a supposed government officer, further illustrate the deceptive nature of schizophrenia. Instead of merely showcasing Nash's symptoms, Alicia Nash, portrayed by Jennifer Connelly, emerges as a central figure in Nash's life and recovery. Alicia's unwavering support, patience, and dedication exemplify the role of loved ones in supporting individuals with mental health challenges. Alicia's strength also reinforces the idea that mental health struggles are not isolated experiences but shared journeys, relying on empathy and understanding to foster resilience. A turning point in the narrative occurs when Nash begins to confront his condition, choosing to acknowledge his hallucinations as compared to prior repulsion. Crowe delivers a masterful performance, capturing the complexity of Nash's character and his journey toward acceptance and self-awareness. One of the most moving scenes for me was when Nash recognized that his hallucinations weren't real and chose to live with the symptoms rather than putting up a fight. In addition to Nash's internal battle, the film also highlights the treatments that were available in mid-20th century which included electroconvulsive therapy and antipsychotic medications. While these methods offer insight into the era's clinical practices, A Beautiful Mind places greater emphasis on the role of social and emotional support in recovery. The film shows how Nash struggled with the side effects of medication and chose to cope with it through sheer willpower. Despite his condition, Nash's remarkable contributions to mathematics and his ability to reclaim his life remain extraordinary. To sum up, A Beautiful Mind is a fascinating examination of schizophrenia as well as a gripping biographical drama. Nash dispels the stigma regarding mental illness and shows that people with schizophrenia may have happy, productive lives by reintegrating into academia and eventually winning a Nobel Prize. In the end, the movie ends on a hopeful note that love and purpose may be found despite serious mental illnesses.



GENDER EQUALITY: NOT THE SAMENESS OF GENDER

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The opposite and solution to patriarchy is not matriarchy but gender equality. Gender equality does not mean “sameness” of gender. It refers to equal rights, opportunities and a fair treatment of people regardless of their gender. If one looks at the nature, they will realise that God has created variety in His creation i.e., plants, birds, animals, and humans. He has not discriminated between any of His creation belonging to the same origin. He has not said that a zebra is superior to a donkey, or a jellyfish is inferior to a shark. The beauty of nature lies in the variety of God’s creation, not in monotony. Everything which God has created is uniquely blessed with special qualities, worth and place of its own. Similarly, He has also not said that, among humans, men are generally superior to all the women in this world. Many Muslims, when start losing an argument against gender equality, use a religion card and often quote a Quranic verse that says, —Men are the protectors and maintainers of women, because Allah has made one of them to excel the other, and because they spend to support them from their means”, to snub other person’s viewpoint and label them as rebels to religion. I have personally tried to study the context of this verse and have learnt that this Holy verse is discussed with reference to a husband-wife relationship in particular. The verse further states, —Therefore, the righteous women are devoutly obedient to Allah and to their husbands, and guard in the husband’s absence what Allah orders them to guard i.e., their chastity and their husband’s property”. What Allah says in Quran has a specific context and it should be understood in that same context. This verse particularly highlights the loyalty towards the husband. It does not imply that all men are generally born superior to all women in all their relationships and interactions, or women in general should be considered as inferior human beings for that matter. Men (husbands) being the protectors and maintainers of women (wives), is not an inborn privilege or luxury. It’s a huge legal, practical and religious responsibility on men’s part and it actually works in the favor and protection of women. Surprisingly, it sounds like a male-privilege or a female-disadvantage to the majority of people. However, it is described as the quality of men which makes them one-degree superior to their wives only (not superior to all the women in the world). It also indicates that they will

have to fulfill their duty in real sense to maintain that superior status. Born a male biologically does not equate superiority. It’s the status, responsibilities and rights in any relationship that count, not the gender. For instance, the status of parents and teachers rank higher than the children and students respectively, regardless of their gender. Yet many men misuse this verse, to enforce their viewpoint against gender equality.

The belief of superiority makes men feel entitled to practice any kind of mistreatment towards all the women around them including their wives, mothers, sisters, girlfriends, female colleagues or women in general. On the other hand, it can also make women believe that they are inferior to men in general and that they are destined to tolerate the mistreatments by all men around them including their husbands, brothers, sons, male colleagues, class fellows, or men on streets etc. They adopt a victim mentality. Such a belief system is historically proven to be quite problematic for both men and women. Both genders interact with each other on various levels in society. And they must learn to respect each other regardless of their gender. I object that women, being God’s creation, might not be valuable to God, or might be considered as inferior or a lesser human being by Him. All genders must coexist peacefully through cooperation, not competition. They must learn to celebrate each other’s strengths and make up for each other’s limitations. Being born as a man or woman is not one’s own so-called “achievement” or “disadvantage”. It’s not even anyone’s choice but God’s decision. Humans should respect God’s decision, embrace their gender, and cherish the privilege of being part of His plan with humility.

Equality means that genders should be treated as equal humans and be given equal opportunities to excel in life while considering their strengths along with their limitations. It’s strange how the majority of people perceive gender equality as equality on the basis of one’s biology. The biology of men and women is different in body and functions. Yet, being human is a common factor among the two of them. I prefer the term —human equality” over gender equality as it sounds less offensive, controversial or threatening to majority of people. Since gender is a major factor on which humans around the world are being discriminated and made to suffer, hence the term gender equality. The focus should be on how these genders contribute in the lives of others, society and the world in general through their capabilities intellect, and cooperation. God doesn’t discriminate on the basis of gender as gender discrimination is primarily a human flaw.

LUCID DREAMING ODYSSEY

Mehreen Ahmed

1492-BH-PSY-20

Have you ever had a dream where you were not just a passive observer but an active participant? A situation where you knew you were dreaming and could even control what was happening in the context? It might have felt like being a movie director who was shaping the plot. This fascinating phenomenon is known as "lucid dreaming". Lucid dreaming occurs when the dreamer is aware of being in the state of dream. Despite the surreal nature of the experience, lucid dreamers possess a unique awareness that they are not experiencing reality. They can manipulate the dream's environment; have the ability to shape it according to their desires, almost like navigating through a virtual reality simulation. Did you recall the movie "Inception"? I did when I first came across this phenomenon. Interestingly, some of the concepts of that film were drawn from Director Christopher Nolan's personal experience and fascination with lucid dreaming.

Lucid dreaming has its connection to "control dreaming". In control dreaming, individuals can consciously influence various elements of their dreams such as altering the setting, summoning characters, or even transforming their own appearance. This interactive aspect adds a layer of depth to the dream experience, eventually blurring the lines between imagination and reality. The term "lucid dreaming" was coined by Frederik van Eeden in 1913 based on his personal experience with dreaming. Although the concept of lucid dreaming dates back to over 2,000 years ago, yet it remains a relatively mysterious and under explored aspect of human consciousness. Even by the late 1970s, it was a belief among various scientists and psychologists that the lucid dreams were merely the product of awakenings during sleep, misremembered in the morning. However, recent research has shed light on its potential benefits. Studies indicate that lucid dreaming may contribute to improved mental health and well-being. From psychological point of view, lucid dreaming is viewed as the interplay of conscious and unconscious mind. Renowned analytical psychologist, Carl Jung, emphasized the importance of dreams as a way to understand the unconscious mind and integrated it to the wakeful life. Modern psychologists view lucid dreaming as a valuable tool for self-reflection; allowing individuals to confront unresolved conflicts, repressed fears, and even rehearse real world scenarios in a safe imaginative environment.

Lucid dreaming is likely to occur during the stage of sleep associated with vivid dreams also known as Rapid Eye Movement (REM) sleep. Neuroscientists have observed unique patterns of brainwave activity during the lucid dreaming which has been linked with the combination of dreaming and wakefulness. This increased sense of awareness enables the lucid dreamers to recognize the state of dream or, in some cases, steer the dream in desired direction. A fascinating account comes from the visionary inventor, Nikola Tesla. Tesla described vivid dreams where he would see his inventions in precise detail prior to real life work. These dreams had high lucidity which enabled him to test and adjust his designs accordingly. Thus, lucid dreaming not only fueled his creativity but also provided to him an edge to deal with complex problems. Therefore, Tesla's dreams exemplify how lucid dreaming can act as a catalyst for innovation. Another revolutionary thinker, who reportedly used lucid-like dream states for exploration of abstract concepts, was Albert Einstein. Einstein often relied on his mind's imaginative capacities during day dream-like states to conceptualize his ideas which lead to his ground breaking theories. One example is his thought experiment regarding riding a beam of light which eventually contributed to the theory of relativity. This provides a powerful testament to how dream like states or lucid dreams can actually expand the boundaries of human understanding.

Beyond its captivating nature, lucid dreaming has also been found to have profound mental health advantages. For this reason, mental health professionals are working to infuse it in psychological treatments. Lucid Dreaming Treatment (LDT) is beginning to be used as a tool for treatment of phobias, nightmares and PTSD. Furthermore, its relation to creative ideation is also being studied. According to various studies, lucid dreaming can serve as a powerful tool for emotional healing and personal growth. By confronting fears or recurring nightmares within a controlled dream, individuals can find resolution and incorporate empowerment. Some therapists even use lucid dreaming techniques to help clients manage anxiety, PTSD, or phobias. The ability to rehearse difficult conversations or visualize success in lucid dreams has also been shown to boost confidence and problem-solving skills. As we continue to unravel the mysteries of the dream world, lucid dreaming stands out as an intriguing frontier of exploration. So, where will your lucid dream odyssey take you? The possibilities are limited only by your own imagination.

BLEEDING BEYOND THE VEINS: THE EMOTIONAL TOLL OF HEMOPHILIA AND RARE BLEEDING DISORDERS

Midhat Khalid

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Living with hemophilia and other rare bleeding disorders often brings more than physical pain; it introduces a profound psychological burden that affects mental well-being and quality of life. These conditions intertwine physical discomfort with emotional strain, eventually creating a cycle of negativity that impacts both individuals and their support systems. The World Federation of Hemophilia estimates that globally, approximately 400,000 individuals are living with hemophilia while the prevalence of other rare bleeding disorders remains largely underreported. These conditions are characterized by an inability to effectively clot blood which manifests in a variety of ways, from spontaneous internal bleeding to excessive bleeding after injury or surgery. In Pakistan, the situation is particularly challenging. While precise figures are difficult to obtain due to underreporting, the Hemophilia Foundation Pakistan estimates that around 25,000 individuals are living with bleeding disorders. However, access to proper diagnosis and treatment remains a significant hurdle for many here.

At the heart of this experience lies the acute pain caused by bleeding episodes. For individuals with hemophilia, spontaneous bleeds into joints and muscles lead to prolonged pain, significantly impairing mobility and routine activities. The physical agony serves as a constant reminder of the challenges posed by their condition, amplifying feelings of vulnerability and frustration. The unpredictable nature of bleeding episodes further intensifies the emotional strain. Fear and anxiety often accompany the uncertainty of when or where a bleed might occur, consequently making it difficult to plan daily activities or enjoy life to the utmost. This sense of unpredictability creates a persistent state of psychological tension that disrupts mental peace and fosters a pervasive sense of unease.

Bleeding episodes frequently derail even the simplest routines. Tasks such as attending school, maintaining a career or participating in social events become daunting or impossible during a bleed. These disruptions breed frustration, helplessness, and over time, a sense of social isolation or missed opportunities emerge. The emotional toll compounds as individuals grapple with the feeling

that their condition is robbing them off life's essential moments. The emotional strain of living with hemophilia extends beyond the individual and impacts family members and close friends. Loved ones often experience emotional challenges including feelings of helplessness, worry or sadness as they witness the pain and struggles of those they care for. This shared emotional burden highlights the critical need for holistic approaches that address not only the individual's needs but also the emotional well-being of their support networks.

Societal stigmas and misconceptions surrounding bleeding disorders further exacerbate the emotional burden. Myths and misinformation often lead to fear, discrimination or social isolation. Individuals with bleeding disorders, both girls and boys, face significant challenges. Girls encounter specific challenges related to menstruation and childbirth while boys face limitations in engaging in sports and physical activities. The concerns about their health and safety lead to difficulties in finding employment, accessing appropriate healthcare and fully participating in social activities which impact their overall well-being and quality of life. Addressing the multifaceted challenges of bleeding disorders requires a blend of physical and psychological care. Education about these conditions is essential for individuals, families, and communities to better understand the lived experiences of those affected. Access to mental health resources is equally crucial, including offering psychological support to manage the anxiety, stress and emotional fatigue associated with bleeding episodes. Furthermore, access to mental health professionals, such as psychologists and psychiatrists, is crucial for individuals and their families. These professionals can provide support in managing anxiety, depression, and other mental health concerns, as well as assist in developing coping strategies and improving overall emotional well-being.

Global awareness campaigns also play a pivotal role. Dispelling myths and fostering empathy can help create a more supportive environment, where individuals with bleeding disorders feel understood and valued. Advocacy and education can pave the way for societal shifts that might reduce stigma, enabling those affected to navigate their condition with dignity and confidence. Hemophilia and rare bleeding disorders affect far more than the body; leaving a profound imprint on mental health and emotional resilience. By addressing these challenges holistically and fostering greater awareness, we can help individuals and their families not only manage their conditions but also thrive despite the obstacles. Recent advancements in research and treatment offer renewed hope. Novel therapies, such as gene therapy, are showing

promising results in treating hemophilia, offering the potential for long-term disease control and improved quality of life. Continued research and development of new treatments, alongside improved access to care and comprehensive support services, are crucial to improving the lives of individuals living with bleeding disorders. In conclusion, living with hemophilia and other rare bleeding disorders incorporate significant emotional and psychological challenges. By addressing these challenges holistically, through a combination of medical interventions, psychological support, and increased societal awareness, we can empower individuals and their families to live fully despite the limitations imposed by the condition.

THE LAST SUPPER OF THE CONDEMNED: A PSYCHOLOGICAL RESPONSE TO MORTALITY

Ayna Maryam

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Many amongst you might have come across the distinguished 15th century mural painting, created during the Italian High Renaissance, by the eminent maestro Leonardo Da Vinci. The work of art, titled "The Last Supper", illustrates a biblical event in which Christ is shown to have the last meal with his apostles before being arrested by the Roman authorities. Emotions, gestures and expressions caught in the visual subjects appeal the viewer at the very first glance. The supper table is seen as filled with bread and wine. The holy food to be eaten is symbolic of the miraculous Eucharist, an act seeking forgiveness of sins and submission to the divine. One of the strokes of genius in this work, vis-à-vis symbolism, is the use of food elements. It has been a practice, dating back to ancient times, in which the death row prisoners are given last meals of their choice. This ritualistic act has been a blend of cultural, historical, religious and judicial spheres. Historical references date to ancient Greek superstition, which held that if the one to be executed died without a full stomach, the dead might come back to the world as hungry ghost. The final meal of choice is seen as a paramount decision involving psychological and symbolic intricacies. Dichotomous links emerge within the contrast between an end to life and a final protest to live.

These meals, on the brink of the closure to life, reveal a pattern of themes that revolve around the human nature, desires and attitudes towards mortality. In this regard, it

prompts a psychological inquiry in its own right. In a historical context, it has been a practice since Middle-Ages in Europe that the executioner dines with the one to be executed to exchange hospitality, humanity, and to foster a bi-directional acceptance of execution. The practice of these last suppers offers a psychological exploration with a notion that the criminals, irrespective of their acts to be punished, deserve a fair treatment to value their human existence. It might also be seen as a collective farewell from the society and institution, which are to undertake an act that will cease the individual from the mightiest of all privileges, the life. Several criminologists and psychologists have tried to dissect this final feast to reveal its hidden motives and subtle significances. Many of them state that these food choices either link to a retrospective event, a cultural statement, a nostalgic memory, a symbolism to control, dietary elements, a statement of guilt or innocence, social class, or defense mechanisms at play. A study titled "Death Row" found chocolate dominating the final food preferences, providing an essential element to the aforementioned food as a stress coping choice. It has been psychologically established that distraction or avoidance is often done in the face of imminent threats. This threat being the greatest of all, the cessation to live, follows a similar pathway. Another study titled "Cruel Conclusions to Last Meals" revealed an average last meal to be calorically rich (2756 calories) and 2.5 times the daily recommended intake of proteins and fats. This study identifies the use of overeating, overconsumptions and binges in approaching a distressing event. Further, it shifts the attention towards the use of food as a defensive facade. The food items chosen might be an act of reliving the freedom and times before confinement, such as luxury or sweet food, a childhood favorite or a home-made specialty. It might be symbolic of reliving the pleasant recollections of a pre-prison life. On the other hand, the denial to engage in this farewell practice offers a rejection, defiance defense, or disapproval of the authority. It points towards a final protest to live. Acceptance, on one end, is beginning of a transformative phase from life to death. It might be attributed to the act of making a retribution and approving of the given death sentence.

One of the most notorious American serial murderers, Ted Bundy, famously denied food prior to his execution through electrocution. He not only declined a wish for any preferred last meal but also did not take a single bite of the regular prison meal served. This could be due to the opposition to a perceived undeserved punishment and an inability to accept an end that he might have considered

rather improbable for him. This final protestation also pertained to the neutralization of his crimes often evident in his personal discourses. Timothy McVeigh, infamously known for his 1995 Oklahoma City bombing that caused 168 deaths, was a U.S. Army veteran who became radicalized by anti-government beliefs. He requested a last meal that consisted of two pints of mint chocolate chip ice cream. On the top of it, his last words included William Ernest Henley's poem "Invictus" which pens down a triumph of a human in adversity or an address of a victorious warrior. The last little sweet feast supports McVeigh's lack of remorse, victor mentality and a personal narrative of justified defiance. In conclusion, a seemingly simple decision; choosing one's last nutritional choices, reveal a great deal of psychological systems at work.

WHY SUICIDE BECOMES THE ANSWER?

Arooj Yasir

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If life is precious then why do people decide to end it by themselves? If suicide is an escape plan for people who have been suffering then how it becomes the sole last refuge? The brief answers to these questions will be stated in this article. Suicide is the act of intentionally causing one's own death. Suicide can be an impulsive or a planned act. Hopelessness is a dominating trait in the individuals with suicidal ideations. There are different explanations on the causes of suicidal behavior across various psychological paradigms, with each providing a unique perspective to it. Freud's theories particularly those in Mourning and Melancholia (1917) suggest that suicide is caused by the unresolved unconscious conflicts which involve grief, internalized aggression and interplay between hate and love within the psychic. According to psychoanalysis, suicidal ideations can be caused when a person unconsciously builds their identity around the lost object (a person, a relationship, or even an ideal).

The aggression which was originally directed towards the lost object because of the ambivalence; when love is mixed with bitterness and disappointment is turned inwardly against oneself, manifesting itself in guilt and potential suicidal tendencies. In extreme cases, self-destruction can become the ultimate expression of aggression. Post-Freud psychoanalytic theorist, Melanie Klein, stated that early relationships shape how

individuals process loss. Inadequate early attachment can lead to the internalization of rejection which may reinforce the feelings of unworthiness and self-harming tendencies. Suicidal behavior is seen as an unconscious attempt to resolve unbearable psychic pain. **The Cognitive Model of Suicidal Behavior** by Wenzel and Beck (2008) advocates a cognitive framework for understanding suicidal behavior. Suicidal behavior originates from "suicide schemas"; deeply ingrained cognitive patterns. These thinking patterns make people more likely to interpret life situations and hardships in a way that leads to suicide. Certain personality traits and cognitive styles i.e., black and white thinking, unrealistic self-criticism, poor problem solving skills and impulsivity can make individuals more vulnerable to suicidal ideations. Suicidal individuals usually focus more on the negative aspects of things rather than positive ones which cause hopelessness. In case of any stressors, the individual with distorted thinking patterns can become easily helpless and ultimately sees suicide as the only solution. From the **humanistic-existential standpoint**, when individuals face deep existential distress, a loss of meaning, and overwhelming feelings of isolation, they become extremely vulnerable to suicidal ideation. Existential psychologist, Maltsberger (2000) argues that failure in finding the meaning of one's life in this world can cause distress big enough to question one's self-worth. Humanistic theorist, **Carl Rogers**, demonstrated how external pressure and conditional self-worth can provide a basis for suicidal behavior.

There are many stereotypes about suicide in our society which cause misconceptions and contribute to the development of stigma. One of the major stereotypes is that suicide is just for attention and not for actual death. Suicide is often seen as an act of coward people. Another myth is that talking about suicide can make someone commit it so it is better to avoid such topic. Suicide jokes are not taken seriously. This stigma contributes to the indifference in the society. Considering some suicidal cases, it has been noted that hopelessness, social isolation along with professional invalidation leads to high suicidal risk (Joiner, 2005). Studies also suggest that high achieving individuals are more prone to perfectionism and self-criticism which can lead to suicidal ideations (Flett & Hewitt, 2002). **Genetic and environmental factors also contribute to suicide** (Brent & Mann, 2005). According to research, **external oppression and discrimination also make vulnerable to suicidal ideations**. An

estimated 703, 000 people worldwide die each year by suicide. The global suicide rate is over twice as high among men than women.

Sylvia Plath committed suicide on February 11, 1963. Her therapist diagnosed her with clinical depression which is clearly reflected in her personal writings. She wrote about feelings of worthlessness and failure which point to the common cognitive distortions in suicidal individuals. It has also been observed that Plath was a perfectionist to the extent that it was maladaptive. Her intense self-criticism and fear of failure made her more vulnerable to suicidal ideations. The pressure of managing career and motherhood simultaneously contributed more to these problems. For some people death can be seen as the “portal to the peace” from all the suffering. Suicidal people often think that death is the end of everything so if one cannot live by peace, they should die instead. For potential help in such situations, Cognitive behavioral therapy (CBT) and Dialectical Behavioral Therapy (DBT) can aid in the prevention of suicide by targeting the negative thoughts and emotional distress among individuals. Strengthening social support systems can also be of significant benefit. In crisis situations, helplines and safety planning should be foremost.

ARE DELUSIONS REALLY THE SOLUTION? THE NEUROSCIENCE OF CREATIVITY AND PERCEIVED REALITY

Zujaj Fatima

2913-BS-PSY-21

You must have come across a very popular and catchy phrase, “delulu is the solulu”, while scrolling social media or might have heard it from one of your cool friends. By delulu (informal of “delusions”), I don’t mean full blown pathological delusions i.e., believing that you are the president of lala land. At first glance this internet meme is hilarious, totally absurd and superficial. However, when I tried to dig it a little deeper it pointed to a fascinating psychological phenomenon at play. The reason why we find it unrealistic is that we have this very rigid concept of reality in our minds, but let’s acknowledge something first; reality is not so real. Our mind works as a prediction machine, taking in the sensory input and interpreting it according to the already available data, believes and expectations. Our reality is more of the neural interpretation of external stimuli. Even time, which seems

to be running out of our hands, is somewhat of a mental construct. So, if our experience of reality is, at its very core, a fabrication, then why are we so obsessed with being “realistic”? And what if this quirky little phrase is not just a meme, rather the key ingredient to being innovative, creative and liberated? Let’s start with the neuroscience. Our brain is the master of predictive coding. As I pointed out previously, your perception of reality is less about what’s “out there” in the world and more about what your brain “expects it to be”. Here, another important concept based on predictive coding is the confirmation bias. It is the tendency to actively look out, seek information and interpret it in ways that confirm pre-existing beliefs. If you believe that you are a complete loser, then your mind is going to be looking for the evidence to support your claim and make it your reality. It is mainly a survival mechanism that keeps our reality stable and predictable. On the brighter side, if you believe that you can achieve extraordinary things in life, then your brain will seek evidence to support this belief.

Then there’s the placebo effect, one of the most fascinating demonstrations of the brain’s power to construct reality. Mostly used in medicinal trials, it holds that even a sugar pill, if believed to be a medicine, can trigger physiological changes, reduce pain and alleviate symptoms. This isn’t magic; it’s neurochemistry. It can also control the reward pathways, releasing endorphins and dopamine. Placebo effect proves that your expectations can alter your experience of reality. Now, let’s discuss creativity. Creativity is essentially the creation of something that didn’t exist before; it is inherently being “unrealistic”. From a neuroscientific perspective, creativity involves the default mode network (DMN). It is a brain network that is activated when you’re daydreaming, imagining, or thinking outside the box. The DMN is our brain’s “delulu” headquarters. It’s where ideas are born, where connections are made between seemingly unrelated concepts. Creative people aren’t just good at thinking differently; they’re good at suspending disbelief and creating their own reality. Every great innovator or inventor in history began with an unconventional mindset. They rejected the reality of masses and made their own versions of it. Flying in sky like a bird was a delusion until Wright brothers decided to reject this limitation on “reality”. Marie Curie was being delusional when she had to believe the existence of invisible radiations, long before she could empirically prove it. Talking to and watching someone in real time who is thousands of miles away was considered to be a fool’s dream. Furthermore, Elon Musk envisioned the reusable rockets and colonization of Mars, despite all

odds. These people were not just thinking out of the box; rather they destroyed the widely believed notions of reality completely, threw it out of the window and made a new one out of scratch. Society, as a whole, creates a version of reality and then everyone is expected to believe in that collective illusion, which is shaped by centuries of beliefs and sometimes, limitations. We are expected to consider it “objective”, standard and universal. This whole concept isn't entirely new. Psychologists like Taylor and Brown (1988) have long studied positive illusions. They found that people who engage in mild self-deception tend to be happier, more resilient, and even more creative. Being “delulu” should not mean ignoring facts or living in a fantasy world. It can probably lead to overconfidence, avoidance of reality and some very embarrassing failures i.e., believing that your crush is secretly in love with you when they are certainly not. Instead, it should reinforce refusing to let “so-called facts” define your limitations. It should incorporate belief in possibilities that the masses cannot see. Because I think the truth is, every great achievement in human history started as a delusion. Every breakthrough, every masterpiece, and every moon landing began with someone who refused to be “realistic” by our collective standards.

UNLOCKING HUMAN POTENTIAL: THE PSYCHOLOGY OF MOTIVATION

Ravin Asghar Butt

2941-BS-PSY-21

As Louis L'Amour aptly states, “Progress begins with action”. Similarly, motivation acts as the metaphorical faucet that unlocks our potential and drives us toward our aspirations. According to psychology, motivation is a process that initiates, guides and maintains goal oriented behaviors. Motivation drives actions that bring individuals closer to their goals. For instance, a student preparing for a competitive exam may feel motivated by the dream of a better future. Similarly, an athlete training tirelessly for an upcoming championship is propelled by the vision of winning. Motivation is the driving force behind human behavior. It is a complex interplay of psychological, biological and environmental factors. Understanding the intricacies of motivation can help us uncover our potential and achieve our goals.

Motivation can be categorized into two primary types: intrinsic motivation and extrinsic motivation. Intrinsic means internal. Intrinsic motivation arises from internal factors such as a person's satisfaction, curiosity or the sums of accomplishment. If one does something because of their passion, it acts as an intrinsic motive. Extrinsic means external. External motivation stems from external factors like awards, recognition or to avoid punishments and unpleasant stimuli. When a person works harder in office to get employee of the month title, then they are motivated by external reward of recognition which enables them to put extra effort. Many psychological theories attempt to explain the mechanism behind motivation. Maslow's Hierarchy of Need posits that humans are motivated by a hierarchy of needs ranging from basic physiological needs to the need of self-actualization. Following Maslow's foundational work, researchers developed Self-Determination Theory which emphasizes the importance of autonomy, competence and relatedness in motivating behavior. Unlike Maslow's focus on internal needs, Expectancy Theory underscores the role of external expectations and rewards in motivating behavior and that motivation is influenced by expectations of success, the value placed on rewards and the perceived ability to achieve desired outcomes. Lastly, Goal-Setting Theory proposes that setting specific, measurable, achievable, relevant, and time bound (SMART) goals can significantly boost motivation. This theory integrates both intrinsic and extrinsic factors.

All these theories suggest that both internal and external motives are playing respective roles. Furthermore, there are many factors behind motivation. These factors can be biological, psychological, environmental or social factors. Biological factors such as “dopamine” or other neurotransmitters play a crucial role in motivation. Dopamine which is often referred as a “neurotransmitter associated with reward processing” is released when we experience or anticipate reward. This neurotransmitter reinforces behaviors associated with rewards which lead to positive outcomes. Psychological factors such as personality traits, self-efficacy and resilience also influence motivation. Individuals with high self-efficacy believe in their ability to succeed, which leads to increased motivation and persistence. They try again and again to reach a goal and their resilience towards achieving the goal motivates them. Many environmental and social interactions significantly impact our motivation. A supported social environment including

family, friends and mentors can provide encouragement. Work and learning environments that are stimulating, challenging and rewarding can also boost motivation. Cultural factors such as values, beliefs and norms shape our aspirations. Moreover, spiritual factors like hope and faith in invocation make a person motivated and dedicated towards their goals.

People who are always motivated use some strategies for enhancing their motivation. They set clear goals which give them direction to do efforts, build resilience and practice mindfulness. They don't lose hope on their failure. They see or use it as another chance to do their best and maintain a positive belief that failure is a teacher. They always keep a reminder of previous achievements. In conclusion, motivation stands as a fundamental psychological mechanism that drives human behavior; shaping the pursuit of personal and professional goals. Through a complex interaction of intrinsic and extrinsic factors, motivation encompasses both the internal passions and external incentives that propel individuals toward achievement. From the dopamine-driven reward system to the impact of supportive social networks and cultural values, these factors collectively shape individuals' resilience and commitment. Strategies to enhance motivation such as setting realistic goals, building resilience, and cultivating a positive outlook, empower individuals to overcome challenges and sustain motivation over time.

NAVIGATING TRAUMA

Asmah Jamil

BS-PSY-2834-21

Trauma serves as a reminder of the fragility and resilience of the human essence. Trauma leaves survivors to be haunted by their intrusive thoughts, memories, and flashbacks that drive them back to the harrowing moments of the past. Our contemplative society is increasingly characterized by rampant geopolitical conflicts and historical grievances marked by violence, displacement, and profound human suffering. Currently, it is the ongoing genocide happening in Palestine that has killed thousands of people and displaced millions. Wherein Israel has deprived Palestinians of their basic human rights and needs that has resulted in a severe

humanitarian crisis in Gaza. Israeli forces are continuing to intensify their assault on the Gaza Strip through horrific bombardments. Diving deep into the depths of trauma unveils how emotions, thoughts, and behavior shape the lived experiences of survivors.

A situation as such has a significant psychological and emotional cost that affects every aspect of day to day living. The trauma Palestinians have endured is a constant force that affects survivors in ways that are behavioural, emotional and cognitive. The psychological ramifications of trauma are complex and impact people on many levels. Cognitively, trauma can disrupt the normal functioning of an individual i.e., it can affect one's thought processes, lead to difficulties in memory, concentration, and decision making. Trauma can lead one to feel confused, agitated, and distressed as they may struggle to make sense of their experiences, might self-blame, and experience shame. Emotionally, trauma can evoke a whirl of emotions ranging from profound sadness to intense anger. It can also involve feelings of guilt or most of the time emotions may overflow, making the horrible experiences resurface. Behaviourally, some individuals may engage in avoidance behaviors to cope with distressing symptoms such as concealing their emotions regarding the traumatic experience. Some people may withdraw from social interactions and isolate themselves. Due to the stigma or mistrust surrounding mental health services, many individuals may avoid seeking treatment.

The pain that the Palestinians experience goes beyond the immediate relocation and bloodshed. Decades of systematic oppression, brutality and loss has exacerbated it. Children who are raised in locations plagued by violence are particularly susceptible to the long-term consequences of trauma. One tragic illustration of how trauma affects young lives is the story of Ahmad Mansara, a 13-year-old Palestinian youngster, who was imprisoned and given a life sentence. Ahmad suffered from physical and psychological torture, as well as solitary incarceration, which has caused him to suffer from PTSD for a long time. This is only one case whereas thousands of Palestinian children endure similar treatment in Israeli prisons, where they are subjected to extended seclusion, torture and neglect.

Trauma's psychological impact is not just felt by children in Gaza. Adults also carry the burden of their retrospective suffering and hence become susceptible to long-term PTSD, anxiety, and despair. The psychological

traumas of abuse and neglect are also experienced by inmates housed in Israeli jails. One such case is of Khalil Awawdeh who spent months behind bars without being charged. Victims of such atrocities are frequently subjected to physical torture, lack of access to healthcare and subpar living conditions. After being released, people frequently bear the unseen wounds of their incarceration which results in long-term mental health issues.

Palestinian trauma is not limited to a certain generation. Each generation has the psychological scars of the previous one, since it is inherited from parents to children. According to research, PTSD and other psychiatric problems are more likely to develop in those who are exposed to ongoing violence and instability. The everyday exposure to violence, displacement and the loss of family members in Gaza and the West Bank fosters long-term mental health problems in youngsters too. Such trauma consequently affects people's relationships, employment, and general quality of life into adulthood. The lack of professional support, combined with the overwhelming psychological strain of daily life in Gaza, has left the population vulnerable to a wide range of such mental health issues.

Amidst the clouds of despair, the Palestinians have demonstrated remarkable strength and resilience in the face of adversity fostering networks of support and resistance. The healing process for Palestinians is deeply tied to the recognition of their suffering and the pursuit of justice. Healing the wounds of trauma requires not only the availability of psychological services but also a commitment to ending the violence that perpetuates this cycle of suffering. The future of Palestinian mental health depends on the world's willingness to address the root causes of their suffering. Till then, the scars of trauma will continue to shape the lives of Palestinians affecting generations to come.

A LETTER FROM GRIEF: I AM NOT YOUR ENEMY

Wufia Fatima

2899-BS-PSY-21

Hey there!

I know you're not fine and that's because of me. You didn't want me to come, yet I came uninvited. I arrived

the day you lost an important part of your life. You thought that the world stopped but it didn't. I heard when you said, "I don't believe it. This can't be real." I know you don't want me here, and trust me I didn't want to come as well but it is never in my control. You call me heavy. You hate my existence. I don't blame you for that. Before you push me away, let me tell you why I came and why I change myself every day. As Kübler-Ross said,

"There is no joy without hardship. If not for death, would we appreciate life? If not for hate, would we know the ultimate goal is love? If not for suffering, would happiness be as sweet?"

I come in waves. One day I am the loud noise in your head while next day, I am the shiver you feel in your body. One day I don't exist and next, I am a river going down your eyes. The 20th century psychologist Elisabeth Kübler-Ross conceptualized me into five phases. You might meet some or all of these. When I first arrived, my existence was vivid and you refused to believe it. It was "denial". You felt that you'll wake up from that nightmare and it'll all be the same. Where in reality, it was your brain protecting you, wrapping you in numbness so that pain could not break you right away, all at once. Then, the "anger", the rage came. You were angry at everyone; friends, family, fate, and even at them for leaving. It felt like no one understood you. Later, "bargaining" took over. You started regretting things; finding ways to reshape what had happened, rewriting the ending. Kübler-Ross said for this stage,

"Guilt is perhaps the most painful companion to death".

Alas! It was so hard to see you like that. After a while, I managed to settle down a bit. That's when "depression" came in. Everything was exhausting and even the simplest tasks seemed impossible. World felt colourless and distant. Nothing made any sense and happiness seemed like something out of reach. I was the heaviest at that time. I am sorry, but trust me I wasn't your enemy. I was just a part of your heart, mourning what it lost. Quite a positive transformation took place at this time that would help you stand on your feet again. Healing was taking root. One day I became "acceptance". You took a breath and it felt comparatively lighter. Memories stopped haunting you and felt like a long, warm hug.

I never leave completely, but I change. I know you search for them in places they used to be. It's normal because when you lose someone, your brain requires some time to adjust itself to a new, harsh reality. It can often feel like being lost in an unknown city; confusing, frightening and exhausting. Your heart has been beating faster lately, and

peaceful sleep is nowhere to be found. You eat less and don't even enjoy your favourite food anymore. Listen! Don't give up on yourself. You are not "broken". This is the path to healing, and your mind is doing its best to cope. Start talking about me, hug the memories, cry your heart out, and scream if you feel like it. I can take it all. I may feel overwhelming, but locking me up won't make me disappear. Don't pretend that I don't exist because healing begins with acknowledgement of my existence. However, if I become unbearable and the sadness don't leave, if you become unable to function, if you feel trapped in guilt, anger, or numbness for too long, then I may have invited something else like clinical depression or prolonged grief disorder. That is when you don't have to face me alone. Before people tell you otherwise, hear me out. Seeking professional help isn't a sign of weakness. It's a way to understand me better and find a way forward.

—The reality is that you will grieve forever. You will not "get over" the loss of a loved one; you will learn to live with it. You will heal, and you will rebuild yourself around the loss you have suffered. You will be whole again, but you will never be the same. Nor should you be the same, nor would you want to".

-Kübler-Ross

I know that you want me to leave. I might fade away with time, but I'll exist forever. I will no longer be the pain that weighs you down but a presence that will remind you of their significance. I promise that one day, you'll remember them with a smile and you'll understand that I did not come to break but to help you hold onto them. I'll be a reminder that you loved them, with all your heart. Until then, I'll stay by your side.

Yours truly,

Grief

STATISTICS



2024: YEAR IN REVIEW.

Jan

- Breakthrough in **quantum enhanced statistical inference**, where quantum computing principles are integrated into traditional statistical methods. This innovation dramatically accelerates complex computations, making it possible to analyze high dimensional datasets in fields like genomics and financial modeling in a fraction of the time previously required.

Feb

- A new wave of **AutoML powered descriptive statistics** emerges, automating the generation of summary statistics and visualizations. Businesses and researchers benefit from real-time insights, streamlining exploratory data analysis in sectors such as retail analytics and clinical research.

March

- Advancements in **causal inference with synthetic controls** revolutionize impact assessment studies. By refining counterfactual modeling, economists and policymakers gain more accurate tools to evaluate interventions, from public health campaigns to economic stimulus programs.

April

- **Federated learning for privacy preserving statistics** takes center stage, enabling collaborative analysis across decentralized datasets without exposing raw data. This is particularly transformative for healthcare and banking, where data privacy regulations restrict information sharing.

May

- The rise of **explainable AI for statistical models** addresses the "black-box" problem in machine learning. New frameworks allow statisticians to interpret complex models, making AI-driven decisions more transparent and trustworthy in legal, medical, and regulatory applications.

June

- **Nonparametric Bayesian networks** gain attraction as a flexible alternative to traditional models. By eliminating strict distributional assumptions, they improve predictions in uncertain environments, such as climate forecasting and financial risk assessment.

July

- **Real-time streaming statistics** become essential for processing live data from IoT devices and social media. Industries like cybersecurity and logistics use these tools for instant anomaly detection, fraud prevention, and dynamic resource allocation.

Aug

- **Topological Data Analysis (TDA)** expands its applications, uncovering hidden structures in complex datasets. From genomic sequencing to cybersecurity threat detection, TDA provides a geometric perspective on data that traditional methods often miss.

Sep

- **New robust statistical methods** emerge to combat adversarial data manipulation. These techniques enhance the reliability of analyses in social media sentiment tracking, forensic accounting, and election polling by filtering out biased or malicious inputs.

Oct

- **Bayesian deep learning for small datasets** bridges the gap between AI and traditional statistics. Researchers in rare disease diagnostics and niche market analysis benefit from models that deliver high accuracy even with limited training data.

Nov

- **Graph statistical models** advance, offering better tools for analyzing interconnected data. Applications range from optimizing social network algorithms to detecting money laundering patterns in financial transaction networks.

Dec

- Innovations in **adaptive clinical trial designs**, where AI dynamically adjusts trial parameters. This reduces costs and accelerates drug development while maintaining rigorous statistical validity, bringing life-saving treatments to market faster.

BOOK REVIEW

INTRODUCTION TO STATISTICAL THEORY PART-1 - Sher Muhammad Chaudhry & Shahid Kamal

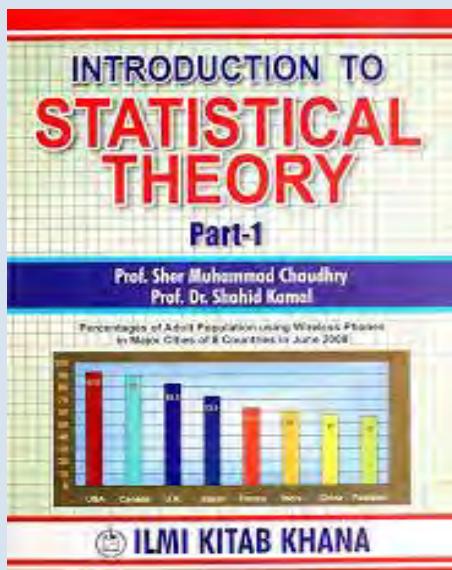
Ateeq ur Rehman

3066-BS-STAT-21

Introduction: Introduction to Statistical Theory Part-1 by Sher Muhammad Chaudhry is a fundamental book for students learning statistics. It provides a strong foundation in statistical concepts, probability distributions, and data analysis techniques essential for understanding statistical theory and its applications.

Statistics plays a crucial role in various fields, including economics, business, medicine, and engineering. This book helps students develop critical thinking skills by applying statistical concepts to real-world scenarios. The emphasis on both theoretical and applied aspects makes it an essential resource for learners.

The book explains statistical concepts in an easy-to-follow manner, making it accessible to students of all levels. It includes a blend of theoretical explanations and practical problem-solving approaches, helping readers apply statistical methods effectively. Additionally, it provides historical insights into the evolution of statistics and its significance in modern research.



Fundamentals of Statistics and Data Analysis: The book begins by introducing the basics of statistics, including data collection, organization, and representation. It explains different types of data and the importance of statistical analysis in various fields. Readers gain an understanding of how statistics help in decision-making and scientific research.

It also introduces descriptive statistics, covering measures of central tendency (mean, median, and mode) and measures of dispersion (variance, standard deviation, and range). These concepts are crucial for summarizing and interpreting data accurately.

Probability Theory and Distributions: Sher Muhammad Chaudhry provides a detailed discussion of probability theory, which is the backbone of statistical analysis. The book covers fundamental probability rules, conditional probability, and Bayes' theorem. It introduces probability distributions such as the binomial, Poisson, and normal distributions, explaining their real-world applications. This section also highlights the importance of probability in decision-making processes, risk assessment, and inferential statistics. Understanding probability distributions allows students to model uncertainties and make informed predictions.

Statistical Inference: Estimation and Hypothesis Testing: A key part of this book focuses on statistical inference, which helps in making predictions and decisions based on data. The authors discuss estimation techniques, confidence intervals, and hypothesis testing. They explain concepts like Type I and Type II errors, the significance level, and p-values in a clear and systematic way.

Inferential statistics allows researchers to draw conclusions about populations based on sample data. The book provides practical examples and step-by-step procedures for conducting hypothesis tests, making it easier for students to grasp these critical concepts.

Regression and Correlation : The book also covers regression and correlation analysis, which are essential tools for understanding relationships between variables. It explains how regression models are built and how correlation measures the strength of association between two variables.

Linear regression, multiple regression, and their applications in predictive modeling are explored in depth. Correlation coefficients are explained with real-world examples, helping students understand how different variables interact in various fields.

Applications and Problem-Solving: One of the strengths of this book is its extensive collection of solved problems. These examples help students grasp difficult concepts and apply statistical methods effectively. Each chapter includes exercises that reinforce learning and improve problem-solving skills. Additionally, the book covers real-world case studies that demonstrate the practical application of statistical concepts in diverse fields. This approach helps students see the relevance of statistics beyond theoretical learning.

Conclusion: Introduction to Statistical Theory Part-1 by Sher Muhammad Chaudhry is a must-read for students aiming to build a strong foundation in statistics. With its clear explanations, real-world examples, and solved problems, it serves as an excellent resource for learning statistical theory and preparing for exams. This book remains an essential guide for anyone seeking to understand the principles of statistics and their applications.

By bridging theory with application, this book ensures that students not only learn statistical methods but also develop the ability to interpret and analyze data effectively. Whether preparing for academic exams or professional research, this book serves as a reliable companion in the journey of statistical learning.

MOVIE REVIEW

THE IMITATION GAME (2014)

Aima Rashid

3017-BS-STAT-23

—Do you know why people like violence? It's because it feels good. But why do we like machines? Because they don't"

—The Imitation Game", directed by Morten Tyldum, is cinematic masterpiece that transcends the boundaries of a traditional biopic. At its core, the film is a gripping exploration of Alan Turing's monumental contributions to cryptography during World War 2. However, beneath the surface of its historical narrative lies a profound meditation on the power of statistics, probability, and its ability to decode chaos. This is not merely a story about breaking the Enigma code; it is a dramatic testament to the role of statistical reasoning in shaping the course of history.

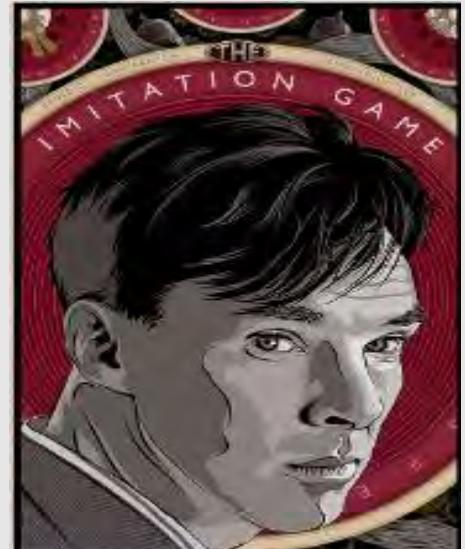
The film opens with a sense of urgency, as the Allies face the seemingly insurmountable challenge of deciphering Nazi Germany's encrypted messages. The enigma machine, a device capable of generating 159 million million million possible settings, becomes the embodiment of statistical impossibility. Turing, portrayed with haunting brilliance by Benedict Cumberbatch, emerges as the unlikely hero—a mathematician whose unorthodox methods and obsession with probability set him apart from his peers. His realization that brute force alone cannot solve the problem is a pivotal moment in the film, underscoring the limitations of traditional approaches in the face of overwhelming statistical complexity.

Statistics, as portrayed in —The Imitation Game" is not just a tool but a lens through which chaos can be understood and tamed. The Enigma machine's encryption process was designed to create randomness, making it nearly impossible to crack through conventional means. Turing's genius lay in recognizing that even within this apparent randomness, patterns and possibilities could be identified. This is the essence of statistics: finding order in disorder and using data to make informed decisions in the face of uncertainty.

"No Statistics, Probability. The Germans are human. They make mistakes. They repeat patterns. If we can find those patterns, we can narrow down the possibilities. We can beat them".

Turing used statistical reasoning to solve the Enigma code by focusing on recurring phrases. Not only this film highlights the life-or-death stakes of statistical reasoning. Statistics play a vital tool for critical decision-making.

The Imitation Game is a powerful tribute to Alan Turing's genius and transformative role of statistics in solving seemingly impossible problems. The film highlights how statistical reasoning, combined with innovation, turned chaos into clarity.



AI DOESN'T THINK — IT CALCULATES: THE POWER OF STATISTICAL LEARNING

Adil Amin

3060-BS-STAT-22

AI might seem like magic, but it's more like a swift learner that gets better with practice. And just like a student needs a good teacher, AI needs statistics to make sense of the world. Think of statistics as the rulebook that helps AI spot patterns, make smart guesses, and even predict what might happen next.

How AI Learns?

Imagine you're teaching a kid to tell the difference between cats and dogs. You show them a bunch of pictures and point out the ears, tails, and fur, and over time, they get better at guessing. AI works the same way—except instead of a kid, it's a computer, and instead of a few pictures, it analyzes millions of data points.

Here's the thing: AI doesn't "understand" anything on its own. It relies on statistical patterns to make decisions. For example: Your keyboard's word suggestions work by analyzing your typing patterns. It remembers phrases you frequently use, like "See you later" or "I'll be there." The more you type, the better it learns your style - including slang, names, and even emojis you prefer. It compares your current words with millions of other users' patterns to predict what you'll type next.

Netflix's show suggestions work like a friend who knows your tastes. It notices which genres you binge, which episodes you rewatch, and even when you lose interest. The system compares your habits with millions of other viewers, then finds patterns - like how people who loved Stranger Things often enjoy Dark too. Your thumbs-up ratings and skipped titles constantly refine its recommendations."

Google Maps predicts traffic like a local taxi driver who knows every shortcut. It analyzes real-time GPS data from millions of phones to spot slowdowns. The system compares current speeds against historical patterns - knowing that Main Street backs up at 5 pm but flows smoothly at 10 am. It constantly reroutes users to balance overall traffic flow.

Without statistics, AI would just be guessing randomly.

Two Simple Ways AI Uses Stats to Solve Problems:

1. Regression: Making Educated Guesses

Let's say a farmer wants to predict how much wheat they'll harvest. AI looks at past data—rainfall, temperature, soil quality—and finds connections. If more rain usually means bigger crops, it'll suggest planting more next season.

But there's a catch: if the AI hasn't seen enough bad years (like droughts), its predictions could be way off. That's why real-world testing is so important—just like you wouldn't trust a weather app that's never seen rain.

2. Neural Networks: Learning Like a Human

Think about how you recognize a friend in a crowd - you don't analyze every detail at once. First, you might notice their posture, then their hair color, then familiar features. AI systems learn similarly through exposure. For faces, they gradually identify key patterns - the curve of an eyebrow, the shape of a jawline - building recognition step by step. This layered learning works for voices too, picking up vocal quirks and speech rhythms over time. Even fraud detection follows this pattern, where unusual transaction sequences stand out after seeing millions of normal ones.

Facebook Tagging System:

Ever notice how you can identify a friend from just their profile in a dim room? Facebook's tagging works on that same principle, but with math backing it up. The system doesn't 'see' faces - it crunches numbers on facial proportions that most people wouldn't even notice. Like how your best friend's smile is slightly wider than average, or how their eyebrows sit just a bit higher. It keeps refining these measurements every time someone confirms a correct tag. After thousands of these confirmations, the computer builds up enough statistical confidence to say 'Yeah, that's probably Jamie' with surprising accuracy - though it still makes mistakes we'd never make.

Where You See AI Every Day:

Healthcare: AI detects tumors by comparing new X-rays against thousands of past scans. If a suspicious spot appears in the same location as 95% of confirmed cancer cases, it gets flagged. But this only works when trained on

diverse scans – miss rare cases in training, and accuracy drops by 40% or more.

Self-Driving Cars: Every 10 milliseconds, the system updates collision probabilities. If a pedestrian's movement suggests a 30% chance of entering your lane within 2 seconds, it preps brakes. These aren't guesses – they're live calculations against millions of miles of driving data, constantly adjusting as variables change.

What's Next? AI in the Next Decade:

Personalized Medicine: AI could analyze your DNA and habits to design custom treatments.

Climate Solutions: Predicting which forests are at risk of fires or which cities need flood prep.

Small Business Tools: Imagine a ChatGPT-like assistant handling inventory or customer service for a local shop.

Final Thought:

Statistics Isn't Just Math—It's the Backbone of AI.

You don't need to be a data scientist to get this: AI is powerful because of statistics. The better we teach it (with clean, fair data), the more it can help—whether that's curing diseases, making jobs easier, or even saving lives.

PAKISTAN'S STATISTICS GRADUATES: EDUCATION & CAREER

Aiman Anjum

3062-BS-STAT-21

In today's world, it becomes more important to understand and use data. This capacity is called statistical literacy. This means having skills for serious reading, understanding, and thinking about the information presented in the form of numbers. This is especially important for university students in Pakistan when preparing for their future careers. Pakistan's sector of higher education plays an important role in designing this statistical literacy. At the university level, about one-third of 3 million students are registered in areas of science, technology, engineering, and mathematics (STEM). Especially 415,008 students study science, mathematics, and statistics in 276,659 information and communication

technologies (ICT); 178,260 are in health science, and 166,457 are in engineering. Only 0.82% of students choose business and technical training, which highlights the potential difference in practical skills development.

	ISCED Broad Field	Female	Male	Total
01	Generic Programmers'	121,807	149,891	271,698
02	Education	202,030	97,773	299,803
03	Arts and humanities	375,078	325,318	700,396
04	Social sciences, journalism or information	131,332	117,138	248,470
05	Business, administration and law	129,842	274,603	404,445
06	Natural sciences, mathematics and Statistics	222,174	192,834	415,008
07	Information & Communication Technologies (ICTs)	74,701	201,958	276,659
08	Engineering	31,741	134,716	166,457
09	Agriculture	9,156	38,556	47,712
10	Health	96,121	82,139	178,260

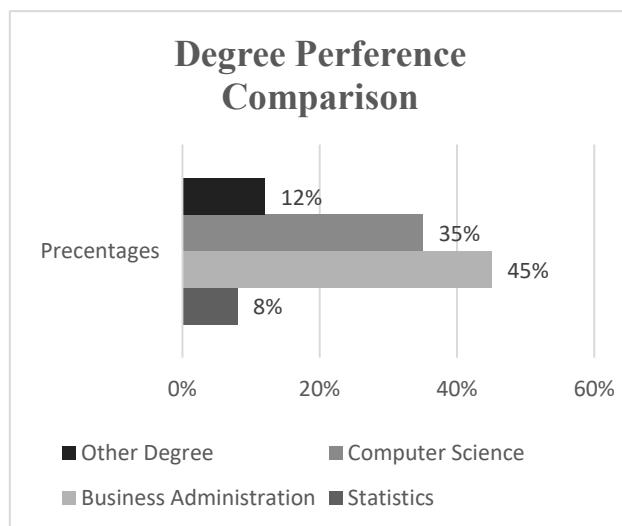
Table: Student enrollment by field of study at Pakistani (HEC) institutions - Source HEC (2020-21)

Student Behavior in Statistics Education:

Statistics education for adults in Pakistan presents a complex image, which takes the form of various factors. Many students find it challenging because of its mathematical nature and technical needs. Studies indicate

that about 40-50% of students struggle with statistical concepts. Statistics show low enrollment degrees compared to areas such as business administration, engineering science, and computer science. According to HEC reports, only a small percentage of students choose data at the graduation level. But it is a high priority as a support subject in business, finance, and social science programs.

The degree of business administration and computer science attracts about 60-70% of the university's registration; the figures as a standalone degree draw an estimated 5-10%. About 30-40% of business and computer science courses now include compulsory statistical modules, indicating their increasing significance. Discriminating evidence suggests that among students taking statistics as an elective in high secondary education, roughly 15-20% consider pursuing it as a university degree. In higher secondary education, statistics is selected as an elective by 10-15% of students, compared with 30-40% for physics and chemistry.



Statistics as a Profession: Career Continuation and Analytics:

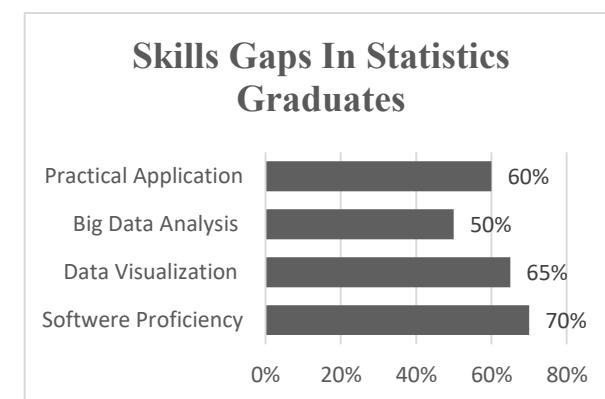
In Pakistan, pursuing statistics as a profession presents notable challenges, reflected in employment statistics across various disciplines. For instance, the overall unemployment rate for graduates stands at 16.1%, significantly higher than the national average of 6.3%. While specific data on statistics graduates is limited, trends in related fields

Globally, statistics is a growing career path, with around 15% of university graduates pursuing a career in statistics or related fields, and in developed countries such as the United States, about 12% of STEM graduates specialize in statistics. This global trend indicates a strong interest in statistics-related professions such as data analysis, data science, and research.

In Pakistan, the situation is different; while data-related fields are growing, statistics is not often considered a primary career choice. Many students switch to other fields after graduating in statistics, possibly due to a lack of awareness about career opportunities in this field. According to the Higher Education Commission (HEC), disciplines of natural sciences, mathematics, and statistics account for about 7% of total enrollments in HEC-recognized institutions. Only a small fraction of these students actively pursue statistics as a career after graduation.

Skills Interval and Industry Demand:

The skills gap in the field of statistics is a growing concern, particularly in areas such as practical applications, big data analysis, data visualization, and software proficiency. Globally, only 30% of graduates in data-related business reports have sufficient statistical software training, such as R, Python, or SAS. According to the LinkedIn survey, 45% of employers revealed that they struggled to find a skilled worker in data visualization tools such as tablets and Power BI.



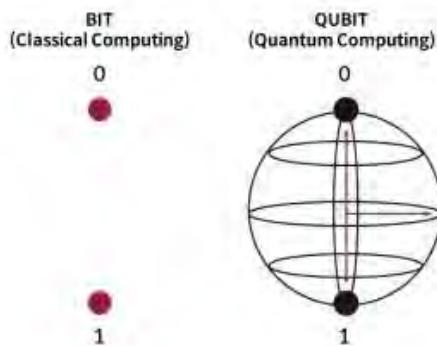
In Pakistan, the situation is quite different. A report from the Higher Education Commission (HEC) states that less than 20% of the experts specialized in the data receive training by hand in large data analysis or advanced statistical software.

QUANTUM LOGIC'S THROUGH STATISTICAL METHODS

Mohsin Ali Gulzar

3028-BS-STAT-21

Imagine you have a magic coin. Not just any coin, but one that can be both heads and tails at the same time. That's kind of like a qubit, the basic unit of information in a quantum computer. Now, imagine trying to figure out how often this coin lands on heads or tails. You can't just flip it once; you need to flip it many, many times to get a reliable idea. That's where statistics comes in.



Quantum computers are incredibly powerful, but they're also incredibly tricky. They deal with these *magic coins* (qubits) that exist in a fuzzy state until we measure them. And when we do measure them, we only get a glimpse of what's going on. So, how do we make sense of all this?

Classical Bit vs. Qubit:

Feature	Classical Bit (Simple Computer)	Qubit (Quantum Computer)
State	Either 0 or 1	Can be 0, 1, or both (superposition)
Processing	Performs computations sequentially	Processes multiple possibilities simultaneously
Storage	Stores data as	Uses quantum

	binary (0s and 1s)	states to store complex information
Connection	No linked bits are independent	Qubits can be entangled, linking their states regardless of distance
Computation Power	Limited by classical logic gates	Exponentially faster for certain problems like factoring large numbers and optimization
Example	Used in traditional computers like laptops and phones	Used in quantum machines for tasks like cryptography and advanced simulations

The Challenge of Quantum Data:

Think of it like trying to listen to a radio station with a lot of static. You hear bits and pieces, but it's hard to get the full picture. Quantum computers produce data that's full of this *static*, which we call noise. This noise comes from errors in the hardware, and it makes it hard to know if the results we're getting are accurate. Every time we measure a qubit, it changes. It's like trying to check the air pressure in a tire by letting some air out each time. Current quantum computers are still in their early stages, and they're prone to errors. Imagine a computer that gets the answer wrong 10% of the time. That's a lot of errors!

Statistics to the Rescue:

Just like a doctor uses tests to diagnose a patient, we use statistical tests to figure out what's going on inside a quantum computer.

Quantum State Tomography: Figuring out the Coin. Imagine flipping that magic coin 1,000 times. You get 520 heads and 480 tails. This gives you a rough idea of the coin's *bias*. Quantum state tomography does something similar, but with qubits. It involves taking many measurements to estimate the quantum state.

Example: if 1000 measurements of a qubit should have produced 500 '0' results and 500 '1' results, but produced 550 '0' results and 450 '1' results, statistics help us determine if that difference is caused by random chance, or an issue with the Qubit.

Error Correction: Cleaning up the static .We use statistical methods to figure out where the errors are coming from and how to fix them. Think of it like using a noise-canceling headset to block out background noise.

For example, we might run a test that repeats the same calculation many times, and then use statistical analysis to identify and correct the errors.

Hypothesis Testing: Is it real or just chance? Sometimes, we want to know if a quantum computer is actually doing something interesting, or if the results are just random. We use statistical tests to determine if the results are statistically significant.

For example, we might run a quantum algorithm and compare the results to what we'd expect from a classical computer. If the results are significantly different, then we know the quantum computer is doing something special.

The Future of Quantum Statistics:

As quantum computers get bigger and better, we'll need even more sophisticated statistical methods. We'll need to be able to analyze huge amounts of data, and we'll need to be able to handle even more noise. We'll need to develop new statistical tools that can handle the unique challenges of quantum data. We'll need to use machine learning to automate the process of analyzing quantum data.

THE EROSION OF COMMUNICATION AND RESPECT: A LEADING CAUSES OF DIVORCE

Ahmad Atiq UL Rehman

0555-MPHIL-STAT

In the minds of most people, marriage represents a lifelong commitment based on love and trust. But a happy and successful relationship between man and woman, including marriage, naturally calls for patience as well as effort and good communications. However, one of the

most common and most harmful causes is when in their day-to-day lives people have lost blessed communication as well as for one another no longer have respect. When both fail to communicate and respect each other, their relationship becomes tenuous. Unresolved conflicts then accumulate, and they come to stack up on top of each other until finally autonomy or Divorce is the only way out.

The Importance of Communication in Marriage:

Effective communication builds the foundation for a successful marriage in many ways. It means that partners are able to reveal their thoughts, feelings, and concerns openly and honestly. With good communication skills, wives can start out strong and get past obstacles cooperatively while resolving misunderstandings gently. Insecurity or lack of trust begins to concern away at the lucky couple's emotional union. Soon, gut feelings turn into premonitions. Miscommunication in marriage breeds disharmony and tension easily slips in between spouses. One common problem in communicating with your partner is the difficulty of actually hearing them. Many partners are busy marching like soldiers instead responding and frequently do not understand at all what another person is saying. This may result in annoyance or feeling that you were never being listened to or understood. It's like an old rice bag that's never taken in front of it actually starts to go off. When such "discomfort" is allowed to grow for a long time, couples become emotionally distant and may trap themselves in a vicious circle where they never advance beyond the current level of interaction to any higher plateau. If some people cannot clearly reveal what a relationship problem is to their partner or friends, they might instead resort to passive aggressive behavior.

The Role of Respect in a Healthy Marriage:

Where respect exists in abundance, both partners feel that their voice counts and they make sense. But if it doesn't exist, or only marginally so, eventually both feel neglected unsustainable situation resulting in a breakup of the marriage after years spent holding everything together with band-aids and scissors. However, lack of respect can manifest itself as gleeking criticism, sullen contempt or that most dreaded of all modern lovers--passive-aggressiveness.

How the Erosion of Communication and Respect Leads to Divorce:

When people stop talking and become disrespectful, they create an atmosphere of negativity from which it is hard to recover. Misunderstood words and blind eyes make emotional distance, bitter disillusionment. A breakdown in communication translates into rows with much repetition but little resolution; the relationship is stretched to breaking point. After a period of emotional disconnection, people begin to feel as though the other doesn't pay attention or value their efforts. With these feelings often comes infidelity or outright abandonment. Frequently, though, this breakdown leads to divorce.

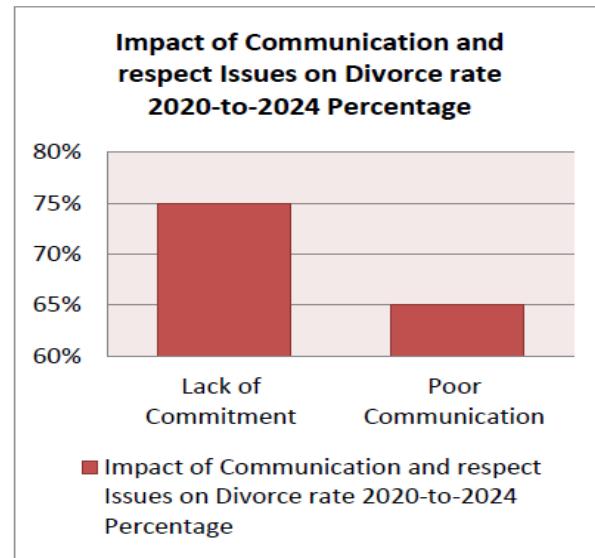
Rebuilding Communication and Respect in a Marriage:

You should also acknowledge their feelings, and give a thoughtful response rather than react like this or that. Instead of resorting to accusation or name-calling, couples should learn to express their emotions in a healthy and positive way. The best way is not with 'you always' or 'you never', but 'I feel hurt when you do not take my concerns seriously.' In this way there's more respect for the other person's feelings that simple black-and-white language will not afford naturally. In addition; Couples who also set boundaries and ensure two-way communication processes help to ensure that both parties feel heard and valued in decisions.

Statistical Data (2020-2024):

When we look at divorce trends from 2020 to 2024, although there is some factual basis for this position, most trends show otherwise: only 2.4 out of every 1,000 people went to court in 2022.

Cause of Divorce	Percentage (%)
Lack of Commitment	75.0
Poor Communication	65.0



Statistical Inference Results: Communication & Respect Issues in Divorce

1. Visualization Analysis:

The bar chart above illustrates the impact of lack of commitment (75%) and poor communication (65%) on divorce rates. The error bars represent a confidence interval (CI) of $\pm 3\%$ for commitment and $\pm 2.8\%$ for communication, ensuring reliability in the reported data.

2. Hypothesis Testing (One-Sample Z-Test):

We conducted a Z-test comparing the divorce rate percentages to a hypothetical population mean of 50% (assuming a neutral divorce rate threshold).

- Z-score for Lack of Commitment: 8.33
- Z-score for Poor Communication: 5.36
- P-values: Both are significantly lower than 0.05, meaning the observed divorce causes significantly exceed the assumed average.

3. Interpretation:

With such low p-values (< 0.0001), lack of commitment and poor communication are shown to be important variables.

The high Z-scores (above 5) mean that these two variables are especially important in causing divorce.

The likelihood is high of lack of commitment and poor communication metaphorically speaking being some of the strongest reasons for divorce.

Conclusion:

Clear communication and respect for others, however, are at the root of most divorces. It leads to cultural trauma, unresolved anger, and isolation but also distances people from each other. The stronger foundation for building positive relationships, however, is open communication, active listening, and mutual appreciation. Living a life with meaning, setting long-term objectives, and expressing appreciation strengthen an individual's emotional happiness and sense of security. Meanwhile effective communication skills, empathy, and stress management all help to create an environment that nurtures respect and emotional maturity. Commitment and communication are the main challenges facing any marriage. But they could be overcome. Through establishing emotional connections, mutual respect and exchange of ideas, couples can build a bridge between themselves. This makes it much easier to survive the rough patches in life. By causing more competition and co-operation, supporter-managers and development all boost confidence, creativity, happiness. However, a relationship which is established properly step by step will make this growth all the easier to achieve apropos of both members.

CHALLENGES AND PROBLEMS FACED BY WOMEN IN SOCIETY: A STATISTICAL STUDY

Ahmad Attiq UL Rehman

0555-MPHIL-STAT

Introduction:

In the course of human civilization, women have been particularly paramount to the society in economic, social as well as cultural transformation. Despite this, females are still discriminated in school, workplace and in career ladder with limited chances to ascend to leadership positions. It is manifested in wage disparities, restricted mobility, harassment at the workplace, and unpaid care work. These include the strict limits in property rights,

limited rights in marriage and reproductive health check. Therefore, there is a need for policy change and modification to the society if women are to have equal rights like their counterpart.

This paper seeks to discuss some of the key issues facing women today such as inequality at the work place in the form of paid less than their male counterparts, sexual harassment, restricted access to education and opportunities, unpaid care work, and cultural norms among others. This is the only way the society can be changed so that women can be given equal rights, opportunities, and can pursue their potential.

Problems and Challenges Faced by Women:

Traditional gender roles restrict women from having ambitions careers, especially when it comes to their families, hence they experience slower promotions, political and leadership inequalities. This is applicable up to date where 1 out of the 3 female population has been subjected to physical or sexual violence as reported by (WHO). Another is that women have been restricted from accessing loans for their business and employment openings and promotions limited to them; others are forced to marry or stay at home beget children at their early ages. Hence, managing conflicts between work, family, and society raises women's Standardized Mean Illness Rating for Anxiety and Depression (SMIRF-AD) scores.

They failed to meet the gender pay ratio, where women are paid less than men even with similar skills and experience. There is job discrimination and sexual harassment among women in the workplace; these women lack proper protection because they are often threatened not to report these acts. Gender-based violence, particularly focusing on the wife battering, rape, and trafficking in persons is a significant human rights abuse. Finally, legal factors such as legal discrimination and inequality affect women mostly in their legal framework of marriage, divorce and ownership of property among other areas. Such laws serve the purpose of restricting women's opportunities for acquisitions and self-actualization. In some cultures and religions, women are restricted from exercising their freedoms and making choices in certain spheres. A large percentage of children get married and give birth before they reach the legal age due to social and cultural norms. Early marriage has negative effects on the health of the couples, one fails to fully develop individually and financial struggles. Parents

have to work at their place of business while also being responsible for a home and dealing with society's pressures, which negatively impacts their mental state.

Statistical Analysis and Inference:

- In low-income countries, girls are **four times more likely** than boys to be out of school (UNESCO).
- Women spend **2.5 times more** hours on unpaid domestic work compared to men (UN Women).

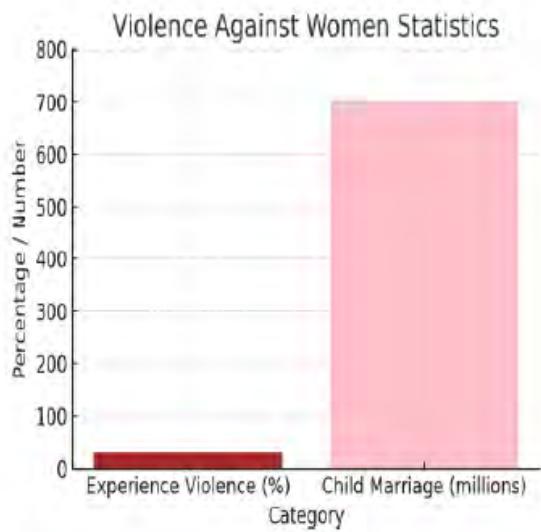
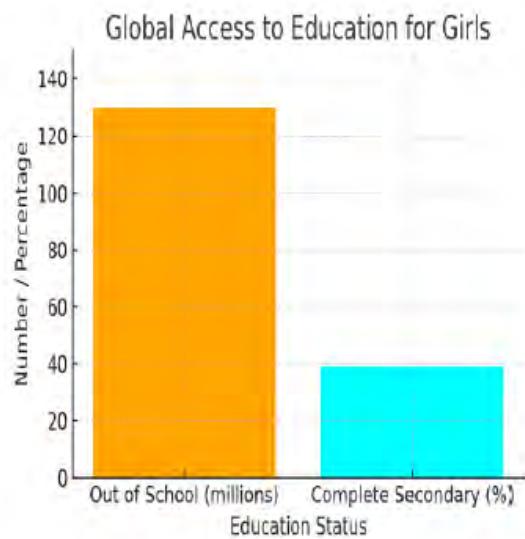
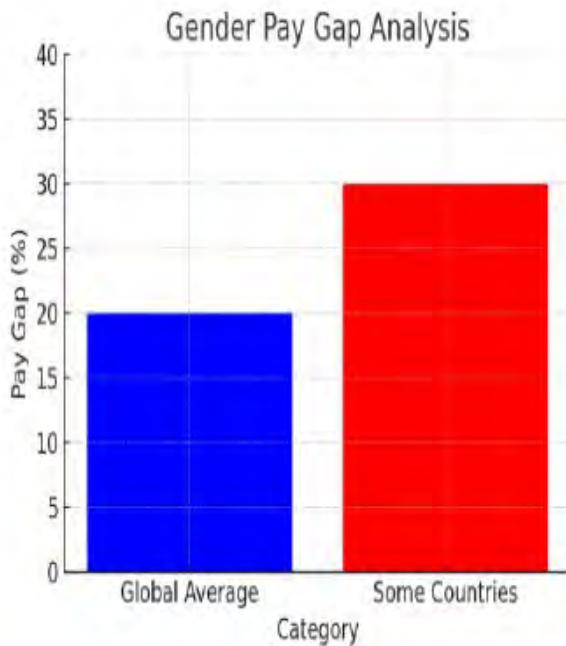
Statistical Inference on the Gender Pay Gap:

(H_0): There is no significant difference between the earnings of men and women.

(H_1): There is a significant difference between the earnings of men and women.

- **t-statistic** = 2.94
- **p-value** = 0.0089

Since the p-value is **less than 0.05**, we reject the **null hypothesis** and conclude that there is a **statistically significant difference** between men's and women's earnings. This confirms the presence of a gender pay gap.



Solutions and Way Forward:

The challenges need to be addressed from multi-faceted perspective. Governments should enforce gender equal laws and policies that support women rights in education, work and healthcare. To achieve that, organizations need to make a commitment to narrowing the pay gap by adopting salary transparency, and fair pay policies. Such companies should have strict anti harassment policy and support female employee through leadership training. Only then, society should work to break traditional stereotypes through gender equality in media, schools and work places. Progress requires encouraging women to pursue careers in leadership and male dominated fields.

Conclusion:

Women are still not able to grow and be independent even today due to gender discrimination, harassment at workplace, the gender pay gap, violence and lack of access to education. But with stronger policies, greater awareness, and hard work from the society, might it won't be possible to have a future of equality and empowerment for women. Now us women and girls must keep on fighting for our rights.

Indeed, empowering women contributes to economic growth, supports the social integrity, and promotes inclusivity. When people, communities and governments collaborate to bust through barriers and buck tradition, change gets made. Such policies for supporting the gender equality and promoting collective action contribute to a less fair world. We can have a future in which women lead a life free of discrimination and limitation with persistence.



ZOOLOGY

2024: YEAR IN REVIEW

Jan

- The metabolic processes of fruit bats and fish swimming mechanics might spark innovations in medicine and robotics. These findings emphasize how animal biology can influence advancements in human technology and health.

Feb

- Discovering new species, including jellyfish and a mussel, could drive innovations in biodiversity conservation and ecological research. These results underscore the continual exploration of animal life and its significance for science and technology. Significant zoological discoveries were also highlighted, revealing the complex interactions between animal behavior and environmental influences.

March

- Significant progress consisted of creating advanced tracking technologies for wildlife, which improved conservation efforts. Furthermore, researchers investigated the genetic adaptations of different species, providing insights into evolutionary processes and their impact on preserving biodiversity.

April

- Significant innovations included the development of sophisticated bioacoustics monitoring systems designed to analyze animal communication and behavior. Additionally, advancements in genetic engineering aimed at boosting disease resistance in threatened species potentially transformed conservation strategies.

May

- Researchers have developed advanced tracking devices that employ satellite technology to monitor wildlife movements in real-time. They have also introduced new techniques for evaluating animal welfare through behavioral analysis, which improves our understanding of the needs of species in captivity and the wild.

June

- Key advancements in zoology comprised the creation of sophisticated tracking technologies for wildlife and the improvement of conservation techniques. Furthermore, scientists unveiled new approaches to examining animal behavior via non-invasive methods, fostering ethical practices in research.

July

- Comprised breakthroughs in comprehending fruit bats' metabolism, offering insights into health sciences. Additionally, researchers investigated the mechanics of fish locomotion, which may have applications in robotics and bio-inspired design, enriching our understanding of animal adaptations.

Aug

- Introduced a new tracking system for migratory birds, boosting conservation initiatives. Furthermore, research into elephant social behaviors offered valuable insights into their communication techniques, which could shape wildlife management approaches and improve animal welfare practices.

Sep

- A revolutionary approach utilizing drone technology has enhanced data collection for monitoring marine life populations, aiding conservation initiatives. Additionally, studies on the genetic diversity of endangered species have provided fresh strategies for their preservation and management in their natural habitats.

Oct

- Highlighted cutting-edge tracking devices leveraging satellite technology to improve wildlife monitoring. Moreover, progress in bioinformatics offered novel tools for evaluating animal behavior, supporting the conservation of diverse species and their habitats.

Nov

- A new noninvasive imaging technique has been developed, enabling researchers to examine the internal structures of animals without causing harm. This advancement holds the potential to significantly improve our understanding of animal physiology and health. Furthermore, research on the social dynamics of wolf packs has yielded important insights into their communication and hunting methods, which could guide conservation efforts and habitat management.

Dec

- A state-of-the-art genetic editing tool has been introduced to boost the resilience of endangered species against diseases. This innovative technology seeks to bolster conservation initiatives by enhancing the health and survival rates of vulnerable populations. In addition, researchers have created a novel behavioral monitoring system that employs artificial intelligence to assess animal interactions in real time, offering profound insights into the social structures and behaviors of different species.

MOVIE REVIEW

UNDER PARIS (2024)

Mahnoor Nadeem

B.Sc. (Hons.) Zoology, GCUL

The ocean, a vast and enigmatic stretch, has historically been a source of fascination and dread for humankind. Its infinite depths, home to various unknown and frequently predatory creatures, inspire wonder and fear. Among the different beings that inhabit the ocean, one creature is distinguished as a symbol of fear and admiration: the shark.

Recently, I had the chance to view the sci-fi horror thriller "Under Paris," which is themed around a shark's transition from a saltwater to a freshwater environment. This transition is a complicated process because of the significant contrasts between these two habitats, such as differences in salt levels, temperature, food resources, and biodiversity. The film showcases a team of scientists monitoring a shark from its early growth stage, recording its development rate, actions, diet, and ecological interactions with other species. The shark starts to show unusual behavior, so three scientists set out on an underwater journey to discover the reason for this oddity. The shark devoured the researchers even though it is not the nature of sharks to attack humans unless they feel threatened. Following a tragic loss, researchers abandoned their study on a particular shark. A decade after researchers abandoned their study following a sad loss, reports of a shark sighting in the Seine River, Paris emerged. Upon investigation, they discovered that the same shark had attacked them years earlier. One of the original researchers joined the new team, tasked with eliminating the creature, which had become a growing threat to the local population. What was particularly astonishing was the shark's unprecedented evolutionary changes. Unlike its original species, this specimen had adapted to consuming humans as a primary food source. It had also developed the ability to survive, grow, and reproduce in freshwater—ability not previously observed. This raised a critical question: why had this transformation occurred in the Seine and not in other rivers, despite their connection to the ocean? The Seine is considered one of the most polluted rivers in France. Once a clear blue water body that served as a recreational site, it eventually deteriorated into a dumping ground due to human negligence. This heavily polluted environment provided an ideal setting for the shark to camouflage, increasing its hunting success rate. Over time, it developed enhanced camouflage abilities, making it even more elusive.

After an intense pursuit, the research team successfully eliminated the shark. However, their analysis of the specimen revealed astonishing discoveries. It was pregnant despite having no mate, proving its ability to reproduce asexually. Furthermore, its breeding cycle was alarmingly short, allowing for rapid population growth. The most unsettling revelation came when the researchers realized that the shark they had killed was not the one they had initially been tracking—suggesting the presence of many more. Determined to locate the source, the researchers conducted extensive searches and eventually identified the breeding hub within the depths of Paris' sewage system. Upon arrival, they discovered an enormous population—millions of evolved sharks thriving in the sewage system. With no natural predators, rapid asexual reproduction,



and a short gestation period, their numbers had multiplied uncontrollably. The situation escalated into a catastrophic disaster for the city.

The most compelling aspect of this fictional account is its depiction of drastic evolutionary shifts in an organism typically known for its biological stasis. Initially, the changes were behavioral—altering its hunting preferences. Gradually, its physical attributes transformed, including changes in skin color, habitat, and even reproductive mechanisms. Such transformations can be attributed to environmental stressors such as rising ocean temperatures due to climate change, habitat destruction caused by pollution, disruption of food chains, and urban runoff. These stressors induce genetic mutations, leading to altered morphology and behavior. This raises an important question: had researchers closely studied the initial irregularities in the shark's behavior, could the disaster have been prevented? More significantly, if humans had not altered their habitat in the first place, would such extreme adaptations have occurred at all? I think that even though the shark was portrayed as the antagonist in this context, the true culprits were humans, whose environmental negligence forced the creature into this evolutionary trajectory. Consider a species accustomed to living in waters with temperatures ranging between 2–7°C. If climate change elevates this range to 9–12°C, the species faces three choices: adapt to the new conditions, migrate to a more suitable habitat, or face extinction. Applying this principle to the film's narrative, the shark might have stumbled upon a sewage pipe with a temperature favorable to its survival. Over time, it adapted further, with each successive change reinforcing its ability to thrive in its new environment. Every organism, including apex predators like sharks, prioritizes survival. Have you ever thought about why most changes in nature occur gradually? Why are sudden, abrupt changes often harmful? The answer may lie in nature's inherent warning system. Much like how the human body signals distress through mild pain before escalating to severe agony if left untreated, nature offers early signs of environmental shifts, allowing time for intervention. For instance, ozone depletion was first identified in the late 1970s, yet warnings were largely ignored. Today, the consequences of this negligence are evident: climate change, the greenhouse effect, increased health risks, agricultural crises, and extreme weather events. These are the direct results of human disregard for environmental warnings.

This film, despite being fictional, holds an important lesson. It highlights how species, even those perceived as living fossils, are susceptible to evolutionary pressures when subjected to relentless environmental stress. The fundamental rule of survival—"Survival of the fittest"—applies universally, whether to humans or apex predators. The question is not whether organisms will adapt but whether humanity will take responsibility for its actions before it is too late.

NEW WORLDS AWAITS – THE FUTURE IS CALLING**Prof. Dr. Atif Yaqub****Professor****Department of Zoology, GCUL****& Sibtain Haider****1606-BS-ZOO-22**

As humanity teeters at the precipice of a monumental era in space exploration, the quest for extraterrestrial life and the audacious vision of establishing colonies on distant worlds resonate with an urgency like never before. The once-fleeting dream of forging human settlements among the stars is now on the verge of reality, propelled by breathtaking technological breakthroughs and an expanding knowledge of our solar system and the cosmos beyond.

The recent missions to Mars have not only made history but also ushered humanity into a new frontier, where dreams of interplanetary exploration are transforming into breathtaking realities. The discoveries made by NASA's Perseverance rover and the UAE's Hope probe have unearthed tantalizing evidence of ancient waters and elusive conditions that once nurtured life on this enigmatic red planet. With day lengths eerily reminiscent of Earth and vast reserves of ice lurking just below the surface, Mars stands poised as a leading contender for human colonization, igniting our imaginations and ambitions.

Researchers, driven by an insatiable quest for knowledge, are tirelessly developing pioneering life support systems that leverage local resources for water and oxygen production—an endeavor that will be vital for our long-term survival amid the alien terrain.

However, Mars is but one actor in this grand cosmic narrative. The icy moons of Jupiter and Saturn, especially Europa and Enceladus, ignite even more audacious imaginings of extraterrestrial existence. Beneath their frozen exteriors lie immense subsurface oceans, potential incubators of life brimming with promise. Upcoming missions, such as NASA's pioneering Europa Clipper, stand poised to penetrate these hidden realms, heralding revelations that could transform our comprehension of

habitability in the cosmos. The quest for discovery is only just beginning as the universe extends its arms, beckoning us to uncover its profound mysteries.

As we embark on this extraordinary expedition, it's crucial to recognize the pivotal role of students and contemporary researchers in the life sciences. Disciplines like astrobiology, environmental science, and biotechnology will be paramount in readying humanity for life beyond our planet. The future of space exploration rests in the hands of these scientists, who must delve into the study of extremophiles—remarkable organisms thriving in harsh environments—shedding light on the possibilities for life in otherworldly settings.

Moreover, research into sustainable farming techniques, closed-loop ecosystems, and genetic engineering will be essential for establishing self-sufficient colonies. It is imperative to foster a culture of innovation and resilience, as these fields will not only facilitate survival in alien landscapes but also enhance our stewardship of Earth. By uniting curiosity with scientific rigor, humanity can propel itself into a future where we are no longer mere observers of the cosmos but active participants in its ongoing saga. This is our moment to seize the stars and embrace the adventures that lie ahead, opening doors to an era of exploration that could redefine our place in the universe. We encourage students to engage in interdisciplinary studies that connect biology, engineering, and environmental science, as these connections will be the key to our future in space.

THE SECRET LIFE INSIDE US: A STORY OF PROBIOTICS**Dr. Iram Liaqat****Associate Professor (TTS)****Department of Zoology, GCUL****& Noor Muhammad****PhD Scholar, Department of Zoology, GCUL**

In the human grand orchestra, with organs in their part and systems humming in unison, there is one force operating in the background, almost silently, almost unseen, and only quite recently gaining its due credit,

though long overdue. It is not in our bones or muscles; there is not a feeling of it in the rhythm of our heartbeat. It does not, however, live anywhere inside the body. Instead, it lives quietly in our gut in the dark, warm tunnels of our intestines, working away at this task without our notice. This world we speak of is the world of probiotics: tiny warriors, peacekeepers, and collaborators that determine our health from the inside out.

Bacteria are something that there seemed to be a good argument for us to be getting rid of. Bacteria had been the bad guys of medicine for generations. They were to be feared, so we were told to be destroyed with soaps, sanitizers, and antibiotics. In the past, microbes caused diseases and infections. However, science is already turning that story on its head. In fact, some bacteria are harmless to the point of being downright essential for life. These are the probiotics, the abbreviation of their Latin name meaning "for life."

Live microorganisms that, when administered in adequate amounts, confer a health benefit to the host. That host, of course, is us. These friendly microbes have been discovered, and because of that, there has been a quiet revolution in medicine and health. They play a role in digestive health, mental well-being, childhood development, and elderly care – anywhere you strive for a balanced, disease-free life.

However, their story did not start in laboratories or clinics. For ages before, we had the means to see probiotics in foods, but humans have been consuming them through fermented foods (without even knowing it). Age-old staples yogurt, kefir, sauerkraut, pickles, miso, and kimchi were not just tasty traditions but microbial goldmines. For them, they were not only for preservation but for vitality. Moreover, science is starting to see what they have been doing and recognizing it.

In fact, records of people making fermented milk already exist in ancient Egypt and Mesopotamia. For centuries, traditional lassi and Dahi have been a part of the daily diets in South Asia, not just for their taste but to cool the digestive system and improve one's gut health. Our ancestors may have known the worth of microbial life before the microscope was invented.

It is a complex, dynamic community of 10 to 100 trillion microbes living inside our intestines. The microbial universe is as unique to a person as a fingerprint and is

governed by genetics, environment, diet, and lifestyle. It has both beneficial and potentially harmful organisms, and it is important to keep the balance between the two. Probiotics help in this regard. Moreover, they help restore equilibrium, especially if that balance is disrupted through stress, illness, antibiotics, or sub-standard dietary choices.

These beneficial microbes play an essential role in digestion. They help to break down complex carbohydrates, fibres, and proteins that our digestive enzymes are incapable of entirely breaking down. In doing this, they create short-chain fatty acids such as butyrate, acetate, and propionate, which feed the cells of the colon and promote anti-inflammatory actions. They also make essential vitamins B12, folate, and K2. Probiotics, in this way, improve not only digestion but also nutrition itself.

Moreover, their effect does not stop in the gut. Recent years have provided us with discoveries of a gut-brain axis. It is a two-way communication network in which nerves, hormones, and immune signals are involved. The gut microbiota, through this axis, can affect mood, behavior, and even mental diseases. Such has been the case that a new discipline has arisen that examines probiotics and their potential benefits to mental health: psychobiotics.

In some studies, particular strains of probiotics from the group *Lactobacillus helveticus* and *Bifidobacterium longum*, for example, have been shown to relieve anxiety and depression. Some reported that bacteria in the gut affect the production of a neurotransmitter called serotonin, commonly referred to as the *feel-good hormone*. Amazingly, 90 percent of serotonin is made in the gut. So, the blood inflaming your gut, which you believe could be related to your anxiety, could be the very thing causing your anxiety, which is closing your eyes to even correcting your GI symptoms in the first place.

Furthermore, probiotics can affect the functioning of our immune system because it is long established that 70% of our immune cells are situated in our gut-associated lymphoid tissue (GALT). Beneficial microbes stimulate immune cells that can either attack or protect the body to recognize between harmful pathogens and harmless particles. It helps to prevent chronic or autoimmune responses as a result. Such modulation is potentially life-changing for people with allergies or inflammatory bowel diseases.

Probiotics are, in practical terms, taken in the form of fermented foods or supplements. Not all are the same, though. Each group of bacteria strains performs different functions. *Lactobacillus rhamnosus GG* is extensively used to prevent or treat diarrhea. *Bifidobacterium bifidum* supports immunity and gut integrity. A good probiotic yeast, such as *Saccharomyces boulardii*, can help maintain gut health after antibiotic treatment or infection. Strain, dose, and delivery system are the three factors that determine whether a probiotic will work.

For these organisms to be effective, they must reach the intestines alive. The stomach is a hostile environment; your stomach is very acidic and contains many digestive enzymes. Hence, probiotic capsules are often enteric-coated and fermented foods, which are considered the best carriers as they protect the bacteria during digestion and provide a synergistic environment with prebiotics.

On the other hand, nondigestible fibres (prebiotics) provide food for good bacteria. Prebiotics, found in foods such as garlic, onions, bananas, or whole grains, and probiotics found in foods such as most yogurts and many other foods, make a powerful team known as synbiotics. It is just like planting good microbes (probiotics) and feeding them to grow using nutrients (prebiotics).

Despite their potential, the rise of probiotics has also brought challenges. Products come out of the market with miracle health benefits. Unfortunately, not all these claims are proven by science. Insufficient numbers of live organisms or strains with no proven health effects may be present in some yogurts or capsules. Consumers are advised to read the labels carefully, choose products with specific strain names and higher CFU (colony-forming unit) counts, and try to select those studied clinically.

In Pakistan and other third-world countries, probiotic awareness is even more necessary. Diarrhea, food poisoning, irritable bowel syndrome, and nutritional deficiency are all gut-related disorders. The overuse and misuse of antibiotics is one of them. Although antibiotics are a crucial treatment for infections, they also kill the friendly bacteria that live in your gut, leaving the microbiota weakened and vulnerable. Replenishing the gut with the addition of probiotics is a simple and natural way to reduce antibiotic-associated side effects.

In addition, Pakistan's rich tradition of fermented foods offers an opportunity to use probiotics in daily diets.

Native strains of beneficial bacteria are already in dahi (yogurt), achar (pickles), kanji (fermented black carrot drink), and other regional specialties. To make probiotic-rich foods readily and culturally acceptable, researchers and food scientists can promote hygienic fermentation practices by documenting local microbial strains.

Currently, at GCU Lahore, studies are being done to isolate indigenous probiotic strains that may be better adapted to local gut flora and have better adaptability with local diet patterns. An exciting frontier is the possibility of developing enteral formulations (Pakistan-specific probiotic formulations) that are affordable and effective and could deepen our traditions.

Probiotics are also gaining attention in pediatrics. Early life introduction of helpful microbes can assist with reinforcing the creation of an invulnerable framework and decrease the danger of sensitivity, asthma, and dermatitis. It shows what nature intended the human microbiome to be at inception: healthy and packed specifically because breast milk itself contains natural probiotics and prebiotics.

Probiotics are used to solve common problems such as constipation, malabsorption, and reduced immunity in elderly populations. This paper also examines studies that show probiotic supplementation can decrease respiratory and other infections in the elderly, improve bowel habits, and even make vaccines more effective in older adults.

Probiotics can be beneficial in hospital settings, preventing infection, helping patients recover faster after surgery, and avoiding complications in critical care units. Although more large-scale clinical trials are still needed, promising evidence exists to support these findings.

However, the most fascinating area of future research is the development of next-generation probiotics. They include genetically modified strains, the functions of which are designed to detect cancer cells, produce targeted drugs, or eliminate toxic compounds in the gut. Precision probiotics consist of formulations tailored to an individual according to that individual's genetic profile of their microbiome, on which scientists are also working.

Imagine a day when, in addition to vitamins, you also take a daily prescription of a unique mixture of beneficial microbials made just for your body. This would mean diagnosing diseases through changes in gut bacteria or

preventing chronic diseases by simply feeding on the inner ecosystem. This may sound futuristic, but the foundations are being laid.

But the probiotic story is ultimately about much more than bacteria. It is about cooperation, adaptation, and the interdependence of life. That speaks a lot to health, which means not the absence of illness but rather a dynamic balance, where the organisms we take for granted are the most important.

With every advance that science makes in understanding the microbiome, it becomes evident that we can only really understand who we are by finding out what is inside us. So misunderstood and falsely dismissed for so much human time, these little allies may have the answers to a healthier and more balanced future.

The next time you sit down to enjoy a bowl of homemade Dahi, a glass of lassi, or eat a pickle, thank yourself, for you are not just nourishing yourself. You are sowing an invisible garden, one that shields you, mends you, and joins you with the most essential beats of life.

The guardians are working inside of you in that unseen world! They require very little, only that you feed them well, treat them kindly, and be mindful of their quiet role in the piece of your health.

INVISIBLE ARCHITECTS: HOW NANOSCALE SCIENCE IS RESHAPING THE FUTURE

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In the contemporary realm of scientific exploration, we stand on the precipice of unprecedented advancements occurring at scales so diminutive that they defy common perception. The confluence of nanobiotechnology, nanobiology, and nanomaterials is revolutionizing our comprehension of biological and material systems, heralding innovations with the potential to profoundly reshape the landscapes of medicine, energy, agriculture, and environmental science. For example, pioneering developments in DNA origami have unlocked the

capability to engineer nanoscale machines that execute highly specific biological functions, such as the targeted delivery of therapeutic agents to cancerous cells, thereby mitigating the deleterious side effects commonly associated with conventional cancer treatments. Furthermore, revolutionary strides in nanopore technology, now supercharged by artificial intelligence algorithms, are redefining biomolecular sequencing. This technological leap enables researchers to unravel the complexities of protein structures and discern previously elusive modifications, which were once deemed unattainable by traditional methodologies.

As we explore the vast potential of nanobiology and intelligent nanomaterials, it's crucial to emphasize their role in technological advancement and in preserving our environment. Continued innovations will pave the way for breakthroughs, such as smart drug delivery systems that release medications precisely where needed, minimizing systemic side effects. Furthermore, integrating nanotechnology into renewable energy sources could significantly enhance efficiency, contributing to a sustainable future.

Collaboration across disciplines—combining insights from biology, materials science, and engineering is essential for realizing the full potential of these technologies. By fostering partnerships between academia, industry, and regulatory bodies, we can ensure that developments are safe and beneficial for society. Education and public engagement will also play vital roles in demystifying nanotechnology, allowing a broader understanding and acceptance of these revolutionary advancements.

In conclusion, as we stand on the horizon of unparalleled innovation driven by nanoscale technologies, we are not just enhancing our capabilities; we are fundamentally redefining what is possible in science, industry, and the sustainability of our planet. The journey ahead has immense promise, and our choices today will shape tomorrow's world.

POSSIBILITIES OF TREATING DIABETES BY ORAL INTAKE OF INSULIN

Akhyaaar Batool

0804-BH-Z-20

Introduction:

Diabetes mellitus is considered a global health problem because of the irregular metabolism of glucose and insulin resistance. Individuals who have diabetes have a decreased life possibility because of the increased risk of some other forms of diseases like hypertension, cardiovascular diseases, renal failure, neurological complications, and cancer. Insulin therapy is required daily in those individuals who have mainly either type I diabetes mellitus or advanced type II diabetes mellitus (T2DM) to regulate and control the blood glucose level. Parenteral and enteral are the two pathways for the intake of insulin. The former pathway includes the oral, buccal, rectal, and sublingual administration of insulin in tablets, capsules, emulsions, carriers, syrups, or powders. The oral insulin delivered to the body in the form of capsules or pills is less painful to administer, having minimum irritation, discomfort, needle stick injuries, and risk of skin infections, thus challenging the demerits associated with subcutaneous insulin injections like restlessness and non-compliance. The focus of current research is centered on oral insulin because of its promising potential in promoting patient comfort, decreasing peripheral hyperglycemia, inciting hepatic salinization, and enhancing adherence and compliance to treatment regimens. Therefore, several challenges are linked with effective oral insulin delivery, including limited diffusion, a minimum absorption rate, breakdown of enzymes in the intestinal tract, and obstacles caused by mucus membranes. Several tiny particles, such as nanoparticles, liposomes, hydrogels, and microcapsules, are currently being harvested to overcome these obstacles. The current study focuses on the development status, advances, and obstacles of insulin administered orally, along with future perspectives.

Challenges:

There are various challenges, such as decreased bioavailability, limited stability, increased inter-individual variability, and significantly inappropriate absorption linked with the administration of oral insulin. There are

three main types of barriers which are associated with oral insulin delivery:

- Formulation-related (linked with formulations such as nanoparticles, liposomes, etc.)
- Biochemical barriers
- Physicochemical barriers

In addition to this, the larger molecular size of insulin molecules creates a hindrance to it while passing through the intestinal tract of the intestine. The challenges associated with enzymes creating hindrance and variability in chemical reactions are promoted by the activity of enzymes in the gastrointestinal tract and the acidic environment of the stomach (Low PH (2)). The destabilization linked with the creation and breakdown of insulin is enhanced by these impediments. The breakdown of the disulfide bonds is the major cause of the instability of the insulin molecule. Furthermore, the physical barriers involving mucosal membranes and epithelial lining subsequently impede the absorption of oral insulin as shown in figure below.

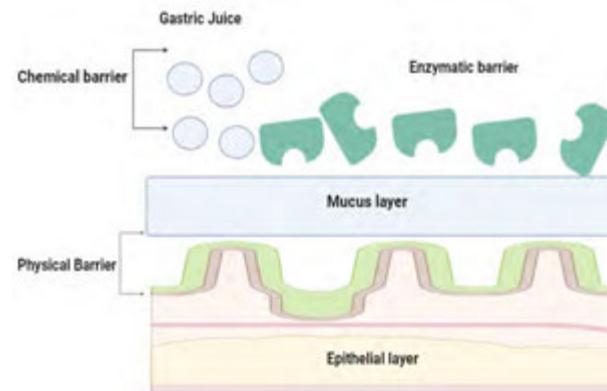


Figure: Barriers to oral insulin include physical and chemical

The effectiveness of oral insulin is significant. The formulations of the protein or the drug synthesized in the laboratory must be compatible with the gut of the body. It must depict the biological activity in the bloodstream of the diabetic individuals. Gaining accurate dosage control is another obstacle linked to the oral delivery of insulin in the body. Regular agencies should improve the clinical trials to ensure the effectiveness and safe use of oral insulin. To guarantee the patient's affordability and eligibility, the manufacturing expense must be considered. Patient acceptance, reliability, and compliance are

significant factors in formulating insulin, even if it is safe to use and functional. Currently, the FDA (Food and Drug Administration) has not indicated any clinical testing associated with oral delivery of insulin yet, and no commercially available oral insulin products are available to diabetic individuals in the market.

Advancements in the Formulation and Administration of Oral Insulin:

Several important drug delivery systems (DDS), including oral routes, have been developed in recent years, rendering individuals with diabetes a more relaxing, comfortable, and less invasive option to regular and traditional insulin injection methods.

Enhancing adherence, increasing the absorption efficacy across the intestinal mucosa, and preserving the homeostasis of insulin are considered the major goals related to these advancements (Figure 2). One significant and workable approach has been utilizing oral insulin formulations and carriers along with absorptive and permeation enhancers. This approach is improving the bioavailability and absorption rate of oral insulin in the blood. A recent study explored the probabilities of strengthening intestinal mucosa by producing surfactants and bile salts. They are both drug-solubilizing and permeation-modifying agents that increase the absorption efficiency of insulin. Along with this, the utilization of ionic lipids, peptide-based enhancers, and enzymatic inhibitors augment the insulin's absorption rate, solubility, and permeability across the gastrointestinal cavity. Another approach includes the synthesis of different nanostructures, such as liposomes and polymeric nanoparticles, regarding the protection of insulin from enzymatic breakdown inside the digestive tract and facilitating systemic assimilation. These approaches are potentially being utilized to decrease dependence on subcutaneous injections for insulin delivery. There are different nanoparticles, such as Lipid polymeric nanostructures, mesoporous silica tiny particles, metal-organic structures, and hybrid nanoparticles, being assimilated for the targeted delivery of drugs orally.

There is another type of nanoparticle known as the small negatively charged inorganic silica nanoparticles, augmenting the intestinal absorption of insulin across the epithelium and inducing a relaxation process by controlling tight junctions in the gastrointestinal cavity. Moreover, innovative strategies are being included,

consisting of sticky and mucoadhesive patches, which are efficient in stabilizing insulin efficacy in the gastrointestinal tract, enhancing the absorption rate at specific sites, and improving mucous absorption. The targeted delivery systems of drugs, including penetration of mucus nanoparticles, can cross the tenacious mucosal obstacles to distribute insulin effectively deeper into the tissues. There are several mucoadhesive formulations, such as amphotericin and quinine, which adhere to mucosal surfaces to promote prolonged insulin release and absorption. These advancing approaches facilitate the precise delivery of drugs, their stability in the intestine, and the efficacy of insulin absorption, as they possess the potential to improve treatment results.

The unique type of liposomes, Biotinylated liposomes, also known as Lipid-based vesicles, are being prepared by the linking of phospholipids with biotin, which is further embedded in the membranous structure of liposomes for the oral delivery of drugs. They are being used to imitate cell membranes' structural and compositional features and present a methodological and regulated method of encapsulating insulin for its further protection from enzymatic breakdown in the gastrointestinal environment. The absorption and residence time of insulin is being increased in the intestinal milieu by using the lipid-based vesicles (lipid bilayer structure) for the accurate administration of insulin. Hydrogels possess significant potential for oral delivery of insulin as they have the considerable capacity to form strong bonds with water molecules, and their polymeric networks are hydrophilic and arranged in a three-dimensional configuration. Hydrogels can also attach to mucosal surfaces because of their mucoadhesive properties, probably enhancing the length of their contact and improving the way in which insulin is degraded by the epithelium of the intestine. Furthermore, the utilization of microneedle patches augments the direct delivery of insulin into the blood, which is made up of tiny needles that can cross the mucosal surfaces without causing discomfort and restlessness.

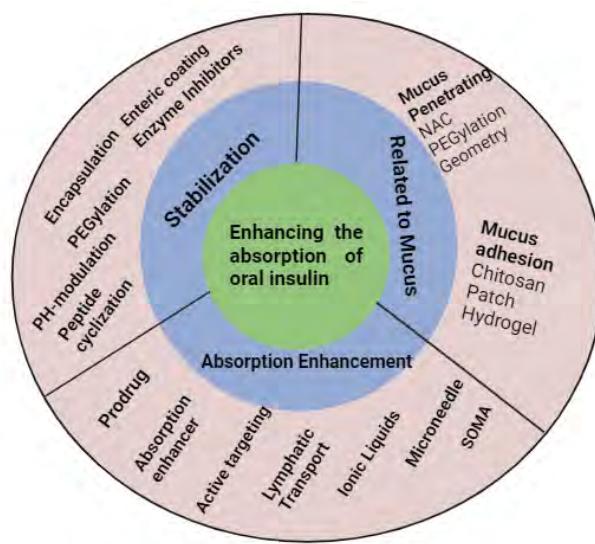


Figure: Improving the absorption of oral insulin (Zhu et al., 2021)

Future Perspectives of Oral Insulin:

The incorporation of digital health platforms, improvement of targeted leadership strategies, and innovation in formulation technologies to enhance therapeutic results are the techniques currently utilized to improve the oral delivery of insulin. The therapeutic effectiveness of oral delivery of insulin has been enhanced and improved because of various significant advancements in formulation techniques, including the use of nanoparticles and lipid-based carrier systems, which are improving the stability and bioavailability of insulin. In addition to the accurate administration of drugs, this has been verified by utilizing innovative delivery techniques, including receptor-mediated nanoparticles and pH-responsive coatings, thus reducing exposure through the system. Moreover, integrating digital health solutions, such as wearable bio-sensors and smart pills, improves patient outcomes. It regulates and optimizes personalized, effective therapy because of real-time observation of the physiological framework and affirmation of adherence to medical procedures. The formation of oral insulin coatings proves to be a highly centralized approach in order to revolutionize diabetes regulation linked with patient-centered, personalized, and predictable interventions. This interdisciplinary approach significantly presents a promising path for the production of oral insulin. Looking from a manufacturing point of view, the output of secure parts and components is crucial for the continuous sustainability of oral insulin

formulations. Extensive research is needed in this program to comprehend the toxicological properties of nanoparticles along with their effect on their respective environment and human physiology.

Conclusion:

Insulin administered orally is an invigorating field of research and developmental procedure for the cure of diabetes in Diabetology. Researchers should overcome these obstacles before oral insulin administration appears to be a viable option for the cure of diabetes mellitus. Among the several barriers associated with its administration, Physiological barriers to insulin absorption, limited bioavailability, and significant inter-individual variability are the barriers that depict how challenging it is to develop an effective oral insulin prescription. This article examines the probabilities of treating diabetes with an oral intake of insulin and presents challenges, formulation techniques, and procedures, along with future perspectives. Peer-reviewed research has proven that insulin can be prevented from the acidic environment of the stomach (PH 2) and enzymatic and peptide degradation by administrating insulin-carrying molecules orally in the body. In addition, several techniques are being used to improve and enhance the permeation and biocompatibility of oral insulin but there are still a lot of challenges that insulin should be faced by insulin to survive in the body. For the long-term and effective prevention and safety of oral insulin, research must be carried out on a variety of patient populations. Current researchers should focus on the development of more physiological and user-friendly permeation enhancers and formulations that will decrease the risk of hypoglycemia, weight gain, and other insulin therapy-related complications.

SECRET LIFE OF WOLF: AWARENESS ABOUT THEIR MICROBIAL PARTNERS AND IMPACTS

Shinza Ilyas

1617-BS-Z-22

Abstract

Wolves are the majestic apex predators of wildlife. They are not just like hunters. In fact, they are the host of the microbial universe (microbiomes). This unseen fellowship

is among the wolves are microbes that play a vital role in their survival, health, and even behavior. Microbes help the digestive system and control the immune system functions, and they shape the wolf's life in different ways. Every howl of a wolf carries more than a beast call that whispers about the silent work of microbiomes that influence the fate of wolves. As we dig into the world of microbiomes, we will be able to note their role in ecological balance and how the actions of humans become harmful to these microscopic allies. This study also highlights the point why the protection of microbes is crucial for the survival of a wolf's species and how it helps the animal itself and the ecosystem.

Introduction

Wolves are always attractive to scientists and true lovers of nature because they are smart, intelligent, and strong animals that help maintain the ecosystem properly. The behavior that their pack show, like hunting skills and adaption ability, has been studied widely, especially in the book *The Hidden Life of Wolves* by Jim Dutcher. This book elaborates the emotions, social bonds and relation of wolves with their environment in a very deep way.



Figure: Northwestern Wolf

However, our primary focus was on their hunting skills and ecological balance, a lesser-known key that leads to their survival value, which depends upon the microbiomes. This unseen world, which includes bacteria, fungi, and viruses, has the ability to affect a wolf's immune system, the process of digestion, and also their behavior and health-regulating activities, just like wolves who regulate ecosystems by controlling the prey population. By studying wolves, we can gain knowledge of microbial species that provide fundamental perceptions about how these animals survive in extreme conditions

and interact with their environment on a microscopic scale. As threats like habitat loss, climate change, and harmful human activities increase, it disrupts the activity of microbiomes. Understanding the relationship between these external threats and microbiomes plays an important role in how these small organisms (microbiomes) support the health and survival of wolves in different ways.

Physical Characteristics of Wolves

Wolves are usually located in either extremely hot or cold environments. They have **thick fur**, providing coverage in extreme environments for survival. They have **large paws**, which help them to cover long distances, such as 30 miles, which means that they can cover that long distance through their legs. Wolves have **jaws** that have the power of approximately **400PSI** (bite power), which helps them to get important nutrients from the bones of other animals. They also have a **keen sense of smell**, which allows them to detect their prey miles away. They have **sharp power of vision** at night, making them a better hunter for capturing prey.



Figure: An accurate picture of Gray Wolf

Critical Role of Microbiomes in Survival of Wolf

One gram of feces contains billions of bacteria, which is very helpful in survival and competition for wolves. Other roles of microbiomes related to survival values are as follows:

Digestion and Nutrition

Wolves are the carnivores that rely only on meat. They need a well-developed digestive system for the proficient breakdown of this meat. Hence, their gut microbiome plays a vital role in the processes of different bacteria such as Clostridium and Bacteroides. They are both helpful in the digestion of protein molecules, and their work is also about taking out essential nutrients from the

bones and cartilage. They help get maximum energy from their food/meal, which makes them strong and active carnivores. In the absence of these microbes, the wolves cannot get essential nutrients for their survival.



Figure: Wolf eats prey for its survival

Microbiome Support to Immune System

If a healthy microbiome is present in a wolf's gut, it will strengthen the immune system by competing with the harmful bacteria and releasing an antimicrobial substance. This cycle can be disrupted by some negative factors like habitat loss, pollution, and food shortage that make the survival of wolves difficult.

Microbiome Effect on Social and Behavioral Interactions:

Recent research shows that the gut microbiomes can cause behavior changes by neurotransmitters, i.e., **serotonin** (stress) and **dopamine** (social behavior). A stabilized form of microbiome can support communication with the pack if there is a disturbance due to a change in their balanced diet, and any environmental stress may have a horrible impact on the pack, which also destroys leadership roles.

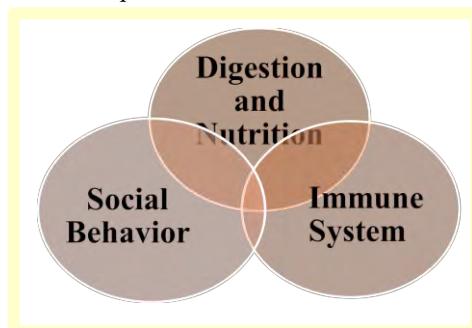


Figure: Steps for survival of wolf's microbiome

Case Study: Parasite *Toxoplasma gondii* and Behavior of Wolf

In this study, the most captivating effect on wolf behavior comes from the parasite *Toxoplasma gondii*. It is known as a microscopic parasite and is famous for altering its host responses. This microscopic parasite can move into the wolf's body in different ways, such as contaminated water, soil, and any infected prey inside the wolf's body through their meal. Studies suggest that wolves that are infected have a few properties that are as follows:

Enhance risk-taking behavior

Some wolves become bolder, and some show aggressive behavior. This kind of behavior puts them in a riskier activity, which is dangerous for them.

Change in Pack

When risk factors enhance, and become bolder, the role of leadership and their hierarchy shifts.

Interaction with larger preys

This point shows that they can potentially affect their survival and hunting criteria.

How *Toxoplasma gondii* Works?

First, *Toxoplasma gondii* starts manipulating the brain and neurotransmitters (Dopamine and Serotonin), causing changes in dopamine levels by the Thyroxine hydroxylase (TH) enzyme, affecting their decision-making ability and social interactions. However, all this impact on wolves is under study; other animals, like rodents and domestic animals, have the same effects as wolves, which indicates their resemblance with other species. This parasite alters the behavior by performing fearless actions on the hosts. Wolves are the leading players that are useful for maintaining ecological balance with their environment; all the changes in their behavior, which is seen in them, are due to parasites that affect their predator-prey cycle (Hunt, balance, sustain) and the overall health of the balanced ecosystem.

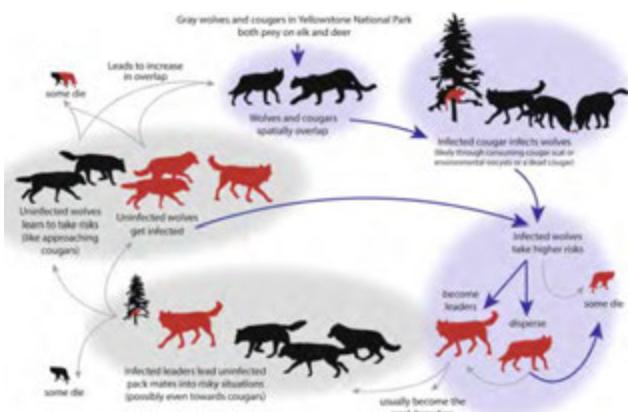


Figure: Predator-Prey Cycle

Environmental and External Factors Influence the Wolf Microbiome

Diet and Hunting

A diet that wolf intake depends upon the habitat. For instance, Yellowstone National Park hunts elk, and Arctic wolves rely on the caribou for food. There is a food difference between them, which is a clear reason for the presence of different types of microbiomes in wolves' bodies, so it means different bacteria are helping with the digestion of specific prey.

Habitat and Climate

Some wolves live in colder areas, and some live in warmer areas, so they both need microbes according to their specific conditions. For instance, a wolf in a colder region has microbiomes that can make the fat molecules more proficient. In contrast, wolves in warmer areas have that kind of microbiome that is helpful in the conservation of energy and digestion-type processes.



Figure: Habitat of different types of Wolves

Wolves as spreaders of microbes

Microbes of Ecosystem

As wolves travel from different areas, they become carriers for microbiomes, which can spread these bacteria, fungi, and other microorganisms (tiny organisms). They can spread this with the help of fur, feces, saliva, and interaction factors related to their environments. So, by this, we get to know that these microbiomes are also helpful for maintaining soil health, the breakdown of organic matter, and their effect on plant growth.

Role in Disease Control

Wolf can control diseases like chronic wasting disease (CWD), bovine tuberculosis, and rabies by controlling their prey's population and removing some sick animals. If the sick ones are removed, only healthier ones will remain, decreasing the risk of outbreak and increasing a happy lifestyle.

Conservation and Future Research

Protection of Wolf Habitats

Conservation of wolves is precisely the protection of wolves; their main focus is to protect their habitat from distortions. This step is also suitable for microbiomes. For instance, protected areas like Yellowstone National Park can hunt elk. They consider them as their primary prey (Keystone prey). When the wolves are introduced, they start controlling their population, which helps to make it a balanced ecosystem.

Studying Wolves Microbiomes

By studying and researching this, we get to know the effect of the environment on microorganisms (microbiomes). This will help in making better conservation strategies for them, and this will also make wolves' lives healthier in different types of environments where they live.

Conclusion

In conclusion, we know that wolves are not only apex predators. They are strong, innovative, and intelligent animals that have hidden a hidden world of microorganisms (small organisms) in them. They work as a host for them. The different processes, such as

digestion, social behavior, and survival values, all have a connection with these small organisms called microbiomes. Still, some human activities like deforestation, pollution, overhunting, etc., can also destroy their delicate balance. By protecting these wolves, we also get microscopic allies that protect wolves and their ecosystem. They call it home.

DECODING BIOLOGY OR LIFE SCIENCES WITH AI: A NEW ERA OF DISCOVERY

Hamaad Iqbal Basra

1642-BS-ZOO-22

Abstract

Artificial Intelligence (AI) is revolutionizing fields like biology and life sciences by providing the practical analysis of datasets, which provides the way for important discoveries. This paper examines the effect of AI on drug development, protein structure prediction, and personalized medicine. AI improved the techniques like genomics, proteomics, image analysis, and systems biology by accelerating scientific advancements and unveiling complex biological processes. Nonetheless, the incorporation of AI brings about the fourth ethical challenge, which includes the concerns related to data privacy, algorithmic bias, and the essential requirement of the transparent models. The ongoing development in machine learning studies and deep learning shapes research practices and promotes precise diagnostics, targeted treatments, and a more intense conception of biological complexes.

Introduction

Biology and life sciences have a great experience in data surge. This accumulation is due to sequencing, imaging, and computational modeling enhancements. Traditionally, they started relying on manual experimentation, and then another point is noted: biological research is seriously time-intensive. The AI-driven analysis enables the rapid explanation of large datasets, which include genetic sequences, protein structures, and physiological data. AI algorithms now detect tangled patterns and also anomalies that are beyond these conventional methods, transforming genomics, proteomics, RNA biology, and cellular dynamics. This shift raises the predictive accuracy of their

research, deepens the insights into biological mechanisms, and accelerates discovery. AI also combined the multimodal data, enabling researchers to model disease progression and develop targeted therapeutic interventions with the unprecedented precision.



Figure: Robotics in a Modern Laboratory

Advancing AI-Driven Biology: Data, Innovation, and Future Directions

1. The Role of AI in Data-Driven Biology

The rapid expansion of biological data presents significant challenges in integration, management, and interpretation. Traditional statistical methods often struggle to cope with the complexity and variability of datasets generated from fields like genomics, proteomics, and biomedical imaging. In contrast, artificial intelligence (AI), mainly through machine learning (ML) and deep learning (DL), offers innovative approaches for uncovering meaningful patterns, predicting biological behaviors, and automating data analysis.

AI-driven algorithms excel at managing complex biological datasets with multiple dimensions, enabling researchers to investigate intricate relationships among gene expression, protein interactions, and metabolic networks. These sophisticated techniques aid in identifying biomarkers, deepening our understanding of disease pathways, and promoting personalized treatment strategies. Furthermore, AI facilitates in silico simulations of biological processes at various levels—molecular, cellular, and systemic—reducing reliance on traditional laboratory methods and paving the way for advancements in drug development, gene therapy, and synthetic biology.

By stimulating the diverse biological datasets, AI also enhances the predictive modeling, leading to more accurate hypotheses about genetic regulation, disease mechanisms, and biomolecular interactions. This drives

the advancement in the precision of medicine, early disease detection, and therapeutic innovations.

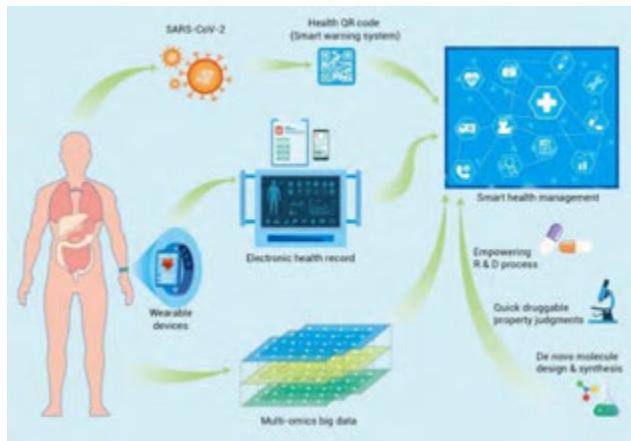


Figure: Role of AI in Life

Core Applications of AI in Biology and Life Sciences

1. Accelerated Data Analysis & Discovery

AI enables the processing of a variety of biological datasets, uncovering patterns and their correlations with the methods that are often missed. In genomics, AI is helping to identify the disease-linked genetic variations and map to note the complex regulatory networks. It also plays a vital role in proteomics by guessing the structure of protein molecules and their interactions, which provides more effectiveness for understanding their molecular functions. AI data integration tools are now facilitating the reconstruction of complex biological pathways and advancement into both types of research, i.e., metabolic and cellular systems.

2. Drug Discovery & Development

AI is also used in pharmaceutical research to speed up the process of drug discovery and optimize clinical trials. I learned about the different models that are important elements of compound libraries, predicted the drug-target interactions, and simulated pharmacokinetics for the betterment of candidate selection. Designs that are generated with the help of AI make a novel molecular structure that offers them a new possibility for drug innovation. Additionally, a drug made by AI that is repurposing identifies the existing drugs that have the potential to make new applications more significant, and it reduces the costs of research and developing timelines.

3. Personalized & Precision Medicine

AI can now turn generalized treatment plans into highly individualized solutions for healthcare. By integrating genetic profiles, electronic health records, and lifestyle data, the AI models can predict patient responses to specific treatments. In oncology, AI helps tailor chemotherapy regimens based on a patient's molecular profile and improves efficacy while limiting the side effects. Predictive analytics also assist in diagnosing early disease and risk assessment by providing a way for proactive healthcare intervention.

4. Bioimage Analysis & Automated Processes

AI improves medical imaging and cellular biology with the help of automated analysis of histopathology slides, X-rays, MRIs, and microscopic images. Deep learning of algorithms can improve the accuracy of finding and detecting the anomalies in medical scans and distinguishing cancerous cells from healthy cells with the help of high precision. There is a high amount of data to measure how images are generated by the variety of data, and AI automation can speed up processes like cell counting and morphological analysis, reducing human error and improving research reproducibility.

5. Systems and the RNA Relation with Biology

AI can facilitate the integration of metabolic activities, signaling molecules, and gene regulatory systems into the complex model for biological interactions. In RNA, AI predicts the structure of RNA, analyzes the levels of gene expression, and examines the post-transcriptional modifications. This revelation will help the researchers understand how RNA influences cellular functions, assisting in developing RNA-based therapies, including mRNA vaccines and gene-editing techniques.

6. Synthetic Biology & Bioengineering

AI-enabled synthetic biology facilitates the systematic design of genetic circuits and enhances the optimization of engineered systems related to life sciences, all of which are due to various applications in the field of medicine, industry, and the environment. Artificial intelligence plays a vital role in the formation of synthetic genes, forecasting their functions, and advancing biofuel production. In the field of bioengineering, AI-driven tools are used to develop more engineered microorganisms for

purposes including bioremediation, carbon capture, and sustainable agriculture, thereby improving both efficiency and accuracy in synthetic biology research.

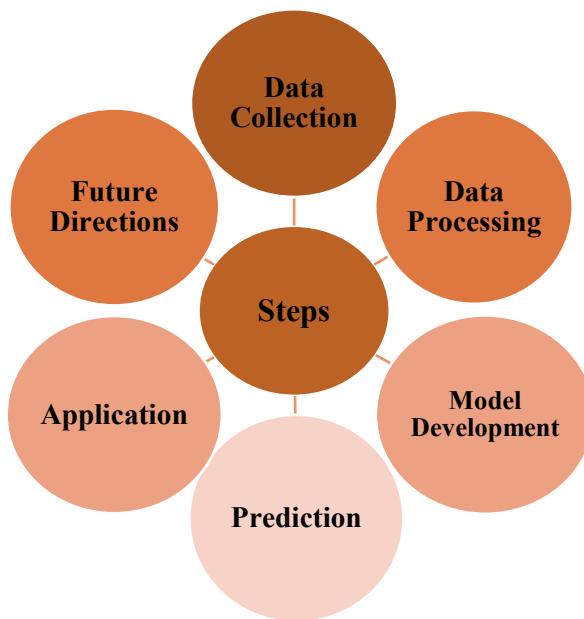


Figure: AI Workflow in Biological Research

Accelerated Discovery and Data Analysis

The combined form of **AI and big data** is altering biological research by enabling different scientists to allow them to do biological complexity on an unprecedented scale. The hypothesis that is driven by research is now complemented by **data-driven discoveries** in which AI can identify patterns without previous assumptions. Massive datasets help researchers decode complex biological systems, from brain functions to microbiomes, and even discover novel drug targets.



Figure: Fusion of AI and Biology

Drug Discovery and Development: The AI-powered drug discovery leverages big data to screen for chemical libraries; the model directly targets the interactions and optimizes pharmacokinetics. The **Uehara International Symposium 2023** highlights the groundbreaking advancements, such as AI models for predicting the potential of drug molecules and neuroscience applications that will decode the brain's activity and make a design that targets neurological treatments. These innovations streamline the development of different drugs with the help of AI, as AI is continuously evolving. Hence, it has a part in the integration of biomedical research that has the power to transform the future of pharmaceuticals as well as the neurosciences.

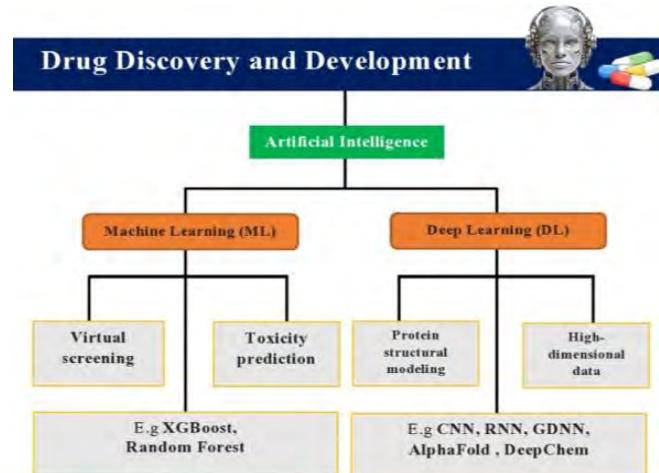


Figure: Role of AI in Drug Discovery and Development

AI-Assisted Experimentation and Automated Processes: There is an increase in the number of robot scientists who are **revolutionizing** research methods. These AI systems can automate the experimental processes, form and test hypotheses, and accelerate discovery. Some experts' predictions are about an intelligent system that could make a discovery that is worth a Nobel Prize by 2050. **AI microscopy and image analysis** for further enhancement in research by lifting the individual's cell behavior with high precision.

Personalized and Precision Medicine: AI models can integrate the **data of microbiomes**, which will predict the trends related to health and treatments that are based on individual variations. By analyzing the vast datasets from genetic profiles, imaging, and clinical records, AI provides **personalized healthcare solutions**.

for improving the diagnostics, treatments, and patient outcomes.

Future Prospects and Challenges of AI in Life Sciences

Challenges in AI Implementation

Despite AI's massive potential in biomedical research and healthcare, it faces significant hurdles. The **quality and integrity of data** remain the primary concerns, as AI models depend upon **accurate, unbiased, and diverse datasets** for valid predictions. The **black-box nature** of many AI algorithms can restrict interpretability, confusing **regulatory approvals** and **clinical adoption**. Additionally, cybersecurity threats, **privacy risks**, and the potential for **algorithmic biases** entail strict mistakes to ensure AI's ability to make medical solutions remain transparent, equitable, and secure.



Figure: Challenges to the health system

Ensuring Ethical and Secure AI Deployment

For AI to prosper in the life sciences, robust guidelines about ethics and cybersecurity are essential. Advanced encryption, blockchain security, and threat detection can protect the data known by AI. The regular update shows the regularity of ethical consent and responsibility for better use of AI in medicines.

Research Area	AI Application	Current Challenges	Future Prospects
Environmental Biology	Ecosystem Modeling, Climate Impact Analysis	Data Integration Across Disciplines	Sustainability, Biodiversity Preservation
Genomics	Sequence Analysis, Mutation Detection	Data Quality, Interpretability	Personalized Medicine, Early Diagnosis
Synthetic Biology	Genetic Circuit Design, Metabolic Engineering	Scalability and Predictability	Industrial Biotechnology, Renewable Resources
Medical Imaging	Pattern Recognition, Anomaly Detection	Privacy and Regulatory Issues	Enhanced Diagnostics, Real-time Monitoring
Proteomics	Protein Folding Prediction, Structural Mapping	Complexity of Protein Interactions	Drug Target Discovery, Customized Therapies

Table: Comprehensive Overview Table

Conclusion

AI is now becoming an important aspect of the life sciences because it not only enhances research methods, improves diagnostics, and accelerates drug development, but it also has the ability to process different datasets, which ensures a better step toward genomics, proteomics, medical imaging, and personalized medicine. Artificial intelligence is a kind of technology that facilitates early disease detection, optimizes treatment strategies, and streamlines drug discovery, significantly reducing the timelines of research and costs. However, challenges like data reliability, algorithmic bias, and ethical concerns must be addressed through these transparent models, which are responsible for AI integration. By fostering interdisciplinary collaboration among biologists, data scientists, and ethicists and by implementing stringent ethical guidelines, AI will continue to drive scientific discovery and medical innovation. Embracing AI in the field of life sciences under ethical collaborations will unlock unpredictable scientific discoveries by improving lifestyles worldwide.

SEXUAL BEHAVIOR ACROSS SPECIES

Bilal Nawaz

1644-BS-ZOO-22

Sexual behavior in the animal kingdom is remarkably diverse; it reflects adaptations to specific environmental pressures and reproductive strategies.

Monogamy and Pair Bonding:

While social monogamy, which forms long-term pair bonds in certain species, is observed among mammals, it is relatively rare; it occurs in only about 10% of the species. This rarity is often attributed to the differing parental investment requirements. In contrast, many bird species exhibit social monogamy, forming partnerships that are crucial for the rearing of their offspring. However, the sexual monogamy is less common due to the instances of infidelity. Environmental factors, such as climate change, can influence these partnerships. For example, species like the wandering albatross form long-lasting bonds essential for chick rearing. Still, the extreme environmental stress has been linked to higher "divorce" rates in species like snow petrels and black-browed albatrosses.

Polygamy and Mating Systems:

Many species engage in polygamous systems, where these individuals have multiple mating partners within a breeding season. This type of strategy enhances genetic diversity and increases reproductive success. For instance, male lions often control pride with several females, ensuring the propagation of their genes. Similarly, female chimpanzees may mate with multiple males, which can reduce the risk of infanticide by confusing paternity.

Lekking Behavior:

In species of animals like the sage grouse, the males congregate in the specific areas, which are known as the leks, to perform elaborate displays. The females visit the leks to select mates based on the quality of these displays, which leads to the intense sexual selection of pressures on the males to exhibit superior traits.

The Role of Pheromones in the Animal Communication and Behavior:

Pheromones are the chemical substances secreted by the animals that trigger the specific behavioral or the physiological responses in the conspecifics. They play a crucial role in communication, particularly concerning their reproductive behaviors.

Mechanisms of the Pheromone Detection

Traditionally, it was believed that mammals possessed two separate olfactory systems—the primary olfactory

system for general odor detection and 2. the vomeronasal system specifically for pheromone detection. However, recent studies have shown that both these systems are actively involved in communicating pheromones. Pheromones are contained in body fluids like urine, sweat, specialized exocrine glands, and the mucous secretions of the genitals.

Pheromones in the Reproductive Behaviors

Many species, like pheromones, are integral to reproductive processes. For example, in the amphibians and reptiles, the pheromones can attract mates and influence the mating behaviors. Male newts release pheromones that attract the females, while male salamanders produce the chemical signals that persuade females to mate. These pheromones can also affect sensory processing and have physiological effects on recipients.

Bio stimulation and Reproductive Efficiency

In livestock species, pheromones are being utilized to enhance the reproductive efficiency. Exposure to the male pheromones can stimulate the luteinizing hormone secretion and synchronized ovulation in females. This effect is mediated by the olfactory cues, likely involving the vomeronasal organ, which is connected to the hypothalamus and plays a crucial role in reproductive regulation. For instance, the presence of a boar during the insemination of a sow improves sperm transport and ovulation.

Sexual Behavior of Giant Pandas:

Giant pandas (*Ailuropoda melanoleuca*) are also known for their unique reproductive habits. In the wild, pandas are solitary animals and only come together for mating. However, due to the various environmental stressors, such as habitat loss and fragmentation, pandas have been experiencing reproductive difficulties. Research has shown that environmental stress can disrupt the pandas' hormonal balance, leading to decreased libido and their reproductive success. Specifically, studies have found that stress can lower testosterone levels in male pandas, which makes it challenging for them to mate successfully. To address this issue, some conservation efforts have been involved in administering testosterone injections to male pandas to stimulate their sexual desire and increase their chances of reproduction. However, the approach is still

being researched, and its long-term effectiveness is yet to be determined.

Regarding the role of the testosterone in pandas, it plays a crucial role in the regulation of their reproductive behavior. By administering testosterone injections, conservationists aim to increase testosterone levels in male pandas, which may help stimulate their sexual desire and improve their reproductive success. However, it's essential to note that this approach is still being researched, and its effectiveness and potential long-term consequences are being carefully evaluated.

Human Pheromones and the Behavioral Influence:

The concept of the pheromones that influence the human behavior has been a topic of interest, particularly in the context of attraction. Despite the lack of scientific evidence supporting the effectiveness of pheromones in humans, there is a rising trend among young people for perfumes and oils claiming to contain these compounds. These kinds of products are marketed with promises of inducing attraction and desire akin to magical love potions. However, scientists express skepticism, noting that humans' vomeronasal organs, which detect pheromones in animals, are largely inactive. Experts believe any effects of such perfumes may be due to a placebo, boosting the wearer's confidence rather than chemical attraction.

Conclusion:

Sexual behaviors across species are diverse and have evolved to maximize reproductive success in varying environmental contexts. Pheromones also play a pivotal role in facilitating these behaviors, as they serve as chemical messengers that convey crucial information about reproductive status and readiness. Understanding these intricate behaviors and the communication mechanisms provides insights into the evolutionary biology of species and has practical applications in areas such as wildlife conservation and livestock management.

THE IMPACT OF HUMAN ACTIVITIES ON ANIMAL POPULATIONS AND ECOSYSTEMS

Laiba Mustafa

1651-BS-Z-22

Abstract:

Human activities have profoundly affected global ecosystems and animal populations. The rapid pace of environmental change has upset the balance of natural habitats, from deforestation and pollution to climate change and overhunting. This paper explores the primary human-driven factors contributing to the decline of animal populations and ecosystems. Also, it analyzes the consequences of these impacts and offers potential solutions to mitigate further damage to animal populations in the existing world.

Introduction:

Over the past few centuries, human civilization has made unprecedented progress, shaping the environment to meet the demands of an ever-increasing population. However, these advancements have come at a substantial cost to the environment. Even though human activities have brought about a lot of good things, like the growth of agriculture, urbanization, and technology, they have also hurt natural environments, causing ecosystems to break up and biodiversity to disappear. Understanding the relationship between human activities and the environment is critical to finding sustainable solutions that preserve the delicate balance of life on Earth and for the protection and conservation of various diversities of animals.

Human Activities That Affect Animal Populations and Ecosystems:

Deforestation

Deforestation is one of the most significant human activities impacting animal populations. Forests provide critical habitats for a wide variety of species. However, human activities, such as logging, agricultural expansion, and urban development, have led to the widespread destruction of these habitats. When forests are cleared, many species face displacement, and their survival is threatened. Additionally, the loss of forest ecosystems disrupts the carbon cycle, exacerbating climate change,

further endangers vulnerable species, and disturbs their habitat and nutritional values.

Pollution

Pollution, in various forms, is another major threat to ecosystems and animal populations. Pesticides and industrial runoff are chemical pollutants that can contaminate water, soil, and the air, creating toxic environments for wildlife. Marine life suffers significantly from ocean pollution, mainly plastic waste, which species ingest or become entangled in. Air pollution also affects the health of terrestrial species, while noise pollution disrupts animal communication and migratory patterns. Overall, these disturbances in animals' environment have a very diverse impact on their everyday activities.

Climate Change

The burning of fossil fuels, deforestation, and other human activities have led to increased greenhouse gas emissions, which are driving global climate change. Shifting weather patterns, rising sea levels, and changing temperatures alter ecosystems and threaten species that rely on stable environmental conditions. Animals are forced to adapt to these changes, migrate to new areas, or face extinction if they cannot cope with the new conditions. Coral reefs, vital for marine biodiversity, are especially vulnerable to climate change, with rising ocean temperatures leading to coral bleaching and the loss of habitat for many aquatic species. These activities result in complete loss of oxygen in water and pose death threats to marine species of both plants and animals.

Overhunting and Overfishing

Overhunting and overfishing have caused dramatic declines in many animal populations. Historically, hunting and fishing were essential for human survival, but modern industrial practices have intensified these activities, pushing many species to the brink of extinction. For example, hunting elephants for their ivory has led to a significant reduction in elephant populations. Similarly, overfishing has depleted fish stocks, threatening marine species and the livelihoods of those who rely on fishing for sustenance.

Habitat Fragmentation

The expansion of cities, roads, and agricultural land has fragmented natural habitats, creating isolated patches that

are insufficient to support thriving wildlife populations. This fragmentation reduces genetic diversity and increases the risk of inbreeding, which can weaken animal populations. It also disrupts migration routes, limiting the ability of species to find food, mates, or suitable habitats, thereby endangering their survival.

Consequences of Human Impact on Animal Populations and Ecosystems:

Biodiversity Loss

Biodiversity, crucial to the health and stability of ecosystems, is directly linked to the decline in animal populations. A diverse range of species is critical in maintaining ecological processes such as pollination, nutrient cycling, and pest control. These processes are disrupted when species disappear, resulting in ecosystem collapse. Because many crops rely on insects for pollination, the loss of pollinators like bees has significant implications for food production.

Ecosystem Imbalance

The extinction of certain species can trigger cascading effects throughout the ecosystem. For example, removing a top predator can lead to an overpopulation of prey species, affecting the vegetation and other animals in the food chain. Such imbalances can lead to ecosystem degradation, reducing the ability of the environment to provide essential services like clean air, water, and fertile soil.

Human Health Implications

Health risks are also associated with ecosystem degradation. Because altered habitats can increase interactions between humans and wild animals and create conditions for spreading pathogens, biodiversity loss may result in new diseases. In addition, human populations may face food insecurity and other health issues due to the depletion of natural resources such as clean water and fertile land.

Solutions and Mitigation Strategies:

Conservation Efforts

One of the most effective ways to mitigate the negative impacts of human activities on animal populations is through conservation efforts. Establishing protected

areas, wildlife reserves, and national parks helps to safeguard critical habitats and ensure the survival of endangered species. To reverse the damage caused by human activities, conservation programs that focus on species recovery, habitat restoration, and sustainable land management are essential.

Sustainable Practices

Ecosystems can be less stressed if sustainable farming, forestry, and fishing methods are used. For instance, sustainable farming techniques, such as agroforestry and crop rotation, help maintain soil fertility and reduce the need for deforestation. Fish populations can recover, and sustainable fishing practices like quotas and protected areas can support marine biodiversity.

Pollution Reduction

Protecting animal populations and ecosystems necessitates pollution reduction efforts like tighter regulations on industrial emissions, waste management, and the use of plastic. To promote cleaner technologies and lessen human activities' impact on the environment, industries and governments must collaborate.

Addressing Climate Change

Preserving animal populations and ecosystems requires combating climate change. It is essential to reduce greenhouse gas emissions through carbon capture technologies, energy efficiency, and renewable energy sources. Additionally, international agreements like the Paris Agreement aim to limit the effects of climate change on biodiversity and limit global warming.

Education and Awareness

To cultivate a culture of environmental stewardship, it is essential to raise awareness about the significance of biodiversity and human activities' effects on ecosystems. Educating individuals, communities, and policymakers about the need for sustainable practices can drive positive change and promote conservation efforts.

Conclusion:

Animal populations and ecosystems around the world have undoubtedly suffered significantly as a result of human activities. However, reducing the harm and bringing the natural world back into balance is possible

through focused conservation efforts, sustainable practices, and global action. The preservation of biodiversity is vital for the health of ecosystems and the well-being of humanity. We can work toward a more sustainable future for humans and animals by comprehending the consequences of our actions and making well-informed decisions.

URBAN WILDLIFE

Hamaad Iqbal Basra

1642-BS-ZOO-22

Have you ever wondered about how these wild animals thrive in urban areas? I'm referring to urban wildlife, which encompasses the fascinating ways the animals adapt to city life, including their feeding mechanisms, nesting habits, and captivating presence. Take, for instance, the humble house sparrow, whose melodic chirping brightens up our mornings. Then, the majestic eagles are soaring overhead, offering a unique view to city dwellers. We also have owls inhabiting urban caves, pigeons nesting in buildings, and monkeys captivating our attention (in tropical regions). Even reptiles like lizards, snakes, toads, and frogs have made cities their home.

Despite all the challenges in cities, like air pollution, noise pollution, and heavy traffic, these animals have developed remarkable survival strategies. For example, pigeons inhabit caves and rooftops, laying eggs and raising their young. Eagles scour the skies for food, while squirrels in parks have grown accustomed to human whispers and find innovative ways to nest. Monkeys have adapted to city life despite originating from tropical regions.

However, these innocent creatures living in urban areas face numerous obstacles, including habitat destruction, human disturbance, and predation. For instance, parrots attempting to build tree nests often have their eggs stolen or destroyed. We must prioritize conservation efforts, creating urban sanctuaries and protecting existing habitats. Government places like parks, colleges, and universities with green spaces are essential in this way, and it is equally important for individuals to take responsibility.

As citizens, we must ensure that our actions do not harm urban wildlife. We can start by not disturbing their habitats and respecting their presence. After all, these creatures are a gift, enriching our lives and making our cities more beautiful and peaceful. So, let us cherish and protect them.

Moreover, we can contribute to urban wildlife conservation by supporting local initiatives and organizations. We can also spread awareness about preserving urban ecosystems and the challenges urban animals face. Working together can create a harmonious coexistence between humans and urban wildlife.

In conclusion, urban wildlife is an integral part of our city's ecosystem, and it's our responsibility to protect and preserve it. We can make a significant difference by taking small steps, such as reducing our carbon footprint, supporting conservation efforts, and respecting urban animals' habitats.

DECODING NANOPARTICLE CYTOTOXICITY: A DUAL PERSPECTIVE ON BENEFITS AND RISKS

Khalid Ahmad

1660-BS-ZOO-22

Abstract

This article seeks to thoroughly understand the mechanisms underpinning nanoparticle cytotoxicity, emphasizing the advantages and risks linked to their application. (Nel et al., 2006) Thanks to their distinctive physicochemical characteristics, nanoparticles have transformed numerous sectors, such as medicine, diagnostics, and industry. (Roco, 2003) Nevertheless, their interactions with biological systems have sparked worries regarding their possible cytotoxic effects. (Oberdörster et al., 2005)

Introduction

Nanotechnology has quickly become a transformative field with immense potential across diverse sectors, such as medicine, electronics, and environmental science. Researchers can create unique nanoparticles that exhibit distinct properties not present in their bulk forms by manipulating materials at the nanoscale (typically ranging

from 1 to 100 nanometers). (SATOSHI Horikoshi, 2013) These characteristics, including larger surface area, improved reactivity, and the capacity to engage with biological systems at the molecular level, render nanoparticles exceptionally promising for various applications. (Didier et al., 2020) Nonetheless, the attributes that enhance the appeal of nanoparticles also invoke concerns regarding their safety and environmental impact.

This dual perspective on the benefits and risks of nanoparticles is critical to ensuring that their applications are safe, effective, and responsible. Understanding the mechanisms underlying nanoparticle-induced cytotoxicity and identifying ways to mitigate these risks is essential for harnessing their full potential while safeguarding against unintended harmful effects. (Skoral et al., 2013) This paper aims to explore the complexities of nanoparticle cytotoxicity, discussing both the therapeutic benefits they offer and the potential risks that must be carefully managed. (A Mohajerani, 2023)

Future risks of nanoparticles may include unforeseen long-term health effects, as their small size allows them to interact with biological systems in complex ways that are not yet fully understood. The accumulation of nanoparticles in the body over time could lead to chronic toxicity or cancer. (Forbes, 2011)

Their widespread use could result in environmental contamination, affecting wildlife and ecosystems. As manufacturing increases, there may be challenges in safely disposing of nanoparticles or recycling them without causing harm. Regulatory frameworks may lag behind technological advancements, exposing people to untested and poorly understood risks. (Sajad et al. 2015)

Future perspectives on nanoparticles are promising, with advancements in medical therapies, drug delivery systems, and diagnostics showing great potential. They could revolutionize personalized medicine by more effectively targeting specific cells or tissues. (Rabajczy et.al ,2016)

In environmental applications, nanoparticles might be used for pollution control and water purification. However, rigorous research on safety, regulation, and long-term effects is needed to harness their potential fully. Developing more sustainable and environmentally

friendly nanoparticles will also be crucial for widespread adoption. (Mukherjee et al., 2011)

Background on Nanoparticles

Nanoparticles are tiny particles with a diameter of 1-100 nanometers. They can comprise various materials, including metals, polymers, lipids, and ceramics. (ISO/TS 80004-1:2010) Nanoparticles have unique physicochemical properties, such as high surface area, reactivity, and ability to interact with biological molecules. (Nel et al., 2006) These properties make nanoparticles useful for various applications, including medicine, diagnostics, and industry.

Nanoparticles can be classified into various types, including metallic, polymeric, liposomes, and ceramic nanoparticles. Metallic nanoparticles, such as gold and silver nanoparticles, are commonly used in medical applications, including diagnostics and therapy. Polymeric nanoparticles, such as poly (lactic-co-glycolic acid) (PLGA) nanoparticles, are widely used in drug delivery applications. Liposomes are commonly used in gene delivery applications.

Nanoparticles can be synthesized using various methods, including physical vapor deposition (PVD), chemical vapor deposition (CVD), sol-gel processing, and emulsion polymerization. (Klabunde, 2001) Nanoparticles can be functionalized with various molecules, such as small molecules, biomolecules, and polymers. Functionalization can enhance the properties of nanoparticles, such as their stability, biocompatibility, and targeting ability.

The physicochemical properties of nanoparticles can influence their interactions with biological systems and their potential toxicity. Nanoparticles have a high surface area, which can enhance their reactivity and interactions with biological molecules. (Nel et al., 2006) They are also small, enabling them to penetrate cells and tissues. (Sahay et al., 2010) Additionally, nanoparticles have high reactivity, allowing them to interact with biological molecules and cause toxicity.

Nanoparticles can interact with biological systems in various ways, including cellular uptake and distribution, interactions with biomolecules, induction of oxidative stress and inflammation, and damage to cellular components. (Xia et al., 2008) The interactions of

nanoparticles with biological systems can influence their potential toxicity and applications.

Mechanisms of Nanoparticle Cytotoxicity

Nanoparticle cytotoxicity involves various mechanisms that can cause damage to cellular components and lead to cell death. One of the primary mechanisms is cellular uptake and distribution, where nanoparticles can enter cells through endocytosis, phagocytosis, or passive diffusion. (Sahay et al., 2010) Once inside the cell, nanoparticles can generate reactive oxygen species (ROS), which can cause damage to DNA, proteins, and lipids. (Xia et al., 2008)

In addition to ROS generation, nanoparticles can also activate immune pathways, leading to the release of pro-inflammatory cytokines, which can cause tissue damage and contribute to various diseases. (Oberdörster et al., 2005) Furthermore, nanoparticles can cause direct and indirect DNA damage, leading to genotoxicity, which can cause mutations and chromosomal aberrations. (Kisin et al., 2007) Nanoparticles can also induce apoptosis, necrosis, and other cell death pathways, leading to cell death and tissue damage. (Xia et al., 2008)

Moreover, nanoparticles can cause oxidative stress, which can lead to damage to cellular components, including DNA, proteins, and lipids. (Kisin et al., 2007) They can also disrupt cellular homeostasis, leading to cellular function and viability changes. (Nel et al., 2006) Additionally, nanoparticles can interact with biomolecules, such as proteins and DNA, leading to their structure and function changes. (Xia et al., 2008) Overall, the mechanisms of nanoparticle cytotoxicity are complex and multifaceted, and further research is needed to fully understand their effects on cellular and tissue function.

Risks of Nanoparticles

While nanoparticles have many potential benefits, they also pose several risks to human health and the environment. Nanoparticles can cause cell death and damage cellular components, known as cytotoxicity. (Xia et al., 2008) They can also cause DNA damage and mutations, leading to genotoxicity. (Kisin et al., 2007) Additionally, nanoparticles can cause inflammation and oxidative stress, leading to various diseases. (Oberdörster et al., 2005) Furthermore, nanoparticles can cause damage

to the nervous system, a process known as neurotoxicity. (Wang et al., 2009)

In addition to the risks to human health, nanoparticles also pose risks to the environment. Nanoparticles can cause harm to aquatic and terrestrial organisms, a process known as ecotoxicity. (Klaine et al., 2008) They can also accumulate in the environment and in organisms, leading to bioaccumulation. (Boxall et al., 2007) Moreover, nanoparticles can persist in the environment for long periods, leading to environmental persistence. (Klaine et al., 2008)

Benefits of Nanoparticles

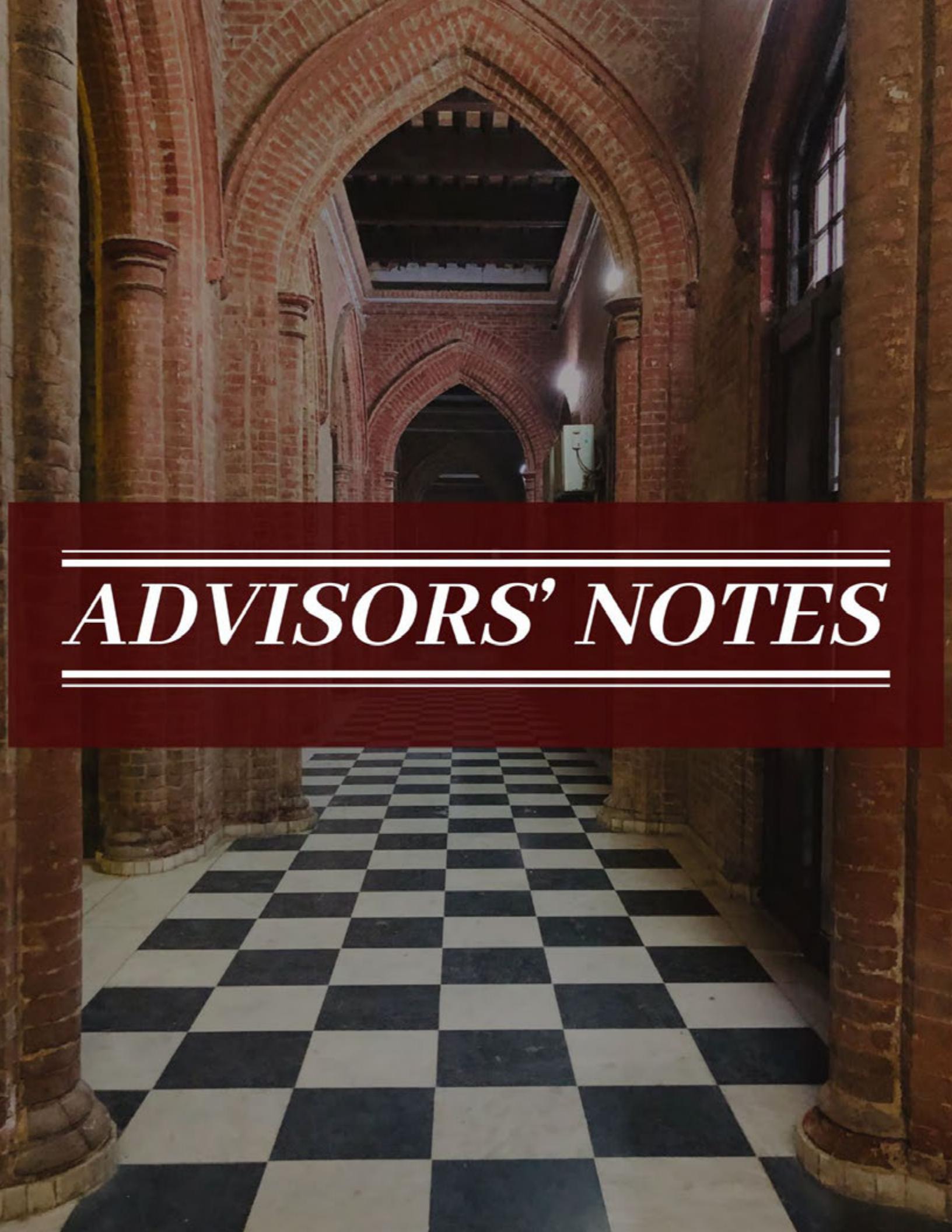
Despite the potential risks, nanoparticles have many potential benefits. In the field of medicine, nanoparticles can be used to deliver drugs directly to specific cells or tissues, a process known as targeted drug delivery. (Sahoo et al., 2007) They can also be used to treat cancer by delivering chemotherapy directly to cancer cells. (Xu et al., 2010) Additionally, nanoparticles can be used to improve imaging and diagnostics. (Cai et al., 2007)

In addition to the medical benefits, nanoparticles also have many industrial benefits. They can be used to create improved materials with unique properties. (Schmidt, 2001) They can also be used to improve energy storage and conversion. (Winter et al., 2004) Furthermore, nanoparticles can be used to clean up environmental pollutants. (Zhang, 2003) Overall, the benefits and risks of nanoparticles need to be carefully considered and weighed. Further research is required to understand nanoparticles' potential risks and benefits thoroughly.

Conclusion

Nanoparticles have the potential to revolutionize various fields, including medicine, diagnostics, and industry, but their interactions with biological systems have raised concerns about their potential cytotoxicity. While they pose risks to human health and the environment, they also offer benefits such as targeted drug delivery, cancer treatment, improved imaging and diagnostics in medicine, enhanced materials, energy storage and conversion, and

environmental remediation in industry. Therefore, it is essential to carefully consider and weigh the benefits and risks of nanoparticles and conduct further research to fully understand their potential and develop strategies to mitigate their adverse effects.



ADVISORS' NOTES

The Scientific Ravi has long been a cornerstone of scientific communication, playing a vital role in disseminating knowledge, promoting critical thinking, and fostering innovation. These articles provide a platform for students to share their research, engage in discussions, and advance our understanding of the world. One of the primary values of *The Scientific Ravi* is its ability to provide scientific literacy. It provides a unique opportunity for people to engage with science, fostering a deeper understanding and appreciation of the scientific method and its application.

Current edition of magazine will encourage readers to question assumptions, evaluate evidence, and think critically about scientific issues.



Dr. Mina Ilyas**Advisor, Intermediate**

Science is pivotal in shaping our future, addressing global challenges, and advancing technology. The Ikram Ul Haq Institute of Industrial Biotechnology continues to foster a research-driven environment, enabling academics and students to explore cutting-edge scientific fields.

Platforms like *The Scientific Ravi* are instrumental in promoting multidisciplinary collaboration, knowledge sharing, and innovation among students from diverse scientific disciplines. These interactions inspire and empower the next generation of scientists and innovators.

I appreciate the active participation of individuals who share their intellectual insights on novel concepts in the scientific world through *The Scientific Ravi*. I extend my gratitude to the managing editor and advisors for their tireless efforts in making *The Scientific Ravi* a resounding success, solidifying GCU's reputation as a hub for scientific excellence and academic distinction.

I am confident that *The Scientific Ravi* will profoundly impact all involved, fostering an innovative and inquisitive society. I wish the magazine immense success and look forward to it inspiring and educating us all.



Dr. M. Tayyab Akhtar**Advisor, Biotechnology**

The Scientific Ravi thrives on the passion and dedication of our contributors. Each article published is a testament to the relentless curiosity and commitment to advancing knowledge that defines our academic community. I am inspired by the insightful writings presented by our students and faculty. Plant Sciences in general and Applied Botany in particular has already proven to offer a unique opportunity in addressing global and national challenges by aligning research with SDGs. Through nature-based solutions, it has promoted sustainability, mental well-being, and innovation, contributing to a healthier, more resilient future for Pakistan. The transformative potential of botany has been showcased in shaping a sustainable and thriving nation.

I am proud to say that students have actively participated in *The Scientific Ravi*—submitting their writings, engaging in peer review, and contributing to the editorial processes. This involvement has enriched their academic experience while honing critical skills in scientific writing, critical thinking, and collaborative work. Through this platform, students have explored important questions, shared their discoveries, and contributed significantly to the collective knowledge of our community.

I would also like to extend my heartfelt thanks to our **Associate Editor and Editor** for their unwavering support, dedication, and excellent work in overseeing the quality of submissions and ensuring the success of the journal. Thank you for your continued support and dedication to excellence. I look forward to the groundbreaking output and thoughtful discussions that have emerged from our collective efforts.



Prof. Dr. Tehreema Iftikhar

Advisor, Botany

The Scientific Ravi is a prestigious platform for aspiring young writers to put forth their amazing and innovative ideas. Over the period *The Scientific Ravi* has been turned into an amazing piece of literature that is worth reading. Chemistry is the central to nearly every facet of modern life from food production, to medicine, to transportation and energy. This year, the students of the Chemistry department have come up with informative and attention-grabbing articles. This edition not only uncovers the scientific reality behind our misconceptions, whether it's the risks of antibiotic misuse or myths about peanut consumption but also explores the essentials of human well-being. From hair to skin care, every aspect of chemistry in healthcare is explored. Beyond this, the significance of chemistry in the advancement of material science is also highlighted in this edition.



As always, we welcome feedback and suggestions from our readers, and we hope that you enjoy this edition of *The Scientific Ravi*. Finally, I extend my heartfelt gratitude to the hardworking students, the dedicated **Associate Editor**, and the exceptional **Editor, Mr. Faiq Ahmad**, for their unwavering commitment and invaluable contributions to this university magazine.

Dr. Muhammad Mushtaq

Advisor, Chemistry

“The ability to express an idea is well-nigh as important as the idea itself.” – Bernard Baruch

It is a privilege to contribute to *The Scientific Ravi*, a platform dedicated to fostering intellectual enrichment through the art of writing. Writing is not merely a means of communication but a catalyst for innovation, refining critical thought, nurturing creativity, and enhancing analytical acumen. Scientific writing, in particular, empowers students to articulate complex ideas with clarity, engage with diverse perspectives, and develop confidence in scholarly discourse.

The vision behind *The Scientific Ravi* is to ignite curiosity, inspire intellectual rigor, and encourage meaningful contributions to the ever-expanding realm of knowledge. By seamlessly integrating students into the discipline of scientific writing, this initiative cultivates their latent potential while reinforcing the indispensable value of articulate expression. More than an academic exercise, *The Scientific Ravi* fosters a culture of inquiry, innovation, and lifelong learning. As we embark on this journey, we celebrate the transformative power of words in shaping intellect and influencing the future.



Dr. Sayyed Sadaqat Hussain Shah**Advisor, Commerce and Finance**

In today's fast-paced world, Artificial Intelligence (AI) is no longer a futuristic concept—it is already embedded in our daily lives, transforming the way we work, learn, and communicate. From smart assistants like Siri and Google Assistant to AI-driven productivity tools, the integration of AI into our routines is reshaping human potential.

As students, researchers, and professionals, leveraging AI can significantly enhance productivity. Beyond academics and work, AI is revolutionizing personal productivity. AI-driven fitness apps recommend tailored workouts and AI scheduling assistants optimize time management. By embracing these innovations, individuals can achieve greater efficiency in their daily lives. However, it is essential to approach AI responsibly. While AI offers convenience, users should develop critical thinking skills and maintain ethical considerations regarding data privacy. Understanding AI's capabilities and limitations ensures its effective and responsible usage.



The integration of AI is not a replacement for human intelligence but an augmentation of our capabilities. By adopting AI in our workflows and routines, we can unlock new possibilities, improve decision-making, and optimize productivity like never before. It is time to embrace AI as a tool for growth and transformation—the future is here, and those who adapt will lead the way.

Dr. Awais Qasim**Advisor, Computer Science**

The Scientific Ravi is a one-of-a-kind university magazine that engages readers with diverse perspectives across various disciplines, providing an avenue for students to develop interdisciplinary dialogue. Economics is an academic discipline that not only deals with resource allocation and markets but policy designs to shape a better future. The economics section of this magazine contains carefully curated articles to inspire thinking on Pakistan's 26th Constitutional Amendment, the need for tax reforms, the journey of iconic fashion brands, Tunisia's unique eco-political challenges, transformative power of AI, gender inequality and a unique perspective on agriculture and food security in Pakistan. The team has worked diligently during the past few months to materialize this project in its current form. I hope that you will enjoy having a glimpse of the current volume.



Dr. Alvina Sabah Idrees**Advisor, Economics**

I am honored to be a part of this esteemed scientific magazine as an advisor. Scientific advancements have always been the driving force of human progress and development, and it is essential to keep track of the latest developments in this field. This magazine provides a platform for young scientists to showcase their work and talent and receive constructive feedback from peers. This helps in fostering a sense of community among scientists and promotes interdisciplinary collaboration. I strongly believe that *The Scientific Ravi* is not only a gateway to scientific knowledge but is also a potential platform to inculcate the love for reading among students that unfortunately has diminished over time. Furthermore, it's a great platform for students to showcase their writing skills. I encourage all readers to keep abreast of the latest scientific advancements and to approach science with an open mind and a quest for knowledge.



Engr. Dr. Sumbel Ijaz**Advisor, Electrical Engineering**

Representing the Department of Entrepreneurship in *The Scientific Ravi* for the first time has been a truly enriching experience. It has provided students with a unique platform to move beyond conventional learning, encouraging them to think critically, explore innovation, and engage with real-world economic challenges. As an advisor, I have witnessed their growing enthusiasm for entrepreneurship, business strategy, and problem-solving, which has been both inspiring and rewarding.



Beyond fostering an entrepreneurial mindset, *The Scientific Ravi*'s literary tradition has significantly enhanced students' writing skills, enabling them to articulate their ideas with clarity and confidence. This blend of analytical thinking and creative

expression has not only sharpened their ability to communicate effectively but also prepared them for leadership roles in business and beyond. Through their contributions to *The Scientific Ravi*, students are developing the essential skills needed to navigate the evolving landscape of entrepreneurship and economic development.

Dr. Saima Sarwar

Advisor, Entrepreneurship

Dear Readers!

Welcome to *The Scientific Ravi*, a platform where students, researchers and faculty come together to share the insights, knowledge and discoveries in the field of microbiology. As microbiology plays a vital role in shaping our understandings of health, life and environment. There is always a room for research in all fields. In microbiology though, this seems to be felt more increasingly. As the advisor of the Department of Microbiology, I believe that our students need to thrive in a research-driven culture. This will ensure the success of our students to elevate further on multiple platforms. In this day and age, students globally are adapting methods that can make them progress on the horizons of the scientific world. We, at the Government College University, Lahore encourage our students to move a step ahead so that they can compete with the global science leaders. Microbiology is an ever-evolving landscape and our students need to focus on its core concepts to bring forth the subject to life. This magazine is a testimony to our students and researchers making distinct landmarks prominent in this field of science.



Dr. Umar Farooq Gohar

Advisor, Microbiology

Dear Readers,

It is an honor and an immense pleasure for me to welcome you to the Physics section of *The Scientific Ravi*. As always, this edition presents you with the latest and most exciting discoveries and inventions in Physics. Physics unravels the mysteries of the universe, be it the smallest particles or the limitless galaxies. Reading and studying physics is not just about writing and solving equations; it is an understanding of all the questions that we can think of. Gravity, planets, space, time, matter, light, and any other aspect that one can imagine are all explained by physics. So! Let go of the concept that Physics is boring because it is nothing but fun.

I would like to express my appreciation to the contributors to this section, both teachers and students. I am also grateful to **the chairperson of the Department of**



Physics, Prof. Dr. Nouman Sarwar Qureshi, for entrusting me with the role of Advisor, *The Scientific Ravi*, and for facilitating the contributions made in this section.

Enjoy Reading!

Dr. Rabia Ahson

Advisor, Physics

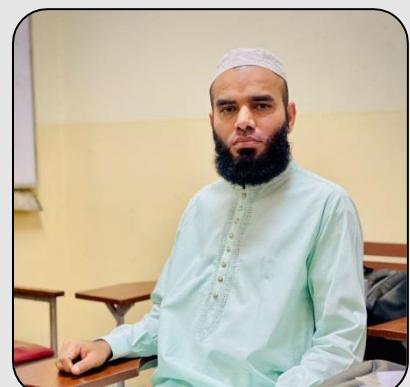
It's a matter of great honour for me to be an advisor of this prestigious magazine named *The Scientific Ravi* and I am performing this role with great pride for more than a decade. This magazine provides an excellent opportunity to the students who want to share their scientific ideas, concepts and theories by writing articles. It provides a platform where students can satisfy their quest to search, research and present new information related to different avenues of Science. Under the dynamic leadership of our **Managing Editor, Editor** and efforts of our brilliant writers, we have gathered articles about the new trends in the field of Psychology as well as the contemporary issues which can be resolved through psychological interventions. The contents of articles indicate that students' written expression is remarkable and a true reflection of their high spirit for scientific inquiry. I am grateful to all the authors for their valuable, informative and thought provoking contributions for the magazine. I would also like to motivate our students to read these articles to broaden their vision and scope of their respective field.



Dr. Nasreen Akhtar

Advisor, Psychology

For aspiring young writers, a supportive platform is essential, and *The Scientific Ravi* Magazine fulfills that role admirably. It encourages genuine expression while providing a space to develop crucial writing skills. The magazine fosters creativity, allowing writers to experiment with their ideas. Through its engaging content and activities, it helps students improve their writing fluency and build the stamina needed for longer compositions. Personally, I have been able to assist students in developing their critical thinking skills. I am thrilled to be part of *The Scientific Ravi* and deeply grateful to the magazine for empowering students to polish their writing and effectively communicate their innermost thoughts.



Dr. Abdur Razzaque Mughal

Advisor, Statistics

As the advisor from the Zoology Department at *The Scientific Ravi*, I am immensely pleased to present this edition of *The Scientific Ravi*; a vital platform for students to showcase their research, insights, and innovative ideas. It is not merely a publication; it is a testament to the intellectual rigour and creativity that our students embody. The Zoology Department is commendable and reflects the vibrant academic spirit that thrives within our institution. This magazine is more than a collection of scientific writings; it is a testament to the passion and potential of emerging scholars who are committed to advancing knowledge and promoting scientific discourse. Each article submitted is a step towards fostering a culture of inquiry and critical thinking, essential components in the realm of scientific exploration.



I would like to extend my heartfelt appreciation to all the student authors, whose insightful contributions and rigorous efforts have given life to these pages. Your commitment to research, critical thinking, and scholarly excellence is truly commendable. I also acknowledge the hard work of the editorial team, whose attention to detail and collaborative spirit have ensured the highest standards of quality and integrity.

I also appreciate our **Associate Editor, Hammad Iqbal Basra**, for his outstanding work and dedication. His meticulous attention to detail and steadfast commitment to excellence have significantly improved the quality of our publications. His efforts are greatly appreciated.

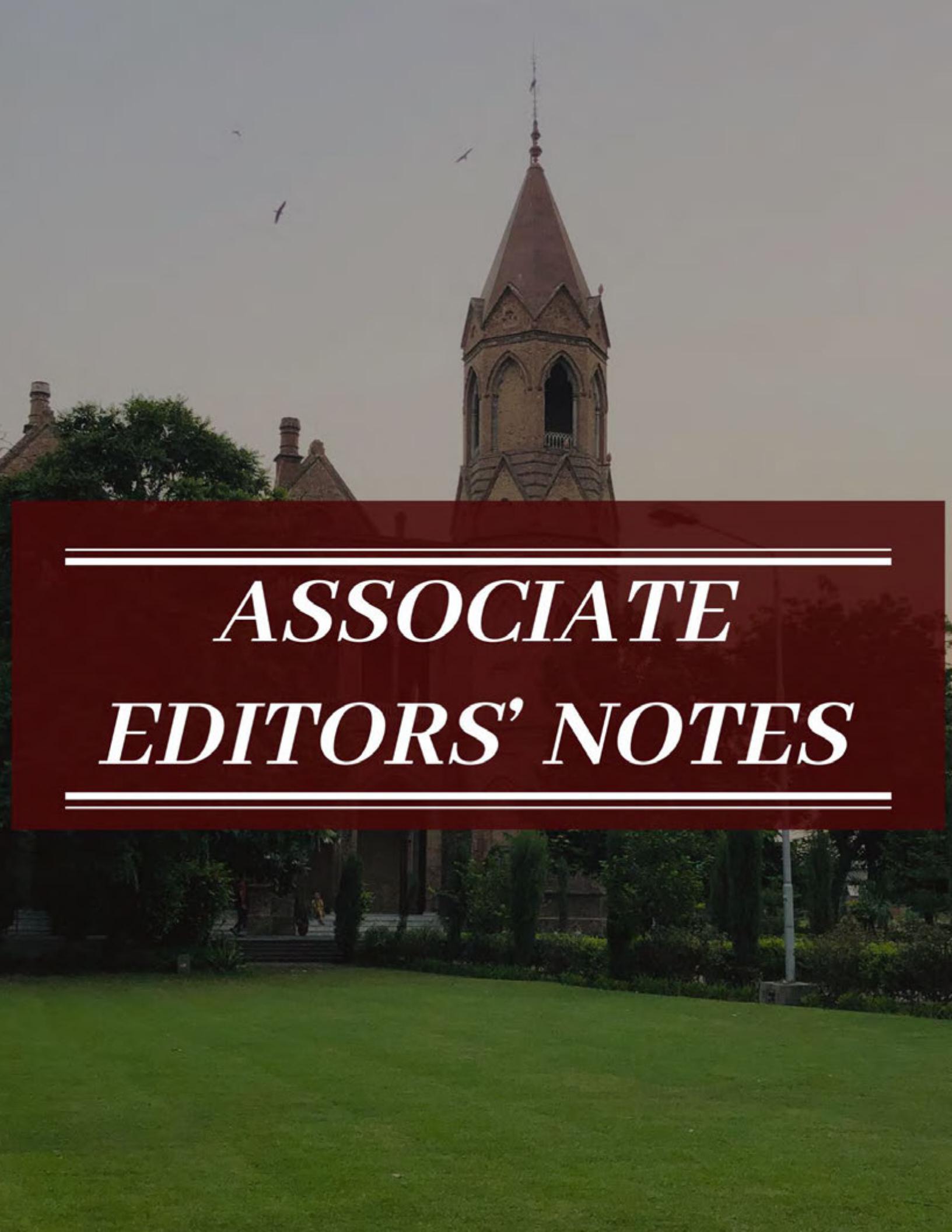
As the advisor of *The Scientific Ravi*, I am proud to witness the enthusiasm and perseverance each of you brings to this journal. Your work not only enriches the academic environment of our institution but also reflects the vibrant future of science.

As we move forward, I urge you to embrace constructive feedback and view the editorial process as an opportunity for growth. The editorial team is here to support you in refining your work and ensure that it meets the high standards we uphold at *The Scientific Ravi*.

In conclusion, I look forward to seeing the continued excellence in your submissions and the innovative ideas that will emerge from our departments. Together, let us strive to make *The Scientific Ravi* a beacon of scholarly achievement and a source of inspiration for future generations. I wish all our contributors continued success and hope this edition inspires readers to explore, question, and innovate.

Dr. Iram Liaqat

Advisor, Zoology



**ASSOCIATE
EDITORS' NOTES**

Scientific knowledge is the systematic and organized body of knowledge obtained through the scientific method. It involves the study of the natural world, the laws that govern it, and the application of this knowledge to improve our lives. *The Scientific Ravi* has always served as a beacon for young, scientist entering this storied institution. It is our responsibility to continue the legacy of this prestigious magazine and providing you the best knowledge we can. *The Scientific Ravi* is to promote science literacy, research, and the science affairs going all over the world.

I am especially grateful to **Dr. Mina Ilyas (Advisor)** for her constant support and giving me the chance to serve as the associate editor for *The Scientific Ravi*. Current volume is digestible, engaging and interesting. It will foster critical thinking in the minds of its readers.



Muhammad Hassan

Associate Editor, Intermediate

We belong together—let's grow together. It is with great enthusiasm and warm regards that I extend my appreciation to all the organizers, contributors, and writers of *The Scientific Ravi* at Government College University in Lahore. This magazine provides young minds and students with a vibrant platform to present their scientific knowledge, share creative ideas, and contribute to stimulating publications.

Progress is driven by science, and publications like *The Scientific Ravi* are pivotal in fostering a research-driven mindset among future scientists. By encouraging a culture of inquiry and collaboration, we create opportunities for discoveries that not only solve practical problems but also broaden our understanding of the world.



I am deeply grateful to the organizing committee for their dedication and hard work in bringing *The Scientific Ravi* to life. Through their efforts, GCUL continues to uphold its reputation for academic excellence and groundbreaking research.

It is my sincere hope that this publication will inspire all of us to pursue scientific research with passion and perseverance. Wishing *The Scientific Ravi* much success, and may it ignite curiosity and passion for science in every reader.

Hamayat Ali

Associate Editor, Biotechnology

Dear Fellows,

With deep gratitude to Allah Almighty, I reflect on my journey as an Associate Editor from the Department of Botany for *The Scientific Ravi*, the official publication of The Government College University Lahore. Being trusted with this role in one of the university's most respected academic traditions has truly been an honour, an experience I will always cherish with pride and humility.

This opportunity not only strengthened my appreciation for scientific literature but also allowed me to witness the transformative power of research and collaboration. During this editorial journey, I had the privilege of working with brilliant minds, reviewing remarkable work, and helping to shape content that reflects both academic honesty and creative thinking. It has been truly rewarding to see how our students are passionately exploring new ideas and pushing the boundaries of botanical and biological sciences.

I am especially grateful to **Prof. Dr. Tehreema Iftikhar**, Advisor of *The Scientific Ravi*, for her constant support and for giving me the chance to be part of this wonderful project. My sincere thanks also go to **Faiq Ahmad**, Editor of *The Scientific Ravi*, whose guidance has helped me navigate the challenges of this role with confidence. I also want to thank my teachers and friends—your encouragement has kept me motivated every step of the way.



As *The Scientific Ravi* continues to grow and welcome voices from different academic and cultural backgrounds, I feel proud to have contributed to its ongoing journey. May this magazine continue to spark curiosity, welcome new ideas, and guide young scientists for years to come.

Thank you, dear readers, for being part of this shared journey toward knowledge and scientific excellence.

Fareed Ahmad Chaudhry

Associate Editor, Botany

As the Associate Editor of the Chemistry Department, I am honored to be part of an editorial team of *The Scientific Ravi*, a platform where students can learn about new research and discoveries. This role has provided me with opportunities to learn handful skills in critical reviewing, editing, and proofreading. In this particular edition, you'll come across compelling articles that share fascinating insights of Chemistry in our daily lives and in the modern research. I am heartedly thankful to **Dr. Muhammad Mushtaq (Advisor)** for providing me with this opportunity. I will like to extend my sincerest gratitude to **Editor, Mr. Faiq Ahmad** for his unwavering support in the compilation and to the students who have submitted their well-researched articles.



Rana Qadeer ul Hassan

Associate Editor, Chemistry

“The best way to predict your future is to create it” – Abraham Lincoln

As a Ravian, I feel privileged to have been part of a journey that has refined my skills and instilled a deep sense of purpose. Collaborating with an exceptional team, learning from their expertise, and contributing to something meaningful has been

truly transformative. As I navigated the world of editing, I discovered that every word, every sentence, and every story has the power to shape perspectives and inspire change.

Through this role, I've learned to appreciate the beauty of language, the importance of clarity, and the impact of thoughtful communication. I want to extend my heartfelt gratitude to **Dr. Ali Raza Elahi, Head of the Department** and my mentor, for nominating me. His guidance, trust, and unwavering support have been invaluable, and I am forever grateful for the opportunity to grow under his mentorship.



Syeda Eman Fatima Kazmi

Associate Editor, Commerce and Finance

It is with great excitement that I present this edition of our Computer Science Department for *The Scientific Ravi*. It reflects the creativity, innovation, and dedication of our students and faculty.

Technology is developing very fast, and we students of computer science are right on the cutting edge of this computer revolution. Whether it's development of apps or the web, or artificial intelligence, the limits of what we can do keep moving, further and further out into the distance. This Computer Science section of *The Scientific Ravi* witnesses the research, study, and collaboration within our department.

I would like to extend appreciation to our writers for their excellent articles, movie critiques, and book reviews. Your enthusiasm for knowledge and perfection is inspiring.



Wajiha Liaqat

Associate Editor, Computer Science

I welcome you to this issue of *The Scientific Ravi*. In the section ahead, we dive into the world of economics. This subject is art and science in its very essence. In these few pages, we have tried to make this complex world of economics accessible and interesting for you with our featured articles, movies and books review, and timeline covering economics of households to economics of the globe.

In this edition, we explore the working wheel of economics behind the well-known brand Levi's, the transformation of economies driven by AI, some issues in Pakistan's economy, and a case study on Tunisia's hybrid transformation. Whether you're a



student, a professional, or simply a curious reader, our goal is to provide clear, engaging insights that spark both thought and conversation.

Thank you for joining us on this journey. I hope you find this issue both enlightening and enjoyable.

Zaigham Abbas

Associate Editor, Economics

As the Associate Editor, I am privileged to have a front-row seat to the exciting and innovative developments, continuous advancements, and breakthroughs taking place within the field of Engineering field and modern technology as well. It was a great journey wherein I interacted with several writers who were ready to pen down their ideas. In this edition, you will find interesting articles about discoveries, the latest techniques, and some exciting knowledge pertaining to all subfields of Engineering. I hope everyone will enjoy the articles written by engineering students with great enthusiasm.

As we look ahead to the future of technology, we should be optimistic and confident in the ability of our community to continue to make important contributions to society. With new technologies and innovative approaches, the opportunities for discovery are endless.



Haiqa

Associate Editor, Electrical Engineering

I, Bakhtawer Khan, am thrilled to present my department in the prestigious magazine, *The Scientific Ravi*.

I would like to particularly thank the **advisor, Dr. Saima Sarwar** for believing in me and having faith in me. As the associate editor, it is an honor to bring you a collection of articles that revolves around the ever evolving world of entrepreneurship. Our dedicated contributors have worked tirelessly to bring you the trending topics regarding business, startups, business trends, and success stories that will not only help emerging entrepreneurs but empower you to turn your ideas into reality. I hope these stories ignite your passion for creating a meaningful impact in the business world.



Bakhtawer Anjum

Associate Editor, Entrepreneurship

As a student of microbiology, I feel it a great honour to contribute to *The Scientific Ravi* in the capacity of Associate Editor. The delight I find in science is unparalleled and the same is true for everyone who made this magazine a possibility. I believe that the responsibility of the scientist is to be accurate on the limits of their assumption. Through microbiology, I get a chance to delve into the deeper principles of life. This magazine is a reflection of how science can bridge distances between us and the things that shape our lives. Our interaction with science is brought to fruition through our researchers in this field. I feel immense pleasure in bringing the tenets of life into the observation of the world through the lens of science. I really do hope you'll be in awe of our researchers in equal terms as me after discovering the mysteries in the facets of this magazine.



Sana Muqadus

Associate Editor, Microbiology

Dreams do come true. Sometimes not, but what can a human do? Try, that is what I would say to a person who has given up. Working as an associate editor has been a journey of unusual happiness, stress, and learning. Editing for my university's magazine is an emotion I cannot describe. From encouraging students to write to worrying about the submission and how the outcome would seem, each step has taught me valuable lessons. At last, these experiences/lessons are what shape us. I am thankful to Allah Almighty for giving me this opportunity. I would like to express my gratitude to **Dr. Rabia Ahson** for being an outstanding mentor and guiding me throughout the entire process. I hope you find the Physics section inspiring and thought-provoking.



Aleena Khan

Associate Editor, Physics

It has been a great privilege for me to render my services for this eminent academic publication, *The Scientific Ravi*. I have always had a staunch belief that acquiring knowledge is a cyclical process whereby each new addition prompts a learner's desire for more. In this regard, a learner is never stationary, but constantly looking for ways to stretch the length and breadth of their intellect, scientific investigation and academic prowess. During this journey, I have been truly inspired by my **Advisor, Dr. Nasreen Akhtar**, for her unwavering support and exemplary supervision. Likewise, I would also like to extend my gratefulness to the **Managing Editor and the Editor**. Under their professional guidance, students from the Department of Psychology have produced exceptional writings with intellectual passion and rigor.



The section is rich in diverse psychological subjects, research insights and critical inquiries. I invite the knowledge seekers to honour these contributions with their astute reading.

Ayna Maryam

Associate Editor, Psychology

Serving as Associate Editor for *The Scientific Ravi* has been one of the most rewarding experiences of my academic journey. Month after month, I've had the privilege of working with brilliant minds from our Statistics Department - reading their drafts late into the night, suggesting improvements over coffee, and watching raw ideas transform into polished articles.

There's something magical about how numbers tell stories. Whether it's predicting disease patterns or analyzing sports performance, statistics gives shape to the chaos around us. This edition contains some of our department's finest work. I owe particular thanks to the writers who tolerated my endless "just one more revision" requests - your passion made this possible. And to our readers, I hope these pages do more than inform; may they spark that moment of wonder when complex equations suddenly make perfect sense.



Muhammad Ashar

Associate Editor, Statistics

We are honored to present the 2024 edition of *The Scientific Ravi*, the annual publication of Government College University, Lahore, committed to advancing critical discourse and scientific inquiry within our academic community. In collaboration with the Department of Zoology student authors, we have sought to engage with pressing scientific and environmental concerns that resonate in the contemporary world in this edition. The articles within this section aim to address pivotal issues, offering reflections and analyses that are both timely and thought-provoking.

This volume represents a collective endeavor shaped through rigorous academic mentorship and editorial diligence. With deep appreciation, I wish to acknowledge **Dr. Iram Liaqat's** guidance and the foundational contributions of **Prof. Dr. Atif Yaqub**. I am equally grateful to **Prof. Dr. Aziz-ur-Rehman, Managing Editor**, and **Mr. Faiq Ahmad, Editor** of *The Scientific Ravi*, whose commitment and editorial oversight have been instrumental to the successful completion of this edition. We aspire that this publication's contents will stimulate intellectual curiosity and foster a deeper engagement with the scientific challenges of our time.



Hammad Iqbal Basra

Associate Editor, Zoology



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