SCIENTIFIC RAVI

2023

A New Era for Astronomy

How the James Webb Space Telescope is transforming our view of universe

The Scientific Ravi 2023

Government College University, Lahore

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First row from left to right: Dr. Alvina Sabah Idrees, Dr. Nasreen Akhtar, Prof. Dr. Tehreema Iftikhar, Prof. Dr. Aziz ur Rehman, Prof. Dr. Asghar Zaidi (T.I), Mr. Shahzaib Ali, Prof. Dr. Atif Yaqub, Dr. Syed Sadaqat Hussain Shah, Dr. Abdur Razzaq, Ms. Mina Ilyas

Second row from left to right: Ms. Aqsa Khalid, Ms. Naila Arshad, Ms. Fatima Saleem, Ms. Ashna Baig, Ms. Syeda Shehwar Zahra, Ms. Nehal Fatima, Ms. Mariyam Siddique, Mr. M. Haris, Mr. Wajahat Usman, Ms. Abdul Rehman Ijaz, Mr. M. Yousaf Riaz

FORMER VICE CHANCELLOR'S NOTE

Scientific knowledge is a formidable base which supports the advancements and improvements in human lives. It is due to the untiring efforts of curious researchers that the present era of mankind enjoys the vast range of commodities and facilities. which were unimaginable in the past. The understanding and propagation of scientific knowledge is therefore a necessity for the individual and collective survival of each nation, as well as the global world.

Government College University, Lahore has always emphasized on the creation of such opportunities which enable the students to actively engage in the process of scientific research. The Scientific Ravi magazine is one such opportunity that provides a platform for the inquisitive minds of Ravians, to present their scientific knowledge with other students belonging to different fields, including life sciences, social sciences and even linguistics. This magazine is not only a means to keep the invaluable traditions of GCU alive, but also a medium to encourage the in-depth understanding of latest scientific and technological advancements among our students.

I congratulate the editorial board of The Scientific Ravi on the successful completion of this edition. I hope that the readers will benefit from the knowledge imparted through this magazine, and will try their level best to use the scientific research being done in their respective fields, for the creation of something valuable for the society.

Prof. Dr. Asghar Zaidi,

Former Vice Chancellor.

Government College University, Lahore.

EDITOR'S NOTE 2023

Dear Esteemed Readers,

First, I am deeply grateful to Allah Almighty for granting me this incredible opportunity to serve as an editor for one of the oldest and most esteemed publications, the Scientific Ravi Magazine. It is an honour and a privilege that I hold with utmost reverence. This year, we embark on an exciting new venture by welcoming the fresh perspectives of international students. This collaborative effort signifies our dedication to fostering an inclusive platform that embraces a wide spectrum of voices and ideas. By involving these young, dynamic minds, we aim to provide a platform for emerging talent, allowing them to showcase their innovative research and unique insights. This initiative not only enriches the content of Scientific Ravi but also fosters a nurturing environment where the next generation of scientists can thrive and share their discoveries with a global audience.

I extend my deepest gratitude to Dr. Aziz ul Rehman for entrusting me with the responsibility of leading this progressive step in our magazine's journey. His vision and unwavering support have been instrumental in shaping this forward-looking endeavour. I must also take this opportunity to express my heartfelt thanks to my family and friends, especially my father and mother for their steadfast support. Their encouragement has been a constant source of strength, enabling me to navigate the intricacies of scientific journalism with confidence.

As we embark on this inclusive journey, I am eager to present you with a curated selection of articles that not only uphold the highest standards of scientific rigour but also reflect the diverse range of perspectives that shape our collective understanding of the world. This fusion of local and international student expertise promises to provide you, our cherished readers, with a truly enriching and enlightening experience. Thank you for being an integral part of this generational endeavour. Your continued engagement and support inspire us to reach new heights in the pursuit of scientific excellence.

Shahzaib Ali

Editor,

The Scientific Ravi 2023

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BIOTECHNOLOGY TIMELINE 2023

January

• Researchers have developed airborne eDNA sensors that can collect and detect animal DNA from the air. Environmental DNA (eDNA) is the genetic material that living things release into the air, water, or soil around them. Environmental DNA (eDNA) metabarcoding is a method for identifying several species from a single environmental sample by combining DNA extraction, PCR amplification, high-throughput sequencing, and bioinformatics analysis. This might be used in forensics, ecology, and conservation.

• A group of researchers at the University of Maryland, Baltimore County (UMBC) developed a novel form of gene editing tool called "prime editing". A modified Cas9 protein and a synthetic RNA guide are used in the gene-editing method known as prime editing to accurately insert, delete, or replace specified DNA regions with fewer off-target effects resulting in very accurate genetic alterations. It has the potential to transform both agriculture and medicine.

February

• Researchers at the University of California, San Francisco (UCSF) have created a CAR T-cell treatment that is efficient against a variety of solid tumors. It uses the applications of genetic modifications to express chimeric antigen receptors (CAR) on the surface of T-cells. These receptors when fed into the body of a cancer patient specifically bind with the cancer cells hence accelerating their destruction of T-cells.

• A group of scientists at the Massachusetts Institute of Technology (MIT) invented a novel biomaterial that can be used to print organs in three dimensions. Biocompatible polymers (like PLA or PCL), hydrogels (like alginate or collagen), and decellularized extracellular matrices (ECM) created from natural tissues that are compatible with the human body and are the most common biomaterials used to 3D print human organs.

March

- It has been announced that the first successful xenogeneic heart transplant from a genetically altered pig to a human patient. This is a significant development in the field of organ transplantation, and it may help thousands of patients each year.
- A group of researchers at the University of California, Berkeley (UC Berkeley) developed a novel kind of plant-based protein that is healthier and more environmentally friendly than conventional protein sources e.g. beef and dairy. Soybeans, peas, rice, and other plants are used to make the protein.

April

- Researchers announced that a human genome was sequenced in the quickest time ever in just five hours and two minutes. This might enable quicker and more precise genetic illness diagnosis.
- Recently, microbiologists have presented a customized phage-antibiotic combination as a countermeasure to antimicrobial resistance, and they proposed further studies to refine this strategy. In the future, antibiotic-resistant bacterial infections may be treated with phages (viruses that infect bacteria).

May

- Single-molecule sensors on a chip with molecular circuit components have also been introduced. These sensors could help develop new diagnostic methods and treatments for a range of disorders.
- A group of researchers at the University of Washington created a novel vaccination that protects against a variety of influenza viruses. An artificial piece of RNA that closely resembles the structure of the influenza virus is used to create the vaccine.

June

- A gene therapy treatment for sickle cell disease has launched its first clinical study. It uses the application of the CRISPR gene editing technique to amend the mutation.
- A group of researchers at Harvard University created a novel kind of microfluidic apparatus that may be used to quickly screen for novel medications and treatments. Small amounts of substances are efficiently directed through complex channels by the microfluidic device, enabling quick assessment of their interactions with particular

disease targets. In a matter of hours, the system can examine millions of various substances.

July

- According to researchers, they were successful in producing ethanol and butanol from a genetically modified variety of the *R. prolifica*. This might lessen our dependence on fossil fuels.
- The use of microbes to harvest valuable components from basalt rocks in space has been shown by scientists. This might open the door for the growth of space mining businesses.

August

- It has been reported that biotechnology is being developed for microbial reactors that can produce oxygen and hydrogen. This might be useful in the exploration of space and other harsh habitats.
- Protein structure prediction has reportedly been a 50-year puzzle that an AI computer has substantially solved. This might result in the creation of novel treatments and medications for numerous diseases.

September

• Researchers have described a bioprinting technique for making cultured meat that resembles steak. This would open the door for the commercialization of cultured meat, an environmentally friendly alternative to producing meat that is currently practiced.

October

• Tomatoes, the first food product altered using CRISPR, go on sale. This represents a significant achievement for the science of gene editing and may pave the way for the creation of novel and nutrient-rich foods.

November

Researchers claim to have created a novel HIV vaccine that is effective against all known strains of the virus and has shown encouraging results in monkeys. Although the vaccine is under development process, it still has the potential to be a significant advancement in the fight against HIV/AIDS.

December

A group of researchers at the University of California, San Diego (UCSD) developed a novel form of immunotherapy that is efficient against a variety of tumors. T-cells that were genetically modified to attack cancer cells were used as part of the therapy.

MEDICAL BIOTECHNOLOGY: CORONAVIRUS VACCINE DISCOVERY AND PRODUCTION

Aiza Amin

0026-BS-BIO-T-21

Introduction:

The field of medical biotechnology straddles the boundaries of biology, technology, and medicine. It has become a crucial force in the fight against the enormous threat posed by the coronavirus pandemic and was vital in the development of the coronavirus vaccine. A brand-new coronavirus, now known as SARS-CoV-2 is the cause of the exceedingly infectious sickness known as Coronavirus 2019 (COVID-19), which manifests a variety of symptoms. Local population, health, and economic conditions have all been impacted by its outbreak. As soon as a disease was identified, hypotheses for its control, regulation, immunization, and treatment began circulating. Medical biotechnology started researching and attempting to manufacture vaccinations utilizing its many approaches from the expansion of the pandemic.

Biotechnology Approaches/Tools in Vaccine Development:

Vaccines are biological products made utilizing medical biotechnology research and equipment. Medical biotechnology uses both live and dead organisms to create vaccines — using biotechnology-produced products validated by a long-established scientific procedure. Recombinant DNA technology and genetic engineering techniques have been vital in the development of vaccines like the mRNA vaccines produced by Pfizer-BioNTech and Modrena.

1. **Recombinant DNA Technology in Vaccine Production:**

   Vaccine manufacturers employ recombinant DNA technology to produce genetically modified vaccinations. Certain genes are inserted into host species like bacteria or yeast to manufacture proteins that imitate the antigens on the pathogen's surface. The immune system stimulated by these proteins, results in an immunological response without causing the illness. This method has been essential in producing vaccinations against diseases such as COVID-19 and hepatitis.

2. **The role of Genetic Engineering in Vaccine Manufacturing:**

   Genetic engineering has had a big impact on vaccine production. It is employed to construct genetically engineered organisms to manufacture proteins or antigens required for vaccination. Due to the precise gene editing made possible by this technology, therapeutic proteins, enzymes, and other compounds may now be produced in massive quantities. By creating antigens without actual infectious organisms and lowering the hazards associated with conventional techniques, genetic engineering contributes to the development of safer and more effective vaccinations.

Different Vaccines for Coronavirus

1. **Viral vector vaccines:** Vaccines with viral vectors transmit genetic material from the target pathogen, such as a virus or bacteria, into the body's cells using a harmless virus (the vector). The cells, on the instructions of genetic material carried by the vector, create a particular antigen, which sets off an immunological response. The Oxford-Astra Zeneca and the Johnson & Johnson COVID-19 vaccine are two examples of viral vector vaccines.
2. **Protein Subunit Vaccines:** Protein subunit vaccines employ proteins and protein fragments isolated from the pathogen to elicit an immune response. These vaccinations cannot spread the disease since they do not contain the entire bacterium. A protein subunit vaccination is the Novavox COVID-19 vaccine.
3. **DNA vaccinations:** DNA vaccines bring a modest amount of DNA holding the genetic instructions for the pathogen to produce a particular antigen. The body's cells absorb this DNA, using the instructions to manufacture the antigen as an outsider and elicit a reaction. The advantages of DNA vaccines are their stability at high temperatures and possible ease of production. An illustration of a DNA vaccine is ZyCoV-D, for which emergency use authorization has been granted in India.
4. **mRNA Vaccines: Pfizer-BioNTech and Moderna:** A revolutionary approach to vaccination is represented by the Pfizer-BioNTech COVID-19 vaccine and the Moderna COVID-19 vaccine, both mRNA vaccines developed by Pfizer-BioNTech. It comprises instructing body cells to produce certain proteins using mRNA strands as a teaching tool. They employ a tiny genetic component called messenger RNA (mRNA) to direct cells in the body to manufacture safe SARS-CoV-2 viral proteins, which induce COVID-19. This translation of viral mRNA into protein prompts the infection and creates defenses against it via the immune system if encountered in the future. They have undergone rigorous testing and are deemed safe for the majority of recipients.

Biotechnology's Impact on Vaccine Availability:

Biotechnology has had a transformative impact on vaccine availability. Biotechnology has sped up the research and manufacture of vaccines using cutting-edge methods such as genetic engineering, recombinant DNA technology, and cell culture. These progressive techniques have sped up the time it takes to respond to newly developing infectious illnesses and boosted vaccination accessibility globally or universally.

Conclusion:

There are platforms for producing recombinant and cell-based vaccines which have been made possible by biotechnology. These platforms can more quickly respond to changing vaccination needs and pathogen changes because they are more scalable, versatile, and adaptive. Because of this, biotechnology has been essential in guaranteeing a more consistent and dependable

supply of vaccinations to combat a variety of infectious illnesses.

SUSTAINABLE BIOTECHNOLOGY: BIOFUELS, BIO-PESTICIDES, AND BIOFERTILIZERS

Eisha Bajwa

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Biotechnology is considered an emerging science for the protection and sustainable development of the environment. With the increase in population, there is an immense need to create alternatives for fulfilling the shortcomings of food, health, and other necessities. Development of industries and urbanization is giving benefits to mankind on the one hand, but on the other hand, it is creating numerous environmental problems which include severe health hazards. In this review, we will see how biotechnology is helping mankind better survive in this era of life.

The accumulation of CO_2 is leading to global warming which is resulting in severe climate changes ultimately affecting human life. Biotechnology is involved in the production of renewable fuels as the continuous use of petroleum products is considered a threat to the environment. Among all the sources that are used as replacements for fuels, biofuels are the best ones. Biotechnology is not only limited to the production of biofuels and methane but nowadays, many genetic manipulations are being done at a molecular level for efficient production of bioenergy such as transgenic plants are used as improved fuel feedstocks. About 60 percent to 80 percent of oil left by the industries is deposited that is unrecoverable but the ability of microbes to convert the hydrocarbons into methane or other by-products helps in the efficient recovery of energy. Biotechnology in the oil wells and coal deposits results in the production of methane from CO_2 with the help of microbes providing energy.

According to the source of biomass, there are three types of biofuels. **First-generation biofuels** are those derived from sugars later converted into ethanol. Different microbes can produce specific types of alcohol. The utilization of first-generation biofuels is not enough for the population. Moreover, they may create challenges in the future. So, another type of biofuel known as a **second-generation biofuel** was introduced which is produced from the lignocellulosic feedstocks. It was observed that these fuels have more potential to produce GHG (greenhouse gas) emissions. They can fulfill more demands as compared to first-generation biofuels. By taking into consideration the second-generation biofuels, a new approach was introduced; utilizing the algae biomass with the help of enzymes secreted by microbes. These are also called the genetic and metabolic second-generation biofuels and are produced from the lignocellulosic non-food plants and wastes of agriculture. Biotechnology is helping to create a

large impact on the economy of a country with the production of bio-fuel diesel. The main target is the best environment for stable production in industrial fermentation. Via the help of biotechnology, genetically modified organisms are used for the degradation of environmental pollutants.

Biotechnology is also playing a very vast role in agriculture. The agriculture sector is the need of the country's economy and population. The green revolution during the middle of the 20th century led to the loss of the environment. Moreover, the use of pesticides, fungicides, insecticides, and many other chemicals is damaging our environment day by day while disturbing the whole ecosystem. Plant biotechnology is helping in solving the issues by genetic modifications and introducing pest resistance plants, increasing the crop yield, and thus reducing the use of pesticides. Biotechnology is introducing such naturally occurring micro-organisms that can be used as bio-fertilizers and bio-pesticides ultimately resulting in a reduction in the use of chemical-based fertilizers. Biotechnology is also devising some new ways to diagnose plant diseases of viral, fungal, and bacterial origin. Through genetic engineering, many crops have been modified till now i.e., modifications for the production of medicines, and other useful products. “GMO foods”, “GMPs” and “Biotech foods” are some foods that have been derived from transgenic plants. This technology is helping mankind to overcome the problems caused by the environment.

The demand for biopesticides in the control of insects has increased in recent years, due to many side effects of synthetic pesticides. Biopesticides are made from natural resources, and micro-organisms by using the genetic engineering technique. There are bio-insecticides, bio-herbicides, and bio-fungicides based on the targets i.e., bio-insecticides for the control of insect pests, and bio-fungicides for the control of diseases. A known quantity of mycoherbicides (that is a type of herbicide) is registered in many countries 4 in Canada, 1 in the Netherlands, Japan, and China, 8 are registered in the USA, and 2 in South Africa. A gram-positive bacterium (facultative aerobic), *Bacillus thuringiensis (Bt)*, produces endotoxins/ Cry proteins having insecticidal properties. The most remarkable property of *Bt* is that it is non-toxic and easy to use to control pests on vegetables, fruits, etc. Biofertilizers, on the other hand, are very important in maintaining the fertility of soil, and also a safer tool than artificial fertilizers. Many microorganisms, fungi, protozoa, and plant tissue are used to produce biofertilizers. Government and private-sector entrepreneurs are encouraged to produce biopesticides and biofertilizers. Biopesticides used for crop protection now are 2% of the world market, and 90% of them are made from *Bacillus thuringiensis*.

Conclusion:

With the increase in environmental problems, the future of life is becoming insecure day by day. Biotechnology is fulfilling its promise with

continuous development for the use of bioenergy and eco-friendly technologies. It is only possible due to the hard work of highly dedicated and skilled scientists. However, the concerns about the use of genetically modified organisms have been bookmarked and will have positive consequences in the future.

CELLULAR INTELLIGENCE: A BIOLOGICAL ENIGMA

Faria Minhas

0006-BH-BIOT-19

Cells; biological bibliophiles constitute a microscopic realm. Intelligence at the cellular level is ever-provoking and intrigues one with its enigmatic yet organized nature. Your cells decipher the information, interpret a genetic database of merely four alphabets (A, C, T, and G), communicate with each other without Saas, and navigate through labyrinths of your bodies with accuracy better than your GPS-equipped vehicles. The art of adaptability, survival, and communication mastered via cellular intelligence is quite a commendable aspect of nature.

Forget cells, let's talk about a single cell of slime mold. No brain, no problem, slime mold got it all covered with the help of cellular intelligence. What may seem like a mere brainless gooey structure is one of the smartest known protists. Slime molds can select meals, move through mazes, and build effective networks. Their adaptability and behavioral responses have often left scientists astounded.

Researchers at Hokkaido University, Japan aimed at solving spatial Tokyo's Railway routes by studying the growing patterns of *Physarum polycephalum*. *Physarum polycephalum* is a yellow slime mold, big enough to be viewed by the naked eye. It has the potential to make its way to the food source and then construct a tunnel-like network for distribution of the nutrients. This very ability of slime mold was exploited by Japanese researchers who allowed it to grow on Petri plates bearing oak flakes at specific points. The placement pattern of oak flakes mimicked the stations of Tokyo.

In the early hours, slime mold grew massively and entirely over the petri plates. However, after a few hours, it began to refine its pattern of growth into a network-like mesh that connected all possible oak flakes. Within 26 hours, the mold had re-created a network that exactly resembled the subway route of Tokyo with even better interconnecting channels to redirect traffic. And with that, it was able to solve the problem over which architects have been scratching their heads off for weeks.

In another research conducted by Germans; Dr. Larry and Dr. Audery, slime mold referred to as Blob was able to learn and familiarize itself with its environment. In the experiment, Blob was allowed to cross a salt-covered bridge, with food placed on the other side of the bridge. Salt

happens to hinder the movement of mold. Initially, Blob crossed the bridge in 10 hours, later reducing the time to 8 hours, and finally, after repeated exposure to the salt bridge, it crossed the bridge in the same time as that of the control group. This showcased the brilliant ability of mold to adapt.

Now who would need sophisticated mathematical algorithms when this slimy protist is available to crack circuitry? This networking and decision-making ability of slime mold is known to be used in the future, creating algorithms that could predict routes of storms or floods. Moreover, since tumor growth happens to be an affair of the vessel network, it could explain the spread of the tumor.

Since Artificial Intelligence (AI) has been the talk of the town, even the thought of combining AI with cellular intelligence is brain-blogging. Integrating slime mold with AI would enhance its innate abilities to form environment-friendly biomass. AI can direct slime mold to adapt sustainable solutions for waste degradation. AI-powered slime molds are expected to revolutionize the healthcare sector. They can search through vast volumes of medical data, analyze patterns, and predict the progression of diseases. Moreover, they can help in opting for the best possible treatment thereby optimizing patient care. The inborn navigation skills of molds when paired with AI would not only ease traffic flow but also would pave the way for self-driving cars.

Not just slime molds, the union of AI with any biological entity be it bacteria or fungi can break the limitations of cellular intelligence. AI will have cellular intelligence to learn from while the biological cells will be backed up by the digital precision of AI, boundaries will blur and breakouts will be bound to happen. No doubt the resultant organisms will exhibit the highest level of decision-making skills, but will they be at par with those of humans? The possibilities are endless, one can imagine.

BIOTECHNOLOGY IN SPACE EXPLORATION, IMPLICATIONS FOR FUTURE MISSIONS

Mahnoor Khalid

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Introduction:

The quest for exploring space has always captivated the human imagination, pushing us to conquer new frontiers. In recent years, the field of biotechnology has emerged as a powerful tool in advancing our understanding of space and addressing the unique challenges it presents. By harnessing the potential of biotechnology, scientists and astronauts have made significant strides in overcoming the physical and biological constraints of space travel. This blog delves into the exciting implications of biotechnology in

space exploration and how it paves the way for future missions.

1. Enhancing Human Adaptation:

Space travel places immense physical and physiological stress on the human body. Microgravity, radiation exposure, and isolation can have profound impacts on the health and well-being of astronauts. Biotechnology offers innovative solutions to mitigate these risks and enhance human adaptation in space.

By studying the physiological changes that occur during spaceflight, scientists can develop targeted interventions. For example, gene therapy may be utilized to protect against radiation-induced damage, or genetically modified organisms could be engineered to produce essential nutrients and medicines on long-duration missions. Furthermore, advances in tissue engineering could lead to the creation of artificial organs or tissue constructs, reducing the reliance on Earth-based medical support.

Biotechnology also enables the exploration of human genetic modifications to enhance adaptation to space conditions. Gene editing techniques like CRISPR could potentially be used to modify genes responsible for bone density, muscle mass, or immune system functioning, making astronauts better equipped for extended space missions.

2. Sustainable Food Production:

Sustaining the nutritional needs of a crew during long-duration space missions is a significant challenge. Biotechnology plays a vital role in enabling sustainable food production in space, ensuring the availability of fresh and nutritious food for astronauts.

Genetic engineering techniques allow scientists to enhance crop varieties to withstand the harsh conditions of space, such as limited water availability and nutrient deficiencies. Genetically modified plants, such as those grown in the Veggie plant growth system aboard the International Space Station (ISS), have shown promise in providing fresh food and oxygen.

Additionally, the development of cellular agriculture and synthetic biology offers alternative approaches to traditional farming in space. Cultured meat and microbial bioreactors could revolutionize food production, reducing resource requirements and enhancing crew autonomy. Bioregenerative life support systems that recycle waste into usable resources through the actions of microbes are also being explored, ensuring a closed-loop system that minimizes waste and resource consumption.

Furthermore, biotechnology can facilitate the creation of sustainable ecosystems in space. Algae-based systems can be used to produce food, oxygen, and even biofuels through photosynthesis, providing a renewable and efficient means of resource utilization.

3. Astrobiology and Exploration:

Biotechnology plays a significant role in astrobiology, the study of life in the universe. One of the primary objectives of space exploration is to identify signs of past or present life on other planets. Biotechnological techniques, such as polymerase chain reaction (PCR) and DNA sequencing, can be used to detect and analyze microbial life in extraterrestrial environments.

The search for life beyond Earth involves the use of extremophiles, organisms capable of surviving in extreme conditions. By studying their unique adaptations, scientists gain insights into the potential habitability of other worlds. Additionally, the field of synthetic biology allows for the creation of novel organisms engineered to survive and thrive in extraterrestrial environments, aiding in the search for life and establishing sustainable ecosystems.

Biotechnology can also facilitate the exploration of celestial bodies like Mars. Mars sample return missions could utilize genetic sequencing to analyze collected samples for signs of past or present microbial life. Understanding the potential risks and interactions between Earth and Mars organisms is crucial to prevent contamination and false positives.

Moreover, biotechnology can contribute to resource utilization on other planets. By leveraging genetic engineering, organisms could be engineered to extract and process resources such as minerals or gases, aiding in the establishment of self-sustaining colonies.

Conclusion:

Biotechnology holds immense promise for the future of space exploration. Its applications in enhancing human adaptation, sustainable food production, and astrobiology offer innovative solutions to overcome the challenges of space travel and colonization. By harnessing the power of biotechnology, scientists, and astronauts can expand our understanding of the universe and pave the way for long-duration missions to distant worlds. As research and technological advancements continue to progress, biotechnology will undoubtedly play a crucial role in shaping the future of space exploration, enabling us to venture further into the cosmos and unlock the mysteries it holds.

FROM DNA TO DIGITAL: HOW PERSONALIZED MEDICINE AND AI ARE REVOLUTIONIZING HEALTHCARE

Maneeha Ajmal

0073-BS –BIOT-20

If you've ever taken a "one-size-fits-all" approach to healthcare, you know that it often feels like you're rolling a dice on your health. But imagine if you could receive treatments that are tailored to your unique genetics, environment, and lifestyle.

Thanks to the rapid advancements in genomics and artificial intelligence (AI), that future is now.

Genomics, the study of an individual's genetic information and its impact on health, is at the forefront of personalized medicine. By analyzing an individual's genome, medical professionals can identify specific genetic variations associated with certain diseases or conditions. Armed with this information, they can develop targeted treatments tailored to the patient's unique needs.

For instance, consider an individual with a genetic predisposition to breast cancer. Through genomic analysis, their doctor can identify this risk and recommend personalized screening and prevention strategies. If breast cancer does develop, the doctor can use this information to develop a targeted treatment plan that is far more effective than a "one-size-fits-all" approach.

However, it is the integration of AI that truly propels personalized medicine into new frontiers. AI algorithms, powered by machine learning, can process and analyze large datasets of patient information, leading to the development of highly personalized treatment plans that surpass the capabilities of traditional methods.

One of the most promising applications of AI in personalized medicine is its ability to predict patient outcomes. By examining extensive patient datasets, AI algorithms can identify patterns and anticipate which treatments are likely to be most effective for individual patients. This not only improves patient outcomes but also optimizes time and resource allocation for healthcare providers.

Moreover, AI and personalized medicine are revolutionizing the diagnostic process. Traditional diagnostic methods often rely on subjective assessments or the expertise of a single healthcare professional. In contrast, AI algorithms can scrutinize medical imaging, laboratory results, and patient records to provide more objective and accurate diagnoses. This enables earlier disease detection and facilitates targeted interventions.

Beyond diagnosis and treatment, personalized medicine and AI are reshaping drug discovery. Developing new drugs is a complex and costly endeavor, but AI can streamline and expedite the process. By analyzing vast amounts of molecular and genetic data, AI algorithms can identify potential drug targets and predict the effectiveness of various compounds. This accelerates the discovery of new treatments while reducing the time and resources required for clinical trials.

AI algorithms analyze vast amounts of data to predict patient outcomes, enhance diagnoses, and optimize treatment plans. The synergy between genomics and AI opens up unprecedented possibilities for personalized medicine.

By analyzing an individual's genetic predispositions, lifestyle factors, and environmental influences, healthcare professionals can identify potential risks and take

preventive measures to mitigate them leading to proactive treatment and diagnosis of disease.

For example, imagine a scenario where an individual undergoes genetic testing and it reveals an elevated risk for cardiovascular disease. Armed with this knowledge, the healthcare team can develop a personalized plan that includes lifestyle modifications, regular cardiovascular screenings, and targeted interventions to address specific risk factors.

AI-powered tools and applications can provide patients with access to their genetic data, personalized health information, and actionable insights. This empowers individuals to actively participate in their own healthcare decisions, make informed choices, and adopt healthier lifestyles.

Traditionally, clinical trials have been time-consuming and costly, often resulting in limited participation and delayed access to innovative treatments. However, AI algorithms can facilitate the identification of suitable candidates for clinical trials based on their genetic profiles and medical history, thereby accelerating the recruitment process and improving the overall success rate of trials.

Through wearable devices, sensors, and continuous monitoring, AI algorithms can analyze patient data and provide timely feedback to healthcare professionals. This enables proactive adjustments to treatment plans based on the individual's response, ultimately leading to better treatment outcomes and improved patient experiences.

While personalized medicine and AI offer remarkable opportunities, there are important considerations to address. Ensuring equity and accessibility is paramount, as efforts should be made to make these advancements accessible to all individuals, regardless of socioeconomic status or geographical location.

Ethical concerns regarding data privacy, consent, and the responsible use of AI in healthcare must also be carefully addressed. Safeguarding patient privacy and ensuring transparency in data usage is crucial for maintaining trust and promoting the widespread adoption of personalized medicine and AI.

In conclusion, personalized medicine and AI are at the forefront of a healthcare revolution. By leveraging the power of genomics and AI algorithms, healthcare professionals can deliver targeted, proactive, and patient-centered care. Embracing these transformative approaches will undoubtedly lead to a healthier, more resilient, and thriving society. By tailoring treatments to individual patients, medical professionals can provide more effective, efficient, and patient-centered care. So, the next time you need medical treatment, ask your doctor about personalized medicine and how it could change your life.

ROLE OF SYNTHETIC BIOLOGY IN DEGRADING PLASTIC WASTE

Mariam Nadeem

Following the period of decline due to the pandemic in 2020, global plastic production has entered the phase of resurgence, showing a notable boom in recent months. According to contemporary studies, **390 million tonnes** of plastic was turned out in 2021. It was most likely that the majority of it would end up as waste, as only **9%** of the total plastic waste is recycled productively, while approximately **12%** of the plastic is ultimately subjected to incineration, and the other **79%** is piled up as waste. Actual recycling methods exhibit significant inefficiencies, recycling a mere **30%** of the total plastic, being successfully reused for various purposes, in a form with inadequate characteristics than the original composition.

However, synthetic biology is a field of science that focuses on living systems and organisms applying engineering techniques to redesign or modify their already existing parts is a great approach to dealing with plastic waste. Synthetic biology is a convincing approach to administer the globally growing problems related to plastic pollution by expediting the degradation process and advancing in making eco-friendly plastics to put back petroleum-based products.

Natural Plastic Eaters and Improving What Already Exists:

Although plastic is considered a major pollutant; however, many microbes have been discovered that can retain the ability to degrade the plastic after several modifications. Fungi, algae, and bacteria are involved in degrading the pollutant plastic. Biotechnological approaches like gene manipulation and genetic modifications can transform a naturally existing microbe into an efficient plastic eater.

The degradation of plastic by microorganisms demands optimal temperature and pH, after exposure to UV light or chemical treatment. To degrade a certain type of plastic, a specific microbe works actively. Strain such as *Ideonella sakaiensis* breaks down the polyethylene terephthalate (PET) into its constituents, with a major drawback. It requires weeks or even months to degrade a limited quantity of plastic.

Here are some examples of genetically modified microbes for plastic degradation:

- To degrade the PET plastic biocatalytically, ***E. coli*** was modified to demonstrate the ability to produce **BIND-PETase**. It can decompose 9.1% of highly crystalline PET waste in a total span of 7 days at optimal room temperature and humidity.
- **Manganese-dependent peroxidase**, a plastic degrading enzyme obtained from ***S. cerevisiae*** **BY 4741** and ***E. coli.***
- ***E. coli*** **BL21** and ***P. chrysosporium*** strains were altered genetically to produce laccase.

Plastic degradation (Zeenat et al., 2021)

Genetic modifications make it possible to obtain what the advancing world demands. Taking the principles of metabolic engineering into use, genes and DNA sequences are being optimized to get the desired results. For all that, in the last twenty years, synthetic biology has paved the path to bring up biotechnological advances like DNA synthesis, new gene editing techniques, high-throughput sequencing, and more.

Degradation of PET by LLC:

One of the predominantly used plastics is PET which encounters a notable drawback of requiring elevated temperatures to degrade different forms of PET to facilitate recycling. As a result, a grey or black mass is produced with very poor quality. Thus, it cannot be considered as recycling. An enzyme named leaf-branch compost cutinase (LLC) was discovered by researchers at Osaka University in 2012, exhibiting the ability to break the chemical bonds found in PET and other commonly used plastics. However, LLC was not highly efficient as it degraded after being exposed to an optimal temperature of **65%,** posing a challenge for its practical application.

Modification of LLC:

Recent research by scientists from the University of Toulouse inscribed the limitations by upgrading the performance of the enzyme. They look into the crystal-like structure of the enzyme to get to know about its active site, responsible for degrading PET chemical bonds, improving the enzyme's efficiency, and elevating its resistance to temperature. After the analysis process, scientists make a grade in isolating a mutant form of the enzyme, exhibiting remarkable refinements. The enhanced version is 10,000 times more potent in degrading the PET bonds with elevated thermal stability to withstand the temperature of **72°C.**

As per the experiment, a mere 3 mg of the engineered enzyme manages to degrade 90% of the total plastic in 10 hours. The leftover terephthalate acid and ethylene-glycol can be transformed into new plastic bottles with the same characteristics as the original ones. Moreover, following genetic modifications, green microalgae named ***Chlamydomonas reinhardtii***, exhibit the ability to produce an enzyme named polyethylene terephthalate hydrolase. This enzyme is effective in degrading the polyethylene terephthalate films into terephthalic acid.

Conclusion:

In general, still there is a long way to go in obtaining benefits from genetically modified microorganisms to degrade plastic waste. This approach can take us to the extent where all the environmental problems like degrading plastic are no longer a problem.

ORGAN ON CHIP: A GROUNDBREAKING DISCOVERY IN THE FIELD OF BIOTECHNOLOGY

Nabiha Saad

0612-BH-BIOT-20

In the realm of biomedical research, organ-on-chip (OOC) technologies are establishing themselves as a ground-breaking strategy with the potential to revolutionize drug discovery, disease modeling, and personalized therapy. Invasive conventional in vitro and animal-based testing can be substituted by these small silicon chips which simulate the integrated systems and operations of the human organs inside a microfluidic substrate. Our knowledge of human physiology has been greatly improved by recent studies in the field of organ-on-chip technologies, which has also opened up new opportunities for therapeutic development.

The organ-on-chip technology owes greatly to the development of very intricate and integrated systems that mimic the systemic design of human organs. The interactions that are native to different organs of the human body have been precisely copied on top of a single silicon chip. The purpose of designing this chip is to allow researchers to study the effect of varying drugs and external environments on such integrated systems. An example depicting this technology is the ‘body-on-chip’ system, which is designed to simulate the functioning of various organs like the heart, liver, and lungs, thus allowing the researchers to find out the effect of certain medications and stresses on different organs simultaneously, resulting in a very thorough evaluation of their potential adverse effects.

Moreover, the development of iPSCs, or induced pluripotent stem cells has played a vital role in the research on organs on a chip. iPSCs are stem cells that have been derived from adult cells, like blood or skin cells, and they possess the ability to differentiate into various other cell types by reprogramming. Organ-on-chip modeling is made possible by the ability to create iPSCs from the cells of an individual and differentiate them into particular cell types, providing a personalized and disease-specific approach. This makes it feasible for researchers to reproduce a patient's particular physiological state on a chip, enabling them to more precisely investigate diseases, screen prospective drug candidates, and devise individualized treatment plans.

The capacity of organ-on-chip systems has also been enhanced by the incorporation of microfluidics and cutting-edge sensing technologies. The accurate regulation of fluid flow made possible by microfluidic devices permits the administration of nutrition and therapeutic agents to organ models while stimulating the flow of blood in the body. Real-time monitoring of numerous data, including biological responses, electrical activity, and biochemical indicators, is another benefit of the incorporation of sensors. This abundance of information provides previously inaccessible details into how organs work and how pharmaceuticals affect people.

Recent developments in organ-on-chip research have also improved the study of neurological illnesses. Drug distribution to the brain has been complicated by the blood-brain barrier (BBB), a

highly selective membrane that divides the brain from circulating blood. The BBB is being modeled as an organ-on-a-chip, which assists in the research and development of new methods to get beyond it and enables researchers to assess the efficacy of drug prospects in getting through the BBB and into brain tissue.

Despite these outstanding advancements, obstacles still stand in the way of the broad use of organ-on-chip technologies. Other aspects need focus, including protocol standardization, scalability, and guaranteeing consistency across multiple labs. Furthermore, despite providing a more accurate picture of human physiology, organ-on-chip models nonetheless trivialize the intricate structure of the human body as a whole.

Organ-on-chip technology has advanced to the pinnacle of biomedical innovation thanks to current studies. Drug development, understanding of diseases, and personalized treatment all stand to benefit greatly from the ability to simulate the organs of humans and their interactions with one another in a controlled setting. Organ-on-chip devices are anticipated to become essential to pharmaceutical research as these technologies advance. This will reduce our reliance on conventional approaches, which frequently fail to predict human responses, and will result in safer and more effective medicines.

STEM CELLS: HEALING WITH POTENTIAL

Faiqa

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In the field of medical science, there exists a discipline that has made scientists curious since its discovery: *The enigmatic world of stem cells*. Stem cell transplant first started in 1959 and since its emergence, it has proved to be an effective treatment of various degenerative diseases. Stem cells have the potential to heal beyond our imagination. The effectiveness is 87.5% and increasing significantly. Stem cell technology has the potential to revolutionize healthcare by utilizing the regenerative ability of one's cells to heal medical ailments.

Stem cells are undifferentiated cells. They do not have any specific shape or function. They can differentiate into many other cells.

- Adult Stem Cells are exceptional in their functions. They can differentiate into some specific cells that are associated with tissues. Hence, they are called **multipotent** or **unipotent** stem cells. For example, neural nerve cells produce new nerve cells in an adult brain. Hematopoietic stem cells differentiate into blood cells.
- Embryonic Stem Cells are obtained from the inner mass of a zygote referred to as the blastocyst. They can restore and heal afflicted tissue and organs.
- Adult stem cells aid in obtaining Induced Pluripotent cells. Inserting genes in the

adult stem cells gives them the ability to differentiate into about 200 new cells including cells of different organs and tissues.

Healing potential:

We are just diving into new aspects of stem cell medicine and regenerative therapies. They have a remarkable ability to generate healthy cells that replace the cells damaged due to diseases. This ability of stem cells **delays aging** and **increases life span**. Many of the patients do not require multiple treatments. ESCs can differentiate in any necessary type of body cell like liver cells, and nerve cells while adult stem cells are restricted specifically to blood cells.

Ethical consideration:

There are several ethical controversies over the use of ESCs. The use of ESCs involves the demolition of human embryos which is considered inappropriate by many religious groups.

According to many scientists:

"Within the delicate framework of life, the destruction of human embryos echoes a moral fracture that calls us to question the boundaries of scientific pursuit and the preservation of our shared humanity."

The use of ASCs and IPSCs is the field of focus by scientists because ASCs avoid all such ethical considerations. Moreover, they are easily available from bone marrow or fat. Scientists can extract these cells from a patient's own body for treating diseases which reduces the risk of infections.

Unleashing the healing potential:

1. **Alzheimer's disease:**

In this process, ASCs are converted into ESCs and then stimulated to create neurons. Scientists at Columbia University were able to convert 50% of the cells and the neurons produced were placed in developing mice which were able to receive signals like normal neurons.

2. **Parkinson's disease:**

These stem cells can develop into brain cells which restore damaged brain cells and help control dopamine levels. Experts believe this can attenuate significant signs of Parkinson's disease.

3. **Huntington's Disease:**

It is a rare hereditary disease that causes nerve cells to gradually break down leading to various physical, cognitive, and psychiatric symptoms. Damaged neurons can be replaced by providing neuroprotection by using SCs.

Important Researches:

Following is the important research related to stem cells.

- In 2016, biologists at the University of Miami Miller School of Medicine performed a clinical trial using stem cells to treat type 1 diabetes. They transplanted insulin-producing

pancreatic cells derived from stem cells into patients with the condition.

- In 2018, researchers at the University of California, Irvine, restored brain function in mice with severe cerebrovascular accident (CVA) using human neural stem cells.
- In 2018, researchers at the Fred Hutchinson Cancer Research Center successfully used genetically engineered stem cells to treat patients suffering from acute sickle cell disease.
- In 2019, a clinical trial led by researchers at the University of California, Los Angeles, used stem cells to deal with macular degeneration (AMD).
- In 2021, scientists at the University of California used neural stem cells extracted from human pluripotent stem cells to promote the regeneration of injured spinal cords in rats.

Pluripotent stem cells differentiate into insulin-producing cells and can control sugar levels when transplanted into diabetic animal models. Stem cells also show potential for treating myocardial infarction.

Challenges:

The challenges faced by stem cell therapy are infection rejection, tumor production, graft-versus-host disease, graft failure, infection, organ damage, cataracts, infertility, cancers, and death. Hemorrhage can occur during neurosurgery. A small portion of stem cells are present in tissues, making them difficult to extract and purify.

Efforts are being made to produce **patient-specific** stem cells to reduce the risk of infections and other complications. A flexible framework is required to ensure the lawful use of stem cell technology. Ethical considerations, patient safety, and international collaboration should be in focus to guarantee a safe future.

REVOLUTIONIZING BREAST CANCER MANAGEMENT, BIOTECHNOLOGICAL INSIGHTS AND TECHNIQUES

Taha Iqram

0097-BS-BIO-T-21

Breast cancer occurs when the breast tissue gets affected. It generally affects the cells that line the milk ducts or the lobules that produce milk. It is the most dominant cancer in women worldwide but it can also affect men although at a much lower rate. Breast cancer management is undergoing a major revolution as a result of biotechnology advancements. These insights and techniques are not only changing the way we detect and diagnose breast cancer, but they are also providing the path for more effective treatment options.

Biotechnology has emerged as an immersive transformation in the early detection of breast cancer. **Mammography**, a common screening

tool, has evolved immensely as a result of biotechnological advances. **Digital mammography** provides high-resolution images that help detect even the slightest abnormalities. Liquid biopsies are possibly the most innovative technique for early detection. These non-invasive tests examine circulation components such as circulating tumor DNA, RNA, and proteins. These methods not only eliminate the need for unwanted treatments but also provide a full view of tumor features, allowing for more tailored treatment recommendations.

Genetics plays an important role in developing breast-ovarian cancer syndrome. This comprises people with the BRCA1 and BRCA2 gene mutations, p53 (Li-Fraumeni syndrome), and PTEN (Cowden syndrome) mutations. Breast cancerous cells possess receptors both on their surface and in the cell's cytoplasm. The chemical messengers (hormones) attach to receptors triggering cell changes.

Chemotherapy has long been used to treat cancer, causing collateral harm to rapidly dividing cells throughout the body. However, the arrival of targeted therapies has transformed breast cancer management. The success of targeted therapy is exemplified by HER2-positive breast cancer. In some breast tumors, HER2, a protein that promotes the growth of cells, is overexpressed. Trastuzumab (Herceptin) and Pertuzumab (Perjeta) are monoclonal antibodies that are designed to suppress HER2 activity, resulting in better treatment outcomes and fewer adverse effects. Tamoxifen and aromatase inhibitors are examples of endocrine therapies that take benefit of hormonal signaling pathways. Biotechnological advances in these pathways have resulted in the development of medications that block hormone receptors, effectively halting tumor progression.

Gene therapy is an innovative biotechnological technique with an opportunity to transform the treatment of several diseases, including breast cancer. Gene therapy is an approach in which genetic material, such as DNA or RNA, is used to treat diseases by changing or correcting the patient's genetic code. One method of gene therapy for breast cancer includes directly delivering therapeutic genes to malignant cells. This can be accomplished through the use of viral vectors or non-viral approaches. Oncogenes such as BRCA1/2 known as breast cancer susceptibility genes 1 and 2, can be inhibited via gene therapy techniques. Researchers can target and inhibit the activity of individual oncogenes using **RNA interference (RNAi)** or other gene silencing techniques, potentially stopping cancer growth.

CRISPR-Cas9 can be used to disable particular genes linked to the development and progression of breast cancer. CRISPR-Cas9 enables researchers to explore the activities of thousands of genes at the same time. This technique can aid in the identification of genes that, when disrupted, affect breast cancer cell proliferation, metastasis, and therapy response.

A technology called **Immunotherapy** which uses biotechnological innovations in the battle against breast cancer is at the forefront of breast cancer treatment. Immune checkpoint inhibitors, a biotechnological invention, have emerged as a breakthrough approach in the treatment of some breast cancer subtypes. CAR T-cell therapy, for example, involves altering a patient's T cells to express CARs that recognize specific proteins in cancer cells. This approach can be utilized to target breast cancer cells and trigger a stronger immune response, resulting in their death.

Nanotechnology, a field at the border of biology and engineering, has enabled the production of nanoparticles created to deliver drugs directly to tumor sites and these nanoparticles can be utilized to improve tumor visibility in imaging techniques such as Magnetic Resonance Imaging. This drug delivery avoids damage to healthy tissues and improves therapeutic effects.

Breast cancer care is undergoing a major transition, inspired by biotechnology breakthroughs and procedures. The merging of scientific discovery, technological innovation, and compassionate patient care is shaping the future of breast cancer treatment. By embracing a multidisciplinary strategy that brings together experts from other sectors, we will be able to realize the full potential of biotechnology in the fight against breast cancer.

REVOLUTIONIZING INDUSTRIES: METAGENOMICS DUAL ROLE IN FOOD AND PHARMACEUTICAL SECTORS

Zoya Ahmad

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Introduction:

In the past, various conventional methods were used for the identification and genetic analysis of microbes. However, these methods were not only time-consuming but were also ineffective in many cases. Instead of culturing these microbes separately in the clinical laboratories, a specific technique known as metagenomics was developed that involved the direct isolation of the samples from surroundings. These samples can be of both origins i.e., biological as well as environmental. This technique includes five main steps. Firstly, the DNA of our desired sample is isolated. Later on, the isolated DNA is sequenced and data is analyzed accordingly and the microbe is identified. Lastly, light is shed on both genetic variation and specific features of our identified microbe.

Application of Metagenomics:

Metagenomics deals with various fields like microbiology, biotechnology, etc. It has a wide range of applications in various emerging industries like the food industry and pharmaceutical industry.

Role in Food Industry:

Metagenomics is used in the food sector to discover and characterize the microbial communities involved in food fermentation, which is crucial in the production of many food products. Identification of food processing enzymes such as amylases, proteases, and lipases, which are used in the production of cheese and other dairy products, bread, and fruit juices, has also been carried out using metagenomics techniques.

1. Kimchi Preparation:

Kimchi is a popular side dish that originated in Korea. It is made by dipping Napa Cabbage in brine and is, later on, left to be fermented for a specific period. Owing to its significant popularity, scientists researched to find out the strains of microbes that help fasten the fermentation process and contribute to its specific aroma as well as flavor. DNA was isolated from samples obtained at different stages of fermentation. Most of the microbes identified in the extracted samples belonged to the family of Lactic acid bacteria. It was found that these species such as Lactobacillus and Leuconostoc help in dropping the pH of the environment making it acidic. They do so by the conversion of sugars (carbohydrates) of cabbage into Lactic acid. Several genes were also found to be involved in the formation of flavor and aroma compounds such as esters and aldehydes, as well as the breakdown of complex carbohydrates such as starch and cellulose. All of this then contributes to its specific tangy odor and taste.

1. Production of Low-Fat cheese:

In a world where everybody is concerned about their health, metagenomics has played a pivotal role in the production of low-fat cheese, promoting a healthier lifestyle. Lipases which are the enzymes degrading fats contribute to lessening the fat content of cheese. To create a low-fat cheese with improved texture lipases were identified and isolated from the cheese microbiome. The researchers created a metagenomics library from the cheese microbiome using functional metagenomics and screened it for lipase activity. The genes encoding this activity were sequenced and characterized after some clones were found to have lipase activity. The scientists then selected the most promising lipases and tested them in the production of low-fat cheese. They found that the addition of these lipases resulted in cheese with a better structure, which they attributed to the ability of the lipases to hydrolyze milk fat and change its structural composition.

Role in the Pharmaceutical Industry:

Metagenomics plays a very important role in the manufacturing of products of medical importance.

Discovery of antibiotics:

Metagenomics is known to have played a very vital role in the production of antibiotics derived from microbes inhabiting the soil. Researchers did so by directly isolating genetic material from the soil. Amidst all this, they found some gene

groups that can produce very effective antibiotics. These antibiotics not only work very effectively against various infections but also do not let the potential bacteria develop resistance against them. During this research, scientists came across some specific genes that are responsible for the production of a very favorable antibiotic named Malicidin. It demonstrated a strong power against many deadly pathogens. It even worked against bacteria like MRSA (Methicillin-resistant Staphylococcus aureus) and VRE (vancomycin-resistant enterococci) which were known to have shown resistance to various previous antibiotics. This method demonstrates how metagenomics can be used to find novel antibiotics that have strong antibacterial properties important for medicinal therapies.

Conclusion:

In short, the revolutionary role metagenomics has played in both food and pharmaceutical industries can simply not be ignored. Metagenomics will continue to unveil more microbes that have the potential capabilities to promise a healthy and bright future for mankind.


BOTANY

BOTANY TIMELINE 2023

January 2023

In January, researchers from University of Nottingham, found that Pollen trapped within rocks dating back 250 million years contains substances resembling sunscreen, which plants generated to shield themselves from detrimental UV-B radiation. These discoveries indicate that a pulse of UV-B radiation may have played a pivotal role in the end-Permian mass extinction event.

February 2023

Researchers from the Institute of Botany, Czech Academy of Sciences, described a new correlation between algae and fungi which they named as alcobiosis. This correlation exists between algae and corticioid basidiomycetes. They found that in this relationship fungus doesn't depend upon its alga for nourishment.

March 2023

A groundbreaking finding from researchers at the University of Bristol has reshaped our understanding of how plants develop branching structures. Through their investigation into the mechanisms driving branching, the team has determined the initial appearance of land plants existed millions of years ago. This study has pinpointed a shared mechanism for branching among vascular plants.

April 2023

Researchers from North Carolina State University introduced a new tool named as "tree of life" to identify, detect and monitor species of *Phytophthora*, a highly destructive pathogen, which have been responsible for plant diseases ranging from the devastating 1840s Irish potato famine to sudden oak death that still plagues West Coast oak population.

May 2023

Scientists found that when the seeds of plants such as pea and sunflower are biofortified with zinc, the seedlings they quickly produce, harvested as microgreens , could both help to mitigate global malnutrition and boost the odds of people surviving a catastrophe. The results showed that zinc biofortification through seed nutri-priming achieves needed levels of zinc in the young pea and sunflower plants

June 2023

Researchers at University of Cambridge discovered a new molecular signaling pathway that triggers when leaves are exposed to low humidity. This ensures that plant roots keep growing towards water.

They found that the leaves under low humidity sends shoot to root signals using abscisic acid (ABA) which signals the roots to keep growing.

July 2023

A new study published in The Embo Journal scientists found that the plant roots have their own thermometer to detect the temperature of soil around them and adjust accordingly. For this purpose scientists used climate chambers. This study also provided insights for plant breeding.

August 2023

Scientists found that Venus flytrap have sensory hairs containing a heat sensor which warns a plant against bushfires. They found that at 37 and 55 degree Celsius when the temperature rose abruptly as in heat wave the trap shut itself.

September 2023

A group of botanists including from University of Oxford Botanic Garden, has issued an urgent call for coordinated action to save the iconic genus *Rafflesia,* which contains the world's largest flowers. A new study found that most of the 42 species are severely threatened, yet just one of these is listed in the International Union for Conservation of Nature (IUCN)'s Red List of Threatened Species.

October 2023

A new study conducted by Helmholtz Centre for Ocean Research Kiel (GEOMAR) showed that variation in physiology of phytoplankton especially the nutrient uptake can impact chemical composition of ocean and even the atmosphere. This suggested that marine phytoplankton physiology can impact global climate.

UVARIOPSIS DICAPRIO; THE FIRST NEWLY IDENTIFIED PLANT SPECIES OF 2022 (A COMPREHENSIVE DESCRIPTION FOR YOUNG RESEARCHERS)

Suman Haroon
0123-BH-BOT-19

Background: *Uvariopsis dicaprio* is an endangered species, first found in the Ebo Forest of Cameroon. It is the first plant to be discovered in 2022 by American actor Leonardo Dicaprio, a conservationist and a member of the Royal Botanic Gardens. This plant is a member of the family Annonaceae. They claimed this plant species to be unknown not only to science but also to local communities. It is named after its discoverer Leonardo Dicaprio. *Uvariopsis dicaprio* is an evergreen plant 4m tall with yellow-green flowers. This plant resembles *Cananga odorata*, which is native to Southeast Asia. It is declared as a new species by using a dichotomous identification key and comparing it morphologically with reference material of all the known species of this genus. Only 50 individuals of this new species are found inhabiting the tropical Ebo Forest of Cameroon. Thus, it is an endangered species that needs to be conserved.

Morphology of *Uvariopsis DiCaprio:*

Description: *Uvariopsis dicaprio* is an evergreen plant 3-4 meters tall. Its trunk is smooth with dark brown bark having white lenticels. The leaves of the *U.dicaprio* are oblanceolate. They are smooth, hairless with color ranging from pale yellow to orange, when they are mature they turn to orange-brown.

The leaves are arranged distichously. *U.dicarpio* is monoecious because the species that are collected from the Ebo Forest are only male. The male flowers are yellow-green and are directly attached to the trunk. The flowers are cauliflower and glossy. The flowers are connected with the stem through a pedicel that is 1.8-2.5 cm long and 1cm wide. A single flower consists of two sepals and two petals with having stamen in the center of the petals.

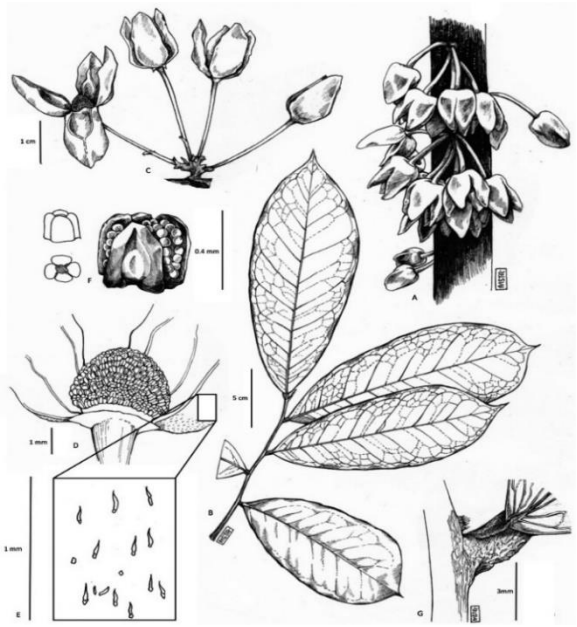


Figure 1 (A) habit, cauliflorous inflorescences on the trunk; (B) leafy branch, one season's growth; (C) inflorescence, showing pedicel articulations, bracts, and bracteoles; (D) flower, with one petal removed to show the staminal dome; (E) detail of sparse hairs on abaxial petal surface. {F} different views of stamens {G} Junction of leaf base with stem showing dome axillary bud.

Habitat: This tree is present only in the tropical Ebo forest of Cameroon. It is extended over an area approximately of four km. It is hypothesized as a new species to the science of *Uvariopsis* via the study of herbarium.

Classification: *Uvariopsis dicaprio* is classified into the following categories.

Kingdom	**Plantae**
Class	Magnoliophyta
Order	Magnoliales
Family	Annonaceae
Genus	*Uvariopsis*
Species	*U. dicaprio*

Morphology: The trunk is smooth, and dark brown and lenticels are present on it longitudinally. It has prop roots and length ranges from 3-4m. Its leaves are yellowish green and Glaborous, distichous having translucent glands in the interior side of the blade. There is no smell or any scent found in the leaves when they are crushed. Three to four leaves are grown in a season annually. Dome-shaped axillary buds are present that may be colorless or red-brown. Numerous bud scales covered with simple hairs and linearly are also present. Female inflorescence is not found in those individuals that are found in the Eba Forest of Cameroon. Male inflorescence is only observed consisting of two sepals and four petals. Petals are free, uniseriate, thin, and leathery in texture. Sepals are glabrous, opposite, and pale brown on drying. Short cylindrical stamens are present having laterally extrose longitudinal two cells of anther. Fruit, seed, and female flower are unknown.

Phenology: Flowers are only observed in specific seasons of spring from March to April.

Pollination: It is a tree that has bright yellowish-green flowers. Thus, the petals are attractive to insects. Its petals are not thick, fleshy, and leathery like other species of this genus. The color, shape, and texture help in pollination. In the center of the petals, the staminal dome is present. It is unique to this species that is adapted for moth pollination. The other species of the *Uvariopsis* do not have any glossy and bright coloured petals thus they are not effective pollination via moth as in *U. dicaprio.*

Conservation status: Only 50 individuals with male inflorescence are found in the tropical forest of Cameroon which covers an area of 4km. Thus, it is a critically endangered species and needs to be conserved.

Conclusion: Since this species has a narrow geographical range with only a few individuals which are prone to several anthropogenic pressures, this species is at high risk of extinction. Therefore, significant measures should be taken to conserve this unique plant.

BONSAI: AN ARTISTIC AND HORTICULTURAL EXCELLENCE

Tooba Zia

The practice of indoor plant propagation, known as bonsai, traces its roots to ancient China. This technique of cultivating single trees in pots has attracted global attention for enhancing the aesthetic appeal of interior spaces.

Bonsai, an art form that involves growing trees in restricted environments to replicate specific natural conditions such as age, weathering, contorted forms, and unique shapes, serves as a testament to the harmonious blend of artistic expression and inspiration drawn from nature. Bonsai trees are modeled and exemplify a fusion of nature's inspiration and artistic expression. In a world where urbanization has reduced space for traditional gardens, bonsai offers a captivating means of creating aesthetically pleasing interiors with miniature

trees. The idea of bonsai is to reconstruct some of nature's most stunning effects on trees which are reduced in scale. The underlying concept is to replicate the captivating effects of nature on reduced-scale trees.

Cultivating bonsai demands qualities like tranquility, patience, serenity, and an open mind to generate beauty and artistic views. It is a delicate balance of 50% horticulture and 50% artistry. The origins of bonsai can be traced back to the concept of miniaturized trees known as Penjing, which evolved into the more refined practice of bonsai. The Art of Bonsai, issued in 1957, introduced the miniature trees and landscapes to many in the West for the very first time. Bonsai can be crafted from a wide range of plants, and although there are over 100 recognized bonsai styles, experts generally consider five fundamental styles as essential: formal upright, informal upright, slanting, cascade, and semi-cascade. The commercial production of ornamental plants like bonsai has experienced substantial growth worldwide, with its monetary value increasing significantly over the past two decades, indicating promising prospects in both domestic and international markets.

How to make Bonsai

There are "tools" that are crucial to begin the process of shaping a tree for bonsai. A horticultural artist requires a pair of scissors which will allow doing the fine work of trimming in a small space. Possibly the most important tool can have in bonsai is concave cutters which allow an artist to cut branches off of the tree and leave behind a concave wound.

The main attributes for the propagation of bonsai are small leaves, shorter internodes of leaves, attractive barks, clusters of roots, and branching characteristics.

Techniques for the production of Bonsai

Selection of Plants

Among the several factors that determine the suitability of a plant as a "Bonsai," the foremost is its hardiness. It might be capable of being grown in shallow containers, and withstand the operations of pruning of roots, branches, and tough training. Plants demonstrating seasonal growth variation and flowering patterns are well-suited for bonsai. Numerous tropical trees can be grown as "Bonsai".

Potting and Repotting

An unglazed shallow and round, oval or rectangular container, having one or more drainage holes of the desired color, is used to plant very young trees. The container after covering the drainage hole with crocks is filled with normal loam soil, with fertilizers, and contains a small amount of leaf mold and river sand. A straight plant is planted in the center of the pot or a little away from the center as per the style of “Bonsai” and the pot is kept in a shade for some days. Repotting of fast-growing plants is done every year.

Pruning and Pinching

Bonsai Propagation is crucial for achieving desired shapes, often supplemented by external

support like copper wire for faster results compared to relying solely on pruning. The wire can guide the direction of shoot growth and can shape the trunk.

Watering and Manuring

Watering frequency varies with seasons, done once a week in winter and at least once a day in summer. However, during and at least once a day is useful to the plants. Over-watering is harmful. Manuring is also essential it is generally done by applying groundnut or mustard cake powder slowly.

Different Styles of Bonsai

Bonsai artists train diverse styles of dwarf trees via pruning, trimming, and wiring plants with a clear sense of the final design of the tree, envisioning a final tree design with a front and back perspective.

Styles of Bonsai

Bonsai artists employ various techniques, including pruning, trimming, and wiring, to create diverse styles of dwarf trees with a clear vision of the final design from both front and back perspectives. These styles include:

1. Formal Upright (Chokkan)
2. Informal Upright (Moyogi)
3. Slanting (Shakkan)
4. Cascade (Kengai)
5. Broom (Hokidachi)
6. Windswept (Fukinagashi)
7. Forest (Yose-ue)

Each style imparts its unique charm and character to the bonsai, allowing enthusiasts to explore a wide spectrum of artistic expression within this captivating horticultural art form.




MUSHROOMS; THE UNKNOWN TREASURE

Maryam Batool

In your childhood, I hope you had the chance to go to an agricultural area, or even in your adulthood when you were on trips in a forest area you came across a very slimy, soft species which I believe you collapsed with your hard touch and thought it to be the waste as it grows from waste.

But believe me, not everything that grows from waste is waste, and nothing in this world created by Allah is without cause. And you can only understand this exotic creature until you are served with creamy mushroom pasta or pizza with loaded mushrooms and olives.

Fortunately, we now recognize mushrooms as a substantial contributor to addressing the food requirements for the projected population of 9 billion people by 2050, and they have the potential to enhance food production in aspects related to security, safety, and quality. Statistics have shown that this Concept has increased the growth of mushrooms in the previous decade. They don't just have the generous touch but they are generous for all the humankind on Earth.

Even if we recognize mushrooms we categorize them as edible, medicinal, and poisonous mushrooms. But mushrooms have much more to offer to this fast-growing world and we need to get over these defined categories, and let the mushrooms fly in our hearts and minds.

Mushrooms are the most remarkable organisms yet mostly invisible and underrated. They are strange and magical in a way that no one can understand and are not just essential parts of our lives but are building blocks of our future. They are the first organisms that appeared on earth, about 1.3 billion years ago and made a place for plants to grow several hundred million years later.

It's the fungi (mushrooms) that help plants to grow and make our life liveable on earth. Just think for a while if the dead tree isn't decaying anymore and if the rotten fruits are staying as it is on the ground, you will be surely irritated over this and have no solution or end up doing the same process on highly expensive machines. So, there's a great need for someone who can degrade this fraction and mushrooms are doing for us with zero cost. They also have the potential to degrade all organic pollution, combat matter, and nuclear matter, and clean up the mess around us.

Mycelium are not just the roots of mushrooms but they're also the roots of our Sustainable Future and Earth's natural internet.

If some of you have seen the Smurfs TV series and looked at their houses which are like mushrooms, they represent the future. In 2014, an architectural team built a 12-meter-high tower in New York with thousands of bricks not of clay but made from mycelium. Yes, it is going to be the sustainable future of us if we start thinking and working on mushrooms the way they should be thought and worked on. If we adopt this we can reduce that 10% of the carbon dioxide emission to our environment.

Now it's time to think of an industry that produces 100 billion items per year and let's estimate how much this industry requires input and to what extent it is depleting our environment, Yes I'm talking about the Fashion Industry. Whether we are fond of it or not fashion is intrinsic to our nature and to make it sustainable, nature is offering us the solution. These are mushrooms, the tiny creatures. We love leather because it is soft, beautiful, and durable but what if something like this has a similar feature in making them they are just fueled with sawdust or the things that nobody wants and no it doesn't smell like mushrooms. We'll surely accept it without losing a moment. It's not about that we are replacing the cute cows but actually, we are protecting them and our environment, saving 96 square kilometers of land by getting 1 kg of mushrooms in one square kilometer of space.

Fungi are the gateway species that can open the door for many biological communities. As Paul Stamets said, **"Engaging mycelium can help save the world"**. Fungi are an urgent need for this devastating world and the health of our planet. It's time to take mushrooms to the world of design and adopt planet-compatible solutions that are right in front of us. It has great potential and is offering us multiple advantages. We just need to explore the ways to unfold its powers and accept these offers immediately for us, for our planet, and for our lives.

THE POWER OF WORDS: HOW TALKING TO PLANTS HELPS THEM GROW

Bushra Bilal
82-PhD-BOT-21

For many years, people have talked to plants as a way of nurturing them and promoting their growth. While this practice may have been traditionally dismissed as mere folklore or New Age pseudoscience, recent scientific studies have revealed surprising evidence that suggests talking to plants can indeed have a positive impact on their overall health and growth. This article delves into the fascinating world of plant communication and explores the reasons behind the beneficial effects of talking to our leafy

friends and unveiling the silent language of plant communication.

The Language of Plants: Contrary to popular belief, plants are not static and indifferent organisms that merely exist. They possess complex sensory mechanisms that allow them to perceive and react to their surroundings. Although plants lack a central nervous system, they have been proven to possess an array of sensory perceptions and responses. Through a network of specialized cells and hormones, plants can detect light, temperature, vibrations, and even sound waves, making them far more aware and receptive than we might imagine.

Sound Therapy for Plants: Research conducted by botanists and plant physiologists suggests that plants positively respond to sound waves, including human speech, music, and other forms of audio stimuli. Similar to the way hearing sounds can affect human mood and emotions, plants have displayed surprising reactions to particular types of communication. By talking to plants in a nurturing and positive manner, their growth rate, development, and even coloration can be enhanced.

Emotional Connection: Another significant aspect of plant communication is the emotional connection that develops between the caregiver and the plant. Talking to plants promotes a sense of nurturing and care, which triggers the release of beneficial hormones in both humans and plants. Research has shown that when we express positive emotions and encourage plants verbally, we release serotonin and dopamine, feel-good hormones that boost happiness and well-being. These hormones can subsequently impact the caregiver's interactions with plants, resulting in better care and attention and thus improved plant health and growth.

The Role of Intention: Beyond the actual words spoken, the intention behind communication with plants is vital. Developing a genuine connection and expressing positive emotions towards plants is essential for effective communication. Plants are incredibly sensitive to the energy emitted by humans, so speaking to them with sincerity, love, and kindness carries more weight than mere words. The vibrations and energy produced by these emotions can stimulate plant growth and development, reinforcing the notion that plants respond not only to sound waves but also to the emotional atmosphere created around them.

Plants Scream in the Face of Stress: Unveiling the Silent Language of Plant Communication

Plant Signaling: To survive and thrive, plants have developed intricate ways to communicate with each other and respond to external stimuli. One such mechanism is the production and release of volatile organic compounds (VOCs). VOCs are chemical compounds released by plants into the atmosphere, acting as a form of chemical language through which plants can communicate with each other, as well as with insects and other organisms.

Screams of Stress: When plants face stressful situations such as insect attacks, drought, extreme temperatures, or physical damage, they respond by releasing specific VOCs, often referred to as "screams." These chemicals serve as warning signals to neighboring plants, alerting them to the imminent danger and preparing them to defend themselves. Researchers have detected these VOCs in the air and found that neighboring plants that receive the distress signals often activate their defense mechanisms as a result. This collective defense mechanism allows the plant community to unite and protect themselves against common threats.

The Role of Science: Advancements in technology have allowed scientists to identify, isolate, and analyze the specific VOCs emitted by plants under stress. Innovative techniques like gas chromatography-mass spectrometry enable researchers to identify the chemical makeup of these VOCs, providing insights into the complex communication network within the plant world. This scientific understanding opens up possibilities for developing innovative strategies to protect and enhance plant health in agriculture and ecology.

While the phenomenon of talking to plants may still evoke skepticism among some, scientific research increasingly supports the notion that verbal communication can positively impact plant growth. The ability of plants to convey distress signals and mobilize defense mechanisms provides compelling evidence of their intelligence and resilience. By recognizing that plants possess a level of sensory perception and responding to their needs through nurturing speech, we can take an active role in fostering their well-being. So, next time you find yourself in the presence of a plant friend; why not strike up a conversation? Your words may hold more power than you know.

SEROTONIN: A NATURAL MOOD STIMULATOR

Mr. Muhammad Waheed
84-PhD-BOT-21

Serotonin is a very important monoamine neurotransmitter that is essential for the better health and well-being of humans. This is not only present in humans but also in other mammals, insects, fungi, and plants. The deficiency of this neurotransmitter is associated with depression and anxiety. So, a proper amount of serotonin within the body is mandatory for normal body functions. The most commonly used method to enhance serotonin are antidepressants *i.e.,* Selective Serotonin Reuptake Inhibitors (SSRIs) or Serotonin and Norepinephrine Reuptake Inhibitors (SNRIs) that boost the concentration of serotonin within the brain but the use of these antidepressants leaves various side effects on the body. The serotonin level can also be enhanced naturally without taking medicines through physical activity, exposure to sunlight, eating

tryptophan-rich food, socializing with loved ones, and managing stress. A man can boost serotonin and gain an optimistic behavior by adopting these measures.

It is very much possible to enhance the serotonin level without medicines. When a person lifts weight, starts running, or pedals the bicycle, the body releases a very important amino acid known as tryptophan, a precursor of serotonin in the brain. This boosting of serotonin and endorphins (a hormone) provides a feeling of euphoria, a state of excitement and happiness, after the intense exercise.

Another natural way to increase the serotonin level is the exposure to sunlight. It is the most effective therapy for Seasonal Affective Disorder (SAD) and for winter blues that are caused by low levels of serotonin. When the eyes catch the sunlight, it causes stimulation in the part of the retina that signals the brain to produce serotonin. No doubt, serotonin is abundantly present in the body but it cannot cross the blood-brain barrier and the brain has to produce its serotonin.

Foods like eggs, pineapple, tofu, salmon, nuts and seeds, turkey, and dairy products like milk and cheese are rich in tryptophan. Foods are the most common method to get serotonin but getting serotonin from food for the brain is more challenging. The human body doesn't convert tryptophan into serotonin very efficiently when food is very rich in protein and tryptophan. The protein breaks into amino acids and these monomers compete with the tryptophan to traverse the blood-brain barrier. Due to this competition, a very small amount of tryptophan can cross the barrier.

One way to get extra serotonin into the brain is to take it from vegetables, legumes, fruit, and whole grains because they contain complex carbohydrates. Carbohydrates force the body to produce and release more insulin that enhances the amino acid absorption leaving the tryptophan into the blood circulatory system. So, it is recommended to mix the high-tryptophan food with carbohydrates to get a mood booster from serotonin. Moreover, social interaction also enhances this neurotransmitter.

Socializing is very important for the wellness of man. The research has proved that spending time with loved ones also enhances serotonin. Oxytocin is also called love hormone and is associated with enhanced mood and social relationships. Researchers have speculated that oxytocin and serotonin have a reciprocal relationship. Whenever a person spends time with his family/ loved ones then there is a sharp increase in oxytocin and vice versa. Similarly, stress management is a key tool for optimum level of serotonin.

A little stress is a part of life and may be good for motivation and no doubt managing stressful events makes the man stronger. However chronic or severe stress may be fatal and decrease the serotonin in the body. Moreover, repeated stress has a negative influence on the brain and causes several psychological and physical problems.

Therefore, a man should learn how to deal with stress because stress management is a key tool to maintain a healthy level of serotonin in the brain.

Serotonin is very much linked to mood booster, enhances focus, helps in regulation of digestion and sleep, and also play a critical role in mental health. Low level is associated with insomnia, anxiety, and depression. Most people depend on medication for mood regulation which certainly has side effects. The change of lifestyle may prove a better option than depending on medication to enhance the serotonin level. The research has proved that physical exertion, sunshine exposure, better diet plan, and stress management increase brain serotonin.

ARCTIC'S CLIMATE WON'T BE CONSERVED BY GREENING- HERE'S WHY

Syeda Shayan Zahra
FAST University

Climate change is taking a toll on our planet and if its effects are not mitigated timely, it would wreak havoc on Earth. The dramatic effects of climate change are visible in the twenty-first century in the form of melting polar ice caps, food insecurity, water scarcity, unprecedented droughts, and numerous wildfires that have burned vast forest areas in recent years. Numerous studies are being carried out worldwide to lessen the impact of disasters caused by climate change. As the primary cause of this climate change is global warming, extensive research is being done to find ways to reduce atmospheric carbon levels.

The Arctic region, where the temperature has tripled to the Earth's average, is one of the most severely affected regions of the globe. Climate change is already causing nature to break down in the Arctic region, putting indigenous peoples' livelihoods, health, and cultural identities at risk. In addition to this, climate change is also causing the summer sea to disappear, endangering marine species due to thinning ice, and putting wildlife in danger due to an increase in wildfires brought on by a warm climate. The Arctic region will change significantly from the one we currently have as a result of these changes, many of which are irreversible. Thus a lot of attention is being paid to protecting this area of the world.

According to a recent study on this area, despite the tundra's growing season beginning earlier, plants there aren't trapping more carbon. Satellite images show that the far Northern region is becoming greener as a result of its three times higher temperature than the global average. According to some theories, this quick "Arctic greening" will reduce the effects of climate change. The underlying theory behind this observation is that since plants absorb carbon dioxide for food production, as the Arctic region becomes greener, more carbon dioxide will be absorbed from the atmosphere by this vegetation,

ultimately lowering greenhouse gas emissions that are warming the planet.

But now the question arises; is that happening?

The Arctic tundra is a vast treeless region extending across North America and Eurasia. The top layer of soil, which is mostly frozen permafrost in the summer, promotes the growth of grasses and low plants.

By monitoring the visible and near-infrared light reflected from the plants, satellite studies have been able to trace the differences in the vegetation of the Arctic region during the past ten years. The healthy, green foliage was found to reflect near-infrared radiation while absorbing visible light. Scientists could predict plant development over large areas by using the information they can gather from reflected light. However, this data gathered by satellites cannot measure the carbon dioxide uptake by plants. Up until recently, there wasn't much information on the intake of carbon dioxide.

The researchers said that when we looked closer and compared the changes from week to week, we discovered why this Arctic greening wouldn't bring a difference. While the earlier snowmelt was stimulating plants' productivity in June, that productivity began to taper off in July—normally their peak season for photosynthesis. By August, productivity was well below normal.

It was observed that none of the Arctic vegetation i.e. shrubs, and other wetland plants were no longer sequestering carbon. The researchers attributed it to waking up earlier and being ready to go to sleep earlier. However, still, researchers have many questions about why plants behave this way.

There are two problems. Firstly, if late in the season tundra ecosystems are not able to take up carbon dioxide, the expected sequestering of carbon by Arctic plants may not be materialized. Secondly, normally tundra plants store more carbon dioxide through photosynthesis than they release, thus making them a vast sink of carbon dioxide. The long cold winters in the Arctic region slow the process of plant decomposition and lock them in frozen ground. However, when snow containing plants and other organic matter thaws, it releases a significant amount of carbon dioxide thus adding up to greenhouse gases.

The local impact goes beyond the carbon changes in vegetation, it not only impacts plants and climate, but there are far-reaching impacts it on other components of ecosystems including animals and people.

Hence, from this current study, it could be concluded that new models need to be developed to evaluate and predict the overall impact of climate change in the Arctic region as any change here will have drastic consequences for the entire planet.

MUSHROOM MYSTERY

Muhammad bin Ali
0123-BH-BOT-19

Threads of knowledge for the use of mushroom goes over millennia, most of the threads have frayed or broken in the chain of knowledge. However, the thread of mushroom knowledge has not been broken.

Mushrooms are weird; some are edible and some may kill you as they look similar to each other. This is the mystery of mushrooms, it speaks to also mycophobia, coined by Gordon Watson. When a person thinks of the landscape with plants and animals, he usually imagines a lifecycle of months and years. Contrary to what one may imagine, mushrooms come and disappear in 4-5 days. It's so powerful and yet so ephemeral that some of the mushrooms can feed and heal you, while at the same time, some of them can even kill you.

Fear is the main trigger that keeps humans away from the unknown or undiscovered things. However, mushrooms aren't new to us as human beings are one of the 23 primates who consume mushrooms, which speaks for a long ancestral use of mushroom and connects back to our evolutionary tree. According to an estimation, out of 8.3-10 million species, our planet contains 5 million species of mushrooms.

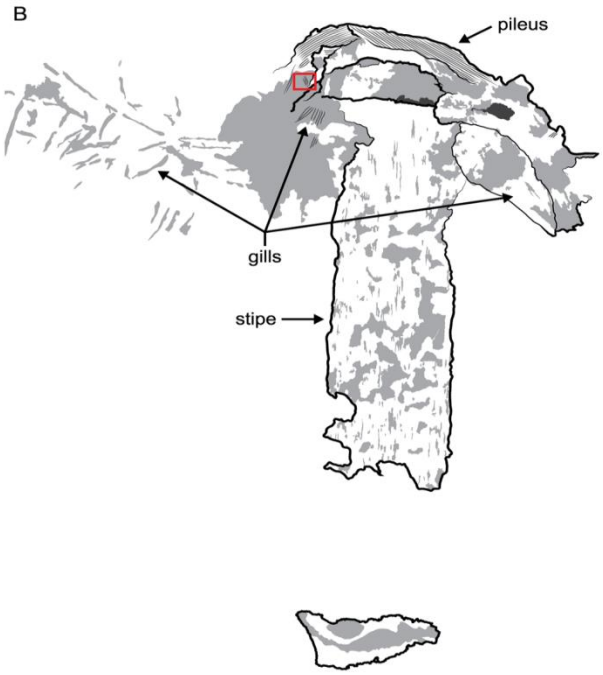
According to the mycologists, the largest storehouse of carbon are fungi as they are the source of around 30 percent of the carbon found in living organisms. Just to give a bigger picture, imagine a single meter of plant roots which may contain a potential network of fungal threads (mycelium) which may run as long as one kilometer. In other words, the network of threads can be taken as a vast natural internet on earth which has membranes sensitive to different environmental changes.

Fungal and animal cells are very similar both inhale O_2 and exhale CO_2 however they differ in nutrient uptake as fungi digest nutrients extracellularly, while animals have an internal system. Fungus have a mycelial network that looks similar to our neural or internet network which makes it a foundation for food web. It works in a way that creates an impact on the flora and ultimately on the fauna in a way to create plants by making mycorrhizal associations grow bigger and feed the animal kingdom to create debris for its mycelium. These deterministic organisms are creating this environment to establish themselves and also setting the stage for ecological evolution.

The more we study about this mysterious organithesm, the more we realize that we didn't know. The largest living thing on this planet Earth isn't a blue whale but it's a mushroom called *Armillaria ostoyae* commonly known as honey mushroom, which is a wood decomposing mushroom. It is present in Malheur National Forest, Oregon, USA. This humangeous fungus has the mycelium which covers an area of three and half square miles. It's not easy to spot as its mycelium is underground and pops up in fruiting season.

Credited: The New York Times. Honey mushroom living underground in Oregon, USA pops out the fruiting bodies to spread spores.

The world's oldest mushroom fossil was found in Brazil named *Gondwanagaricites magnificus* which was 5 cm tall and was transformed into a mineral called goethite. The estimated age of this mushroom is about 115 million years ago.



(A) Photo taken under a microscope (B) Interpretive drawing of (A), Credit: Heads *et al*, doi: 10.1371/journal.pone.0178327

Neurogenesis-causing *Hericium erinaceus* commonly known as lion's mane because they are like cascading white icicles, are edible mushrooms that generate myelin on exons of nerves. It is found to be useful for the treatment of Alzheimer's muscular dystrophy. Several clinical studies talk about the treatment of mild cognitive dysfunction or forgetting. Lion's Mane can also preserve the cognitive function that can help football players and boxers.

All gourmet mushrooms are medicinal mushrooms like shiitake (*Lentinula edodes*), maitake also called dancing mushroom (*Grifola frondosa*), reishi (*Ganoderma lucidum*), Chaga (*Inonotus obliquus*) and lion's mane. *Trametes versicolor* commonly known as Turkey tail mushroom helps in the treatment of breast cancer. *Flammulina filiformis* or Enoki mushrooms are also useful against cancerous diseases. Zombie mushroom that tears the ant's body known as *cordycep militaris* enhances athletic performance and oxygen utilization.

Photo-Credit: Stephen Axford. The growing fruiting body of *Cordycep* on the insect. Mushrooms are mysterious organisms that require more research to dig out their enormous benefits for human beings. On the other hand, knowledge of mushrooms is also essential to find out the ones which are toxic like *Amanita phalloides.*

PULSES: THE PROTEINACEOUS SUPERFOOD FROM PLANTS

Wasim Abbas

83-Phd-21

The term "pulses" is the formal label for the group of nutriments that comprises Mung bean, Faba bean, lentils, chickpeas, etc. These are all plant-based foods that belong to the Papilionaceae family. Pulses hold significant importance as a source of sustenance for billions of people across the world. The terms "pulses" and "legumes" are often used interchangeably, but it's worth noting that while all pulses are legumes, not all legumes are considered pulses. Pulses are widely utilized as a staple food on a global scale.

According to the Food and Agriculture Organization (FAO), there are 11 primary types of pulses, including Chickpeas, Cowpeas, Bambra beans, dry beans, dry peas, dry broad beans, lentils, vetches, and lupins. Each year, February 10th is celebrated as World Pulses Day by the FAO. This organization actively promotes the cultivation of pulses worldwide

due to their efficient use of water and minimal need for fertilizers. From an ecological standpoint, pulses are a sustainable source of protein-rich food. Consequently, pulses are prominently featured in official dietary guidelines for promoting healthy eating and managing various health conditions.

Below are some top motives to start adding these to your daily food.

A super food rich in protein and fiber: 100g boiled pulses offers 9g of protein and more than 7g of fiber. The highest amount of protein content is in Mung dal which is 24g per 100g. Pulses contain a high percentage of folate and lysine and this makes them the perfect component of multi-grain flour. Formerly, animals were considered the chief source of protein. However, using animals to acquire proteins was considered unethical in certain ethnic groups. Thus, the attention shifted to pulses for use as a protein source. Pulses are the 2nd most consumed crops globally after cereals as these contain 21 to 25% of proteins. Pulses also contain higher amounts of Phytochemicals, Vitamin B complex (Niacin, Riboflavin, Thiamine), and minerals like potassium, magnesium, zinc, and iron. They contain much more antioxidants as compared to blueberries and cranberries.

Weight loss and pulses: Pulses are good for weight loss as they contain more complex carbohydrates and proteins compared to cereals and vegetables. More complex carbohydrates and proteins provide satiety for longer durations. Studies depict that people on low low-calorie diet when taking 100g of pulses daily, lost four times more weight as compared to people who take only a tablespoon daily along with salads.

Diabetes and pulses: Pulse starches are resistant to digestive enzymes' action due to their high retrogradation tendency, resulting in a low glycemic index. These benefits of pulses help maintain blood glucose and insulin levels

Prevention of Cardiac diseases: The use of pulses in a routine diet helps prevent many cardiac problems as flavonoids present in pulses maintain our blood pressure.

Anti-tumor activity: Many pulses are dark-colored and pigmented. These pulses tend to have more phenolics than light-colored varieties. Phenolics and flavonoids in the hull of pulse grains also vary in color. Flavonoids and Polyphenols are anti-tumor, anti–inflammatory, and anti–allergic in their action. So we must use pulses in our daily routine diet at least once.

Pulses as anti-aging agents: Polyphenolics of pulses are highly useful for the prevention of lipid peroxidation and scavenging free oxygen radicals due to their high antioxidant activities. So their daily use helps to prevent aging-related damage to the body.

Pulses and rheumatoid arthritis: Kidney beans, and red beans are rich in antioxidants so these help to control inflammation and swelling of joints in rheumatoid arthritis. People who use pulses regularly have good joints as a whole as

pulses also provide a good amount of vitamins and minerals.

Pulses as immunity boosters: Routine usage of pulses boosts immunity as these contain high protein content along with many vitamins and minerals. Many recent studies on pulses showed better immune functions in COVID–19 and HIV patients.

Pulses are eco-friendly: Pulses utilize less water for their growth and have a low carbon footprint as well. Pulses only need 162 liters for ½ Kg yield as compared to the same amount of meat which needs 4000 liters of water for its growth. Pulses also need less synthetic nitrogenous fertilizers as these form symbiotic relationships with bacteria. These have root nodules. Root nodules are a mutualistic association between the roots of leguminous plants and the Rhizobia genus of bacteria. In root nodules, these mutualistic bacteria fix atmospheric nitrogen into organo–nitrogen compounds.

Conclusion: Thus pulses are grains of immense importance possessing high nutritive value. Their nutritive content could be enhanced by producing genetically engineered varieties. Moreover, as climate change is harshly impacting their yield focus should be driven towards finding ways to protect these highly beneficial crops.

PROSPECTIVE HEALTH BENEFITS OF *ALLIUM CEPA*

Muhammad Shaheer Haider

1241-MSc-BOT-14

Allium cepa, commonly known as onion, belongs to the family Liliaceae. Originally originating in Afghanistan, USSR, and Iran, onion is now being cultivated in more than 176 countries. The phytochemical profile of *Allium cepa* has made it popular among people. Onion has high therapeutic potential and is used to alleviate and treat various diseases.

Chemical Profile of *Allium cepa*

Onion contains about 90% water with high sugar and dietary fiber. It is rich in folic acid, calcium, magnesium, phosphorus, and potassium. Research has shown that onions contain a high concentration of phenolic compounds such as kaempferol, ferulic acid, quercetin, gallic acid, and protocatechuic acid. Flavonoid content is also high in onions. In contrast to apples, broccoli, and blueberries onions contain 5 to 10 % more quercetin which is effective in treating cancer and cardiac diseases. Other research has shown onion to be rich in a variety of compounds such as anthocyanins etc.

Bioactive compounds

The pungent smell of onion is due to the high sulfur compounds present in it that create a burning sensation in the throat and mouth. Several saponins such as 5-Hydroxy-3-methyl-4-propylsulfanyl-5H-furan-2-one are also present in onion and garlic. Several researchers reported antitumor, antifungal, blood coagulability, cytotoxicity, cholesterol-

lowering, and antispasmodic effects of saponins isolated from onion and garlic. Carbohydrates such as glucose, fructose, and sucrose are also present in onion. Two external fleshy layers of onion are rich sources of fructans. A diet rich in onions is found to be effective in treating and preventing several diseases such as cancer and CVD.

Therapeutic potential of *Allium cepa*

A. cepa is an effective microbial agent. Many microorganisms have been found vulnerable to extracts of *Allium cepa*. Quercetin present in high concentrations in onions has been proven effective in inhibiting the growth of *Micrococcus luteus* and *Staphylococcus aureus*. Three different essential oils of onions have high antimicrobial efficacy against pathogens such as *Salmonella enteritidis, Fusarium oxysporum, Penicillium cyclopium, Staphylococcus aureus, and Aspergillus niger*. These three essential oils are red, green, and yellow.

Treatment of Cardiovascular diseases

CVDs are the major cause of death across the globe. Hypertension, peripheral artery disease, cerebral disease, pulmonary inflammation, rheumatic heart disease, congenital cardiovascular disease, and heart insufficiency are all cardiovascular diseases. There are several causes of these diseases. However, onion is found effective in treating many of them. Flavonoid content in onion is used to treat and prevent heartburn and CVDs. Onions can also cure diabetes and stomach cancer. Quercetin present in onions minimizes oxidative content thus reducing the risk of strokes and cardiac problems. Leaves of *Allium cepa* have shown cardio-protective activity.

Wound healing

Prostaglandins, β-sitosterol, kaempferol, myritical acid, and ferulic acid are contained in the *A. cepa* bulb. Traditionally, bulb extract of onion has been used as abortifacient. The group treated with *A. cepa* showed extensive granulation growth begun on its surface. The treated unit of wound displayed complete healing of wounds with almost normal architecture of the reticulin and collagen.

Anticancer effects

Cancer, the uncontrolled proliferation of abnormal cells, results in the death of millions of people globally. The present anti-cancerous drugs have low pharmaceutical indexes which means that their higher doses can have extremely adverse impacts on human health. Therefore, much research is now being conducted to find a cure for cancer through natural *i.e.* herbal products. Researchers suggest that due to the presence of different organosulfur derivatives, flavonoids, polyphenols, quercetin, and its glycosides onions also have anticancer potential. Organosulfur compounds are found to be strong anticarcinogens that activate detoxifying compounds thus eliminating cancer-causing substances. A group of researchers showed that polyphenols isolated from lyophilized *A. cepa* inhibit the development of human AGS cells (a human gastric adenocarcinoma cell line).

Antidiabetic activity

According to a WHO report, globally around 442 million people suffer from diabetes. Various medicines have been introduced at the commercial level to treat diabetes, however many of them have serious side effects. Thus a shift has been made towards herbal products for diabetes treatment. Currently, several types of research are being carried out to determine the antidiabetic activity of onion. Much research is being conducted on diabetic rats to understand the effects of natural products on diabetes. Kaempferol-3-O-β-D-6 (P-coumaroyl) glucopyranoside present in *Allium cepa* is found to promote glucose uptake in rat's soleus muscle thus showing antidiabetic activity. Oral uptake of onion extract has been found to significantly reduce blood glucose levels in diabetic rats after 24 hours of uptake.

Conclusion

The above details show that *Allium cepa* (onion) is highly advantageous. It has several benefits related to health. If taken in small quantities daily it can save us from chronic diseases. Although much research has been conducted on its pharmaceutical importance, still more work needs to be done to explore the hidden benefits of onion.

CLIMATIC DEGRADATION OF DESERTS

Yusra Sadiq

Lahore College for Women University

While deserts could become the "**powerhouses of tomorrow**" by capturing and exporting solar energy, life in these regions could become unbearable due to global warming, according to a report published by the United Nations Environment Programmed.

Deserts are the areas where living conditions are challenging and sometimes uninhabitable. Like other ecosystems of the world, climate change is also impacting deserts in unprecedented ways. It's hard to imagine the impact of global warming on the world's already hot deserts. However, even small changes in temperature or precipitation could drastically impact plants and animals in desert ecosystems. In some cases, global warming is predicted to increase the area of deserts, which already cover a quarter of Earth.

Anthropogenic activities like firewood gathering and grazing of animals are converting semi-arid regions of the world into deserts, a process known as desertification. Global warming is drying up water holes in deserts.

The water table is depleting rapidly. The warm temperature is also increasing the incidence of wildfires thus eliminating the slow-growing vegetation and replacing it with fast-growing trees. Scientists have predicted that after 2050 heat events with temperatures above 56°C will become more frequent in the Middle East and North Africa. Likewise Sahara desert which is considered an open-air museum of nature for scientists is also bearing the brunt of climate change. Evidence suggests that previously there were many wetlands in the Sahara desert which now have vanished. Due to the imminent threat to deserts, much research is being conducted on deserts.

In recent research conducted, scientists were surprised to find the production of nitrous oxide, the third most potent greenhouse gas, in desert heat. This new study published in the journal *Biogeochemistry*, examined how and why desert-inhabiting bacteria are emitting nitrous oxide. This research has been established on the work published in 2020 when the researchers under the supervision of UCR landscape ecologist Darrel Jenerette discovered that desert soils produce substantial amounts of nitrous oxide after rain.

The traditional view as explained by prominent researchers is that nitrous oxide comes from fertilized agricultural fields like those in the Midwest. Growers add more nitrogen ammonium and nitrates than needed by plants after rain bacteria excess nitrates into nitrous oxide by a process known as denitrification. This process enables bacteria to survive in excess water when there is no oxygen in the soil. In such circumstances, bacteria use nitrates in place of oxygen and give out nitrous oxide which is known as the denitrification process.

This denitrification in deserts may arise from different sources of nitrates. One reason for this high concentration of nitrates is the combustion of fossil fuels. Combustion releases pollution that gets deposited in soils over time and re-emerges after rain as nitrous oxide. Nitrogen released from automobiles and industrial processes is of different types. When combined these nitrogen forms are known as NOx and they can produce tropospheric ozone which is a greenhouse gas and adversely affects the lungs. This ozone form shouldn't be confused with the beneficial one that lies above the stratosphere and protects Earth from UV radiation.

To determine whether remains of fossil fuels can cause desert denitrification, two Southern California sites were picked in the University of California Natural Reserve System. For examining the nature of air after the addition of nitrate in the soil, a coffin-like box was used which contained measurement instruments. It also had an air conditioning unit as the temperature often reached up to 120 degrees. Generally, temperature up to 100 degrees Fahrenheit is believed to prevent microbial activity. However, in current research “it was surprising to see much N_2O despite much heat" says Krichels, a participant in this current research. According to Krichel, this concentration was ten times higher than anything he saw in the Midwest.

Much evidence collected by various researchers suggests that droughts are becoming common globally and that these droughts will be punctuated by large rain events. Resultantly, the drying and wetting cycles will become more common which will result in high emission of greenhouse gases. Like in the Sonoran desert, scientists have found that vegetative cover is declining sharply due to climate change. A comparative study on the vegetation of the Sonoran desert has shown a significant reduction in perennial vegetation than it was in 1985.

To conclude, we can say that most people are unaware of these processes taking place in desert soils and that the nitrogen added up by them can become a part of the atmosphere thus severely damaging climate and human health. In present times, there is a dire need to take well-planned steps to mitigate these harmful impacts, as the soil is home to multiple life forms and any such change can drastically impact the entire globe.

IMPACT OF INVASIVE FLORA ON INDIGENOUS VEGETATION

Tahira Khalid

0104-BH-BOT-19

Invasive plants are introduced into the new habitat either unintentionally or deliberately. These plants damage the local vegetation by competing for space, nutrients, and water. Accompanied with hazardous effects, there are some benefits of these plants but these do not exceed the negative impacts. Invasive plants are considered the major threat to vegetation as they replace native plants, increase the disease rate, or even kill them. In Pakistan just for the ornamental purposes, many invasive species are intentionally cultivated most of which belong to the family Asteraceae. The term invasive species is not only applied to the flora, it also includes the fauna. This article discusses the impact of a few worst invasive plants like *Parthenium hysterophorus, Prosopis juliflora, Lantana camara, Broussonetia papyrifera,* and *Ageratum Conyzoides*.

***Parthenium hysterophorus*:** It is an invasive herb that belongs to the family Asteraceae. It is commonly known as gandi booti or ragweed. In

Pakistan, it was first reported in 1980 since then it has been rapidly growing in different areas of the KPK, Punjab, and Sindh. The reasons for its invasiveness are allelopathy, high reproductive potential, adaptive nature, rapid growth rate, and the absence of natural enemies. It is spreading everywhere and replacing the native flora. The impacts of *P. hysterophorus* on local vegetation as well as on humans are very clear. It contains many growth-inhibiting chemicals like ambrosin, hysterin, and parthenin.

These growth inhibitors are released into the environment and suppress the native crops. Many types of research show the yield decline in different countries. 40% crop in India has been decreased due to this invasive herb. If the spread of *Parthenium hysterophorus* is not controlled, it decreases the Sorghum grain between 40-97%. It also acts as a host of disease-causing viruses. These viruses attack other plants and destroy them. It shows that *Parthenium hysterophorus* is one of the major causes of crop loss. On the other hand, it also causes allergy, bronchitis, dermatitis, and several other diseases in humans and animals. Surprisingly, it is used in bouquets as an ornamental plant.

***Prosopis juliflora*:** It is an invasive tree which is commonly known as kikar or mesquite. For the stabilization of dunes, it was first cultivated in Sindh back in 1857. The reasons for its invasiveness include the great potential to tolerate salinity, drought, and waterlogging. It produces a large number of seeds that's why it is rapidly expanding and replacing the local vegetation. Many poor people use it to fulfill their domestic needs. Like *Parthenium hysterophorus*, it contains many harmful metabolites which cause the death of herbivores. Due to its aggressive colonization, the growth of native plant species has decreased. In Sindh and mainly in Southern Kirthar National Park, it is considered the major pest as it replaces the local vegetation of *Acacia*, *Tamarix*, and many other shrubs.

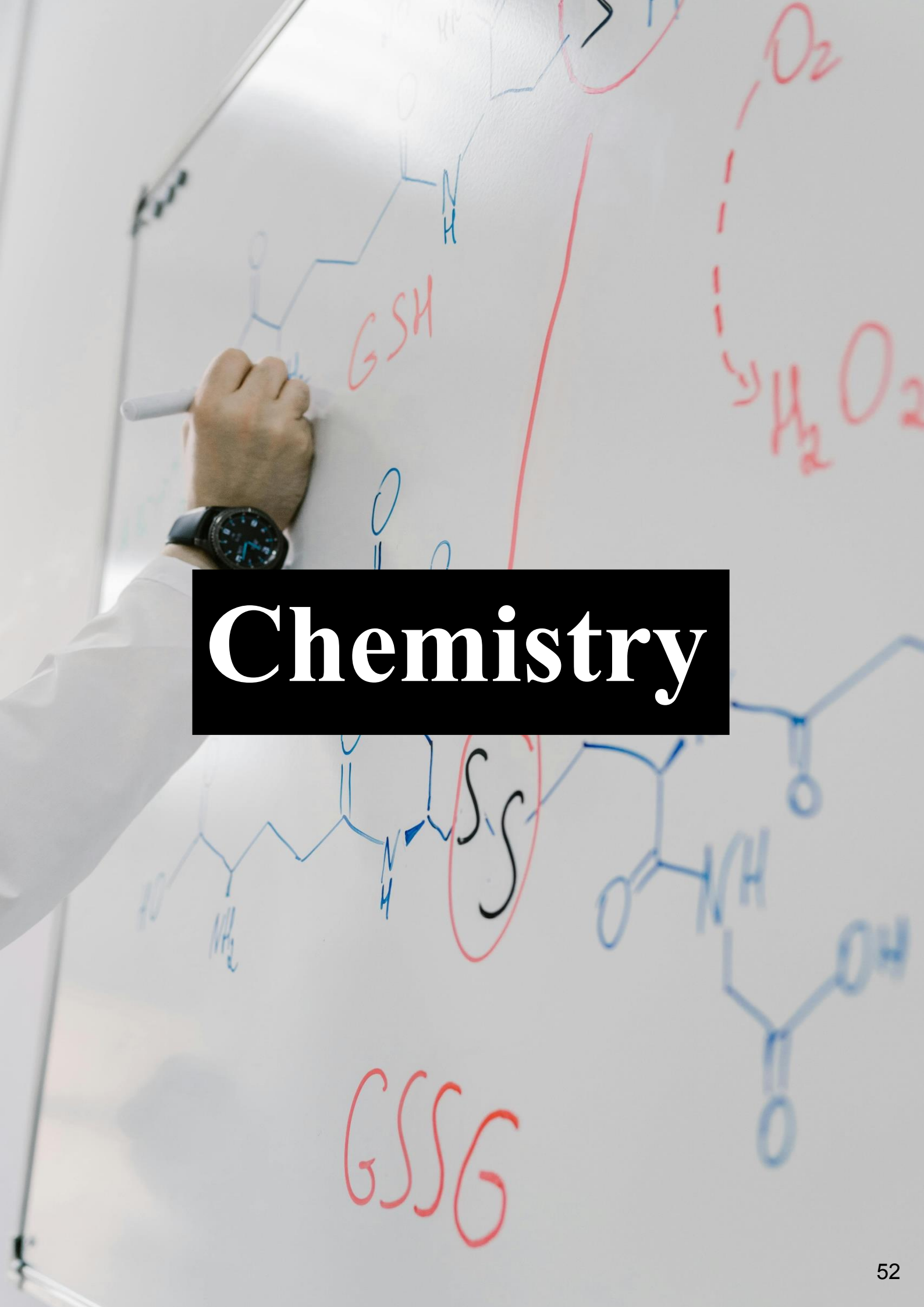
***Lantana camara*:**

It is the invasive shrub which is commonly known as Punch Phuli. It grows mainly in tropical and subtropical regions. The main reasons for its invasiveness include land disturbance, climate, over-grazing, and topography. Birds spread their seeds and they grows rapidly there. It is cultivated intentionally as it is an ornamental plant and it produces fruit (Berry-like drupe) in large quantities. Animals die due to photosensitivity and poisoning after grazing as it contains triterpenoid compounds. *Lantana camara* is a weed that infests many crops in natural and semi-natural vegetation, encroaches on agricultural land in many nations, and lowers the carrying capacity of pastures. Because of the increase in dry biomass, it may suffocate

plants and intensify fires, displacing natural scrub communities.

***Broussonetia papyrifera*:** It is commonly known as Paper mulberry or jangli toot. It is an invasive tree that was intentionally introduced to Islamabad in 1960. The factors which contribute to its invasiveness are rapid growth rate, allelopathy, and vegetative regeneration; can also tolerate different habitats and seed dispersal. It grows so rapidly that it changes the xerophytic land into the mesophytic. *Broussonetia papyrifera* has adverse effects on local vegetation as well as on humans. It reduces the local plant species by their lethal chemicals and causes their death. Many beneficial woody and herbaceous species have declined due to this worst invasive plant. Humans suffer from Asthma and Rhinitis after inhalation of its pollens. The natural vegetation of the National Park and adjacent valleys in the eastern part of Islamabad and south of Azad Jammu and Kashmir are increasingly at risk from this alien species.

Thus, from the above discussion, it can be concluded that the negative aspects of invasive plants exceed their benefits. Moreover, it is a major threat to the local vegetation. Hence, we should avoid them as ornamental plants and protect the beneficial local vegetation.



Chemistry

CHEMISTRY TIMELINE 2023

January 2023: Hydrogen Storage Advancement

The new year started with promising developments in hydrogen storage technology. Researchers created a ground-breaking substance that enhances the safety and efficiency of hydrogen storage dramatically. This accomplishment is essential for moving hydrogen forward as a clean energy source since it overcomes one of the major hurdles in hydrogen-based technologies.

February 2023: Carbon Capture Breakthrough

The month of February represented a watershed moment in the fight against climate change. Scientists have introduced a unique carbon capture method that uses sophisticated nanomaterials to absorb and preserve carbon dioxide exhaust from industrial operations more efficiently and cost-effectively. This advancement has the potential to be critical in lowering emissions of greenhouse gases.

March 2023: DNA-Based Computing

Researchers successfully used molecules of DNA as data storage and processing components in March, di splaying a spectacular combination of biology and chemistry.
This discovery could pave the way for small, highly effective molecular computers that do sophisticated c alculations, data storage, and encryption.

April 2023: Sustainable Plastic Alternatives

The challenge of worldwide plastic pollution saw a possible resolution in April. New agricultural waste-derived biodegradable plastics have been released on the market. These environmentally friendly substitutes have the same functionality as conventional plastics while drastically lowering waste and adverse effects on our surroundings.

May 2023: Water Purification Advancement

An advanced water purification method based on cutting-edge nanomaterials was developed in May. This ground-breaking technology enables communities who lack access to safe drinking water with affordable and extremely effective water filtration solutions.

June 2023: Superconductivity at Room Temperature

A significant advancement in the field of superconductivity was made in June. A substance was discovered by researchers that displayed superconductivity at normal temperature, a phenomenon that was previously only possible at very low temperatures. By significantly lowering energy losses, this discovery has the potential to revolutionize energy transmission, storage, and transportation.

July 2023: Green Chemistry Breakthrough

A big development toward environmentally friendly chemical manufacturing procedures occurred in July. A green chemistry innovation has led to the creation of a sustainable synthesis technique that considerably lessens the environmental impact of chemical manufacture. This invention prioritizes the usage of waste-generating chemicals, limits the production of trash, and maximizes the use of renewable feedstocks.

August 2023: Personalized Medicine Milestone

In August, advances in pharmacogenomics marked a significant turning point for customized medicine. Understanding the genetic elements that affect a person's response to medications has advanced significantly. Using this knowledge to tailor medication therapies based on a patient's genetic profile leads to better therapeutic outcomes and fewer adverse effects.

September 2023: Atomic-Level Drug Delivery

A ground-breaking development in drug delivery technology brought the year to a close. As researchers created techniques for precision medicine delivery at the atomic scale, nanotechnology advanced to new heights. This innovation makes it possible to administer medications specifically to certain cells or tissues, increasing therapeutic effectiveness while lowering negative effects. It has the potential to completely change how people receive medical care, especially in fields like cancer therapy.

A SECOND SKIN?

Nehal Fatima

How would you feel if I were to tell you that now you can mount electronic devices directly to your skin or even implant them inside your body? Let me introduce you to a new electronic device called “Second Skin”. It is an electronic system, fully integrated and composed of electronic components capable of performing multifunctional tasks such as providing smart health care, improved capabilities and even preventing certain diseases. It can also connect you to the internet by serving as a module and allowing for wireless communication. It seems like shining metal armor; the only difference is that it is not shiny or metallic.

Second skin wearables, as the name suggests, are second to skin, meaning these are a class of materials that are designed in such a way that they provide a comfortable and flexible layer of protection for the skin. These wearables come with a variety of applications, from enhancing the performance of medical devices to improving the fit and comfort of clothing. At the heart of these materials is a complex chemistry that enables them to provide the desired properties of comfort, flexibility, and durability.

The chemistry behind these second-skin wearables is based on “polymers” which can be applied to the skin as a “thin film”. These biocompatible polymers are made of acrylics or silicone and can stick to the skin without resulting in irritation or discomfort. This film is designed in such a way that it allows the skin to “breathe” and prevents any build-up of moisture which may cause irritation or discomfort.

The success of these breakthrough second-skin wearables lies in the chemistry of the polymers that make these up. These polymers are designed to move and stretch with the skin and be flexible. This flexibility is made possible through crosslinking, which is a chemical process that creates strong bonds between adjacent polymer chains. Thus, by carefully adjusting the degree of crosslinking, it becomes possible to produce materials that are highly flexible and durable, while also being comfortable and breathable.

The use of additives to improve the performance is another aspect of the chemistry of second-skin wearables. For instance, a hydrophilic coating can help some materials absorb moisture, while treatment with anti-microbial agents can be used to stop and prevent the growth of bacteria or other microorganisms. These additional processes and materials have enormous applications and enormous new possibilities. Moreover, these additives can be selected carefully and incorporated into the polymer to provide desired properties without having to compromise the overall performance of the film.

A wide range of applications have driven the development of second-to-skin wearables. Especially, in the medical field, these second-skin wearables can be used to enhance the

performance and scope of medical devices, such as wound dressings, or any such application which requires comfort, flexibility, or conformation to the shape of the body. Besides medicine, the second skin wearables have found applications in the field of sports, where they can be applied to improve the fit and comfort of sportswear, including compression garments, which need to be supportive and flexible.

The recent development in second-skin wearables has been promoted by advances in materials science and nanotechnology. Research is being done to develop newer materials and newer polymers that can serve to be more flexible, durable, and comfortable than the existing ones. New applications for these materials, such as smart textiles which could monitor vital signs or deliver drugs directly to the skin are also being investigated.

In conclusion, the chemistry of second skin wearables is a complex and rapidly developing field that holds great promise for a wide range of applications. By carefully controlling the properties of the polymers used and incorporating the right additives, it is possible to create materials that are highly flexible, durable, and comfortable, while also providing the necessary properties of breathability and moisture management. With ongoing research and development, these materials will likely continue to play an increasingly important role in a wide range of industries and applications.

CARBON SEQUESTRATION BY FOREST ECOSYSTEM TO CURB CLIMATE CHANGE

Sundas Shehzad

As a significant component of the terrestrial ecosystem, forests cover 30 to 43% of the planet's surface. For human consumption, forests are a significant source of fiber and fuel, and they play a vital role in the economies of many parts of the world. Additionally, forests offer a variety of functions, such as carbon sequestration, wildlife habitats, and clean water. The main source of vegetative carbon is forest biomass, which is also found in forest soil. Approximately 359 billion tons of carbon are stored in forest vegetation worldwide. In general, there is twice as much carbon stored in forest ecosystems as there is in the atmosphere.

One of the biggest risks the world currently faces is deemed to be climate change. The concentration of atmospheric carbon dioxide (CO_2) has increased from 280 ppm at the time of the preindustrial revolution to 394 ppm at present due to the combustion of fossil fuels and deforestation. The outcome is an unusually rapid rise in the average global surface temperature. These modifications, along with variations in precipitation and nitrogen depositions, are probably going to have a big impact on tree development, forest dynamics, and ultimately carbon storage in forest ecosystems. Predicting

ecological carbon dynamics in forest ecosystems requires an understanding of the cumulative effects of major climate changes, such as global warming, higher CO_2, precipitation change, and nitrogen deposition. The amount of carbon that forest ecosystems sequester into ecosystems (carbon sinks). When climate change stimulates photosynthesis, due to increased CO_2, improved growing conditions, or by decrease in plant or microbial respiration process because of altered chemical or physical composition of the plants, the ecosystems act as carbon sinks. Otherwise, the converse processes can make ecosystems act as carbon sources.

Gross primary productivity (GPP) is the total amount of photosynthetic production during a year. The net primary productivity (NPP) of an ecosystem, or the actual carbon fixed into plants, is the equilibrium between GPP and the carbon lost through plant respiration (i.e., the construction and maintenance cost). The stored carbon is released back into the atmosphere through respiration as leaves and branches fall and deteriorate. Organic matter that has died will shift in part to the soil. The net carbon balance of an ecosystem is determined after accounting for carbon losses caused by microbial respiration in soil and litter. Net ecosystem productivity (NEP) is the term used to describe this net balance.

For decades, researchers have examined how changing atmospheric CO2 concentrations affect forest ecosystems. Free-air CO_2 enrichment (FACE) technology, which enables the fumigation of intact forest ecosystems with air enriched in CO_2 in large-diameter plots without barriers, has been used more recently to expose trees to increased CO_2. Experimental research offers concrete proof of increased ecosystem productivity, carbon sequestration, and vegetation in forests with high CO_2 levels.

Determining the terrestrial carbon feedback to climate change necessitates experimental research on how hotter temperatures affect forest carbon sequestration. Several warming studies have been carried out in forest ecosystems employing closed- and open-top chambers, overhead infrared lamps, passive heating, electrical surface soil warming, and greenhouses. The Next Generation Ecosystem Experiments-Tropics (NGEE-Tropics) project was started to investigate how other natural and anthropogenic changes, such as changing precipitation patterns, rising greenhouse gas concentrations, and rising temperatures, affect the impact of tropical forests on the planet's climate.

Many different forest ecosystems have had their precipitation altered by changing the amount of rain that falls, its seasonality, or both. Rainout shelters have frequently been used to imitate drought, whereas irrigation in conjunction with rainout shelters has been used to simulate increases in precipitation. Plant growth often responded favorably to experimental precipitation increases and unfavorably to experimental precipitation declines.

Since 1864, there has been a rise in knowledge of the effects of ozone (O_3) on plants, especially in the second half of the twentieth century. At the beginning of studies carried out in greenhouses, growth chambers, and open-top chambers, ecologists typically employ twice the O_3 concentration or increase it at a particular level, like how elevated CO_2 is done. Experimental research revealed that elevated O_3 typically reduced the formation of biomass, with root biomass being more sensitive to elevated ozone levels.

As a result of human activity, atmospheric deposition of reactive nitrogen compounds (i.e., nitrogen in forms that interact with the biosphere and atmosphere) can have significant effects on carbon sequestration in forest ecosystems.

Future climate change is significantly influenced by how forest carbon sequestration responds to climatic change. Technological developments like large-scale air warming (including ecosystem level) and enhanced infrared heating can help us better understand understudied processes that affect both aboveground and belowground vegetation.

CHEMISTRY OF ALGAE

Hiba-tul-Noor
0237-BH-CHEM-19

Look around. The whole word that meets our eye is a lot more than it seems. For instance, when we breathe it seems as if we are just taking air in and out, however, in reality, gas exchange is taking place at the cellular level which is mandatory for our survival. The air we inhale is rich in oxygen, however, the exhaled gas is mostly carbon dioxide. Although it is common knowledge that plants release oxygen in our atmosphere, it is a surprising fact that this task was executed by tiny organisms some 650 million years ago, way before the first complex plant species were found. These tiny organisms are known as **Algae**. It is not wrong to say that life began due to the oxygen released by Algae in ancient times. The word Algae is derived from the Latin word "*alga"* meaning **seaweed**. It is a diverse group of chiefly photosynthetic and aquatic plant-like organisms that ranges from unicellular, diatomic to multicellular kelp about 200 feet in length.

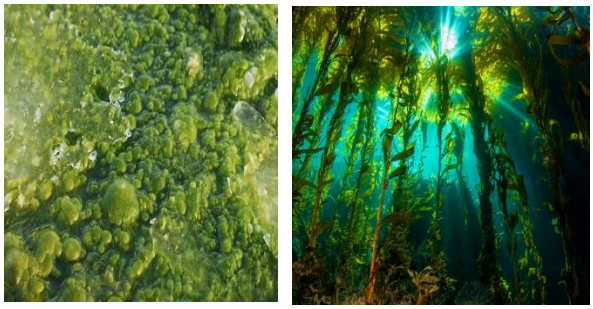


Figure: the picture on the right is a slimy, stinky green algae, and on the left is the Kelp Forest.

One interesting fact about kelp is that they are so long that they may function as shelter for giant sharks.

Recently chemists have celebrated Earth Weak (April 16-22, 2023), which was based on the theme of "The Nosy Chemistry of Algae". Most of us have seen algae as green mushy material growing around but that is not it about algae. You may have heard the joke:

*If it is **green and greasy** it is **biology**, if **smelly** it is **chemistry** and if it doesn't work at all it is **physics**.*

But in the case of algae, it is not only biology, but it links to chemistry in a variety of ways. From supporting life to providing essentials like food, clothing, bioplastic, and even biofuels algae play a crucial role that cannot be denied.

Let us take a brief moment to admire the wonders of Algae. Algae is composed of elements about 50% carbon, 10% nitrogen, and 2% phosphorus in the form of proteins, carbohydrates, lipids, and nuclear acids. That is why these elements in water are necessary for the growth of Algae but what happens when extra elements are added to water bodies in the form of household waste and sewage?

The answer is simple, extra nutrients mean extra growth. This rapid growth of algae results in algal blooms that cover the surface of the water, blocking sunlight for other organisms and consequently leading to the deaths of these underlying organisms. The decomposers then decay these dead bodies by utilizing oxygen dissolved in water and the cycle goes on. This results in turning fresh water into a stinky pound.

What is special about algae?

Here are some amazing facts about algae that may lead you to admire the importance of this tiny creature.

Algae glows

A few **dinoflagellates** produce glow on their own via **bioluminescence**. Bioluminescence is a natural phenomenon that occurs when an emissive molecule **luciferin** reacts in the presence of an enzyme ***luciferase***. These dinoflagellates produce a glow in the ocean. This glow is the cold light because only 20% of this light is converted into thermal energy.

In 2016 Disney launched an animated movie **MOANA**. In this movie, these glowing algae help Moana to escape from the realm of a giant turtle "Tomatoa". Isn't it exciting?

- Some algae produce glow via **chlorophyll fluorescence**. Most of the chlorophyll in plants when irradiated by light produce **red fluorescence**. When a violet-colored laser beam of 405nm wavelength is allowed to fall on green algae it produces a pink glow.

- Algae belongs to autotrophs, but it still requires some food to live. Hence where it found these thriving requirements it grew there. Some greenish algae grow in the cave and fulfill their needs from the light produced by electrical lightning.
- Standing alongside a pool or lake on a hot sunny day some of us may have noticed bubbles rising from aquatic plants. These bubbles are oxygen gas which is produced by algae through photosynthesis.
- Diatomaceous earth, also called **cellulite** which is often used in chemistry laboratories for filtration is produced by some algae.
- The light that brightens the surface of the ocean is produced from quick flashes of light emitted by dinoflagellates which lasts just for 0.5 μ seconds.

In the end, we may say that despite being slimy and stinky algae is playing it important role in our environment. It has found its use in our personal care products to the food we eat, clothes we wear, drugs we take, fertilizers we use, and biofuel which is now our utmost need.

COFFEE TO PREVENT ALZHEIMER'S?

Fizza Zehra
Kinnaird College for Women's University

What is the first thing that comes to your mind when you hear the word protein? What if you come to know they control you? Your DNA (that contains all the genetic information about your characteristics) is even controlled by the proteins!

Think of proteins as choreographers of life. Being biological catalysts (molecules that speed up the chemical reactions in your body) they regulate all the reactions. Living organisms must defend themselves, reproduce, digest the dietary contents, and communicate with each other. Guess what controls them? Yes, Proteins! 20 amino acids arranged like a string of beads can fold in millions of ways, where the slightest changes can result in life-changing consequences. Akin to alphabets where 26 alphabets can make up thousands of words, 20 amino acids in different combinations can form numerous proteins.

Nature employs proteins due to their incredible capabilities to manifest its wonders! Millions of cells in your body require oxygen to work, how is it transported? It's the superhero that we call hemoglobin within the crimson rivers that relinquishes oxygen to the waiting cells. The slightest twists and replacements in the primary bead sequence (amino acids) of proteins twist one's life. Alzheimer's, a neurodegenerative disease, weaves the tapestry of mosaic memories due to the accumulation of misfolded proteins between the synapses. The exact mechanism of onset and the factors' causing Alzheimer's are still unclear, but it is thought to occur due to "Tau" named protein that plays an important role in the normal functioning of the brain. Due to the development of certain medical conditions,

however, these tau proteins can agglomerate and clump together to form fiber-like structures. Thus, prospective research that aims at curing neurodegenerative diseases focuses on preventing the clumping of these tau proteins.

You may have guessed by now from the title of this article, however, that espresso has come to the rescue of those researchers. According to research carried out by researchers at the University of Verona and published in the *Journal of Agricultural and Food Chemistry,* it has been found that certain chemicals found in coffee and chai may be advantageous against neuronal diseases. But how does coffee help in preventing the clumping of these proteins?

Researchers made use of Nuclear Magnetic Resonance Imaging (NMR) to study the composition of the espresso essence and were able to identify its main components and performed in-vitro studies to collect relevant data.

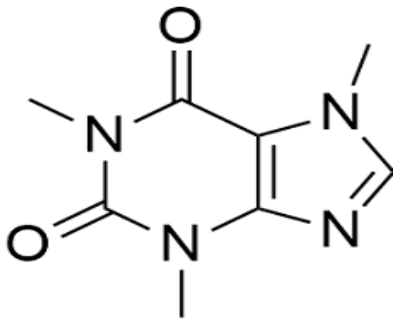


Figure : 1Structure of Caffeine

Although the exact reason and mechanism of why this works is still unknown it is prospected that the molecules under study which included the alkaloids caffeine and trigonelline, and the flavonoids genistein and theobromine had a positive impact on the length of the fibrils. It was found that a high concentration of these molecules resulted in shorter-sized fibrils which didn't make large-sized sheets. When the researchers used the pure extract of these magic molecules, the results were even more promising.

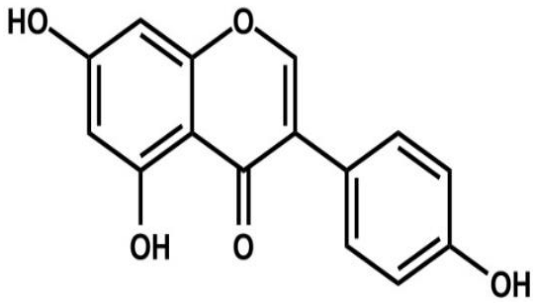


Figure 2: Structure of Genistein

It was found that shorter fibers of accumulated tau proteins were not poisonous to the cells and also prevented further aggregation. In another experiment, it was predicted that this may occur due to the binding of these molecules to already-made tau fibrils, although this isn't proven yet but holds immense significance in the field of medicine and neurodegenerative diseases.

Therefore, if you are a coffee addict or a chai lover, it is a tiding for you that coffee not only helps you wake up but also does wonders for your body and mind. From now on, be more mindful when taking your "energy drinks" to make the most out of their magical composition.

FERROFLUIDS

Laiba

Ferrofluids, which are colloidal suspensions of magnetic nanoparticles, have garnered significant interest and research from scientists and engineers due to their remarkable properties. These intriguing liquids possess both fluidic and magnetic characteristics, making them a subject of great fascination. Let us delve into the chemistry behind ferrofluids, examining their composition, synthesis methods, and key features. By gaining a deeper understanding of the intricacies of ferrofluid chemistry, we can appreciate their diverse applications in fields such as electronics, medicine, engineering, and art.

Ferrofluids are colloidal suspensions inclusive of nanoscale magnetic particles, usually iron oxide (Fe_3O_4) or magnetite, dispersed in a provider fluid. The carrier fluid may be a diffusion of organic solvents, inclusive of kerosene or mineral oil, or even water-based aqueous solvents. The nanoparticles are glossed over with a surfactant or a stabilizing agent, which prevents their agglomeration and ensures balance.

The synthesis of ferrofluids entails numerous steps. Initially, the iron oxide particles are prepared through chemical precipitation or thermal decomposition methods. Those particles are then subjected to surface amendment, wherein a surfactant or an amphiphilic molecule is brought to the particle floor to create a stabilizing layer. This accretion prevents particle aggregation and gives colloidal stability. The choice of surfactant plays a vital position in figuring out the houses of the ferrofluid, consisting of viscosity, magnetic response, and balance.

Ferrofluids exhibit several fascinating traits due to their unique chemistry. One of their defining features is their reaction to an external magnetic discipline. When uncovered to a magnetic subject, the nanoparticles align themselves alongside the sector strains, forming chains or clusters, giving upward thrust to a macroscopic magnetic response. This phenomenon, referred to as magnetization, permits ferrofluids to be manipulated and controlled via magnetic fields.

Another top-notch asset of ferrofluids is their high stability and low sedimentation rate. The presence of the stabilizing layer around the nanoparticles prevents their settling, making sure of the lengthy-term balance of the fluid. This asset is essential for numerous programs in which uniform dispersion and steady overall performance is required.

Ferrofluids additionally show off rheological properties. Due to the presence of nanoparticles, they have a high viscosity and may display both Newtonian and non-Newtonian behavior depending on the particle’s attenuation and surfactant choice. Those properties make

ferrofluids suitable for applications inclusive of damping systems, seals, and lubrication.

Moreover, ferrofluids may be tailored to have precise properties by way of controlling the dimensions, shape, and composition of the nanoparticles, in addition to the choice of carrier fluid and surfactant. By modifying these parameters, researchers can optimize the magnetic reaction, balance, and viscosity of the ferrofluid for unique applications.

The precise mixture of magnetic and fluidic parameters makes ferrofluids versatile and relevant in numerous fields. In electronics, ferrofluids are utilized in loudspeakers, wherein they offer damping and cooling consequences, resulting in stepped-forward sound first-class and heat dissipation. Additionally, they discover applications in statistics storage gadgets, such as magnetic seals, and microfluidic systems.

Inside the clinical area, ferrofluids play a crucial role in drug shipping, where they may be guided to websites on the usage of outside magnetic fields. Magnetic resonance imaging (MRI), magnetic hyperthermia-based treatment, and remedies for cancer are different promising areas in which ferrofluids are being explored.

Engineering packages of ferrofluids encompass their use as lubricants in high-pace rotating machinery, presenting friction reduction and cooling. They are additionally employed in sealing structures to save you from leaks and as damping fluids for vibration management.

Ferrofluids have even found their manner in the sector of artwork, in which they are used to create visually lovely and interactive presentations. Artists include ferrofluids in sculptures and artwork, harnessing their magnetic residences to create dynamic and fascinating artwork.

Ferrofluids constitute a charming intersection of chemistry, physics, and substances science. Their precise composition, synthesis techniques, and magnetic properties make them an area of active research and innovation. From electronics and remedy to engineering and art, ferrofluids have verified their impressive capability in a wide range of programs. By way of unraveling the chemistry in the back of these magnetic liquid marvels, scientists and engineers can continue to push the boundaries of this thrilling area, establishing new avenues for advancements and discoveries.

Global Warming: An Urgent Call for Environmental Action

Hafsa Sohail

Global warming is the long-term rise in the average surface temperature of the Earth caused by human activity, especially the production of greenhouse gases into the atmosphere. This phenomenon has gotten a lot of attention because of its potential to have a big impact on the environment, ecosystems, and human cultures.

The natural greenhouse effect of the Earth is an important phenomenon that contributes to the preservation of a habitable environment. Human activities, such as the use of fossil fuels (coal, oil, and natural gas), deforestation, and industrial operations, have increased the concentration of greenhouse gases in the atmosphere, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These gases capture heat from the Sun, causing the planet's surface to warm. Global warming is a major issue that requires immediate response. It is caused mostly by an increase in greenhouse gases in the Earth's atmosphere. The rapid rise in global average temperatures threatens ecosystems, weather patterns, and human societies.

The fundamental cause of global warming is the excessive emission of greenhouse gases into the atmosphere, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These gases capture heat from the sun, causing the Earth's temperature to gradually rise. The main human activities leading to elevated levels of greenhouse gases include the combustion of fossil fuels, deforestation, and industrial processes. The transportation sector, which includes cars, planes, and ships, contributes significantly to CO_2 emissions, while deforestation interrupts the natural carbon cycle by diminishing the planet's ability to absorb CO_2.

The implications of global warming are far-reaching and profound. Rising sea levels are a direct outcome of melting polar ice caps and glaciers, threatening coastal towns. Hurricanes, droughts, and heat waves have become more often and severe because of the disruption of weather patterns caused by rising global temperatures. This has serious ramifications for agriculture, water resources, and human well-being in general. Furthermore, global warming contributes to coral bleaching and the loss of marine biodiversity, affecting aquatic ecosystems on which millions of people rely for food and a living.

Addressing global warming necessitates a multifaceted approach that includes changes at the individual, societal, and governmental levels. Transitioning to renewable energy sources such as solar, wind, and hydroelectric power is a crucial step in lowering CO_2 emissions. Government policies that encourage the use of these technologies while penalizing the use of fossil fuels can hasten the transition to greener energy production. Furthermore, afforestation and restoration activities are critical to restoring the planet's natural ability to absorb CO_2. Methane emissions from animals and rice paddies can be reduced by reducing meat consumption and using sustainable farming techniques.

Global warming is a transnational issue, governments must work together to achieve tangible results. The Paris Agreement, signed in 2015, is seen as a watershed moment in international efforts to tackle climate change. The accord aspires to keep global warming to far below 2 degrees Celsius over pre-industrial levels

and encourages countries to raise their climate commitments over time. However, as nations cope with their economic, political, and environmental conditions, effective implementation and adherence to these pledges remain a problem.

Despite the growing consensus on the importance of addressing global warming, problems and opposition persist. Because of economic interests and fears about job losses, industries that rely heavily on fossil fuels frequently oppose switching to cleaner energy sources. Political divisions and geopolitical tensions can also stymie international climate cooperation. To overcome these obstacles, a mix of education, public awareness campaigns, and joint efforts to highlight the benefits of sustainable practices is required.

Individuals play an important part in combating global warming. People can help to reduce their carbon footprint by making conscientious decisions in their daily lives, such as taking public transportation, decreasing energy use, and eliminating waste. Educating oneself and others on the effects of global warming can foster a sense of community responsibility and drive for good change.

Global warming continues to be one of the most pressing issues of our day. Rising temperatures are already having an impact on ecosystems, economies, and societies around the world. It is, nevertheless, not too late to act. We can limit the effects of global warming and establish a sustainable future for future generations by combining policy changes, technological improvements, international cooperation, and individual responsibility. The time has come to act, and our dedication to this cause will determine the health of our planet and the well-being of all its inhabitants.

ROLE OF BIOSENSORS IN HEALTHCARE SERVICES

Nayab Yousaf

Biosensors have become indispensable instruments in the quickly changing world of healthcare, revolutionizing how we detect, track, and treat illnesses. These tiny gadgets, which are frequently only a few millimeters in size, are crucial in providing real-time, precise, and tailored information that is necessary for healthcare services. Biosensors are transforming the healthcare sector and enhancing patient outcomes in a variety of ways, from early disease identification to monitoring therapy effectiveness.

Disease Early Detection

Early illness identification is one of the most significant contributions that biosensors make to healthcare services. Even before symptoms appear, these sensors can identify specific biomarkers linked to a variety of medical disorders. Biosensors, for instance, can identify

high glucose levels in diabetic patients or find blood-borne cancer-related indicators. This early detection enables prompt intervention and more efficient treatment plans, frequently halting the progression of diseases into advanced stages and greatly enhancing the quality of life for patients.

Individualized Medicine

Personalized medicine, which adapts therapies to individual patients based on their physiological reactions, is made possible by the use of biosensors. Healthcare professionals can modify drug dosages, treatment plans, and treatments as necessary by continually monitoring patients' biomarkers in real time. This degree of accuracy improves therapeutic effectiveness while reducing adverse effects, which ultimately improves patient outcomes and lessens the strain on the healthcare system.

Remote Watching

Biosensors are essential in the era of telemedicine and remote patient care for ongoing monitoring outside of conventional clinical settings. Biosensors that patients can wear or implant communicate data to medical staff in real time, enabling preventive therapies and lowering the need for frequent in-person visits. Because it allows for remote monitoring of patients' vital signs, oxygen levels, and other crucial data, this device has shown to be very important during the COVID-19 pandemic by reducing the danger of virus exposure.

Diabetes, hypertension, and cardiovascular problems are examples of chronic diseases that need continual management and observation. By giving patients crucial information and understanding of their condition, biosensors enable patients to actively participate in controlling their health. The use of continuous glucose monitoring (CGM) systems, for instance, enables diabetic patients to keep track of their blood sugar levels and make educated decisions regarding the dosage of their insulin and their dietary intake. In addition to enhancing patients' well-being, this proactive strategy lowers the long-term healthcare expenditures related to managing chronic conditions.

An innovative era in medicine is beginning with the incorporation of biosensors into healthcare services. These amazing tools improve chronic disease management by facilitating individualized treatment strategies, enabling early disease detection, and supporting remote monitoring. With the potential for better health outcomes, lower healthcare costs, and better overall patient care, biosensor technology's impact on healthcare services will only grow as it develops. As healthcare professionals work to deliver more effective, efficient, and patient-centered care in the contemporary healthcare landscape, embracing biosensors is not just a choice — it is a must.

Constant Improvements and Future Outlook

With ongoing research and development efforts aimed at improving their sensitivity, specificity, and usability, the field of biosensors is always changing. Two key trends that promise to increase patients' access to biosensors are their miniaturization and integration with wearable technology. Biosensors can be effortlessly incorporated into commonplace items like timepieces, clothing, and even contact lenses as they get smaller and less noticeable. This integration will give people more control over their health by giving them access to real-time health data.

Additionally, improvements in machine learning and artificial intelligence (AI) are anticipated to enhance the capabilities of biosensors. Biosensor data is generated by a large volume of data that AI can analyze, find subtle patterns, and forecast health trends.

This technology enables preventive measures and individualized actions by warning healthcare professionals and patients of possible problems before they become serious.

In the future, biosensors have the potential to transform not just how diseases are identified and treated but also how precision medicine, drug discovery, and our understanding of human biology are practiced. These technologies will play an even bigger role in enhancing patient care and transforming the healthcare environment for years to come as they continue to develop and become more integrated into healthcare systems.

The relationship between biosensors and healthcare is a shining example of human ingenuity and offers hope for a better, more proactive method of providing healthcare.

BEHIND-THE-SCENES OF FOOD PRESERVATION: STABILITY STUDIES

Muhammad Saeed Anwar
0251-BH-CHEM-19

Stability studies hold significant importance in ensuring the integrity, safety, and quality of food and pharmaceutical products. These studies involve subjecting products to various testing conditions, allowing for a thorough evaluation of physical, chemical, microbial, sensory, and nutritional changes that may occur over time. The findings obtained from stability studies are instrumental in determining the shelf life, storage conditions, and appropriate packaging materials necessary to maintain the preservation of these products.

When it comes to food products, stability studies are conducted to establish the shelf life and identify the optimal storage conditions required to prevent spoilage during that period. These studies expose food items to different environmental factors such as temperature, light, humidity, and other relevant parameters. By observing the effects of these conditions on the physical, chemical, microbial, sensory, and

nutritional characteristics of the food, specific shelf life and storage recommendations can be established to ensure the product remains stable throughout its intended lifespan.

Similarly, stability studies play a crucial role in the pharmaceutical industry. These studies are conducted to assess the stability, safety, and changes that may occur in pharmaceutical products over time. By subjecting these products to various testing conditions, such as temperature, humidity, light, and oxygen levels, manufacturers can evaluate the physical, chemical, and nutritional attributes of the products, ensuring their stability and efficacy throughout their shelf life.

The primary goals of stability studies include examining changes in product quality over time, estimating shelf life, and recommending appropriate storage conditions. By monitoring and documenting changes in product quality, stability studies provide valuable insights into how a product may degrade or evolve. This knowledge is crucial for determining the appropriate shelf life of a product, allowing for proper distribution, storage, and usage.

Stability studies also aid in establishing guidelines for optimal storage conditions. By subjecting products to different storage environments and analyzing their effects on stability, researchers can recommend specific temperature, light, humidity, and other relevant parameters that will ensure the product remains stable and maintains its desired quality throughout its shelf life.

Microbial testing is a crucial component of stability studies for food products. By examining the presence and quantity of microorganisms throughout the product's intended shelf life, researchers can assess the product's stability and safety. Microbial testing involves various steps, including sample preparation, incubation, enumeration, identification, and data analysis.

Chemical testing is another essential aspect of stability studies. This testing involves analyzing food products for chemical changes that may occur over an extended period. It includes examining the product's chemical composition and nutrient quantity to ensure stability. Proper sample preparation, sealed storage to prevent moisture loss, and rigorous analysis of samples over time are key steps in chemical testing.

Sensory evaluation plays a significant role in stability studies, particularly for food products. Through sensory evaluation, trained individuals assess the taste, aroma, color, and texture of food samples. This evaluation provides valuable insights into the stability and quality of the product throughout its designated shelf life.

Packaging testing is also an integral part of stability studies. The selection of appropriate packaging materials is essential to protect the product from external factors such as temperature, sunlight, humidity, and oxygen entry. Packaging materials must act as effective

barriers against microbial contamination while remaining inert and durable during handling and transportation.

To ensure consistency and reliability in assessing product stability, standard stability testing procedures and tests have been established. Regulatory authorities such as the FDA, WHO, and ICH provide guidelines for conducting these tests. Examples of standard stability testing methods include shelf-life testing, accelerated shelf-life testing, and real-time stability testing. These standardized protocols ensure that stability studies are conducted uniformly and produce reliable results.

In conclusion, stability studies are vital for ensuring the safety, quality, and efficacy of food and pharmaceutical products. By systematically evaluating the physical, chemical, microbial, sensory, and nutritional characteristics of these products under various storage conditions, manufacturers, and regulations.

REPLICATION OF OLFACTORY SENSE

Amber Shaheen Abbassi

The sense of smell, or olfaction, is a remarkable human ability with implications spanning from sensory perception to emotional response. In recent years, the burgeoning field of nanotechnology has paved the way for revolutionary advancements in sensor design and fabrication. This article explores the application of nanotechnology and nano-sensors to replicate the olfactory sense, delving into the multidisciplinary approaches of fabrication, characterization, and real-world applications. The success of this endeavor could revolutionize industries such as food quality assessment, environmental monitoring, and healthcare diagnostics.

The human olfactory system is a complex arrangement of sensory receptors and neural pathways that enable the detection and interpretation of odor molecules. Replicating this intricate sense using nanotechnology offers the potential to transform various industries. Nano-sensors, with their ability to detect and respond to specific molecules, hold the key to recreating the olfactory experience artificially.

Advancements in nanotechnology have revolutionized the realm of sensor design and fabrication. Recent research showcases the potential of nano-sensors to mimic the olfactory receptors present in the human nose. Nanostructured materials, such as carbon nanotubes, metal oxides, and polymers, have demonstrated high sensitivity and selectivity in detecting odor molecules. The integration of receptor-like molecules onto nano-sensor surfaces has enabled the identification of complex odor patterns, akin to the human olfactory system.

The methodology employed in this research involves a multidisciplinary approach that bridges materials science, chemistry, and electronics. Nano-sensors are fabricated using advanced deposition techniques that create nanostructured surfaces. These nanostructures amplify the surface area, leading to increased sensitivity. Subsequently, receptor-like molecules are immobilized onto these surfaces, mimicking the function of olfactory receptors.

The fabrication process is critical to the success of nano-sensors. Nanostructured materials, carefully selected based on their properties, are deposited onto substrates. The choice of deposition technique, such as chemical vapor deposition or physical vapor deposition, influences the uniformity and morphology of the nanostructures. Receptor-like molecules are attached to the nano-sensor surface through functionalization methods, ensuring specificity towards certain odor molecules.

The performance of the fabricated nano-sensors is rigorously characterized. Scanning Electron Microscopy (SEM) provides insights into the morphology of the nanostructures, confirming successful deposition. X-ray Photoelectron Spectroscopy (XPS) facilitated chemical analysis, confirming the presence of receptor-like molecules. Sensitivity tests involved exposing the nano-sensors to known odor molecules at varying concentrations to determine their detection limits and response profiles.

The nano-sensors demonstrate exceptional sensitivity and specificity in detecting odor molecules. The acquired data is used to develop pattern recognition algorithms that can distinguish between different odors. This artificial olfactory system holds immense potential in applications such as food quality assessment, where the detection of spoilage odors could prevent the consumption of contaminated products.

Intelligent machines (AI) and nano-sensors when used together, have the potential to accurately mimic the olfactory sense. Detection and analysis of tiny, molecular-level connections are made possible by nano-sensors. They can simulate the intricate process of smell when AI is integrated into them because they can recognize and decipher the chemical signatures of different odours. The creation of very sensitive nano-sensors that can instantly identify a variety of volatile organic compounds (VOCs) and other odour molecules is the first step in this integration. With each nano-sensor responding just to smell molecules, these devices can be made to replicate the receptors that reside in the human olfactory system.

The actual strength of this synergy is AI's capacity to handle and interpret the enormous volume of data produced by nano-sensors. The patterns and correlations between the signals generated by these sensors and the odours they represent can be recognized by AI algorithms. Like how our brain develops its olfactory talents

via experience, AI may continually increase its capacity to recognize and categorize different odours by utilizing machine and deep learning. This AI-driven nano-sensor network can eventually become more adept at differentiating and classifying a wide range of aromas, creating a sophisticated artificial olfactory sense.

Moreover, the combination of nano-sensors and AI has a wide range of real-world uses. For example, it can be used in environmental monitoring to find pollutants, in the food sector to judge the quality and freshness of the products, or even in medicine to use odour-based diagnostics to find diseases early. Through the integration of nan- sensors and AI, the olfactory sense can be replicated, opening new prospects for improving our understanding of the environment and tackling a variety of problems in a variety of fields.

COMPUTATIONAL CHEMISTRY

Hina Shehzadi

The outstanding increase in speed and computational efficiency of computers can be combined with the principles of science to reach new heights. Chemistry, like other scientific fields, has been profusely influenced by technological advancements, so much so that computational chemistry has formally become a branch of chemistry. Computational Chemistry applies chemical, computational, and mathematical concepts to solve complex chemistry problems and explain their solutions via simulations of experimental results.

The reduced cost and improved CPU speed have allowed us to improve our understanding as well as develop newer procedures for computations which can further be applied to model, design, and operate numerous microscopic phenomena ranging from atoms and molecules to macroscopic industrial-scale processes.

Advantages of Computational Chemistry

1. Digital Designs

The traditional experimental techniques are rapidly being replaced by digital designs. A digital design allows for a relatively comprehensive, effective, and faster exploration of the design process space that experimentation cannot achieve alone. Moreover, technological risks can be addressed and quantified systematically. The high price of experimentation and physical design testing can thus be reduced largely.

Moreover, the efficiency of the experimentation process can be improved by combining the experimental data with the digital model. The analysis of this model-based data, in turn, provides exact values, and estimates of parameter, and parameter reliability, respectively. This information can then be used in assessing risks and also provides a quantitative assessment

of the direction in which experimental efforts should be focused.

2. Computer Modeling combined with Machine Learning

Computational procedures and algorithms can be dramatically accelerated when combined with Machine-Learning Models and may result in a transformation of chemical sciences by improving insights available from computational chemistry methods such as molecular modeling. Since the general trend in the scientific world of today is the exploration and characterization of new chemical compounds with optimal properties but at minimal cost and time, it requires rapid, relatively cheaper, and better research methods. Computational Modeling together with machine learning is the solution to all these popular demands.

Machine learning methods have seen unprecedented advancement in technology, and enabled several applications in medical and chemical fields. For instance, in medical diagnoses, particle physics, nano-sciences, and bioinformatics. Moreover, the discovery and design of new materials, chemicals, and processes have also been accelerated with the use of this method.

3. Computer-Assisted Drug Designing

Computational Modeling plays a very important role in designing drugs, which is an independent discipline of computational chemistry. This includes the use of various computational techniques, methodologies, and algorithms for the development of bioactive compounds. These computational techniques can be applied to predict, and design potential bio-molecules. Thus, using computational modeling for this purpose can drastically reduce the cost and it can be more time-efficient.

4. Docking

Molecular docking is a type of computational modeling technique. It allows easy prediction of the most suitable binding orientation of a molecule such as a ligand, to another molecule e.g. a receptor when there is an interaction between the two to form a stable complex.

The technique of molecular docking is an application of computational modeling and is useful in the field of pharmaceutical chemistry given its numerous applications in recognition, disease study, development of agricultural products i.e., pesticides, and in making sensors.

The data obtained that comes along the preferred orientation of the bound molecules can be used to give the energy profile, strength, and stability of complexes, such as the free binding energy, binding affinity, and constant, respectively.

The newest use of molecular docking is the prediction of the binding orientation of small molecules such as drugs to their bio-molecular receptors/target, which may be a protein, carbohydrate, or nucleic acid, to understand their

potential binding parameters. This provides a strong basis in the form of raw data for the development of rational drug designs of modern, more efficient, and more specific agents. Moreover, the use of molecular docking has the benefit of reducing the time taken and higher costs that come with the development of new pharmaceutical, agricultural, medical, and technological products experimentally.

All of the tools and techniques provided by computational modeling make it possible for researchers to design and study their own chemical and biological systems via the use of numerous theoretical approximations. Therefore, it can be said with great emphasis that the future of computer modeling is bright, and its applications in chemistry seem promising given the unprecedented processing capabilities, and the incessant development of the software in this field, and there is no doubt that the models made will be the perfect “virtual twins” of real chemical systems.

Department of Commerce and Finance

Timeline of Department of Commerce and Finance

January 2023:

- Start of the year with a focus on economic recovery and fiscal policies.
- Cryptocurrency market continues to evolve, with increased regulatory discussions.
- Many businesses are implementing updated accounting standards such as ASC 606 for revenue recognition and ASC 842 for lease accounting.

February 2023:

- Stock markets experience volatility due to concerns over inflation and interest rates.
- Central banks closely monitor economic indicators.
- Tax season is in full swing, with accountants and tax professionals helping individuals and businesses file their returns.

March 2023:

- Interest rates see adjustments by some central banks.
- Sustainability and environmental accounting practices continue to gain importance, with companies disclosing more information on their ESG (Environmental, Social, and Governance) initiatives.

April 2023:

- Mergers and acquisitions activity picks up in various industries.
- Increased adoption of blockchain and decentralized finance (DeFi) technologies.
- Quarterly financial reporting for public companies, along with the release of earnings reports and annual reports.

May 2023:

- Companies release Q1 earnings reports, influencing market sentiment.
- Continued discussions on the role of digital currencies in the global economy.
- Regulatory updates, such as any changes in accounting standards or reporting requirements, are on the radar of accounting professionals.
- Accountants are busy conducting internal audits to ensure compliance and efficient financial management.

June 2023:

- Discussion on potential regulatory changes for fintech companies.
- Rising concerns about cybersecurity and data protection in financial services.
- Mid-year financial reviews and forecasts are conducted, allowing businesses to evaluate their financial health and make adjustments as necessary.

- More emphasis on data analytics and AI-driven solutions for financial analysis and risk assessment.

July 2023:

- Governments and organizations work on recovery plans post-COVID.
- Debate on the impact of inflation and its implications for investments.
- Preparations for the upcoming fiscal year begin, including budgeting, cost analysis, and strategic financial planning.
- International tax and transfer pricing considerations continue to be a focal point for multinational corporations.

August 2023:

- Focus on green finance and climate-related investments.
- Increased attention on the stability of the housing market.
- Accountants and auditors are involved in internal control assessments and risk management reviews, especially in light of any cybersecurity threats.
- Continuing professional development for accountants to stay updated on evolving accounting standards and technologies.

September 2023:

- Central banks assess economic conditions and their monetary policies.
- Growing interest in non-fungible tokens (NFTs) and the digital art market.
- The final quarter of the year is approached with a focus on year-end financial closings, ensuring accuracy and compliance.
- Accountants are keeping an eye on potential tax law changes that may impact the next tax season.
- These are general updates and specific developments in accounting may vary depending on the region, industry, and individual organizations.

Advancing Businesses Toward Sustainable Development Goals

Shahzaib Ali

0829-BH-E-BAF-20

sheikh.shahzaib567@gmail.com

From the past to the present, business has always played a significant role in societies. They act like core elements to solve a gigantic or minuscule problem. In the case of sustainable development goals, we can't ignore the potential of business to play a positive role in it. Businesses are not only to create profit maximization but to create societal value. Without profits, no organization stands. On the other side, without a societal role, organizations lack the license to operate, which is detrimental to the organization's long-term financial sustainability. I am using the wedding cake model to define the role of business in achieving SDGs. The wedding cake model consists of three parts biosphere, society, and economy. At the top of them, there is a partnership.

Biosphere:

The biosphere is a place where living organisms live. We find gigantic mountains, fast deserts, deep oceans, and dark forests here. It consists of four SDGs climate action (13), life below water (14), life above land (15), clean water and sanitation (6).

Climate Change (SDG 13):

Climate change is a grave problem in the world and it creates severe consequences in many parts of the world. Businesses are the key contributors to climate change and greenhouse gas emissions. The World Economic Forum positions failure to reduce climate change as the number 1 risk to business. Firms can significantly mitigate climate change and get new business opportunities by using market-based instruments carbon taxes, cap and trade schemes, and more. This leads to vast cost reduction and decreases the company's dependence on natural resources.

Life Below Water (SDG 14):

Life below water is a crucial topic and organizations are affecting it by negative externalities. If the firm causes a negative externality, then the social cost exceeds the market price of products and services. The externalities such as excessive use of plastic and high fertilizers which end up in the ocean and disturb marine life. Businesses can mitigate this thing and contribute to SDG 13 by doing research on reducing plastic packaging, preventing waste,

and becoming an example for other industries to follow.

Life above Land (SDG 15):

Moving toward SDG 15, Companies need to manage natural resources effectively as they are limited. In terms of economy, the major four factors are land, labor, capital, and enterprise. So, the land comes first which is very crucial and businesses can contribute to it by setting up arrangements that prevent land degradation and the ecosystem. Companies can also adopt certified sustainability standards and invest in ecosystem restoration projects which in return generate money.

Clean Water (SDG 6):

Clean water and sanitation are one of the significant topics. Many industries use water for their product and clean water is rampantly reducing. Businesses can also play their part in reducing this thing. The financial industries can drive sustainable solutions by investing in the business and helping them adopt eco-friendly practices. Long-term investors are also looking for projects which will high demand in the future such as water purification plants and water-saving technology. So, businesses are one of the important players in achieving this goal.

Society:

Society is the place where people live and interact with each other. We should take care of the biosphere but we should take care of ourselves of humanity. What do you need people to live well and in dignity? In this portion, we will discover SDGs that are for this purpose and how businesses are contributing to this goal. Moreover, this portion is divided into two part which is as follows.

Part 1:

Part one of the society section represents a few important sustainable development goals such as no poverty, zero hunger, health care and well-being, and affordable and clean energy.

No Poverty (SDG 1):

Companies can contribute to SDG 1 by various means. It's the first and most important one. First, companies should avoid the negative impact on human rights within the organization and ensure its activities and partners are not playing any role in increasing poverty. Companies should also pay a fair amount of taxes to the government, and facilitate its employees and their families through health, education, and other means. Last but not least companies should pay livable wages, not minimum wages to the employees. This thing helps the company achieve SDG 1. There is one good case study of Tony's Chocolonely, working toward the slave-free chocolate industry.

Zero Hunger (SDG 2):

Zero hunger is one of the significant SGDs. We are living in a world where people are producing enough food but there is still hunger and malnutrition. Above all, this problem is getting

worse because of a growing population and climate change. One of the major barriers to achieving this goal is volatility in the prices of commodities either high or low. Financial markets can play a significant role by providing economic tools to stabilize the commodity producer's income. The commodity exchange program can be held on international, national, and local levels to reduce this problem. Moreover, financial institutes can also play their part by providing access to finance, insurance, and other financial tool to the farmers. They can also invest in research and rural infrastructure.

Health Care and Well-being (SDG 3):

Health care and well-being are vital elements to live a good life. Businesses can contribute to this goal in various ways. Businesses can ensure employee safety by providing a safe and healthy environment, providing access to healthcare to the company, starting health awareness and education programs, research and innovation, and value-based affordable healthcare solutions. In return, businesses can enhance their brand reputation, upsurge employee productivity and customer loyalty, and have long-term sustainability and resilience.

Affordable and Clean Energy (SDG 7):

Over a billion people are living in the region without any electricity and most of the region is located in the sub-Sahara and Africa. On the other hand, other region has access to energy but only quite a small portion of it comes from renewable resources. SDG 7 is about Affordable and Clean energy and business can also play an unprecedented role in this goal. Most businesses are moving toward clean and affordable energy consumption as since 2007 Google has used clean energy for most of its production and is a carbon-neutral company. The business is promoting and highlighting the importance of clean and affordable energy which plays an important role in society.

Part 2:

Part two of the Society section represents other vital sustainable development goals, such as sustainable cities and communities, gender equality, and reducing inequalities.

Sustainable Cities and Communities (SDG 11):

Two-thirds of the world's population is going to reside in the cities. Cities always play an important role in history to this age and beyond. That's why they need to be resilient and sustainable in all of it mean and a single malefaction can play a detrimental role in society. In cities, businesses can contribute in many ways such as electricity grid, infrastructure, water supply, etc. Businesses can contribute in different ways to play their parts such as rising start-ups launching apps for users to identify any issue such as a full trash can and then report it to the related department and also highlight the location or picture. Such things engage communities to

solve bigger problems that couldn't be identified otherwise.

Quality Education (SDG 4):

Social enterprises and non-profit organizations can play a significant role in promoting quality education. Many organizations are working for this purpose and even within the business employees have to go out for training to develop their skills and become new persons. Businesses are working in many ways to create a positive impact in the world and quality education is one of them. Without it, nobody can stand in this world.

Gender Inequality (SDG 5):

Gender inequality is one of the grave problems that we are facing nowadays. As per UN statistics about 155 countries have a law that limits women's potential for example 41 countries prohibit women from working in certain factories job, and twenty-nine countries would not allow women to work at night. However, businesses and non-profit organization can play their parts to reduce that thing and promote equality. Businesses can create an environment where both men and women can work together and there is not any kind of discrimination.

Reduce Inequality (SDG 10):

Reduce inequality falls in many ways such as income, gender, and ethnicity. It is one of the biggest issues too and it is not restricted within the country but outside the country too. Business and non-profit organizations can play a significant part in reducing this thing and promoting equality in every possible way. Goal setting within the organization and institute will help the marginalized people to come out of their zone. Setting targets helps people to bet the best. As they say, turn your dreams into goals and goals into reality.

Economy:

Society organizes itself but there is a need to be sustainable and efficient. In this section, we will look at how businesses can contribute to decent work and economic growth, industrial innovation, and infrastructure.

Decent Work and Economy Growth (SDG 8)

For sustainable, inclusive, and sustainable growth decent work and economic growth (SDG8) is crucial. Every year there is a rampant increase in the unemployment rate. Businesses can create a safe workplace environment which can help increase the productivity of the employee and in return, there is economic growth. Moreover, businesses can also contribute to the goal by ensuring fair wages and equality among employees which as a result creates positive results in the growth of SDG 8.

Industry Innovation and Infrastructure (SDG 9)

Industrial innovation and infrastructure play an important role in the society. This goal mostly focuses on research, innovation, and domestic

technological advancement in underdeveloped countries. Innovation leads to liberating the labor work from inefficient to precisely We couldn't achieve this thing yet as two dimensions stand as obstacles in the ways the first is the Panel well-being failure and the other is Timeline well-being failure. However, businesses can play a major role in the enforcement of SDG 9 in their workplace and beyond which as a result creates a positive impact on the environment. Lastly, SDG 9 is the backbone of all SDGs and it creates a huge impact.

Responsible consumption and Production (SDG 12)

Responsible consumption and production are one of the significant goals of SDGs. Businesses can play a major part in it especially the manufacturing industries by producing less waste. One model the business can adopt is the circular economy. By closing the loop of waste and resources our economy will move one step further to resemble an ecosystem and in return, businesses will be more profitable by resource efficiency and procurement process of their products. Businesses can also adopt the technique of rethink, refuse, reuse, repair, reduce, and recycle (6R) in their process to contribute to this goal and create an advantageous impact in society.

Partnership:

Nobody can achieve all the SDGs by themselves, but we need people, organizations, governments, and societies to work together and achieve these goals to create a better prosperous future for the people and planet.

Partnership for Goals (SDG 17)

Businesses provide funds to the NGOs as its corporate social responsibilities and then NGOs address core issues such partnership is a Transactional Partnership. Moreover, we also need a transformational partnership, a partnership that develops a new transformational value proportion. Businesses should collaborate with NGOs to develop a new perspective and work toward a common cause to bring change to society. Governments, social corporations, and society working together, especially with businesses can create a huge impact and can bring a positive change.

Peace Justice and Strong Institution (SDG 16)

SDG 16 promote and deals with peace, justice, and strong institution, and it plays a positive role in society. Without it, it's very difficult to achieve the other goals in a place where people have to face trafficking, corruption, and homicide in everyday life. Businesses can also play their role in achieving this goal. There are many issues that people are facing such as serious and organized crime, hacking, identity theft, etc. The banking sector and other companies can play their part in reducing and eliminating those things as the banking sector is making sure that there is no element of terror financing and money laundering

which in return helps to create a safe and secure environment.

Conclusion:

In conclusion, businesses are one of the important stakeholders in the world and have the power to solve extreme problems and create a positive impact in the world we are living in. SDGs on the other hand are also important to reduce and eliminate societal problems and also help to create a beautiful world where the future generation lives and thrives and businesses are one of the factors to turn this goal into reality.

AI AS A SERVICE (AIAAS)

Menahil Amjad
0425-BH (E)-BAF20

The concept of artificial intelligence is not new to us rather it's the oldest yet most awaited invention of mankind. The idea of man being freed from all of his duties and rest through his life is a dream of most people even those who own or run a business. With the advancement of technology, this dream is fast becoming a reality through the concept of AI as a Service. AI as a Service, or AIaaS for short, is an emerging trend that enables businesses to access the technologies and benefits of artificial intelligence without having to invest in costly infrastructure, equipment, and talent. AIaaS can assist businesses in organizing the data they collect on their customers, and perform trivial tasks that allow business owners and their employees to concentrate on more important work throughout the day activities. AIaaS makes it possible for small businesses to implement

AI technology into their budgets without having to invest in infrastructure to make it happen. It also makes it easier for individuals who don't have a strong background in machine learning or AI to understand the technology and still be able to get their work done. Small businesses are at the top of the list to invest in AI as they seek to leverage emerging technologies to expand their reach and optimize their business operations. According to Tractica "annual global AI software revenue is forecast to grow to $126 billion by 2025." as we are seeing, AIaaS is one of the primary drivers of that growth. AIaaS is rapidly changing the landscape of business operations, as it offers pre-built models and related services to customers for their ML-driven building blocks. For the last two centuries, the world has been transitioning towards more advanced technologies to improve the quality of life for people. AIaaS not only advances technology but also provides greater affordability and accessibility to the general public, thus ensuring that no one is left behind in the race for innovation and progress.

However, despite the growing popularity of AIaaS, there are still inconsistent rationales for its adoption. Some research suggests that organizations adopt AIaaS to access pre-trained models and automatic hyper-parameter tuning. On the other hand, some researchers emphasize

the potential downsides of AIaaS, particularly in terms of privacy risks. As we move forward with AI as a Service, it's important to balance these perceived benefits and risks effectively so that businesses can maximize their investments in this technology while minimizing any negative impact on their operations or stakeholders, while implementation is key to unlocking business value from emerging technologies such as e-health and ICT resources. Therefore, further research should be conducted to determine the most effective strategies for implementing and leveraging these technologies while discovering new models and applications in a way that benefits all stakeholders. Overall, it is clear that AIaaS has significant potential to revolutionize business operations across various industries, especially small businesses so it is advised for them to invest in Alaas in the next two years.

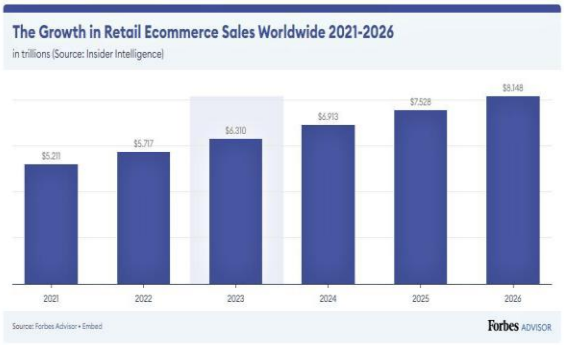
E-COMMERCE IN PAKISTAN: SUCCESS OR FAILURE?

Maryam Shafique Khan

E-commerce means buying and selling goods and services without physically visiting a store. E-commerce was initiated in 1982, with Boston Computer Exchange as the first online marketplace. All over the world e-commerce is functioning successfully. Some major examples of successful online marketplaces are Amazon, Alibaba Aliexpress, Paypal, and eBay. Nowadays not only material goods but skills and services are also being sold online, on a freelance basis. Some successfully working job websites are Fiverr, Upwork, Guru, and Freelancer.

The statistics below show the rising trend in e-commerce in the past few 3 years and prediction of increment in the coming 3 years.

With the rapid success of e-commerce all over the world, Pakistan stands a little behind in this field.



The first e-commerce store developed in Pakistan was Paypal in 2001. But there are a lot of holes in the system.

There are a lot of Pakistani e-commerce stores but they are not as successful as the online markets in other countries. Most people in Pakistan prefer buying things from a physical store rather than an online one. There are many reasons for this mistrust. A few of them will be discussed here. First of all, is the problem of trust. Most people do not trust online sellers and fear that they will be a scam. Many online sellers tend to send poor-quality products, which are often different from what they show in the pictures. A lot of people have poor online

shopping experiences due to which trusting honest sellers is also difficult for them. Another reason is that the range of the products available is limited to a few types of goods. Only those goods are bought online that are for day-to-day use like clothing and food.

Other goods like furniture and electronics are still preferred to be bought in person, and the reason here is that these are comparatively expensive goods so people cannot risk a scam. A very major contributor is that internet penetration is very low in Pakistan with only 35% of the citizens having access to the internet. Besides having access to the internet, digital literacy is very low. Many people consider online shopping websites very complex and hard to use. Usually, elderly people tend to opt for traditional ways of trade. The last and the most neglected reason is the underdeveloped e-commerce infrastructure. The system of logistics is not running very smoothly and if the product is damaged during the delivery, the loss is borne by the consumer which discourages them from shopping online again. The payment gateways are not properly set up. 70% of online payments are still made using the cash-on-delivery service. The procedure of making online payments requires a lot of improvements.

Despite a lot of shortcomings, the Pakistani e-commerce marketplaces are increasing gradually. At present many international e-commerce markets are working in Pakistan and some Pakistani-based e-commerce websites are also really successful. For example, Daraz. pk is the biggest e-commerce store in Pakistan, followed by olx, savyour, Kaymu, goto, priceoye, and various others. The trend to shop online arose in Pakistan during the lockdown in 2020 due to Covid-19. The e-commerce sales in Pakistan in 2021 were 13.2% and in 2022, the figure rose to 14.7% and is expected to hit 16.9% in 2023. The revenue through e-commerce is expected to be $632.1 M in 2023.

Significant steps can be taken to increase the trend of e-commerce in Pakistan. Micro-financial sources should be provided for people to establish their businesses at smaller levels. The trend of microfinance is not very common in Pakistan with only a few microfinance banks, mainly Finca Microfinance Bank and Telenor Microfinance Bank. The largest online market in Pakistan is media and digital skills like cloud computing and virtual assistance. These services are more in demand at the international level. With the emerging demand, these skills should be nourished in people to increase not only personal income but national income also. The scope of e-commerce is very wide and can be very beneficial if established properly. E-commerce businesses are easier for the seller to establish as they require less capital.

EFFECTS OF COVID-19 ON BUSINESS AND RESEARCH

Menahil Amjad

The Covid-19 pandemic, caused by the novel coronavirus has had very dominating effects on both business and research. Movement restrictions imposed by many governments worldwide have considerably decreased the global sales and production volumes of many business enterprises and thus, negatively affected their performance in terms of financial reporting and disclosure. According to a literature review conducted by Donthu and Gustafsson, the effects of the COVID-19 pandemic on business and research were analyzed based on three perspectives: consumer behavior, market trends, and predicted lasting effects.

Around the globe, societies were in lockdown, and citizens were asked to respect social distancing and stay at home. *Consumer behavior* in terms of demand and preferences also underwent significant changes during these times. As we are social beings, isolation may be extremely harmful to our mental health. Feelings of loneliness have, among other things, been connected to poorer cognitive performance, negativity, depression, and sensitivity to social threats. There were many indications that this was happening during the current pandemic, as there had been an increase in domestic violence, quarrels among neighbors, and an increase in the sales of firearms. However, we have also seen an increase in other, more positive types of behavior caused by social distancing that has not been researched. People have started to nest, develop new skills, and take better care of where they live. For instance, they may learn how to bake, try to get fit, do a puzzle, or read more. There has also been an increase in purchases of cleaning products, and more trash is being recycled. Another consequence of the lockdowns is the extreme increase in the usage of the Internet and social media. Previous research has indicated that humans who feel lonely tend to use social media more and, in some cases, even prefer social media over physical interaction. Currently, the situation has made social media the main mode of contacting or socializing with others. In many cases, the Internet is at present also the main way to get essential supplies and receive essential services, like seeing a doctor.

However, the changes in *market trends* caused by the pandemic have also had significant negative effects on businesses' financial performance. Given the current crisis induced by COVID-19, ensuring business resilience amidst an ongoing economic recession has become a critical challenge for entrepreneurs. Uncertainty about the situation and its further development has caused consumer spending to lessen which made it difficult for businesses to sustain their financial performance. Industries such as the travel industry were deeply affected as 80% of hotel rooms were empty, airlines cut their workforce by 90%, and tourism destinations were likely to see no profits in 2020. Furthermore, expos, conferences, sporting events, and other large gatherings as well as cultural establishments such

as galleries and museums were been abruptly called off. Consulting in general and personal services, like hairdressers, gyms, and taxis, had also come to a standstill due to lockdowns. Finally, important industries like the car, truck, and electronics industries were abruptly been closed but they started to function two months after their closure.

Nevertheless, despite the significant negative effects on businesses, some companies were able to explore business opportunities arising from the unique situation caused by the COVID-19 pandemic. This is true for several Internet-based businesses, such as those related to online entertainment, food delivery, online shopping, online education, and solutions for remote work. People have also changed their consumption patterns, increasing the demand for takeout, snacks, and alcohol as well as cleaning products as we spend more time in our homes. Other industries that are doing well are those related to healthcare and medication as well as herbs and vitamins.

In conclusion, the COVID-19 pandemic has brought about significant changes in consumer behaviour, and businesses have been significantly impacted by these changes. While there have been challenges for most industries due to the pandemic, some companies have been able to adapt to new market trends and explore new opportunities available in this unique situation. The lesson learned by the entrepreneurs is that they had to ensure that their businesses have resilience, smart strategies like understanding the changing consumer behavior as well as leveraging technology and fast adaptability not only for individual firms but also collectively among different sectors of society. The future is always uncertain but the apparent flexibility, innovation, and diversification of activities can play a key role in any company's potential success during a pandemic period like this one.

FAMILY-OWNED BUSINESSES

Menahil Amjad

0425-BH (E)-BAF-20

Family-owned businesses have long been the backbone of economies worldwide They come in various sizes, from small shops to global conglomerates, and span across industries, including retail, manufacturing, agriculture, and technology. These enterprises are characterized individually by their unique blend of personal commitment, tradition, and entrepreneurial spirit. Studies have shown that family-owned businesses bring a special dynamic to the business landscape as the philosophy and values of family and owner greatly affect their decision-making processes and success.

The impact of family-owned businesses is significant and expands beyond just economic dynamics to social sustainability and welfare as well. These businesses are substantial employers, creating and providing jobs for millions of people

worldwide. In many regions, they are crucial in sustaining local economies, including both developing and developed countries. Research indicated that family businesses are responsible for 80% of businesses in developed countries and they are the largest driver of the economy as they account for up to 49 GDP in the United States alone and contribute to 78% of new job creation in the country. They play a vital role in the shared values and culture of a family that can create a strong bond among employees and a sense of purpose that extends beyond the profit of just the company. They are typically deeply embedded in their communities and often support local charities, events, and initiatives, fostering a strong sense of community, cohesion, and giving back. Their smaller, more flexible structures immensely allow them to make more agile decisions and adapt quickly to market conditions and customer needs, which gives them a competitive advantage over non-family-owned businesses.

However, it has its challenges to face as well. One of the challenges being faced is its transition from one generation to the next as it requires a deep understanding of business operations and family dynamics that is essential for a successful handover. Studies have shown that only about a third of the family businesses make it to the second generation and an even smaller percentage about 15% make it to the third generation this is because

The intersection of family and business can lead to conflicts that are emotionally charged and these conflicts may relate to management, ownership, or differing visions for the company's future and overall success. Additionally, some family-owned businesses can face difficulty in coping with the competitive market and technological advancements as they have much smaller resources and professionalism compared to non-family-owned businesses. Other than that family-owned businesses face difficulty in raising funds and implementing formal governance structures and practices to ensure transparency, accountability, and long-term sustainability.

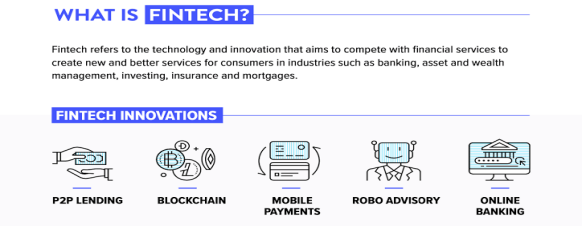
In conclusion, family businesses are an integral part of the global economy, contributing significantly to income generation, job creation, and community development. They possess unique advantages such as strong values, flexibility, and a deep connection to the communities they serve. While they face unique challenges, their significance, resilience, and contributions to society can never be underestimated. With careful succession planning, effective conflict resolution, and a commitment to professionalism, family-owned businesses can continue to thrive and leave lasting legacies for generations to come in the future.

FINTECH: REVOLUTIONIZING FINANCE IN THE DIGITAL AGE

Naila Arshed Javad

0939-BH-BAF-20

In the rapidly evolving landscape of finance, the term "Fintech" has become more than just a buzzword; it's a transformative force reshaping the financial industry as we know it. Fintech, short for financial technology, represents a fusion of finance and cutting-edge technology, and its impact is nothing short of revolutionary.



Source: SMU Boot Camps

What is Financial Technology (FinTech)?

The term “fintech company” describes any business that uses technology to modify, enhance, or automate financial services for businesses. Fintech, short for financial technology, represents a fusion of finance and cutting-edge technology, and its impact is nothing short of revolutionary.

FinTech is a catch-all term referring to software, mobile applications, and other technologies created to improve and automate traditional forms of finance for businesses and consumers alike. FinTech can include everything from straightforward mobile payment apps to complex blockchain networks housing encrypted transactions.

A Brief History and Exigency of FinTech:

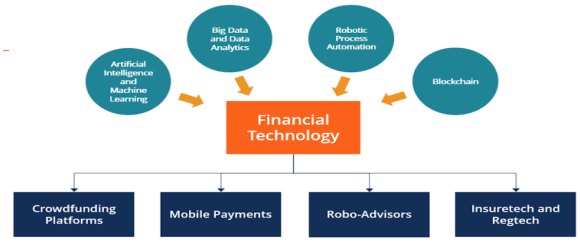
While fintech seems like a recent series of technological breakthroughs, the basic concept has existed for some time. Early credit cards in the 1950s generally represent the first fintech products available to the public, in that they eliminated the need for consumers to carry physical currency in their day-to-day lives. From there, fintech evolved to include bank mainframes and online stock trading services.

Fintech emerged as a response to the inefficiencies and limitations of traditional banking. It represents an emergence of finance and technology, harnessing the power of digital innovation to revolutionize the way we manage, invest, and move money. Fintech companies range from startups to tech giants, and they're disrupting every facet of finance.

How does Fintech work?

While fintech is a complex idea, it is feasible to obtain a thorough understanding. FinTech streamlines financial transactions for consumers and businesses, making them more accessible and often less expensive. It can also refer to businesses and services that use artificial

intelligence, big data, and encrypted blockchain technology to conduct highly secure transactions within an internal network.



Source: Fintech Industry in India: The Digital Transformation of Financial

Accessibility and Inclusion:

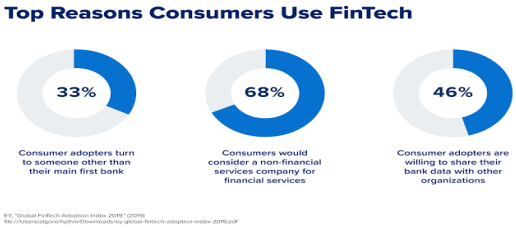
The power of Fintech to democratize finance is one of its most enticing features. It empowers consumers and organizations by making financial services more accessible, generally at a cheaper cost than traditional banking. Fintech, whether in the form of peer-to-peer lending platforms, digital wallets, or robo-advisors, has increased financial inclusion and allowed millions more people to engage in the global economy.

FinTech Trends:

Fintech has evolved in reaction to advances in the broader technology sector throughout the years. Several dominant trends determined this rise in 2022:

1. Digital banking is becoming more popular. It is now easier to access digital banking than ever before. Many customers currently handle their money, apply for and pay for loans, and buy insurance through digital-first banks. This ease of use and convenience will almost certainly fuel additional expansion in this sector, with the worldwide digital banking platform market predicted to rise at a compound annual growth rate (CAGR) of 11.5 percent by 2026.

2. Blockchain technology enables decentralized transactions without the involvement of a government entity or other third-party organization. Blockchain technology and applications have been rapidly expanding in recent years, and this trend is likely to continue.



Source: Columbia Engineering Boot Camps

Innovation and Efficiency:

Fintech companies thrive on innovation. They are constantly developing new solutions that streamline processes, reduce bureaucracy, and enhance efficiency. Blockchain technology, for example, underpins cryptocurrencies like Bitcoin, which not only challenges the

conventional monetary system but also offers secure, transparent, and faster transactions. Smart contracts, another Fintech innovation, are poised to revolutionize legal agreements, automating processes and reducing the need for intermediaries.

Accessible investment:

Investing was once reserved for the wealthy and financially adept. Fintech is making investment more accessible. For example, robo-advisors utilize algorithms to provide personalized investment advice and portfolio management at a fraction of the cost of traditional financial advisors. Apps such as Robinhood have popularized commission-free stock trading, making it more accessible to the general public.

How Safe is FinTech?

Consumers trust FinTech enterprises in general; according to Forbes, 68% of individuals are eager to use financial instruments developed by non-traditional (e.g., non-financial, non-banking) institutions. However, many fintech applications are still in their early stages and are not subject to the same safety standards as banks. This is not to say that consumers should not trust fintech companies with their money; rather, caution can be advantageous. Most customers believe that the benefits of cooperating with a fintech company exceed the risks.

Regulatory Challenges and The Collaborative Future:

While Fintech brings remarkable benefits, it also raises complex regulatory issues. Striking the right balance between innovation and consumer protection is an ongoing challenge. Regulators around the world are grappling with how to ensure a level playing field, prevent financial crimes, and safeguard data privacy in this evolving landscape.

The rise of Fintech doesn't necessarily mean the end of traditional banking. We're witnessing a trend where established financial institutions are partnering with Fintech firms to combine their strengths. This collaborative approach can result in the best of both worlds: the stability and trust of traditional banks and the innovation of Fintech startups.

Conclusion:

Fintech is transforming finance by making it more accessible, efficient, and customer-focused. It is removing barriers, empowering people, and ushering in a new era of financial services. While challenges and risks persist, the potential benefits of Fintech are too substantial to ignore. As we move forward, a delicate balance between innovation and regulation will be vital to ensure a financial world that is both dynamic and secure. Fintech is not just a disruption; it's a transformation that has the potential to make

finance more accessible, efficient, and inclusive for all.


COMPUTER
SCIENCE

COMPUTER SCIENCE TIMELINE – 2023

January 2023:

- Microsoft releases ChatGPT-powered Bing, a new search engine that uses large language models to provide more comprehensive and informative results.

February 2023:

- OpenAI releases GPT-4, a new large language model that is significantly more powerful and capable than its predecessor, GPT-3.

March 2023:

- Google AI releases Imagen, a new text-to-image diffusion model that can generate realistic images from text descriptions.

April 2023:

- Meta AI releases CICERO, a new AI chatbot that can negotiate and collaborate with humans in a realistic and engaging way.

May 2023:

- DeepMind AI releases Gato, a new general-purpose AI agent that can perform a wide range of tasks, including playing games, translating languages, and writing different kinds of creative content.

June 2023:

- IBM announces the development of the new Osprey quantum computer chip with 1,121 qubits, the most powerful quantum computer chip ever built.

July 2023:

- Google AI releases Bard, a new large language model from Google AI, trained on a massive dataset of text and code.

August 2023:

- Microsoft announces the development of a new AI-powered code generation tool that can automatically generate high-quality code from natural language descriptions.

September 2023:

- Amazon announces the development of a new cloud-based AI platform that makes it easier for businesses of all sizes to build and deploy AI applications.

October 2023:

- A team of researchers at Stanford University develops a new type of AI algorithm that can learn to perform tasks without any human supervision.

CYBER SECURITY:

Muhammad Saad Asif

247-BSCS-2022

Introduction:

With the growing dependence on digital technologies, robust cybersecurity measures have become essential. Cybersecurity refers to the practice of defending computer systems, networks, and data from unauthorized access, theft, and damage. In this digital era, where cyber threats are omnipresent, understanding the significance of cybersecurity and adopting effective strategies to protect our online presence is crucial.

Importance of Cybersecurity:

In our interconnected world, cybersecurity is more critical than ever. Consider a situation where your data, including financial details, falls into the wrong hands. The repercussions could be severe, leading to identity theft, financial loss, and emotional distress. Cybersecurity acts as a barrier, shielding you from such scenarios. It includes various measures, technologies, and practices to protect your digital existence. Moreover, cybersecurity is essential for maintaining the stability and integrity of businesses, governments, and critical infrastructures.

According to Microsoft, nearly 80% of nation-state attackers targeted government agencies, think tanks, and other non-government organizations, with 58% of nation-state attacks originating from Russia.

Most Common Cyber Security Threats:

Understanding prevalent cybersecurity threats is crucial for effective protection. Some of the most common threats include:

- **Malware Attacks:** Malware is malicious software designed to infiltrate systems, unauthorized access, and cause harm or steal sensitive data. Types of malware include viruses, worms, Trojans, ransomware, and spyware. Malware can spread through email attachments, compromised websites, or malicious downloads.
- **Phishing Attacks:** Phishing involves deceptive emails, messages, or websites impersonating legitimate entities to deceive individuals into revealing sensitive information, such as passwords or credit card details.
- **Social Engineering Attacks:** These attacks manipulate individuals into revealing confidential information or taking actions that compromise their security. They exploit human psychology rather than technological vulnerabilities. For instance, an Indian engineer associated with a sensitive organization was deceived by a supposed Pakistani spy who extracted details of Indian missile development.
- **Denial-of-Service (DoS) Attacks:** DoS attacks disrupt the regular functioning of computer systems or networks by flooding

them with excessive traffic or requests, making the system unavailable to legitimate users.

- **Data Breaches:** Data breaches involve unauthorized access to sensitive data, leading to potential misuse. They can result from weak security controls, software vulnerabilities, or human mistakes.

In 2022, companies like Twitter and Optus experienced significant data breaches. The carding marketplace, Biden Cash, released data of over 1.2 million cards for free.

Measures for Enhancing Cyber Security:

1. Use strong and unique passwords.
2. Update software and systems regularly.
3. Implement two-factor authentication.
4. Backup data regularly.
5. Educate employees about cybersecurity best practices.

Conclusion:

The challenges are real, and the need for a secure digital environment is universal. Everyone wants to use the internet, conduct online transactions, and communicate securely. Cybersecurity provides that assurance. It enables individuals and organizations to protect themselves against malicious threats, ensuring data confidentiality, integrity, and availability.

By adopting robust security measures, staying updated on the latest threats, and practicing good cyber hygiene, we can confidently navigate the digital world. Whether you're a tech enthusiast, a business owner, or someone who values privacy, cybersecurity is essential. It's about protecting our digital lives and maintaining the trust we have in the online realm.

THE SIGNIFICANCE OF DATA SCIENCE

Syed Usman Ali Bukhari

105-BSCS-19

Data Science is one of the emerging disciplines and holds tremendous importance in the guidance of researchers and scholars. The more we dive deep and start exploring the landscape we come to know about the critical value of data science. Today's world is data-driven; it simply means data is everything. Data is generated with every keystroke. The rate at which data is growing is unprecedented. The rate of generation per day is predicted to be 463 exabytes by the year 2025. Handling such an enormous amount of data is a giant challenge. However, the issue is not only to handle such data but to ensure its reliability and integrity is also the responsibility of data scientists. The collection and storage of reliable data are crucial in establishing the basis for constructing systems that extract valuable insights from raw data. After the confirmation of the data's reliability, the next step is to structure the data for efficient manipulation by algorithms that will work to learn and extract trends, patterns and parameters from the data [1].

From the existing data, we can learn some valuable insights and draw some conclusions based on the available which is called solving an inference problem. Make predictions about a natural phenomenon by understanding the historical data. Make informed decisions. Uncover the hidden patterns and relationships inside the data. We can apply some data science tools and techniques like decision trees, probabilistic models, classification models, and unsupervised learning algorithms that extract some patterns and insights from data. Data Science is not only

limited to pattern finding and predictions, Data can also be used to explore new research problems, for the betterment of mankind. We can prove and disprove some facts. Employ data to train some models that work for the benefit of society.

Data Science has vast applications in academia. Students must educate themselves about Data Science tools and techniques. The knowledge of Data Science can be applied in various fields of study. We can provide solutions to problems in interdisciplinary departments. It would not be wrong to mention that data science is applicable everywhere. However, it must also be under consideration that data science cannot surpass human intelligence, creativity, and intuition. We can simulate human intelligence but we cannot replace it as explained in [2].

Data collection is the first and foremost step. As Machine Learning models are data-driven, we require such data that satisfies the requirements and standards. It is also a crucial step as it requires careful observation of every feature that is taken into account while preparing the dataset. There are many ways in which data can be collected and several program tools exist for

this purpose e.g., Web scraping is a method to extract the data from an online website and structure it. Data structures are employed to efficiently manipulate and explore the collected data. It must also be ensured that the data is derived from a reliable source to ensure the model's integrity and eliminate potential bias.

Exploratory Data Analysis reveals certain characteristics of data such as the distribution of data which includes identifying the central tendency of the data. Some patterns like correlation. Some elements like outliers and true outliers. Missing features and null data. Some visualization tools are also used to make a pictorial view such as scatter plots, heatmaps, histograms, and box-plot. It also helps in feature engineering where one is trying to identify the important features that have a great impact on the data and removing the features which don't contribute to decision-making or proving a hypothesis.

After the preparation of data, a suitable model is selected for training. Choosing a specific model at the start cannot be determined easily so, one must start from a basic model and check the performance of the training by using test data. After that to increase the accuracy of prediction other models can

also be employed. The model must be evaluated with a validation dataset which is also called an unseen dataset to test its generalizability. The real-world data is changing rapidly and the model needs to adapt to the changes to make better predictions.

Different performance metrics like accuracy, F1-score, and loss can be used to evaluate a model When one is sure about the performance of the model then it can be deployed on an application on the web or mobile. The trained model will make predictions based on the provided features and help in decision-making, performing regression, classifying the objects, and many more services. Data science is one of the fastest-growing disciplines. Data is being generated at an exponential rate but to make it useful we need to employ tools and techniques from data science.

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CYBER SECURITY GUIDE: PREVENTING ONLINE ATTACKS

Muhammad Ihtisham

0269-BSCS-19

Understanding Cyber Security

Cyber security is defined as the protection of computer systems and networks from unauthorized access, attacks, and damage. It involves implementing measures to prevent hackers and other online criminals from gaining access to sensitive information or causing harm.

Importance of Cyber Security in the Digital Age

The importance of cyber security in today's digital age cannot be emphasized enough. With increasing reliance on technology and widespread use of the Internet, individuals and organizations are more vulnerable to cyber-attacks than ever before. According to the Department of Homeland Security, cyber security can be described as the activity or process, ability or capability, or state whereby information and communication systems and the information contained therein are protected and/or defended against interception, unauthorized use or alteration, or exploitation. Cyber security is not limited to the protection of data but also extends to the safeguarding of systems and networks.

Common Types of Cyber Attacks

There are many common types of cyber-attacks that individuals and organizations should be aware of:

1. Phishing and social engineering attacks: This includes deceptive tactics aimed at extracting sensitive personal information, like passwords or credit card details, through methods such as impersonating trusted entities or employing psychological manipulation.

2. Malware attacks: These include the use of malicious software, such as viruses, ransomware, or worms to obtain unauthorized access to systems or damaged data.

3. Denial of Service attacks: This refers to a system or network that is overwhelming with requests or traffic, causing it to become unavailable to legitimate users.

4. Exploitation of vulnerabilities: It includes identifying and exploiting weaknesses in software, systems, or networks to gain unauthorized access or control.

How Cyber Attacks Impact Online Presence

Cyber-attacks can have a significant impact on an individual or organization's online presence. They can lead to data breaches, where sensitive information is stolen or exposed. This can result in financial loss, reputational damage, and legal consequences. Additionally, cyber-attacks can disrupt normal operations, leading to lost time and reduced productivity. In addition, cyber-attacks can also lead to the compromise of personal information, such as passwords or financial data, which can be used for identity theft or fraudulent activities.

Preventive Measures Against Cyber Attacks

Given the increased risk of cyber-attacks, individuals and organizations need to take proactive steps to secure their internet presence. Here are some precautions you can take to reduce the risk of cyber-attacks:

1. Employ strong and unique passwords: Use complex passwords that must contain a combination of numbers, letters (upper and lower case), and special characters (i.e.! @$&%). And not using the same password for multiple accounts and changing passwords every month.

2. Implement multi-factor authentication: Enhance security by implementing multi-factor authentication (MFA) wherever feasible. MFA necessitates users to provide an extra layer of verification, like a code sent to their mobile device, alongside their password.

3. Keep software and systems up to date: Routinely keep your operating system, applications, and security software up to date. This ensures you have the most recent patches and safeguards against known vulnerabilities and potential exploits.

4. Practice safe browsing habits: Be careful when clicking on suspicious links or downloading files from unknown sources.

5. Avoid Pirated software: Avoid downloading and using pirated (crack) software, always try to download from official websites or stores.

Strengthening Online Security: Step-by-Step Guide

1. Educate and Train: Continuously educate yourself and, if applicable, your employees about the latest cyber threats and best practices to combat them. Regularly attend seminars or webinars about online security.

2. Secure Physical Access: Ensure that computer hardware is physically secure. This means using locks on server rooms and logging any physical access to critical systems.

3. Use Firewalls: Install and maintain a robust firewall to filter out malicious traffic before it reaches your system.

4. Back-Up Regularly: Make sure you have regular backups of your data. Store these backups in multiple locations, including offline ones, to protect against ransomware attacks.

5. Limit User Privileges: Grant the least amount of access necessary for users to perform their tasks. For instance, not everyone needs administrative access.

Maintaining a Secure Online Presence

1. Monitor Regularly: Regularly monitor and analyze your network for signs of any irregularities or unauthorized access.

2. Have an Incident Response Plan: Be prepared for any security incidents by having a predefined plan in place. This will allow for a quick and efficient response to any breaches.

3. Stay Informed: Keep abreast of the latest in cyber threats and mitigation techniques. Join cyber security forums or groups that share such information.

4. Avoid Oversharing: Be cautious about the amount of personal or company information you share online. This can be used for social engineering or other targeted attacks.

5. Use HTTPS: Ensure your website uses HTTPS, ensuring that any data transferred is encrypted and secure from eavesdropping.

Cyber Security: Best Practices and Recommendations

1. Regular Audits: Regularly conduct security assessments to check for vulnerabilities and ensure compliance with security standards.

2. Collaborate: Work with other organizations in your industry to share knowledge about threats and best practices. This collaborative approach can provide a broader insight into potential threats.

3. Stay Updated with Laws and Regulations: Cyber security laws and regulations can vary by region and are continuously updated. Be sure you are compliant and understand the responsibilities they entail.

4. Use Encrypted Communications: When transmitting sensitive data, use encryption. This includes emails, chats, and other forms of communication.

5. Limit Remote Access: If you have remote employees or use remote tools, ensure they have secure connections, like VPNs, and that any remote access is strictly controlled and monitored.

Conclusion

In the swiftly evolving landscape of the digital age, cyber security stands as the bedrock ensuring the safety and continuity of our online interactions. As threats become more sophisticated, so too must our defenses. The journey to robust cyber security is multifaceted, requiring a combination of strong technical safeguards, educated human behaviors, and proactive measures. For individuals and organizations alike, understanding and prioritizing online safety is not just a choice but a necessity. By implementing the practices and recommendations outlined in this guide, we can collectively create a safer digital environment for all. Whether you're an individual seeking to protect your data or an organization striving to maintain trust, a secure online presence is a testament to foresight and responsibility in this interconnected world.

QUANTUM COMPUTING: A THREAT TO MODERN SECURITY

Muhammad Zakariya Tariq

2021-1-816

Within the dynamic realm of technology's ongoing evolution, quantum computing emerges as a phenomenon of both wonder and concern. While holding the potential to lead us into a new era marked by unparalleled computational capabilities and profound scientific discoveries, quantum computers also present a formidable threat to the bedrock principles of modern security.

So first understand what is a quantum computer. In a classical computer, the smallest unit of data that a computer can process and store is called a bit. It can have two possible states 0 and 1, where 0 represents low energy and 1 represents high energy. However, in quantum computers, there are qubits. Each qubit can be in any proportion of 0 or 1. This is called superposition. It collapses into 0 and 1 only when it is observed (just like Schrödinger's cat).

Four classical bits can have sixteen possible configurations and at a time we can use only one. However, in the case of qubits, it can be in all possible states at once. Just imagine that you have to find a phone number in a telephone directory. A classical computer will go through each page one by one. However, in the quantum computer approach, it's like checking all pages at once by creating instances such that each goes through only one page. This ability makes it super-efficient and hence supercomputer.

These unmatched characteristics enable quantum computers to efficiently solve certain mathematical

problems that form the basis of many encryption algorithms used today. For example, Shor's algorithm can factor large numbers exponentially faster than the best-known classical algorithms. This poses a significant threat to the security of data that relies on current encryption methods, including data transmitted over the internet and stored in various databases.

Many secure communication systems rely on public key cryptography, such as RSA and ECC (Elliptic Curve Cryptography). Quantum computers, when they become powerful enough, can easily factor in large numbers or solve discrete logarithm problems, which are the foundations of these encryption methods. As a result, encrypted data and communications can be decrypted, compromising the confidentiality of sensitive information.

Notably, if quantum computers can indeed breach current encryption systems, they have the potential to unlock historical data that was once deemed secure, thereby jeopardizing the confidentiality of past communications and stored information. Moreover, the threat extends to impersonation attacks, where adversaries could exploit quantum computing's decryption capabilities to assume the identities of legitimate users, opening avenues for identity theft and unauthorized system access.

It is alarming for big tech companies and governments. That's why they are putting so much time and money into it. Luckily, this is not affecting our lives today but shortly, it can. A man is both, in love with and fearful of his creations. While we navigate this uncharted territory, we must remain vigilant, proactive, and dedicated to fortifying our digital defenses against the formidable power of quantum adversaries.

THE LIMITATIONS OF CHATGPT: UNDERSTANDING THE CHALLENGES OF AI-POWERED LANGUAGE MODELS AND THE NEED FOR HUMAN OVERSIGHT

Malika Mujahid

0059-BSCS-21

From virtual assistants like Siri and Alexa to chatbots on customer service websites, AI-powered language models like ChatGPT are becoming integral to our daily lives. These models have revolutionized how we interact with technology, enabling us to communicate more naturally and intuitively with machines. However, as these models become more advanced and widespread, it's crucial that we also understand their limitations and the potential risks they pose. Ever Since ChatGPT has been accessible to the entire world, it has not stopped amusing people with its varied and vast capability of generating realistic and coherent texts, which further molds its content according to the tone and style of the input text. ChatGPT has served people with exceptional demonstrations, such as creating entirely new writing expressions that are nearly impossible to distinguish either as human-written content or simple text powered by an AI model. ChatGPT has refined the ways we interact with technology, serving us with more productive and effective communication, which has led this AI-

powered model to be incorporated within the industries of customer service, Education, Healthcare, and beyond. Where it seems so easy and smooth to assimilate AI models into our day-to-day jobs, simultaneously there is a massive stream of challenges that these models have to deal with.

Considering ChatGPT as one of these AI-powered Language models, the major drawback or limitation we can put forward by it is, its incompetence to comprehend the nuances of human conversation and to understand it at a broader level. Even after training it over the vast corpus of data set it tends to give a response that is completely irrelevant and illogical which causes the user on the other end to lose their calm. As ChatGPT is trained over the datasets that are present on the internet and very readily available, the AI-powered Language model tends to generate some highly offensive, biased, and provocative responses which depicts the limitation of AI-powered models. The model is prone to generate technically correct responses but is unacceptable and nonsensical in context. As ChatGPT is so powerful when it comes to dealing with academic and research-related affairs, it consequently affects the innate intellectual capability and creativity of a person. The subsequent effect of this is the erosion of our ability to cater to a healthy emotional and intellectual connection with each other. When these AI-powered models are put forward to the masses the concern of accountability and responsibility rises above.

As ChatGPT is prone to facilitate irrelevant information, manipulate public information, and provide us with misleading data, who is responsible and answerable for all these actions? Here comes the need to incorporate a proper and proactive approach in the development and deployment of these AI-powered models. The need for Human oversight cannot be denied as it will allow the developers and the policymakers to encompass transparency in their data collection and use, testing of algorithms, filtering out the biased and offensive patterns, regular auditing, and appropriate testing of the models. One of the key ways to ensure the safety and ethical use of AI-language models is through mindful training and oversight. From selecting the appropriate training data set to monitoring the models' response to intervening when necessary to correct all sorts of errors or biases, the experience of using AI models can be made smooth.

Another way to deal with it is to keep an eye on the ongoing research and development to improve the capabilities of these models to overcome the limitations. This can be done by investing more in the technologies and techniques that can help the AI models better understand the context and common-sense knowledge, as well as developing more sophisticated methods for detecting and mitigating bias. One thing to keep under consideration is that to keep an eye on the AI models is not to stifle innovation and progress in the field of technology and AI, but to make sure that these technologies are developed and deployed in such a manner that they are safe, beneficial and ethical to the society. By working on the limitations of AI-powered language models like ChatGPT, we can unlock their full

potential while minimizing the risks and ensuring their responsible use.

WHY EVERYONE SHOULD LEARN COMPUTER SCIENCE

Sahil Asif

42-BSCS-19

sahilasif40@gmail.com

Computer science? That stuff is for nerds and geeks! That's no longer the truth. In a rapidly modernizing world, where technology continues to play an increasingly important role in our lives, the benefits of learning computer science for everyone are becoming more apparent with each passing day.

In this article, we will explore and demonstrate why everyone, regardless of their background or career path, should learn computer science.

Computer Science is Everywhere

Computer science is no longer confined to the realm of computer programming. It is everywhere. From smartphones and social media to self-driving cars and smart homes, computer science is playing an increasingly important role in our daily lives. By learning computer science, we can better understand the technology that surrounds us and use it to our advantage.

It Enhances Problem-Solving Skills

Life is all about resilience and smartly tackling and solving problems as they come.Learning computer science is one of the most important things one can add to their skill set to enhance their problem-solving skills.

At its very core, computer science all is about breaking down complex problems into smaller, more manageable tasks, and then developing algorithms and solutions to address and solve those tasks. So naturally, the problem-solving skills acquired while learning computer science can be applied to a wide range of fields, from science and engineering to business and law, and to even life itself.

It Opens Up Career Opportunities

The IT Industry is booming! In a rapidly modernizing world, everything and everyone is digitizing themselves the demand for computer science skills is increasing across all industries.

So, by learning computer science, individuals can open up themselves to a wide range of extremely lucrative and high-paying career opportunities in the Information Technology field, from data analysts, web developers, and software engineers to cyber security specialists, product managers, and digital marketers.

Even, say, if someone is not interested in pursuing a technical career and all the described opportunities, just having basic computer science knowledge and skills can be an asset in any field and go a long way to improve your career, whichever that may be.

It Fosters Creativity

Computer science is not just about following rules and solving problems, it is about having a deep insight into the problem itself and finding unique and out-of-the-box ways to solve that problem. Its essence is all about creativity and innovation. So, by learning computer science, individuals can develop their creativity and come up with new and innovative solutions to complex problems.

Not just that, but bringing your idea and conception to reality, and creating a visual representation of what you thought in your mind, is a joy on its own. So, it ignites the passion for creativity and realizing your visions. Some of the most successful startups and companies in the world were founded by computer scientists with a passion for creativity and innovation.

It Prepares Us for the Future

Today's world is changing at a rapid pace, and technology is becoming more and more important and playing an increasingly important role in our lives. By learning computer science, individuals can have a sense of vision and prepare themselves for the future and the challenges that come with it. Whether it is learning how to code or understanding the impact of technology on society, computer science skills are becoming increasingly important in today's world.

Whether it is to better understand the technology that surrounds us, enhance problem-solving skills, open up career opportunities, foster creativity, or prepare for the future, the benefits of learning computer science are clear. So why not take the first step and start learning today? In conclusion, everyone should learn computer science.

ECONOMICS

TIMELINE OF ECONOMICS 2023

JANUARY:

The stock market ended 2022 on a very low note. During the year, the S&P 500 fell by 19%, the teach heavy NASDAQ composite by 33% and the Dow Jones Industrial average by 9%, their worst performance since 2008. In the market value, Apple shed $846 billion while Amazon $834 billion. Despite the big falls in March and September, the Britain's FTSE 100 actually finished 2022 slightly above its mark at the start of the year.

FEBRAURY:

"The share of the renewable energy in the world's power generation will rise from 29% to 35% in 2025", said by International Energy Agency in its latest forecast. Although, the demand for electricity is expected to keep growing, and 70% of that increase will come from China, India and South East Asia, emissions from the power sector will "plateau".

MARCH:

The Britain's economy will shrink by just 0.2% this year and is doing much better than the last year according to the government's budget; that is improvement on the contraction of 1.4% previously forecast. Some of the major measures unveiled in the budget are new but temporary regime for capital allowances and more generous childcare support. It also reduced alcohol taxes for pubs.

APRIL:

The International Monetary Fund has slightly reduced its estimate of growth in the world economy this year, to 2.8%. The fund is expecting the US GDP to increase by 1.6% and the euro's area by 0.8%, though the Britain economy could shrink by 0.3%. The IMF in its statement said that the fog around the world economic outlook has thickened, in part because of the recent stress in financial markets caused by the collapse of Silicon Valley bank and Credit Suisse.

MAY:

In the first three months of 2023, Apple revenues from the iPhone grew much more as compared with the same time period in 2022. That has spread the fear among the investors that the last year lockdowns at the factories in China that assembles the device would impact income from Apple's biggest money spinner. The overall revenue of the company dropped, as the sales of the MacBook's and iPads fells.

JUNE:

A major shift in the labor market as New York introduced a minimum wage of food delivery workers of $17.96 an hour, plus tips which rises to $19.96 in 2025. In other cities, the minimum wage for other workers in $15. But still the labor activists complained that the new rate is still too low and would not cover worker's cost. Moreover, the food delivery companies like Uber and Grub said that New York had bitten off more than it could chew and that litigation is on the table.

JULY:

The Organization for Economic Cooperation and Development published a report into the adoption of generative Artificial Intelligence in the workplace. According to the report, the impact of AI on jobs had been limited so far, but there remained a significant potential for disruption. The roles of the managers, engineers and Chief executives are more exposed to AI. The least exposed are the cleaners, collectors and the laborers.

AUGUST:

One of the major developments happened on the International Political Economy front is that BRICS (Brazil, Russia, India, China and South Africa) invited six new nations to join them including Saudi Arabia and Iran. Russian President Vladimir Putin did not attend the meeting in South Africa's capital, Johannesburg, as he risked being arrested under a warrant of the International Criminal Court. But as per message being sent, Russia was ready to pick up the slack from Ukraine as a global supplier of grain.

SEPTEMBER:

BYD's (Build Your Dreams) Motors net profit has surged by 205% in the first half of the year as compared to the first half of 2022. The production companies of China are making a big push in making of electric vehicles outside its domestic markets. In its production, 37% rests to EV sales into Europe. Most important of all, China is expected to overtake Japan as the world's biggest exporter of cars this year.

PAKISTAN: IS THERE A WAY FORWARD?

Waqar Ul Hassan
0109-MPHIL-ECON-21

The Julis-Rabinowitz Center for Public Policy and Finance recently hosted an event at Princeton University titled "Pakistan: Is There a Way Forward?" where former governor of State Bank of Pakistan Dr. Raza Baqir and Professor & Director of Julis-Rabinowitz Center for Public Policy and Finance Atif Mian were invited to speak about the challenges faced by Pakistan and the possible solutions.

Dr. Baqir highlighted the need to understand the viewpoint of the people of Pakistan when discussing the country's problems. According to him, the major problems of Pakistan are the current account deficit and fiscal account deficit. He believes that these issues are a result of macro instability, which includes factors such as uncertainty, high inflation, and low growth rates.

Professor Atif highlighted the fragile tax system of Pakistan, pointing out that incentives for real investment are very low. People tend to invest in the real estate sector, which is dead capital, rather than sectors that can generate exportable goods and services. He also noted that the agricultural earnings of commercial farmers are also meager, just a few dollars in a quarter of a year.

Dr. Baqir explained the issue of hot investment and hot money. He stated that an inflation episode in Pakistan is a supply-side phenomenon, but monetary-side policymakers are unable to understand it. Therefore, they raise interest rates to cater to inflation. Due to high-interest rates, investors put their money into banks for profit. When interest rates start to decline, they withdraw their money, leading to a hot investment or hot money phenomenon. Investors cannot convert their out investment into real investment, leading to a decrease in employment opportunities in the country. He highlighted the Roshan Digital Account initiative as a potential solution to this problem. Unfortunately, the current regime did not carry this initiative forward after a vote of no confidence. Dr. Baqir believes that this is an example of political instability in Pakistan.

Dr. Baqir also highlighted the low participation of women in the economy of Pakistan. He said that even compared to other Muslim nations, the inclusion of women in the financial system is lower. He believes that developing countries such as Pakistan need a proactive approach to increase their participation in the economy.

Professor Atif shed light on the downfall of the textile sector of Pakistan. He said that Pakistan has not attracted foreign direct investment in this sector, and only one Chinese company is working in the Pakistani textile sector. He suggested that the lack of diversity and innovation in the sector is preventing investors from showing interest. However, he gave credit to the private sector for

the remarkable achievement of the Tyre sector, which can export its Tyres to the USA.

Both speakers addressed the issue of the center of power in Pakistan. They argued that the center of power should be the people of Pakistan, rather than just one or two stakeholders among all. General Syed Asim Munir, the chief of army staff, recently stated in an in-camera session of the National Assembly that the center of gravity in Pakistan is the people. He also emphasized that there is no Old or New Pakistan, only one Pakistan that is Our Pakistan.

Professor Atif stressed the need for societal change to change the economy in the right direction for the sake of the people of Pakistan. He pointed out that even Saudi Arabia has realized this phenomenon and has opened its society to modernization. Pakistani people must have the moral authority to show patience, and tolerance, and remain cool, calm, and calculated to promote policy discussions, as Bangladesh has done. This is the only doable rule of civil discourse to promote growth and development in the country.

Dr. Raza Baqir also emphasized the importance of Pakistani institutions and stakeholders in instilling confidence in both local and external investors. He stressed the need for security conditions to be up to par to attract foreign direct investment, and for uncertainty to be kept low. Unfortunately, many investors, especially external ones, perceive Pakistan to have a credibility issue. This lack of credibility among different stakeholders poses a significant challenge for Pakistan to attract much-needed investment. Therefore, the country must work towards improving its credibility and trustworthiness to ensure a more stable economic environment.

The speakers discussed various issues facing Pakistan, including macro instability, low tax incentives, low female participation in the economy, the downfall of the textile sector, the issue of the center of power, and the credibility issue for investors.

In the end, the speakers emphasized the need for collective decisions among Pakistani stakeholders, where the rules of the game should be decided among all stakeholders. They were optimistic about the way forward for Pakistan, noting that if Pakistan could overcome the COVID-19 crisis, it could also come out of the current economic crisis through ownership realization, governors of mechanisms, unity, and harmony.

Overall, the event shed light on the current economic situation in Pakistan and highlighted the need for collective action to address the issues facing the country. It also provided some optimism for the future and demonstrated that there is a way forward for Pakistan.

APPLYING THE GRAVITY MODEL TO PAK-INDIA TRADE CHALLENGES AND OPPORTUNITY

Faheem Jabbar

Pakistan and India share a complex history of political, economic, and social interactions. Despite being neighboring countries, their economic relationship has been limited due to various reasons, including political tensions, terrorism, and trade barriers. However, there is potential for increased trade between the two countries, given their economic size and geographical proximity. The Gravity Model is a useful tool that can help understand the factors that influence trade between countries. This blog post aims to explore the challenges and opportunities of applying the Gravity Model to Pak-India trade. The purpose of this blog post is to shed light on the potential for increasing trade between Pakistan and India, the challenges that have hindered their economic relationship, and the possible ways to overcome these challenges.

The Gravity Model is a widely used economic model that predicts the flow of goods and services between two countries based on their economic size, geographical proximity, and other factors. Let's apply the Gravity Model to Pakistan and India to understand their trade relationship. The Gravity model states that the bilateral trade between two countries is positively related to the product of the two countries' GDPs and the closer the two countries are, the larger the volume of trade between them is expected to be.

India has a larger economy than Pakistan, with a GDP of USD 3.05 trillion in 2020, while Pakistan's GDP was USD 296 billion in the same year. India's larger economy indicates that it has a greater potential to be a trade partner for Pakistan. Pakistan and India share a long border, which spans over 2300 km. The proximity between the two countries suggests that they should have a significant trade relationship.

Other factors that can affect trade flows between Pakistan and India include trade barriers and restrictions, infrastructure, and cultural and historical ties. While the economic size of India makes it a more attractive trading partner for Pakistan, political tensions and conflicts have hindered their trade relationship. India has imposed high tariffs on several Pakistani products, while Pakistan has also imposed high tariffs on Indian products. Additionally, there are limited direct transport links between the two countries, which increases the cost of trade and makes it less attractive for businesses.

Despite these challenges, there is still significant potential for trade between Pakistan and India. Both countries have complementary economies, with Pakistan excelling in textiles and agriculture, while India is a major producer of technology, pharmaceuticals, and services. Additionally, both countries are members of the South Asian Association for Regional Cooperation (SAARC), which aims to promote regional economic cooperation and integration.

The China-Pakistan Economic Corridor (CPEC) could also provide new trade routes and

opportunities for increased economic cooperation between the two countries. The CPEC includes the development of infrastructure, such as roads and railways, to connect China's western regions to the Pakistani port of Gwadar on the Arabian Sea. This could potentially create new trade routes and increase trade flows between Pakistan, India, and China.

While political tensions and conflicts have hindered their trade relationship, the Gravity Model suggests that there is significant potential for increased trade and economic cooperation between Pakistan and India. Addressing trade barriers and investing in infrastructure can help unlock this potential and contribute to regional stability and prosperity.

The political tensions and conflicts between Pakistan and India have been the biggest impediment to increasing trade between the two countries. The two countries have had a contentious relationship since their independence from British colonial rule in 1947, with disputes over issues such as Kashmir and terrorism.

The Kashmir issue is a long-standing territorial dispute between the two countries, with both India and Pakistan claiming the region as their own. The dispute has resulted in several wars and conflicts between the two countries, making it one of the most contentious issues in the region.

Terrorism is another major issue that has affected trade relations between the two countries. India has accused Pakistan of supporting terrorist groups, which has resulted in strained diplomatic relations and the imposition of trade barriers and restrictions. These political tensions and conflicts have resulted in the imposition of trade barriers and restrictions, making it difficult for businesses in both countries to engage in trade. For instance, India has imposed a ban on the import of goods from Pakistan, including textiles and agricultural products. Similarly, Pakistan has imposed high tariffs on Indian goods such as sugar and cotton.

The political tensions and conflicts between the two countries have limited the potential for increased trade and economic cooperation, making it difficult to realize the benefits of their complementary economies and geographical proximity.

Infrastructure and logistics are also significant challenges to increased trade between Pakistan and India. The lack of adequate infrastructure, including transportation and logistics networks, has hindered the growth of trade between the two countries.

There are limited direct transport links between Pakistan and India, with the majority of trade taking place through third-party countries. This increases the cost of transportation and logistics and makes it more difficult for businesses to engage in trade.

Despite the challenges, there are still several opportunities for increased trade between Pakistan and India.

The China-Pakistan Economic Corridor (CPEC) is a major infrastructure development project between China and Pakistan. The project includes the development of roads, railways, and other infrastructure to connect China's western regions to the Pakistani port of Gwadar on the Arabian Sea. The project has the potential to create new trade routes and increase trade flows between Pakistan and China, which could also benefit India.

India could potentially use the CPEC route to access the Central Asian and Chinese markets, and Pakistan could benefit from India's market access in return. This could lead to increased economic cooperation and trade between the two countries.

Pakistan is known for its agricultural and textile industries, while India is a major producer of technology, pharmaceuticals, and services. These sectors present an opportunity for increased trade between the two countries.

Pakistan could export textiles and agricultural products to India, while India could export technology and services to Pakistan. This could help increase trade and promote economic growth in both countries. Furthermore, increased trade in agriculture and textiles could lead to job creation and poverty reduction, which would benefit both countries.

In conclusion, the application of the Gravity Model to Pakistan-India trade highlights the challenges and opportunities for increased economic cooperation and trade between the two countries.

Pakistan and India have complementary economies, geographical proximity, and cultural ties that suggest a significant potential for trade. However, political tensions and conflicts, trade barriers and restrictions, and inadequate infrastructure have hindered their trade relationship.

To unlock the potential for increased trade and economic cooperation, there needs to be a concerted effort to address these challenges. This includes reducing trade barriers, improving infrastructure, and promoting regional economic integration through initiatives such as the China-Pakistan Economic Corridor and the South Asian Association for Regional Cooperation.

Increased trade and economic cooperation between Pakistan and India can benefit both countries and contribute to regional stability and prosperity. It is time for policymakers to recognize the potential for economic cooperation and act to address the challenges and seize the opportunities for Pak-India trade.

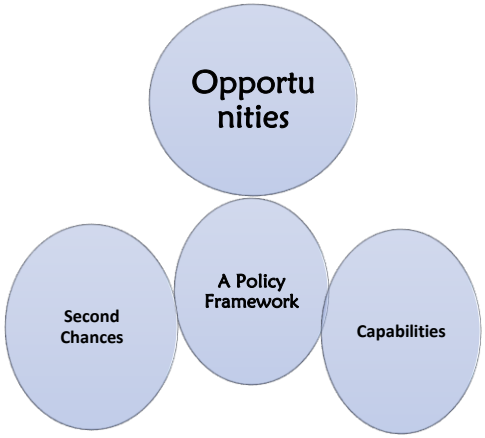
OPPORTUNITIES, CAPABILITIES, SECOND CHANCES AND YOUTH A FRAMEWORK FOR POLICY

Asfandyar Akbar

Young people and their families make the most of the decisions but it's the policymakers and the potential institutes that affect the policies through their way of delivering the public. The potential "Youth lens" there are three strategic directions for reforms:

1. Opportunities: It is the broadening of the opportunities for the youth bulge in terms of education and health services as the basics. Expanding the base for working, improving their citizenship, and giving them a voice so that they could also participate in the articulation of the policies.
2. Capabilities: Developing the capabilities of the youth by recognizing them as decision-making agents and by helping them as their decisions are well-informed, adequately resourced, and judicious.
3. Second Chances: To catch up from the bad choices, bad results, and bad experiences- it is to give them a second chance so that they can receive the potential opportunities to thrive in their fields of performance.

The situation today presents unprecedented opportunities for the youth and the investment will likely have a huge return- as they are considered to be the biggest asset of any nation. It is the achievement of the past development decades that the child of the past and now the young has survived childhood diseases and has gone through primary schooling making for a huge impact of resilience and nation building atmosphere.



The future is in the hands of the young people. They will determine the future economies and their incomes. Their potential will have the opportunities to go longer to achieve the competencies in the comity of nations.

What Policy?

By Whom?

Who will direct the Policy?

Implementation?

How it will be influenced?

What is the potential policy?

Where lies the gap?

These are some of the basic questions that underline the base for the potential policy for the young people of any country-especially those of the developing world. These suggest some of the major chunks that put the policy base on the table of any policymaker.

It is the sectoral policies that affect the opportunities for human capital investment. The Public financing, provisions, and regulation of the education system have largely determined the quality of workers and their skills.

If we have to test the economic theory- and its value is longevity, the model of the human capital passes it with flying colors. An individual will invest in his or her human capital until the additional level of education, health, or the acquisition of the skills marginal benefit passes the additional added cost.

One of the assumptions of the model is it is who that makes the investment decisions in human capital. The model assumes that a young person makes his or her own decisions. The models assume the bargaining among household members to determine human capital investments. In some phases of life, it is the adults who make the investment decisions and in some of tase, it is the parents who have to say all.

The model of the youth lens assures to the fact that despite the enrollment ratio getting higher, still the children and the adults coming out of the education system are not well trained to be focused in the labor market. Simply focusing on primary education will not deliver to the national economies. In many parts of the world, there has been an enormous gap between the numbers graduating from the schooling system and the relevant skills required for the proper labor market.

"School is … like an island, where there are all kinds of people and you learn a lot from them. However, I know that real life is not going to be like this, it will be difficult, we will have to face that, but at school, you start learning how . . . to be prepared."

"Many parents fear for their children and would 'ask' them to follow their way of doing things, without allowing youth to try new things, for fear of the danger."

So, there are opportunities. How one should select among them? This is one of the basic questions that arise in most of the developing world. They have the opportunities but there is a lack of capabilities in the young people that how they will survive this whole.

At the very start of the age, the adults, parents, and guardians make more of the decisions affecting the general well-being of the students. But as the children age, they start to recognize that their life could be well settled by their own decisions framing the quality of the outcome they want to enhance.

The independence in the decision of the schooling and the health behaviors, which are very difficult for the adults to monitor and control. By applying the youth lens- meant to apply the policy addressing the parents and the guardians needs to account for the behavior of young people, even when they are very young or living in what are seemingly traditional settings. So how one can complement the policy to the young people? It is the access to information, their command over the resources, and the skills to decide.

Before acting upon a certain decision after the information has been received and assessed. The filtration part of the information is one of the most critical parts- as most of the young people are not well trained on how to cope with the decision-making in that case. Educational systems that focus on rote learning and memorizing the facts only fail to inculcate critical thinking in the young people which leads to the further lowering of well-informed decisions.

Economists would generally say that youth are probably quite rational, given their preferences, the resources they command, and the perceived cost of their actions. Whether youth would say the same of economists is another matter. The economists apply the different lens of models in three ways: Traditional Economic analysis, Development Psychology, and Behavioral Economics.

After the broadening of the opportunities and the young people likely to seek out the capabilities base, there are many scenarios where there happens to be a gap between the availing of the opportunities and the capabilities range. There comes the most important aspect- to give a chance to the young so that they can make well-informed decisions about their life.

Bad outcomes are a part of the journey- as young people make inexperienced decision making they are less averse to risk-taking. The adults and the youth are not that well experienced to make much better decisions in risky situations which leads to the misrepresentation of the journey towards availing the broadening opportunities base.

"The system in my country … does not track down those [who] 'drop-out' in time to ensure that they do not end up becoming a liability to the world. That is what is happening here; thousands of young people walking aimlessly in the streets [with no] jobs, no social services, and therefore nothing."

The undesirable outcomes are partly a legacy of the past policies and practices that have failed to deliver the basic services so important to the foundations for better youth outcomes. The failure to spend properly has an enormous implication that has already been documented.

The mainstream programs need to be flexible so that early mistakes do not run into permanent liabilities. The second chance would ensure the fact that all those who were not well informed before dare to take action again and start the journey of integrity once again.

Pakistan is located in South Asia- a country with 65 percent of its youth residing in the country as it is one of its big resources. But the matter of the fact is that its government does not have that much potential to increase the opportunities base for its young youth and adults- offering the capabilities range and the offering of second chances in case there are not well-informed decisions. With the higher education budget of 65 billion rupees, there could be no expectations besides the fact that the universities will perform not to the optimum level in terms of research and innovation. Due to this fact, it has been noted that there is an enormous level of brain drain happening in the country- as its talented and professional people are going abroad in search of better opportunities nod build their capabilities base.

Since we have developed a wonderful scenario of discussing the youth lens from different perspectives. Offering the opportunities base and developing the capabilities of the youth, there has been an enormous potential in the policy framework that has been applied to the context of mitigating the world of second chances for all those who have been not well-informed. There has been a wonderful clue to the fact that youth policy plays a pivotal role in the embarking of the national economies- leading to the multi-dimensional geographic and socio-economic diversity in the region. The investment in the youth has an immense rate of return as it develops the whole region with the making of the mind, knowledge, and geographic fulfillment.

CULTURAL ECONOMICS: PRESERVING THE HERITAGE OF OUR WORLD

Waleeza Rafiq

0917-BHE-ECO-20

In a society that is rapidly becoming more globalized, cultural legacy is essential for forming

Identities, creating diversity, and fostering social cohesion. The field of cultural economics studies how society's tradition, culture, and art have an economic impact. It is impossible to exaggerate how crucial it is to protect cultural heritage because it not only enhances the human experience but also has a big impact on regional and international economies. In this article, the importance of preserving our cultural legacy and its financial advantages are discussed. Cultural legacy includes both material and intangible components, such as historical places, monuments, artifacts, customs, languages, folklore, and artwork. These features are evidence of the imagination, inventiveness, and knowledge of earlier generations. Preserving cultural heritage not only helps us stay connected to our roots but also gives future generations a feeling of continuity and identity. Additionally, it promotes tolerance and collaboration on a worldwide scale by fostering respect for different cultures and mutual understanding.

Cultural tourism is one of the economic advantages of protecting cultural assets that is most obvious. Tourists from all over the world flock to historical sites, museums, galleries, and cultural events. The local economies benefit greatly from the money spent by these tourists on lodging, local transportation, gifts, and diverse cultural activities. Cultural tourism has grown to be an important component of economic growth in many areas, creating jobs and assisting small companies. Cultural heritage preservation not only draws tourists but also generates job possibilities. Heritage preservation supports a wide range of specialized and semi-skilled jobs, including conservators, archaeologists, tour guides, and craftspeople. Governments and organizations can support economic growth and lower unemployment rates by making investments in cultural preservation.

The arts, including the performing, literary, and craft industries, are all supported by cultural heritage. In addition to boosting a country's GDP, these sectors also act as a soft power strategy to promote that nation's voluminous cultural heritage abroad. In addition to bringing in money, the creations of artists and craftspeople spur innovation and creativity in other industries, which further boosts economic growth. Sustainable development depends heavily on cultural heritage. Communities can keep their cultural identity while addressing contemporary issues by preserving traditional traditions and knowledge. Indigenous agricultural knowledge, for instance, can guide and shape contemporary farming methods, enhancing both environmental protection and food security. A nation's soft power and cultural diplomacy are strengthened when its cultural heritage is preserved. It promotes international cooperation and understanding by allowing countries to interact culturally. Cultural diplomacy improves international visibility, trade, and bilateral ties. Countries having a strong cultural legacy are

frequently viewed as desirable locations for collaboration and investment.

Cultural heritage is threatened in many ways despite its importance. Significant threats exist for historical sites and traditions as a result of rapid urbanization, environmental change, war, and neglect. In some instances, cultural items are forcibly stolen and sold on the black market, destroying irreplaceable cultural heritage. Cultural sites are also at risk from natural disasters and climate change and need immediate protection measures. Cultural heritage loss has a huge financial impact in addition to eroding a community's collective memory. Reduced tourism earnings, employment losses in the cultural and tourism industries, and fewer prospects for economic growth are all consequences of heritage destruction. Furthermore, the loss of cultural identity can cause social discontent that undermines communal harmony and well-being.

Collaboration between governments, NGOs, local communities, and international organizations is crucial for preserving cultural heritage. Implementing efficient preservation techniques entails:

1. Legal Protection: Strengthening and implementing laws to guard against the destruction, looting, and illegal trading of cultural heritage.
2. Promoting cultural awareness and educating the populace on the need for heritage preservation are two aspects of education and awareness.
3. Investing in conservation means allocating funds for the upkeep and repair of historical buildings and artifacts.
4. Using sustainable tourism strategies to reduce the negative effects on cultural assets.
5. Digital preservation is the process of recording and preserving cultural assets in digital form for future generations.

Cultural heritage is a priceless resource that improves our quality of life and makes a huge impact on the world's economies. Its preservation fosters mutual understanding and respect among other cultures in addition to helping local communities and businesses. Keeping our cultural heritage alive is an investment in our shared identity and a sustainable future as we negotiate the difficulties of the modern world. We can work together to ensure that the legacy of our world remains for future generations by realizing the economic significance of cultural heritage.

INCOME DISPARITY AND ITS THREATS IN PAKISTAN

Rida Zia

1042-BH-ECON-20

Many nations, including Pakistan, struggle with severe income disparity. The difference in wealth or income between the richest and poorest people

or families serves as a proxy for inequality. Pakistan has some of the greatest levels of income disparity in the world, and this hurts the country's economy.

In Pakistan, the problem of income inequality is not a recent development. The gap between the rich and the poor has been widening over the past few decades as a result of it. According to UNDP's Human Development Reports on Pakistan, over 46% of the nation's total income is earned by the top 20% of people, which includes company owners, elected officials, and rich people. Yet, just around 6% of the overall income goes to the poorest 20% of the population, which includes the most disadvantaged and vulnerable groups like farmers, laborers, and daily wage workers. Due to the large income gaps, wealth and resources are distributed unevenly, which causes societal unrest and instability.

In rural areas, where the majority of the population lives below the poverty line, the income difference is particularly pronounced. The urban-rural split is particularly relevant since resources and wealth are concentrated more in metropolitan regions. People from rural areas have moved to urban centers in quest of better economic prospects, resulting in a substantial urban-rural movement. However, this has resulted in overcrowding and a strain on already limited resources in urban areas, exacerbating the problem of income inequality.

The unequal distribution of opportunities is one of the main effects of economic inequality. The wealthiest in Pakistan have access to the best facilities, while the poor have limited access to education, healthcare, and other necessities. This results in a poverty cycle that is difficult to escape. The effects of income disparity on the economy are extensive. It significantly affects social mobility and poverty. The opportunities accessible to the rest of the population are constrained when a tiny percentage of the population controls a significant portion of the wealth and resources. As a result, there is a concentration of poverty among people who are least able to achieve their fundamental needs. Poverty also limits access to education and healthcare, which are crucial for social mobility.

Political instability can also result from income inequality. The impoverished may resort to extremist groups or political parties that promise dramatic changes if they feel they have no interest in the system and do not profit from the nation's economic prosperity. Political upheaval and instability may result from this, which over time could be detrimental to the economy. Moreover, income inequality slows down economic expansion. The purchasing power of the economy is constrained when a sizable section of the population is impoverished. As a result, there is a decrease in the demand for products and services, which slows economic growth. Additionally, it reduces investment opportunities because companies are less inclined to make investments in regions with limited purchasing power. In

contrast, a more equitable distribution of wealth and resources would increase overall purchasing power, leading to increased demand for goods and services, and a boost in economic growth.

Moreover, income disparity can result in a concentration of economic power in the hands of a small number of people or businesses. Monopolies, price-fixing, and other deceptive practices that hurt customers and small firms may come from this. The emergence of monopolies can be influenced by income disparity in several different ways. First, when a small number of people or businesses own a sizable amount of the wealth, they can have more clout and sway over the market. Due to the ability of market leaders to utilize their resources to stifle competition or engage in anti-competitive behavior, this might make it more challenging for new enterprises to enter the market. This significant income disparity has led to a concentration of wealth and power in the hands of a few individuals and companies, which can contribute to the formation of monopolies and limited competition in the market.

For instance, a few big players control the market in several industries, including telecommunications and energy, making it harder for new companies to participate and reducing competition. To preserve their dominance, these businesses may also engage in anti-competitive behavior like collusion or price fixing. Furthermore, as wealthy people and corporations utilize their resources to acquire smaller businesses and consolidate power, income disparity can also contribute to the mergers and acquisitions that lead to industry consolidation. This can make it difficult for new companies to get started and eventually result in the formation of monopolies, aggravating the problem of income disparity in the nation. When there are fewer companies in a given market, consumers have fewer choices and are more likely to be subjected to higher prices and lower-quality products or services.

In Pakistan, there are several causes for income inequality. The absence of progressive taxation systems is one of the causes. In Pakistan, the wealthy do not pay adequate taxes, which causes them to amass riches far more quickly than the poor. The dearth of opportunity for the underprivileged is another factor. Due to their restricted access to education, Pakistan's underprivileged population finds it difficult to land well-paying work. To alleviate income disparity, the Pakistani government has adopted several actions. The Benazir Income Support Program, which gives cash transfers to the underprivileged, is one such measure. The government has also increased the minimum wage and provided subsidies for essential goods such as food and fuel. However, these measures have not been sufficient to address the issue.

The government of Pakistan must put in place a comprehensive set of policies to alleviate income disparity. This entails expanding the revenue base, implementing a progressive tax system,

spending money on healthcare and education, and offering assistance and support to start-ups and small enterprises. Also, the government needs to put laws in place to encourage inclusive growth and make sure that the advantages of economic progress are shared fairly across all facets of society. In conclusion, income inequality is a significant challenge for Pakistan, and its implications on the economy and society are severe. The widening gap between the rich and poor has led to a concentration of wealth and power in the hands of a few individuals and corporations, contributing to the formation of monopolies and limited competition in the market. This has resulted in economic and political instability, reduced social mobility, and limited opportunities for the poor. To address this issue, the government of Pakistan needs to take bold steps to promote inclusive growth and ensure that the benefits of economic growth are distributed evenly among all segments of society. Such policies include implementing a progressive tax system, investing in education and health care, and providing support for entrepreneurs and small businesses. Only by taking comprehensive measures can Pakistan create a more equitable and prosperous society for all of its citizens.

PAKISTAN AND POPULATION INFLUX

Author: Hassam Waheed

Lecturer at the department of economics, GCU Lahore

The growth of human capital is an important factor in the modern-day paradigm of economic development. Human capital growth needs some explanation. Often the meaning of growth comes to the mind as the increase in the numbers, but contrary to it the human capital growth means how well the individuals of any respective nation are trained. What kind of skills do they have? And how effectively they are using these skills to participate in the process of economic development? The developed nations of the world have always given more importance to human capital, and they are investing in human capital by providing better health and education facilities to individuals. In this regard, the success story of many developed nations can be seen, where individuals have been given more importance than machines.

Pakistan is an ideal example of population mismanagement. In the last couple of decades, the population has been increasing at a rapid pace. The evidence is the population growth rate in the census of 2023, which is above 2 percent, and more importantly, it is the highest in the region. There are various reasons behind this higher population growth rate. Although the policymakers had started to make policies to cater to this issue in the late 90's, they failed to implement these policies in true spirit. One of the basic reasons behind this failure to cater the population growth is religion and religious parties. Most of the religious parties are against

the use of contraceptive items and the political elite for the sake of support never discourages this kind of practice from the religious parties. Hence the conclusion can be drawn that Pakistan is lagging due to some vested interests and weak implementation of the policies. Population is a vital component when it comes to human capital development. As the number of people increases it becomes difficult for the government to invest in such a way that every individual can get benefit. Hence population growth, human capital development, and economic prosperity are very much linked with each other.

The developing nations have been facing this problem of increased population growth for the last many years. The population is also increasing in Pakistan with every passing day. As a developing nation, this is a big challenge for Pakistan. According to the recent census in the year 2023, the total population in Pakistan is 241,492,917. This makes Pakistan the fifth largest nation in the world, with a population increase of 2.10 percent. The association between increase in the population and economic prosperity is intricate and multifaceted. The increase in the population can present both opportunities and challenges for economic prosperity; these two concepts are affected by a range of social, economic, and policy factors. Sustainable economic development always requires cautious consideration of population dynamics, natural resource management, good health, and education facilities with more job opportunities. A growing population can lead to a larger labor force, which, if matched with adequate job opportunities, can drive economic growth by increasing production and output. This can be especially beneficial in industries that require a substantial workforce.

The rapid increase in population can pressurize natural resources i.e., land, water, energy, and food. This leads to resource scarcity, environmental degradation, and a decline in overall living standards. On the other hand, the population also negatively impacts employment levels in the country. If economic growth does not keep pace with population growth, it can result in higher unemployment or underemployment rates, especially among young people. This can lead to social and economic instability. A swiftly growing population can strain public services such as healthcare, education, and infrastructure. This can negatively impact the quality and accessibility of these services, affecting overall well-being. In the end, it can be concluded that the high growth rate of the population is creating problems. It is negatively impacting the economic development of Pakistan. A high rate of population growth in Pakistan means a rise in poverty, illiteracy, and low living standards. Now the future lies in the hands of policymakers, which should first acknowledge that population influx is a problem. Let’s hope that the odds may favor the mango people of Pakistan and that policymakers adopt a policy that reduces population growth.

THE STATUS OF HIGHER EDUCATION IN PAKISTAN: CHALLENGES AND THE WAY FORWARD

Wajahat Usman

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Higher education is one of the most important pillars through which the nation builds its knowledge base and establishes its modern economy. To transform the 63 percent of youth into real wealth requires establishing a high-quality and market-driven higher education system in the country.

To achieve the 4th SDG's goal is the optimum target through different policy initiatives. There are about 235 universities in 160 districts, of which 55 universities have 119 campuses. Few districts have many universities and few don't have a single campus out there. Access to higher education has become one of the political issues as the establishment of the new university has become the main desire to achieve the ballot outcomes. As per higher education statistics, there are about 2.25 million students enrolled in these universities. About 56 thousand faculty members are associated with these Higher education institutes.

One of the big problems of Higher education institutes is the influx coming from the school level. The nationwide study conducted in grades five, six, and eight by the faculty at Agha Khan University's Institute for Educational Development (IED) revealed that the average mathematics score was 27 out of 100, while 34 out of 100 in science.

In the global context, universities are about professors who are deeply engaged in research and innovation. Overall, professors in social sciences and other disciplines are 0.54% and 5.34% respectively of the total faculty size. Comparing, the University of Yale has about 18.62% of professors in social sciences and 33.85% of professors in other disciplines.

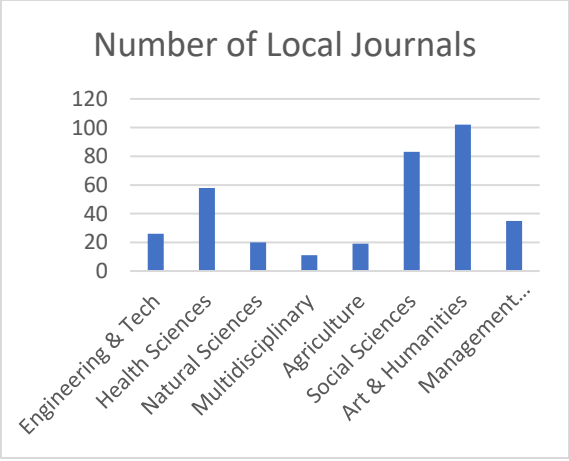
There is also a big debate on the quality of graduates from these Higher education institutions. Only 2 percent of the students get jobs once they graduate. According to the 2022 Report by the Pakistan Institute of Development Economics, over 31 percent of youth with degrees are unemployed.

One of the other main challenges is the very low academia-industry linkages. In one of the seminars, the Rector of Ghulam Ishaq Khan University (GIKI) revealed that our university decided to make internship compulsory in 1993. Right after 25 years of our decision, the HEC decided to make internships compulsory for all. As per the report shared by Technical Director Nimir Industries, they spend about 1.2 million rupees per newly hired employee and they return the same investment in the next three years, making it a total of four years to equip the employee as per demand.

The curriculum taught is also outdated and does no match with industry's demand lacking both

quality and relevance. There is also less attention towards 21st-century fields like AI, ICT, and other emerging technologies. Out of 2.2 million students, only there are 2.2 lakh students enrolled in these studies. As per the calculations of Systems Limited; a Pakistani tech company, there is a need for 30,000 trained computer scientists each year to increase IT exports by $1 billion.

Since its establishment, quantity has remained the focus of HEC. As per the HEC Annual Report, more than 26500 research papers were published in the year 2020-21. The point of concern was that only 297 papers were top-cited. There are 354 locally published journals in different disciplines but these are not well peer-reviewed as well as carry less significance in industry adaption. This large production of research papers is based on the HEC policy of promotion from one grade to another.



Source: State of Pakistan Economy 2022-23, IBA Karachi

ISCED_Broad field	Bach	Master	MS/MPhil	PGD	PhD	Total
00 Generic programmes and qualifications	108,727	9,912			1	**118,640**
01 Education	181,329	99,339	6,186	523	1,058	**288,435**
02 Arts and humanities	422,341	84,728	17,544	476	3,629	**528,718**
03 Social sciences, journalism and information	133,767	26,267	11,984	558	2,422	**174,998**
04 Business, administration and law	206,330	28,682	38,292	1,830	2,685	**277,819**
05 Natural sciences, mathematics and statistics	181,546	37,076	42,709	158	8,431	**269,920**
06 Information and Communication Technologies (ICTs)	192,751	16,456	15,383	539	1,620	**226,749**
07 Engineering, manufacturing and construction	131,101	1,593	21,842	188	2,952	**157,676**
08 Agriculture, forestry, fisheries and veterinary	39,252	414	6,398		1,475	**47,539**
09 Health and welfare	98,134	6,344	11,132	1,228	2,045	**118,883**
10 Services	11,881	3,705	1,074	43	171	**16,874**
Total	**1,707,159**	**314,516**	**172,544**	**5,543**	**26,489**	**2,226,251**

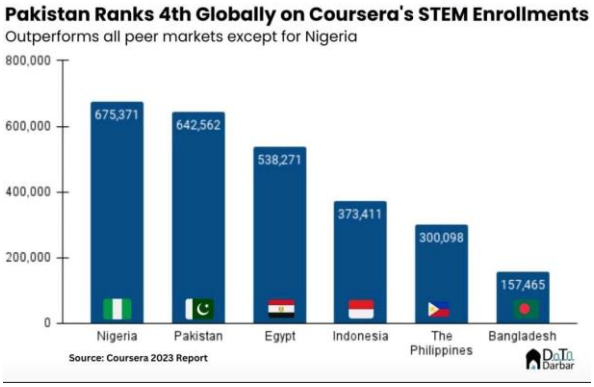
Source: Higher Education Commission

The relationship between the production of the research papers and innovation is very alarming and there is a point to ponder about the creativity of the researcher. Pakistan ranked 99th among 132 countries in the Global Innovation Index, lagging behind India, Indonesia, Malaysia, and Iran. The lower ranking in the freedom of expression, religious practices, and performance in academics raises a very serious concern about the performance of HEC.

Higher Education Commission (HEC) is an independent body whose chairman is appointed with autonomy and authority to make the right policies. The removal of the former chairman Dr. Tariq Banuri has raised several questions on the appointment and the authority. The appointment criteria for such institutions should be strict and carefully monitored as this institution is very sensitive as far as the country's future is concerned. Before jumping into the critical policy recommendation part, there is an ample need to assess and evaluate where we went wrong

because those who are ignorant of the past are condemned to repeat it.

To connect the dots in real context, there is a need for well reformed primary and secondary education system in the country with a focus on skill development and creating a taste for education and research so that you have good brains in higher education.



There is an urgent need for us to shift our policy paradigm from "brick and mortar" to the 21st-century demand. The establishment of the new university or sub-campus should be reflected in the demand of the specific territory rather than any political influence.

The system of the *professor hiring program* should be clearly defined to bring foreign professors at market value to spend time in Pakistani universities. Foreign professors should be demanded to translate the culture of the best universities in terms of research, innovation, and skill building.

The linkages between academia and industry are key to the skill enhancement of the students. The Memorandums of Understanding (MoUs) should be signed with the relevant industry, businesses, chamber of commerce, research groups, policy think tanks, and academia. This will enhance the technical knowledge of the students. Moreover, communication and soft skills are also the center of attention. The university-level clubs and societies could help in this regard. Sports is considered one of the best activities to bring discipline and teamwork in the individual. As businesses predict that 44 percent of worker's skills will be disrupted by 2027, and with technology moving faster, the World Economic Forum has set five essential skills for graduates including Analytical thinking, creative thinking, AI and big data, leadership, curiosity and lifelong learning.

The fields related to IT should be given special focus as they produce a growth multiplier effect. Pakistan being the 3rd top country in freelancing shows the level of potential in the masses of this country. The Coursera report 2023, covering a hundred countries revealed that in the science, technology, engineering, and Mathematics (STEM) skills category, Pakistan has the total contribution of 642,562 learners on the platform, and the fourth highest, only behind India, United

States and Nigeria. This shows the taste of learning in the people of Pakistan. Critically heading the same, Business Incubation centers should be established in each university with the goal of more startups, generating employment, bringing the culture of Innovation, and abolishing the traditional "Sarkari Naukri Syndrome". The Office of Research, Innovation, and

Commercialization should step up to fuel this startup culture through its newly found data, analysis, and reports for better impact.

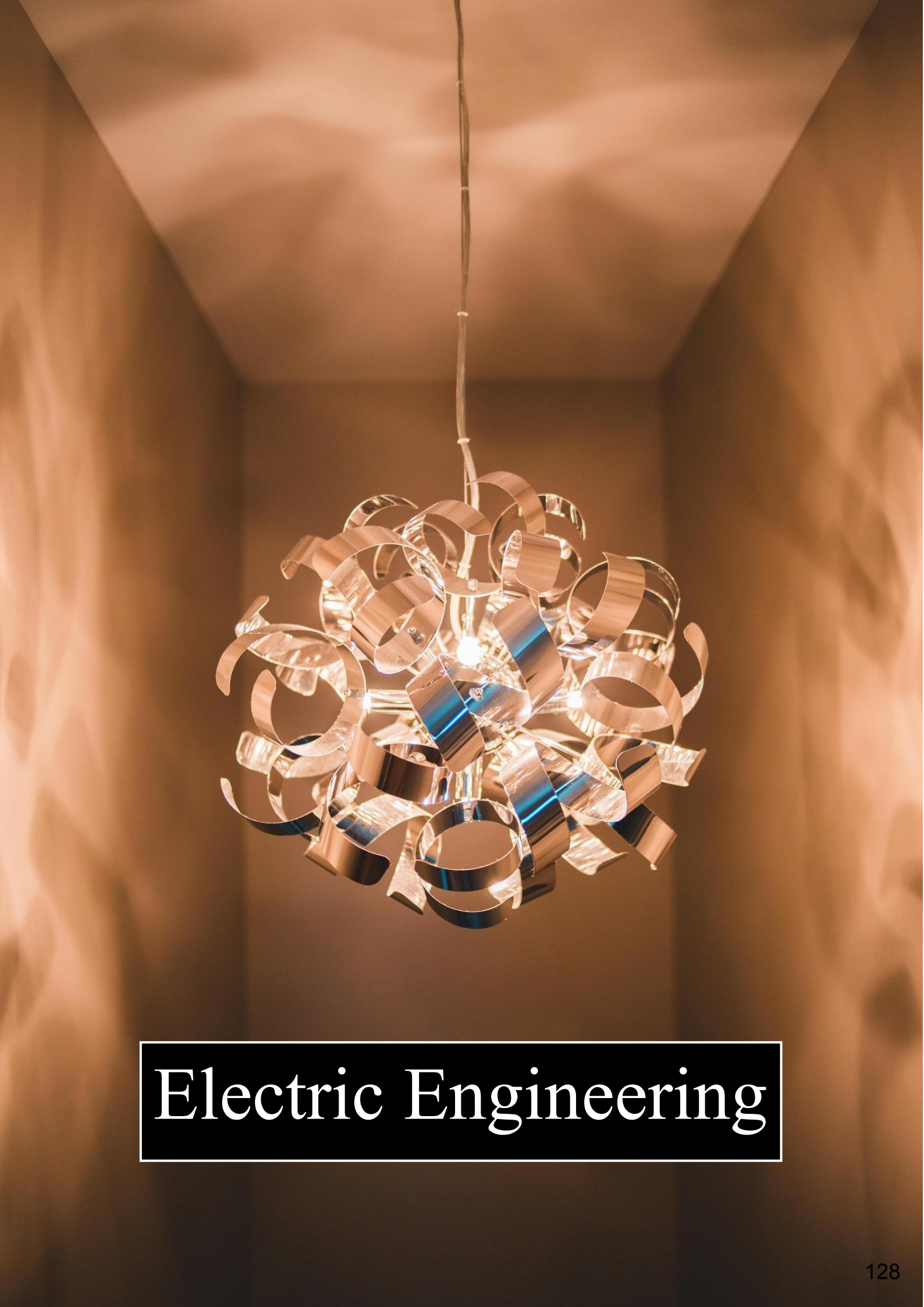
There should be a strict system of research publication. Like the model followed in most of the developed countries, for promotion, the faculty member must win an industry project or write a paper that could be translated into the practical world. The HEC Vision 2025, has set an ambitious research agenda to boost Higher education institutions as the principal drivers of knowledge-based economy in Pakistan. The professional future outlook in the image of this vision is the real policy that one can recommend for better work.

Social Progress Indicators

	Pakistan		India		Bangladesh		Nepal	
	score	rank	score	rank	score	rank	score	rank
Deaths from interpersonal violence (death/100,000)	6.72	116	2.91	77	2.42	69	1.74	56
Freedom of expression (0-1)	0.49	126	0.55	114	0.29	141	0.79	69
Freedom of religion (0-3)	1.3	158	2.36	137	3.19	110	3.02	116
Discrimination & violence against minorities (1-10)	8.8	150	8.2	137	8.6	145	9.4	158
Academic freedom (0-1)	0.56	105	0.46	120	0.26	139	0.85	60

Source: State of Pakistan Economy 2022-23, IBA Karachi

The already built Quality Enhancement Cells (QEC) in universities should be restructured as per international standards. The Monitoring and Evaluation (M&E) system should be renovated to properly assess the quality of teaching, examination, employees' performance, and day-to-day working of the institutions. This whole structure should be digitalized for time efficiency and cost control.



Electric Engineering

Timeline of 2023

January 2023:

- Advancements in renewable energy storage technologies.

February 2023:

- Developments in AI-driven power grid optimization.

March 2023:

- New breakthroughs in high-temperature superconductors.

April 2023:

- Launch of innovative consumer electronics.

May 2023:

- Progress in quantum computing for electrical simulations.

June 2023:

- Advancements in wireless charging technologies.

July 2023:

- New semiconductor materials for more efficient devices.

August 2023:

- Smart grid implementations for energy management.

September 2023:

- Sustainable energy sources integration into power grids.

October 2023:

- Ongoing research into improving battery technologies for electric vehicles and renewable energy storage.

SMART GRID TECHNOLOGY

Syed Jalal Haider

Introduction:

The 21st century has witnessed a remarkable transformation in the way we generate, distribute, and consume electricity. Conventional power grids, designed for a different era, are facing unprecedented challenges such as increasing demand, integration of renewable energy sources, and the need for improved reliability. As a response to these challenges, the concept of smart grid technology has emerged as a promising solution to revolutionize the energy sector.

Smart grid technology involves the integration of digital communication, advanced sensing technologies, and real-time data analytics into power grids. This integration empowers grid operators with the tools to monitor, control, and optimize the flow of electricity in ways that were previously unimaginable. By enabling two-way communication between consumers and the grid, smart grids offer numerous benefits including enhanced efficiency, reduced energy wastage, and improve overall grid reliability.

Methodology:

To gain insights into the emerging trends in smart grid technology, a comprehensive approach was adopted to gather relevant information. A combination of literature review, case studies, and expert interviews formed the foundation of our research methodology.

Literature Review: Extensive research was conducted to identify scholarly articles, research papers, and reports related to smart grid technology. By analyzing existing literature, we were able to identify the key trends that are currently shaping the field.

Case Studies: Real-world case studies were examined to understand the practical implementation and impact of various smart grid technologies. These case studies provided valuable insights into the challenges faced, solutions applied, and outcomes achieved in different contexts.

Expert Interviews: Interviews were conducted with experts in the field of electrical engineering and smart grid technology. These discussions provided firsthand perspectives on the trends, challenges, and opportunities within the industry.

By triangulating information from these three sources, our research aimed to provide a comprehensive overview of the emerging trends in smart grid technology. The following sections delve into the results of our research, highlighting the key trends that are shaping the future of energy distribution.

Results and Discussion:

The research conducted on emerging trends in smart grid technology has revealed several significant developments that are poised to transform the energy landscape:

Grid Automation: Automation has become a cornerstone of modern smart grids. Advanced sensors and control systems enable real-time monitoring of grid components, allowing operators to detect and respond to issues quickly. This trend enhances grid reliability and reduces downtime by enabling faster fault detection and isolation.

Demand Response: Smart grids facilitate demand response programs, allowing consumers to adjust their electricity usage based on real-time price signals. This not only helps balance supply and demand but also empowers consumers to make informed decisions about their energy consumption.

Renewable Energy Integration: The integration of renewable energy sources, such as solar and wind, presents a complex challenge due to their intermittent nature. Smart grids enable better management of these sources by forecasting generation and adjusting distribution in response to fluctuations.

Energy Storage: Energy storage technologies play a pivotal role in mitigating the variability of renewable sources and optimizing grid performance. From batteries to pumped hydro storage, advancements in energy storage are enabling smoother grid operations and facilitating energy trading.

Artificial Intelligence (AI) Applications: AI-driven analytics and predictive algorithms are revolutionizing grid management. AI can optimize energy distribution, predict equipment failures, and enhance energy efficiency by analyzing vast amounts of data in real-time.

Microgrids and Decentralization: The concept of microgrids is gaining traction, allowing localized energy generation, distribution, and consumption. This trend enhances grid resilience by reducing dependency on centralized power plants.

Cybersecurity and Data Privacy: With increased digitization, ensuring the security and privacy of grid data is paramount. Emerging trends include robust cybersecurity measures and data encryption to safeguard against potential threats.

These trends collectively illustrate a paradigm shift in the energy sector, where smart grid technology plays a pivotal role in building a more sustainable, efficient, and resilient energy infrastructure. The integration of these trends is leading to a future where electricity grids are more adaptable, responsive, and capable of meeting the evolving demands of a changing world.

Summary and Conclusions:

The journey of smart grid technology from concept to reality marks a pivotal moment in the evolution of energy systems. The integration of digital technologies, data analytics, and renewable energy sources has given rise to a dynamic and intelligent electricity grid that is

poised to redefine how we produce, distribute, and consume power.

The journey is not without its challenges. Technical complexities, regulatory frameworks, and financial considerations must be navigated to fully harness the benefits of these trends. However, the demonstrated successes of pilot projects and real-world implementations offer a glimpse of the immense possibilities that lie ahead.

In conclusion, the emerging trends in smart grid technology hold the promise of a cleaner, more efficient, and adaptable energy landscape. The continued collaboration of researchers, engineers, policymakers, and stakeholders will play a pivotal role in driving these trends forward, shaping the future of electricity grids for generations to come.

WAR OF CURRENTS

Abdul Rehman Ijaz

In the realm of electrical engineering, two towering figures emerged as pioneers and visionaries: Thomas Edison and Nikola Tesla. The magnitude of their contributions to the field is truly remarkable, but it is their clash of ideas and approaches that continue to capture the imagination of many. Prepare yourself to delve into the captivating and intriguing clash between Edison and Tesla, as we explore their backgrounds, divergent perspectives on electricity, the famous War of Currents, and the enduring legacy they left behind.

Step into the realm of Thomas Edison and Nikola Tesla, and you will encounter two individuals whose names are synonymous with innovation. Edison, an American inventor and businessman, etched his name in history with his revolutionary inventions such as the phonograph and the practical electric light bulb. A self-made man known for his unyielding work ethic and entrepreneurial spirit, Edison's indomitable drive propelled him to unimaginable heights. On the other hand, Nikola Tesla, a Serbian-American inventor and engineer, possessed an unrivaled brilliance and eccentricity that paved the way for groundbreaking contributions to alternating current (AC) systems, wireless power transmission, and a plethora of other revolutionary inventions.

The dynamic duo of Edison and Tesla is characterized by their contrasting views on the nature of electricity. Edison ardently championed direct current (DC), which involved the flow of electric charge in a single direction. In stark contrast, Tesla fervently advocated for alternating current (AC), where the flow of electric charge periodically reverses direction. It is this fundamental difference in opinion that laid the foundation for the epic clash that would inevitably ensue.

Enter the stage of the "War of Currents," a fierce and unrelenting battle between Edison's DC system and Tesla's AC system, as they vied for

dominance in the burgeoning field of electric power distribution. Edison, backed by the might of General Electric, launched a relentless campaign to discredit AC, emphasizing its alleged dangers, including its association with a series of public electrocutions conducted using AC as a means of execution. Tesla, undeterred, championed the unparalleled efficiency and safety of AC power transmission.

Edison's DC system relied on generators and direct current to power electrical devices. While effective for short distances, its long-distance transmission capabilities were hampered by significant energy losses over extended cables. Despite its limitations, Edison staunchly defended DC, vigorously arguing against the perceived dangers of AC while simultaneously attempting to discredit Tesla's revolutionary alternating current system. In stark contrast to Edison's DC system, Tesla's AC system boasted a multitude of advantages, particularly in the realm of long-distance power transmission. AC could be effortlessly transformed to different voltages using transformers, enabling efficient distribution across vast distances. Tesla's system also facilitated the use of polyphase AC motors, which would go on to revolutionize industrial machinery and power generation.

The battle for electrical supremacy intensified as supporters on both sides engaged in a heated and passionate public debate. Edison launched smear campaigns, openly electrocuting animals with AC to showcase its supposed perils, while Tesla countered by staging elaborate demonstrations to highlight the safety and efficiency of his AC system.

Beyond the realm of technological differences, the clash between Edison and Tesla was also fueled by their divergent personalities. Edison, characterized by his tireless work ethic, marketing prowess, and stubbornness, clashed with Tesla's visionary and dreamer persona. Tesla, often focused on grand ideas, found himself lacking in business acumen. It was their contrasting personalities that influenced their strategies and ultimately shaped public perception of their respective endeavors.

The legacy and contributions of both Edison and Tesla have left an indelible mark on the field of electrical engineering. Edison's inventions and innovations transformed the world as we knew it. His practical electric light bulb revolutionized the way we illuminate our lives, replacing antiquated gas lamps and candles. Additionally, Edison's pioneering

Edison's inventions and innovations transformed the world as we knew it. His practical electric light bulb revolutionized the way we illuminate our lives, replacing antiquated gas lamps and candles. Additionally, Edison's pioneering efforts led to the development of the phonograph, an early sound recording and playback device that laid the foundation for modern audio technology. Furthermore, his instrumental role in establishing the first electric power distribution systems paved

the way for the electrification of cities and homes, bringing the marvel of electricity to the masses.

On the other hand, Tesla's contributions were nothing short of groundbreaking and far-reaching. His development of the alternating current (AC) system revolutionized the transmission and distribution of electric power. AC's ability for efficient long-distance transmission made electricity accessible to a broader population. Tesla's invention of the induction motor, based on AC principles, enabled the widespread use of electric motors in industrial applications, thereby contributing to the growth of manufacturing and automation.

Tesla's visionary work extended beyond power distribution. His pioneering efforts in wireless power transmission and radio communication laid the foundation for modern wireless technologies. Tesla envisioned a world where electricity could be transmitted through the air, eliminating the need for wires. While his wireless power transmission experiments were not fully realized during his lifetime, they served as inspiration for future advancements in wireless charging and communication systems, propelling us toward a more connected future.

In conclusion, the clash between Thomas Edison and Nikola Tesla was not merely a battle of ideas, technologies, and personalities. It was a clash that captivated the public's imagination, with their differing views on electricity and the famous War of Currents as the backdrop. Both inventors made immense contributions to the field of electrical engineering, shaping the modern world we live in today. Edison's practicality, business acumen, and relentless pursuit of innovation led to numerous inventions that transformed society. Meanwhile, Tesla's brilliance, unwavering vision, and groundbreaking ideas pushed the boundaries of scientific and technological possibilities. Together, their work laid the foundation for the electrical systems we rely on, from illuminating our homes to powering our industries.

The clash of Edison and Tesla serves as a powerful reminder of the importance of innovation, competition, and the relentless pursuit of knowledge. Their rivalry, though intense, ultimately propelled electrical engineering forward, leading to advancements that continue to shape our lives in profound ways. We owe a debt of gratitude to both Edison and Tesla for their immense contributions, as their legacies continue to inspire generations of scientists, engineers, and dreamers to push the boundaries of what is possible.

Revolutionizing Water and Wastewater Management: How Artificial Intelligence is Solving Global Challenges

Abdur Rehman Ijaz

Introduction:

Since water scarcity and environmental pollution continue to be major problems on a global scale, the application of artificial intelligence (AI) in water and wastewater management has grown in

popularity. Water and wastewater management systems have benefited from developing and applying AI technologies including machine learning, neural networks, and natural language processing. This essay will go through the uses of AI in water and wastewater management as well as their advantages.

AI in Water and Wastewater Management Applications:

Water quality monitoring

Real-time water quality monitoring using AI technologies enables the early detection of contaminants and the avoidance of potential health risks. For example, machine learning algorithms can recognize patterns in water quality data, enabling more precise and prompt detection of contaminants, including bacteria, viruses, and poisons. To continuously monitor water quality and identify changes that could signal contamination, AI-powered sensors can also be installed in water treatment facilities and distribution networks.

Water distribution network optimization

By lowering water losses, strengthening pressure control, and increasing operational effectiveness, AI technology can also be used to optimize water distribution networks. To forecast water consumption and find leaks, machine learning algorithms can be used to analyze data from sensors placed throughout the network. To cut down on water losses and energy usage, this information can be utilized to optimize the performance of pumps, valves, and other network components. The occurrence of water hammer incidents, which can harm pipelines and shorten their lifespan, can also be predicted using AI-powered models.

Optimizing wastewater treatment

By increasing the treatment facilities' effectiveness and lowering their discharge's environmental impact, AI technology can be utilized to optimize wastewater treatment operations. Data from sensors installed in treatment facilities can be analyzed using machine learning algorithms to optimize the performance of pumps, blowers, and other equipment. The concentration of contaminants in the effluent can also be predicted using AI-powered models, which can then be utilized to tailor the treatment procedure. This can lessen the impact of the effluent discharge on the environment and the quantity of energy and chemicals consumed in the treatment process.

Water demand forecasting

Water demand forecasting using AI technologies is essential for efficient water management. To forecast future water demand, machine learning algorithms can be used to analyze previous data on water usage trends, weather, and other factors. To satisfy the anticipated demand, this information can be utilized to operate water treatment facilities, distribution networks, and other water system components as efficiently as possible.

Smart irrigation

AI innovations can enhance irrigation systems' effectiveness by lowering water waste and increasing water use efficiency. To forecast agricultural water demand and optimize irrigation scheduling, machine learning algorithms can be used to analyze data from soil moisture sensors, meteorological stations, and other sources. This can help reduce water use by up to 30%, improve crop yields, and reduce the environmental impact of irrigation.

Benefits of AI in Water and Wastewater Management

Increased Effectiveness

Artificial intelligence (AI) technology can aid in enhancing the effectiveness of water and wastewater management procedures by maximizing the performance of pumps, valves, and other elements of the water system. This could improve the system's overall performance by lowering energy usage and water loss.

Cost Savings

By maximizing the use of resources like electricity, chemicals, and water, AI technology can also assist in lowering the cost of water and wastewater management. The financial sustainability of water and wastewater utilities can be improved, and operational expenses can be decreased as a result.

Improved water quality

By enabling early detection of impurities and rapid action to avoid potential health risks, AI technology can aid in improving water quality. This could enhance the general quality of life and safeguard public health.

Reduced environmental impact

By maximizing resource utilization and minimizing waste, artificial intelligence (AI) technology can assist in reducing the environmental effects of water and wastewater management systems.

Better ability to make decisions

Thanks to AI technologies, water, and wastewater management can make better decisions by having access to more precise and timely information. This can lead to better performance and lower costs by optimizing the operation of water treatment facilities, distribution networks, and other water system components.

Limitations and Obstacles

Despite the potential advantages of AI in managing water and wastewater, some various obstacles and restrictions need to be overcome. These consist of:

Data reliability and accessibility

AI technologies largely rely on high-quality data to produce precise predictions and insights. However, in some areas, particularly in poor nations, data availability and quality might be a problem.

Cost and complexity:

AI technology deployment can be costly and complicated, requiring large hardware, software, and knowledge expenditures. Especially for small and medium-sized water and wastewater utilities, this could be a roadblock to implementation.

Conclusion

Water and wastewater management could be revolutionized by AI technology, enabling more effective, efficient, and sustainable operations. AI has many uses in water and wastewater management, from smart irrigation to monitoring water quality. But some obstacles and constraints must be overcome, including issues with data availability and quality, cost and complexity, security and privacy, and morality. To ensure that AI solutions are effective in addressing these issues, cooperation between water and wastewater utilities, technology providers, legislators, and other stakeholders.

WATT'S THE BUZZ? AN ELECTRIFYING ODYSSEY

Rutba

She was a weird child, everyone said this. She would listen to them as if she were an alien and then roll her eyes back. Every evening she would lock herself in the annexe of her house and no one would see what she did there. It was Christmas. Her house was full of relatives whom she had never seen before. She was looking at them from the window of the annex. They were having fun. One of the uncles was playing Joker making others laugh hard. She didn't find it fun, "Stupid brainless shallows". While saying this she rolled her eyes and couldn't unsee what she saw. After an hour someone entered the house and headed towards the lounge. She could hear the sounds of laughter, spoons hitting the plates, puns, and small talk.

"Oh my beautiful Darla, where have you been?"

"What are you carrying in this trolley?"

"Come meet your cousins."

She answered nothing, walked straight towards the uncle she was watching earlier, with her trolley, and said, "Hang this in the center of room, Joker." He couldn't say a word and stood up as an obedient child.

Everyone stopped doing what they were doing, looking at the huge round magnet hung by the uncle. When he stepped down the ladder, he slightly looked at her and moved the ladder away. She stepped forward with a hoola hoop in her hand. There was something uncommon about it. It wasn't a plastic colorful hoop. It was metallic with a wire of chili lights wound around it.

She stood right under the magnet. The height of the magnet from the floor was movable by the rope the uncle was holding, standing aside. "Move it up and down slightly." She instructed him. He nodded as if it was the only option he had.

She put the loop exactly under the magnet on the floor and stepped back. The uncle started moving

the magnet up and down and then what happened amazed everyone. The ice cream of Anna was melting down from her spoon into the bowl and she was looking with her mouth open. The hoola hoop was dancing up and down without any support as the magnet above was moved. The chili lights around it were also turning on and off as if they were dancing too.

“Faster”, she said. The dance of the hoop and the lights became faster too. She let this all happen for 5 minutes and then asked the uncle to stop. He pulled the magnet and put it away.

She came forward, stood in the middle of the hoop, and started speaking. She looked like a professor from Harry Potter. “This isn’t just a magic trick! It’s the foundation of how many things in our world work. Here’s how it works. When you move the magnet near this loop, something amazing happens. The loop starts feeling a bit lazy and decides to wake up. It generates electricity! The magnet’s movement wakes up the electrons in the wire, making them dance and create an electric current. “

She took a pause to look at her proud mother and continued with a clap, “But here’s where the real magic comes in: the faster you move the magnet, the stronger the electric current becomes. It’s like the hoop gets excited when the magnet is in a hurry and produces more electricity to keep up with the pace.”

She bent her knees a bit, opened her arms wide, and bowed like a performer who ended the performance successfully, ready to receive some appreciation. The granny was going to start the clap but she pointed towards her, saying, “From the electricity that lights up your home to the power that runs your gadgets, they all owe a bit of their magic to this phenomenon.” She pulled her pointed finger back as if allowing her to clap now. Everyone started clapping with smiles on their faces. Folding her arms back with a slight smile of success on her face, she received applause. Uncle, standing there, asked, “What is it called?”

“Electromagnetic Induction! Joker.”

DATA: THE NEW CURRENCY

Abdur Rehman Ijaz

Imagine a world where an Artificial Intelligence Bot installed inside your device knows more about you than your parents ever could have. AI becomes a remedy for every problem you ever faced or ever going to face. For instance, let’s say you had an emotional breakdown as your boyfriend Jeremy dumped you. Instead of a friend, you discuss the matter with an AI who has already constructed your personality’s insecurities and flaws. Based on data AI can determine what soothes you. AI can recommend you take a trip with your loved ones so it may help during the grief phase. But, let me ask you, is it a recommendation? AI has collected enough data to subtly convince you to follow his commands, this sounds more like a manipulation than a recommendation.

AI constitutes every possible algorithm and outcome of your decisions and based on different circumstances predicts countless futures. In early 2023, An experiment was performed where scientists retrieved data from a model. After a few days, AI was able to predict every possible response of the model to every question asked. This is a disturbing fact. Can AI mirror us if they receive data? Can they predict our future? Can AI manipulate us into their interests and suddenly conquer the world?

There is a common misconception that if AI receives our data, it will be a doom for humanity. This is not possible, because AI is not conscious. It's not AI we have to be scared of, it's the people who control it. Social media applications are the powerhouses of the extraction of data. You might have experienced a scenario where you were talking to your friend Jules about how you want to spend your budget on shoes and later on, you'll be seeing advertisements of shoes in your feed. No, we are not being watched or heard by social media developers all the time. It's the algorithm that had gathered so much data that it constituted the need for shoes. What if they use this data against us? What if they subtly incept the idea that we have to vote for conservatives and hate liberals? Democracy will be ruined.

After hearing risks of data extraction, one might think that AI shouldn't be accepted. It has such high risks and if the data of leaders or politicians gets into the wrong hands, it can alter the future. But, back in the 20th century, after hearing high risks of the atomic bomb, Oppenheimer still created it because it was inevitable. If he hadn't invented it someone else would have become Oppenheimer therefore Improvising and adapting to trends is the only way of moving forward. History is proof that Change is the only Constant.

BILLIONAIRES, SUBMARINE, AND THE TITANIC: DEEP POCKETS DIVE DEEP

Asma Arshad

The ultra-rich are quite literally delving deeper into their bucket lists. As the rest of us ponder whether to upgrade to the latest smartphone or invest in a slightly fancier blender, the elite are out there
engineering experiences that whisk them to the bottom of the ocean.

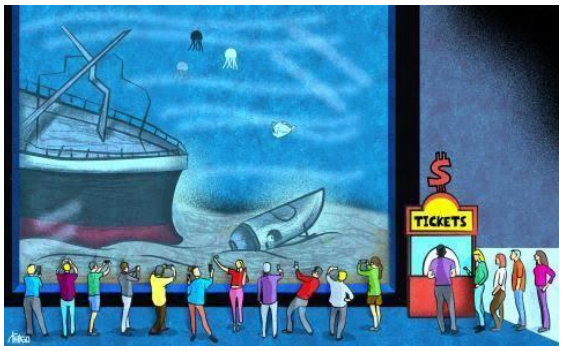
Recently, a submarine filled with billionaires decided to acquaint themselves with the Titanic wreckage. For those out of the loop, this isn't a modern retelling of Jules Verne's "20,000 Leagues Under the Sea." Think of it as the 21st-century billionaire version – cheekily titled, "20,000 Bitcoins Below Sea Level."

The Titanic stands as an iconic testament to human ambition – and a reminder that perhaps, just maybe, we shouldn't go around claiming 'even God can't sink it'. The ability to even approach this monumental shipwreck speaks volumes about engineering advancements. It's mind-blowing, on par with discovering that your

grandparents are Snapchat pros.

But the real kicker? While billionaires like Musk and Bezos show us that the 'sky's not the limit' with theirspace adventures, some prefer their thrills underwater. And sure, visiting the Titanic might be on par withbuying a sports car during a mid-life crisis, only a tad wetter.

However, this isn't just about one-upping each other at elite parties. The union of affluence and cutting-edge tech has spurred innovations that eventually find their way to us common folks. Today's billionaire's plaything might just be tomorrow's household item. Remember when the first computers seemed like a luxury? Now, they're pocket-sized essentials for many. There is, however, a flip side. The dangers of such deep-sea exploits are real. Without a broader goal, are these risks just an extravagant dance with "natural selection"?



***Credits**: The search for Titan | Cartoon Movement*

There's an inherent responsibility that comes with immense wealth. It should ideally drive advancements in science, engineering, and technology that benefit not just a select few but the larger community. Everybillionaire's deep-sea venture or space exploration is, directly or indirectly, a nudge forward in technological understanding.

In conclusion, while the recent submarine escapade might have provided some chuckles and a dash ofenvy, it serves as a reminder. The realms of science and engineering, when fueled by wealth, have the potential to change the world. And as for our deep-sea adventurers, here's hoping their next escapaderemains buoyant. After all, while "money might not buy happiness", it should at least ensure your submarine doesn't become a permanent part of the ocean's floor.

WHAT IS ARTIFICIAL INTELLIGENCE (AI)?

Shahzaib Ali

Artificial intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. While AI is an interdisciplinary science with multiple approaches, advancements in machine learning and deep learning, in particular, are creating a paradigm shift in virtually every sector of the tech industry.

Artificial intelligence allows machines to model, or even improve upon, the capabilities of the human mind. From the development of self-driving cars to the proliferation of generative AI tools like ChatGPT and Google's Bard, AI is

increasingly becoming part of everyday life and an area companies across every industry are investing.

In the realm of technology, Artificial Intelligence (AI) has emerged as a transformative force, revolutionizing various industries and aspects of our lives. Its applications are vast and continuously evolving, promising to reshape the way we work, live, and interact with the world. In this article, we will delve into four key AI applications, each with its unique potential and impact.

APPLICATIONS:

Healthcare: AI has advanced the field of healthcare significantly, strengthening patient care and advancing scientific inquiry. Analysis of medical images is one of its important uses. Medical pictures such as X-rays, MRIs, and CT scans can be deciphered with astonishing accuracy by AI-powered systems. Radiologists may identify diseases like cancer early thanks to these technologies, which improve the effectiveness of treatment.

Additionally, AI is crucial in the drug discovery process. Massive datasets can be analyzed by machine learning algorithms to find prospective medication candidates and forecast their efficacy, greatly accelerating the drug development process.

Autonomous Vehicles: Self-driving automobiles are a revolutionary use of artificial intelligence in the transportation sector. With the help of sensors and machine learning algorithms, these vehicles can navigate, make judgments, and adjust to shifting road conditions without the need for a driver.

The use of autonomous cars has the potential to reduce collisions, traffic jams, and fuel consumption. They have the potential to revolutionize urban mobility by enhancing the security and effectiveness of transportation.

Finance: Risk management, fraud detection, and trading have all undergone significant changes as a result of AI in the financial sector. AI systems can instantly analyze enormous volumes of financial data to spot anomalies that might be signs of fraud. As a result, transactions are now more secure, and fraud-related financial losses have decreased.

CONCLUSION

In conclusion, there are plenty of uses for AI that are always growing. AI is transforming many facets of our lives, from transforming healthcare and economics to enabling driverless vehicles and improving communication with NLP. We may anticipate many more cutting-edge uses for AI as the field develops, which will improve productivity, efficiency, and quality of life in general. As we travel along this revolutionary path into the future, it will be crucial that we embrace AI's promise responsibly and ethically.

AI, A DOUBLE-EDGED SWORD

Malaika basit

0019-Bsc-Engg-22

AI, an artificial intelligence. This term was first invented by John McCarthy in 1950. AI is the stimulation of human intelligence processes by machines with computer systems installed within them. Intelligence is something that human is bestowed with. It involves critical thinking, analysis, and reasoning. The core concept of inventing an AI system was to use human intelligence as a prototype and develop a system integrated through machine learning algorithms, natural language processing, and computer vision. Unimate was the first digitally operated and programmable robot, invented in 1954 by George Devol. Sophia is the first robot innovation ambassador for the United Nations Development Programme. Sophia's invention is orbiting around robot-human interaction. Sophia has been to Jimmy Fallon's show. Now Sophia is eyeing a career in the music industry and working on several works in a project called 'Sophia Pop'. All of this is fascinating on the one hand but on the other hand, is a threat to the media industry. AI is taking over the jobs of influencers, bloggers, music artists, and actors.

Because of robots unemployment rate is getting higher each year which is causing depression, anxiety, and a high risk of suicide in society. In modern subway stations, most of the tasks are being done by a robot which is no doubt increasing the efficiency at stations. Convenience stores with AI technologies have been built up that provide 24/7 service to the customers.

AI is not only about robots, there are several computer-programmed systems of AI. All of us are familiar with ChatGPT. It is a natural language processing tool. It carries out human-like conversations and assists with tasks such as writing an essay, emails, and codes. The pros of ChatGPT are time-saving and assistance. Sometimes ChatGPT also bullies students by not giving them the required answers as it has low EI.

With all these pros it also has cons. ChatGPT is making students less productive in their homework. Students do not understand the concepts clearly and completely rely on AI to find solutions to their problems.

AI requires a high cost for creation and is expensive to implement. It lacks creativity, difficult to implement ethics, and is more likely to increase human laziness. There was a myth that AI would take over the world so far this fictional notion has not come to realization. AI will take the lead only if we fail in self-discipline.


ENVIRONMENTAL SCIENCE

ENVIRONMENTAL SCIENCE TIMELINE 2023

- **January**

The UN calls for massive financial support for Pakistan; Brazil backs the fight against climate change; The UK records its warmest year since records began.

- **February**

Scientists in the United States say Antarctica sea ice levels have reached a record low. The National Snow & Ice Data Center's data shows that on 13 February sea ice extent fell to 1.91 million square kilometers, the second year in a row that it has fallen below 2 million square kilometers

- **March**

global Recycling Day is celebrated on March 18 every year and encourages us to rethink what we throw away by seeing it as an opportunity instead of waste. By recycling, we lessen our energy use, improve air and water quality, and combat climate change, all while saving money and natural resources

- **April**

As we approach April, there are several significant environmental days to be aware of, including World Health Day, Earth Day, and Stop Food Waste Day. Each of these events presents an opportunity for individuals, communities, and governments to come together and make a positive impact.

- **May**

Global temperatures are likely to surge to record levels in the next five years, fueled by heat-trapping greenhouse gases and a naturally occurring El Nino. According to this report issued by the World Meteorological Organization, there is a 66% likelihood that the annual average near-surface global temperature between 2023 and 2027 will be more than 1.5°C above pre-industrial levels for at least one year.

- **June**

Climate change is taking a major human, economic, and environmental toll on Europe, the fastest-warming continent of the world. The year 2023 was marked by extreme heat, drought and wildfires

- **July**

"The global average temperature for July 2023 is confirmed to be the highest on record for any month," said Samantha Burgess, Deputy Director at the European Commission's Copernicus Climate Change Service.

- **August**

The "crazy" extreme weather rampaging around the globe in 2023 will become the norm within a decade without dramatic climate action, the world's leading climate scientists have said.

THE HOT TOPIC OVER THE WORLD "CLIMATE CHANGE" (A MYTH OR A FACT?)

Hamdia Mahmood

0440-BH-ENV-20

hamdiamahmood697@gmail.com

Introduction:

One of the most pressing issues of the present day is climate change, which is the subject of intense discussion and attention all over the world. Although, the majority of scientists agree that climate change is nothing but a fact just a small percentage of doubters still debate whether it's a fiction or an obvious truth. Well, we will review the evidence, the consensus among experts, and the arguments put out by skeptics in this article.

Understanding Climate Change:

'Climatic change'' refers to long-term variations in earthly climatic trends, including those linked to temperature, precipitation, and wind patterns. These changes can be attributed to natural processes, but the current dispute centers on how human activities, particularly carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) emissions, affect the climate of the world.

Scientific Consensus:

The urgent need to address climate change is acknowledged by a significant number of climatic specialists. The Intergovernmental Panel on Climate Change (IPCC), a global team of specialists, has been studying the problem for many years. A recurrent subject in their articles is the connection between human activities, particularly the combustion of fossil fuels and deforestation, and the rise in global temperature.

The Myths

1. The earth's climate is always changing.
2. Plants need CO2 (carbon dioxide).
3. Global warming is not a real case.
4. Climate change is not a problem for the present world.
5. Renewable energy is just a money-making phenomenon.
6. Animals will adapt to climate change.
7. Getting rid of humans is the only solution.
8. China is only responsible for climate change.

The Evidence:

The last century's temperature data reveal an increasing tendency, with each succeeding decade being warmer than the one before it. As predicted by climate models, extreme weather phenomena including hurricanes, heatwaves, and

wildfires have increased in frequency and intensity.

Ice core samples, which give a historical record of Earth's climate, are another important source of poof. These cores show that the level of greenhouse gas concentration in the atmosphere right now is unparalleled in the last 800,000 years.

The Main Cause (Anthropogenic Activities):

The amount of greenhouse gases in the atmosphere has dramatically grown as a result of the burning of fossil fuels, deforestation, industrial operations, and agriculture. These gases cause the greenhouse effect by capturing the solar heat and preventing it from escaping into space. As a result, climate change is brought on by an increase in the planet's average temperature.

Debunking Climate Change Myths:

While there's a scientific consensus on climate change skeptics have put forth various arguments to question its reality. Let's address some of the common myths they cite.

1. **Natural climate variability:** Skeptics often claim that the Earth's climate has always undergone natural fluctuations, implying that current changes are just part of a natural cycle. While it is true that natural factors can influence climate, extensive research shows that human activities are primarily responsible for the recent rapid warming.

2. **Cherry-picked data:** Skeptics may selectively choose data to highlight short-term fluctuations or cherry-pick locations to suggest that global warming is not uniform. However, considering the complete set of data and analyzing global trends reveal an undeniable warming pattern.

3. **Climate-Gate Controversy:** In 2009, hacked emails from climate scientists were misinterpreted to suggest manipulation of data to support global warming. Numerous subsequent investigations have found no evidence of scientific misconduct, and the consensus on climate change remains unaffected.

4. **Miss-Information and Industry Influence:** Another factor contributing to the climate change debate is the spread of misinformation. Campaigns to cast doubt on climate change and its causes have been deliberately supported by some interest organizations with vested interests in the fossil fuel industry and other polluting sectors. These initiatives have complicated

the situation making it difficult for the general population to distinguish truth from miss- conception

Conclusion:

A vast majority of climatic experts worldwide agree that climate change is a proven scientific reality. Extreme weather occurrences, melting ice caps, and rising global temperatures are all clearly demonstrated by the data. The main causes of this phenomenon are human actions, particularly the combustion of fossil fuels.

While only a small percentage of doubters continue to deny climate change, the scientific community has carefully considered and rejected their claims. We must accept the existence of climate change and act quickly to lessen its effects. To protect our world for future generations, we must move toward cleaner energy and renewable sources, embrace sustainable lifestyles, use green technologies, go green, and promote international collaboration.

REVIEW ARTICLE (THE PLASTIC WARS)

Nehsoon Tahir

0451-BH-ENV-20

INTRODUCTION

A 54-minute filmed documentary is written by Mr. Rick Young. It was aired on 31st March 2020. The production credit goes to Mrs. Laura Sullivan, Emma Schwartz, and Fritz Karmer. The production is directed under the supervision of Mr. Brent E. Huffman, Mrs.Katerina Monevassitis, and Mr. Rick Young. The credit for broadcast is to the production company Public Broadcasting Service (PBS). The documentary is certified for TV.PG broadcast. The episode can be seen through the provided link,

(https://www.pbs.org/wgbh/frontline/documentary/plastic-wars/)

The key issue highlighted in the documentary is the adverse effects of plastic pollution on every living being and the attitude of people towards plastic in terms of manufacturing, usage, disposal, and recycling of plastic.

SUMMARY

The documentary opens with awful news covered and broadcasted by almost every News channel in the USA and worldwide. The news is about an agonized sea turtle who was bleeding and suffering from intense pain because of a plastic straw lodged into its nose.

This asserts an assumption that plastic pollution is a planetary crisis as it is deteriorating and compromising the stability of everything in the environment and nature. It is expressed that "The underwater paradise is a plastic nightmare." Not only turtles, but gigantic whales endure the same pollution of plastics as it is demonstrated in the documentary that huge whales were dead and

about 48.5 pounds of plastic was found in their stomach.

Hence, plastic is declared as the enemy number 1 of nature. Some estimations and assumptions are made as the USA is the world's largest plastic producer. It invests about $10 billion in new plastic plans and for the growth of new inventions and promotions of plastic. It is estimated that by about 2050, the production of plastic will triple and the nightmare of plastic becomes a super-intense night terror. The issue with the plastic waste mentioned is primarily mixed plastic waste. Much of the time and wealth is invested in the segregation of that mixed plastic waste.

In addition to this another issue which is highlighted is that not all types of plastic are recycled. Plastics come in many forms such as nylon, P.E.E.T, Polystyrene etc. A glimpse of information regarding the chasing arrow symbol of recycling is presented in the episode. The symbol has a number with it, indicating which type of plastic is recyclable and which is not.

Looking into the history of plastic comes the Era when the first time a town was declared a PLASTICTOWN. Most of the things in that town were made up of plastic. From utensils to large flooring and roofing material, everything was plastic, unaware of its upcoming consequences.

In 1970, a protest against the use and manufacturing of plastic was seen and it was declared as the largest mass protest in the history of the USA. The plastic industry has faced resilience since the uprising of people against plastic. The main motto of the protest was “Save our earth before it's too late.” Parallel to this protest, some iconic ad campaigns were launched with an impulsive message, “People start pollution, People can stop it.”

However, many industries and stakeholders used the term recycle just to keep the product in the market. Stakeholders in the region where plastic was banned promoted recycling only to promote plastic products. The work of recycling was to get leniency in using and selling plastic. The situation was called a “win-to-win”. China took initiatives for recycling to a mass extent which was later seen to be just verbal recycling not practical. Every work on recycling was groundless. Only a small fraction of waste plastic imported by China was recycled. Other was going to landfills for environmental media degradation. Soon China refused to import plastic waste. So, the next destination of enormous plastic waste from the USA was Indonesia.

Many companies claim to be engaged in recycling plastic but most of them are deceptive. A lot of this waste terminates in water bodies such as lakes, rivers, seas, and oceans. Approximately, 60% comes from Asia as there are mostly developing countries, producing and importing plastic waste. After exploring the catastrophic consequences of production, usage of plastic, and mismanagement of plastic waste it is critically acclaimed to Rethink for the deeds, especially by developed nations like the USA.

➢ CONCLUSION

Everything in its excess is dangerous, so explosive use of plastic will also have negative drawbacks. The number of types of plastic either recyclable or non-recyclable should be defined. It would be profitable in a couple of ways. It would ultimately reduce the burden and impact of plastic pollution. It will also result in the conservation of petrochemical resources which could be utilized as energy resources and can help us meet our energy needs and may eradicate our energy crisis. Considering the factor of the population in a similar regard is also necessary to manage the resources. A controlled population will undoubtedly assist in proper management and sustainable development. Basic awareness about solid waste segregation at the source level should be made mandatory. The education of environmental protection and its perks should be taught at basic levels. The use and waste of plastic should be minimal. This is not only for our present and future but for our future futurity.

THE ROLE OF MACHINE LEARNING IN TACKLING CLIMATE CHANGE

Bamidele Segun Samuel

International Student from Nigeria

bamidelesegunsamuel@gmail.com

Climate change denotes a crucial and urgent difficulty of our time; one that generates broad-reaching consequences for ecosystems, economies, and societies. As we confront the complexities of this global phenomenon, technology has emerged as a potent instrument in our pursuit of understanding, predicting, and reducing the adverse effects of climate change. In particular, machine learning, categorized under artificial intelligence, has received a lot of attention recently thanks to its potential to use data and algorithms to simulate and improve human learning.

In this article, I will be presenting the role machine learning can play in climate change efforts. I would also refer to some real-life case studies where machine learning has been utilized to tackle climate change. Finally, I would conclude the article by writing on the challenges of using machine learning to tackle climate change.

Exploring the Complexities of Climate Change Using Machine Learning

Machine learning techniques have been demonstrated to possess substantial pragmatic significance when examining the complexities of climate change. Recently, the International Business Machines Corporation (IBM) and the National Aeronautics and Space Administration (NASA) collaborated to use artificial intelligence (AI) technology to extract new insights from NASA's vast collections of Earth and geospatial

science data. This collaborative effort will leverage AI foundation model technology to analyze NASA's Earth-observing satellite data for the very first time. The collaboration became a necessity to assist researchers in analyzing and interpreting insights from the large datasets obtained through the acquisition of earth observations. IBM's foundational model technology has the potential to hasten the discovery and analysis of such data, thereby expediting the scientific comprehension of Earth and the response to climate-related concerns.

Machine Learning in Climate Pattern Recognition and Enhanced Accuracy

One of the primary strengths inherent in machine learning lies in its capacity for discerning patterns. Machine learning algorithms can recognize recurring trends, correlations, and anomalies through the thorough analysis of historical climate data. For example, researchers at Stanford University leveraged machine learning techniques to anticipate coral bleaching incidents. Their model precisely predicted coral bleaching occurrences up to eight months in advance by scrutinizing past ocean temperature statistics and coral health markers.

Such invaluable insights serve to facilitate the creation of predictive models that surpass linear approximations and more accurately reflect the intricate nuances of Earth's climate system. Moreover, the real-time processing and adaptation capabilities of machine learning make it a highly fitting tool for refining climate models in the face of new data. This dynamic adaptation is particularly advantageous given the perpetually evolving nature of climate phenomena.

Informing Climate Policy and Decision-Making Using Machine Learning

Machine-learning-powered climate models possess the capacity to facilitate data-driven policy choices. The provision of precise forecasts concerning forthcoming climate circumstances allows policymakers to execute strategies that tackle specific obstacles presented by climate change. To illustrate, urban planners may leverage predictive models to construct resilient cities equipped to endure severe weather occurrences. Furthermore, agricultural policies may benefit from machine learning's capability to anticipate changes in growing seasons and adjust to evolving circumstances. In addition, machine learning heightens disaster preparedness and response, aiding communities in preparing for and minimizing the impacts of climate-related calamities.

Challenges with the Use of Machine Learning to Tackle Climate Change

Although machine learning has significant potential to assist in the fight against climate change, several obstacles must be overcome to fully harness its capabilities. These challenges consist of the following:

One challenge is the issue of data quality and quantity. To achieve precise outcomes, machine learning algorithms rely on significant amounts of high-quality data. Climate data is often intricate, diverse, and dispersed throughout various sources. The irregularity of facts misplaced statistics, and prejudices can hinder the effectiveness of artificial intelligence algorithms.

Another challenge is data bias and representativeness. Biases inherent in past climate data can impact the results of machine learning. If the training data is not a precise representation of the entire climate system or includes implicit biases, models may not be successful in generalizing effectively to new regions or conditions.

Finally, machine learning models, particularly those that are deep, can impose a considerable computational burden. Given the enormity and intricacy of climate data, a significant number of computational resources and infrastructure is essential. Therefore, smaller research groups or organizations with limited resources may be constrained from accessing advanced machine-learning techniques.

Conclusion

Machine learning possesses the capability to enhance our comprehension of climate change, predict the effects of climate change, and develop solutions to climate change. While there are challenges to using machine learning in climate change efforts, this technology has the potential to be a major player in the fight against climate change.

THE NEED TO MITIGATE THE EFFECT OF CLIMATE CHANGE

Zakariyahu Shinkafa Abdullahi

Usmanu Danfodiyo University, Sokoto. Sokoto state, Nigeria.

zakariyahuabdullahi@gmail.com

Climate action is a global responsibility. This is against the background that the world is so connected, as one would see it as a unit. Climate change is the changes in the weather conditions of a place which may be brought about as a result of anthropological activities or a natural phenomenon. Anthropological activities like deforestation, industrialization, and transportation among others.

These activities would translate to the pollution of the atmosphere with toxic chemical compounds, e. g. Chlorofluorocarbon (CFC) and Carbon dioxide (CO2). These two chemical compounds affect both human being and animals alike and also contributes to the pollution of the environment. Too much consumption of these compounds can damage the lungs and respiratory organs used by animals. This would make breathing very difficult for these species because

they cannot survive without breathing. Industrial wastes are also emptied into the waterways, thereby threatening marine life. The wastes from the industry also form debris around the water body. This is another obstacle to the survival of aquatic life.

Another major issue to contend with is deforestation. Deforestation is an issue that needs to be dealt with. Deforestation can be said to be an act of cutting down a tree. Afforestation is the opposite of deforestation and it is the planting of a tree. Deforestation threatens the diversity of plant species, as it renders some species to become extinct or threatened species. In this scenario, plant species reduce in numbers and this would translate to pollution of the atmosphere because carbon dioxide in the atmosphere is used to make food by the plants. In addition, once these plants that convert carbon dioxide to food are no longer in existence, life on Earth will be threatened. Both plants and animals are interdependent. Deforestation also needs to be tackled because of its impact on curtailing the effects of climate change.

Rising sea levels also make marine lives uncomfortable, because they change their habitat, thereby rendering them unproductive and may later cause their death. This is because the anatomical structure of the marine species can only make them survive in aquatic medium and may find it difficult to survive on land. It also causes flooding. As the level of water rises, it would find its way on land, thereby causing the water to spread over the land and destroy buildings, and bridges and causing loss of properties, with the threat to human life.

Transportation also contributes to the pollution of the atmosphere, as the car or airplane exhaust releases carbon dioxide into the atmosphere. It is estimated that airplane exhaust plays a major part in the pollution of the atmosphere. Because it releases large amounts of carbon dioxide into the atmosphere.

Deforestation, industrialization, and transportation are the major causes of global warming which are mostly human activities. However, studies have shown that some natural phenomena are also major contributing factors to global warming and subsequently climate change.

These activities if left un-tackled will continue to have a devastating effect on the planet Earth. It has been stated that deforestation causes the reduction of plant species which would make the atmosphere accumulate large amounts of carbon dioxide. This, in turn, causes the depletion of the ozone layer. The ozone layer is known to shield the earth from the devastating effect of ultraviolet light-which if left unhindered would cause the heating up of the planet-Earth, thereby increasing

the temperature of the Earth. This would eventually cause global warming.

Industrialization and factory chimney also releases carbon exhaust that would cause pollution of the atmosphere. Aside from this, the industry also releases some plastic waste which pollutes the water body. The aquatic life is killed in the process.

Global leaders need to step up in their efforts to curtail the effects of climate change. Advocacy has been going on. The climate action has been incorporated into the SDG (Sustainable Development Goal) goals. There should be an incentive apart from the certification of the advocates. This would serve as a motivation for the advocates and also an inspiration to those who have not joined in the advocacy. Sensitization of people about the causes, effects, and dangers of climate change should be prioritized.

So that individuals can take action. This is the reason climate action is goal number 13 of the SDG goals. Deforestation without subsequent afforestation should be discouraged. Adoption of the use of electric vehicles as against the use of diesel-petrol-powered vehicles should be encouraged and used as a means of transportation.

Industry should find ways to recycle their wastes, instead of releasing them to pollute the air, land, and water. All waste should be recycled. If these can be done, we will be halfway to solving the global menace called climate change.

THE IMPACT OF CLIMATE CHANGE ON BIODIVERSITY AND ECOSYSTEM SERVICES

M. Ali Fayyaz

0437-BH-E-ENVSC-20

Abstract:

Climate change is one of the greatest threats to the environment and human well-being. Its impacts are already being felt across the globe, and they will continue to worsen in the coming years. The most significant impacts of climate change are on biodiversity and ecosystem services. This research article reviews the latest scientific research on the impact of climate change on biodiversity and ecosystem services. It covers the causes and effects of climate change, its impacts on biodiversity and ecosystem services, and potential adaptation and mitigation measures.

Introduction:

Climate change is the gradual increase in the average temperature of the Earth's atmosphere

due to human activities, such as burning fossil fuels and deforestation. The impacts of climate change are far-reaching, and they affect every aspect of the environment, including biodiversity and ecosystem services. Biodiversity is the variety of living organisms in an ecosystem, and ecosystem services are the benefits that people derive from ecosystems, such as clean water, air, and food. Climate change threatens both biodiversity and ecosystem services, and their loss can have severe consequences for human well-being.

Causes and Effects of Climate Change:

The primary cause of climate change is the increase in greenhouse gas emissions, such as carbon dioxide and methane, resulting from human activities. The effects of climate change are varied and can be felt across the globe. They include rising sea levels, more frequent and severe weather events, and changing precipitation patterns. These changes have profound implications for biodiversity and ecosystem services.

Impact of Climate Change on Biodiversity:

Climate change affects biodiversity in many ways. One of the most significant impacts is the loss of habitats due to rising temperatures and changing precipitation patterns. This loss of habitat can lead to the extinction of species that are unable to adapt quickly enough to the changing climate. Climate change can also cause changes in the timing of life cycle events, such as flowering and migration, leading to mismatches between species that depend on each other for survival.

Impact of Climate Change on Ecosystem Services:

Climate change can also have significant impacts on ecosystem services. Changes in temperature and precipitation patterns can affect the distribution and abundance of species that provide ecosystem services, such as pollinators and predators. Changes in the timing of life cycle events can also affect the timing of ecosystem services, such as crop pollination. Climate change can also affect the provision of regulating services, such as water regulation and air purification.

Adaptation and Mitigation Measures:

Adaptation and mitigation measures are necessary to address the impacts of climate change on biodiversity and ecosystem services. Adaptation measures include protecting and restoring habitats, managing species, and developing new agricultural practices. Mitigation measures include reducing greenhouse gas emissions and promoting the use of renewable energy sources. Both adaptation and mitigation measures are essential to ensure the resilience of biodiversity and the provision of ecosystem services in the face of climate change.

Conclusion:

Climate change is one of the most significant threats to biodiversity and ecosystem services. Its impacts are already being felt, and they will continue to worsen in the coming years. This research article has reviewed the latest scientific research on the impact of climate change on biodiversity and ecosystem services, highlighting the causes and effects of climate change, its impacts on biodiversity and ecosystem services, and potential adaptation and mitigation measures. The findings emphasize the urgent need for action to address the impacts of climate change on the environment and human well-being.

SMART WASTE MANAGEMENT

Ajmal-Khan

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The consequences of inadequate waste management can be felt everywhere, be it the increasing volume of landfills, hazardous waste causing severe pollution, or even the harmful effects generated by gases and chemicals emitted during the process. Improper waste disposal has severe implications for the environment, and it is critical to address the negative consequences before it's too late. One executable mixture for mitigating the damaging contact of cast-off direction is done with smart and comprehensive discarded direction practices. Smart waste management refers to the execution of recycling, composting, and waste-to-energy techniques to reduce the amount of waste sent to landfills, minimize the environmental impact of waste, increase sustainability, and promote a clean environment.

Implementing smart waste management practices has the potential to significantly reduce the amount of waste that ends up in landfills. By adopting strategies such as recycling, composting, and incineration, cast-off recreation can be achieved, eventually prima to a decrease in the measure of cast-off that inevitably faints off in landfills. This approach not only helps extend the lifespan of existing landfills but also reduces the need to open new landfills. In addition, the incorporation of technology such as smart bins and sensors can further optimize waste collection routes and schedules, reducing transportation costs and associated emissions. Smart waste management also brings economic benefits which include potential revenue streams from the sale of recycled materials, reduced costs associated with waste disposal, and the potential for job creation in the waste management and recycling industries. Overall, smart waste management practices can make a significant contribution to reducing the amount of landfill space needed to dispose of waste, while providing several economic and environmental benefits. By implementing these strategies we can move towards a sustainable, waste-free future.

By utilizing technology to sort waste into different categories based on their nature and potential environmental harm, waste that can be recycled, reused, or repurposed is separated from hazardous waste such as chemical waste, medical waste, and electronic waste. A proper power of risky waste, for illustration by burning and deep burial, is crucial to forestall the merchandise of pollutants to air and water sources. This is important because hazardous waste has been shown to cause serious environmental damage, including the release of toxic substances into soil, groundwater, and the atmosphere. Aside from proper waste disposal smart waste management programs include public instruction and awareness campaigns to promote responsible waste disposal and reduce littering. These programs can help educate the public on the importance of waste reduction as well as the noxious effects of pollution caused by hazardous waste. By implementing smart waste management practices, we can ensure a cleaner environment for future generations. Overall by ensuring that waste is properly sorted and disposed of, we can effectively reduce pollution caused by hazardous cast-off and make progress towards a cleaner, healthier environment.

Through the implementation of effective waste management practices, we can significantly reduce the negative impact of improper waste disposal on our celestial body. These practices can range from simple actions like recycling and composting to the use of more environmentally friendly products and technologies. As we move forward we must continue to prioritize waste reduction and management to defend our planet and future generations.

Smart waste management is a total game changer in the world of garbage. Why, you ask? Well, it can help us cut down on how much we throw away. With fancy-pants tech like IoT sensors, we can put these special trash cans in public spots to figure out where we're generating the most waste. Then we can launch targeted campaigns telling folks and companies to stop being so wasteful. Plus, these smart cans can remind us to recycle by giving us instant feedback on what we're throwing away and how we can recycle better.

And that's not all! Smart waste management also makes garbage collectors more efficient. They can save gas by only coming when they need to empty a can, rather than prowling around all the time. And they can take the most efficient routes, cutting down how much time and gas they need even more. This saves waste management companies money, too.

But wait, there's more! Smart waste management can also help protect our planet. We can use solar power to run garbage trucks and other cool stuff,

which means we're not pumping out as many greenhouse gases. And we can make new things out of old stuff, which cuts down on how much we need to make from scratch.

Sure, there are some problems with smart waste management. Like, it can cost a lot of cash to get all the new gear. And there's a chance someone might steal our data. But if we're careful and make good rules for using this stuff, we can have a cleaner planet and a happier life. So, let's give it a try!

ABIOTIC CALAMITIES FOR PLANTS IN PAKISTAN, THEIR IMPACT ON THE ECOSYSTEM, AND HOW TO TACKLE THIS ISSUE

Hamdia Mahmood
0440-BH-ENV-20

Introduction

Abiotic stress is the adverse impact of non-living factors on living organisms. Abiotic stress can adversely affect soil, plant, and human health. It can also damage the agricultural economy. Therefore, effective methods must be used to control or prevent these abiotic stresses. Pakistan is facing these stresses severely. In this article, we'll discuss the salient features of these abiotic stresses and the Pakistan government's policies to tackle them.

1. Drought

When a region experiences an extended period with below-average rain and snowfall, it's usually called a drought. This phenomenon can drastically affect the area's ecosystem and agricultural output. While some droughts may last for years, even short but intense droughts can cause severe harm to their respective local economies. No matter its length or severity, all types of droughts are incredibly detrimental.

Salient Features

- During a drought, temperatures may rise above average; the soil becomes dry, and crops cannot grow or become stunted with insufficient water.
- A lack of soil moisture or insufficient water in the soil characterizes drought.
- Arid and semi-arid regions are far more vulnerable to drought than humid environments, making them particularly susceptible.

Impact on Local Ecosystem

The severe lack of water caused by drought can diminish the development and fitness of flora, causing a shift in the kinds and placement of vegetation across an ecosystem. However, these kinds of droughts can decimate the resources available to animals, finally changing their behavior and population size. Because of this,

they may be forced to migrate in search of water or food.

2. Water Logging

Waterlogging occurs when there is excess water in an area, and it results in saturated soil and stagnant water. This can occur when the soil cannot absorb water due to its high clay content or when there is excess precipitation or water from other sources. Such as a flood or a broken water main.

Salient Features

- The plants find it difficult to grow in the water-logged soil. The movement of the animals is hindered because of water saturation with the soil.
- The stagnant water in water logged-land ranges from a few inches to several feet.
- Water-logged land has poor drainage, due to this the excess water does not drain away easily and instead remains in the area.

Impact on Local Ecosystem

Water logging has a significant impact on local ecosystems. The extra water accumulating in soils due to runoff or other factors can lead to anaerobic conditions. This can cause oxygen depletion and emit harmful substances into the environment. Another impact is that it can also limit nutrient availability in the soil, affecting plant growth and reducing biodiversity. Furthermore, flooding caused by waterlogging can lead to the displacement of animals and even death due to drowning.

3. Salinity

Salinity measures the amount of salt in a body of water, typically expressed as parts per thousand (ppt) or per million (ppm). It is essential in determining the physical, chemical, and biological characteristics of aquatic environments. Plus, it has huge implications for plants and animals that inhabit these habitats - not to mention human endeavors such as agriculture and industry.

Salient Features

- Exchangeable sodium levels often reach 15% or higher
- The pH can vary from 8.5 to beyond, depending on the exchangeable sodium and soluble salts.
- The electrical conductivity typically exceeds 4 mmhos/cm with a generally measurable content of 0.1%.

Impact on Local Ecosystem

Salinity in the soil can prevent nutrients from being absorbed by plants, making them susceptible to malnutrition and disease. Salt also

affects the water cycle, leading to an increase in evaporation and, thus, a decrease in available freshwater resources. This is especially problematic in arid climates as the water table can drop rapidly due to the lack of rain and irrigation. In addition, animals that depend on plant life for food and habitat may be negatively affected when the vegetation is weakened from salinity.

Strategies / Policies to Tackle these Abiotic Stresses

The use of naturally water-stress tolerant plants in landscaping and gardening can assist in conserving water and reducing the need for irrigation during drought. These plants have managed to thrive in areas having limited water availability, so that's why they are well-suited for drought-prone regions. Cactus plants are well-known for their capacity to thrive in dry conditions.

They are native to desert regions and have developed thick, fleshy stems that store water for extended periods. The government of Pakistan is planning to go for molecular biology approaches to elevate crop salt tolerance. Exploiting naturally occurring inter- and intraspecific genetic variability through the hybridization of salt-tolerant genotypes with high-yielding varieties well adapted to the target environment has been proposed as a fruitful means to increase crop production.

THIS CHANGES EVERYTHING: CAPITALISM VS. THE CLIMATE - (A COMPREHENSIVE REVIEW)

Hamdia Mahmoood

As I picked up "This Changes Everything: Capitalism vs. the Climate" by Naomi Klein, I knew I was in for a thought-provoking read. The title made me curious about the relationship between capitalism and climate change. As someone highly concerned about the state of our planet, I was excited to dive into this book and learn more about this critical topic.

Klein's introduction lays out the urgency of the issue and the need for immediate action. She argues that climate change is an environmental problem and a fundamental challenge to our world's economic and social systems. This book clarifies that the time for incremental change has passed. We must fundamentally rethink our economic system and relationship with the natural world to create a more sustainable and just future. She narrates:

"The pursuit of corporate profits, economic growth, and the material trappings of affluence is systematically eroding the life-support systems of the planet."

As someone who has long been skeptical of capitalism's ability to address environmental problems, I found Klein's argument compelling. I was passionate about how she would develop her argument and what evidence she would present to support it.

Klein's book is structured around the central argument that climate change results from capitalism's fundamental flaws. She presents a robust case that our economic system, based on the pursuit of infinite growth and profit, is inherently at odds with our planet's finite resources. Throughout the book, Klein weaves a compelling narrative that combines scientific data, historical analysis, and personal anecdotes to illustrate the devastating impact of climate change and the urgent need for action.

One of the book's strengths is its focus on the intersections between climate change and other social justice issues, such as economic inequality and racial injustice. Klein argues that these issues are intertwined and that solutions to one cannot be achieved without addressing the others. This interdisciplinary approach makes the book especially relevant for readers interested in the intersection of social and environmental justice.

Klein presents a compelling case for why we must fundamentally rethink our economic system if we hope to address the urgent issue of climate change. I recommend this book to anyone curious about the intersection of climate change and capitalism and to those interested in social justice issues more broadly.

While I found "This Changes Everything" compelling and thought-provoking, I found a few aspects of the book problematic. One of the significant issues I had with the book was its need for concrete solutions to its identified problems. While Klein thoroughly analyzes the root causes of climate change and the flaws of capitalism, she offers relatively few concrete policy recommendations or examples of successful grassroots movements.

Another difference of opinion I had with the book was its occasional use of overly simplistic language or metaphors. While I appreciate Klein's efforts to make complex concepts accessible to a general audience, the language sometimes felt too simplistic. It needed to capture the complexity of the issues at hand fully.

Finally, I felt that the book could have enlightened me with a more nuanced discussion of the role of technology in addressing climate change. While Klein acknowledges the potential of renewable energy and other technological innovations to help address the problem, she is

often critical of the idea that technological solutions alone will be sufficient. While I agree that we need a more holistic approach to addressing climate change, technology is vital in creating more sustainable and equitable societies.

Despite these critiques, I found "This Changes Everything" compelling and essential book. Klein's passionate and engaging writing style makes the issue of climate change accessible to a broad audience, and her interdisciplinary approach underscores the importance of addressing social justice issues in the fight against climate change. While the book could have been more vital in some areas, it remains essential to the ongoing conversation about climate change and its relationship to capitalism.

"Climate change can be a people's shock, a blow from below. It could disperse power into the hands of the many rather than consolidate it in the hands of the few."

In conclusion, "This Changes Everything: Capitalism vs. the Climate" is a powerful and urgent call to action on one of the most concerning issues of our time. Klein's analysis of the root causes of climate change and its intersection with capitalism is compelling and well-supported. While the book could have been more vital in terms of concrete policy recommendations and a more nuanced discussion of technology, it remains an essential contribution to the ongoing conversation about climate change and its relationship to our economic and social systems.

E-WASTE RECYCLING

Zara Shabbir

0427-BH-ENV-20

zarashabbir427@gmail.com

Introduction:

The amount of waste that needs to be handled locally and worldwide can be decreased by sustainably managing electronics by lowering the number of materials used, boosting reuse, refurbishing and extending the life of devices, and recycling.

The biggest and fastest-expanding commercial sector in Europe is the production of electrical and electronic equipment (EEE). This rise in EEE production and demand could be linked to a rise in the use of a certain class of EEE goods, namely ICT Products.

One of the biggest and fastest-growing waste streams is electronic waste (e-waste). The management of this expanding waste stream has become problematic, particularly in under.

Managing E-waste:

Management of harmful leaks into the environment, as well as the recovery of rare precious metals. Furthermore, it offers secure working circumstances for employees and business participants.

Only a small number of wealthy nations can adequately recycle or dispose of the e-waste they produce.

Therefore, only a small portion of the created e-waste is appropriately recycled. It has been demonstrated that a nation like the US, which is one of the biggest e-waste generators and formally recycles 13.6% of its e-waste, according to the Take Back Coalition. Britain recycles 17% at most. 60 percent of waste in the EU is recycled through recycling formally. Owners either store the remaining items disposed of or deliver them to emerging nations as recycling of componentry. Thus, e-waste presents a significant barrier in terms of its recycling and disposal in both developed and developing nations.

Generation of E-waste in Pakistan:

India, Pakistan, and Bangladesh are some of the countries most severely impacted by e-waste. The report claims that Pakistan generated 433 kilotons of electronic garbage in the previous year. India, one of the top three producers of digital recycling, generated 3,230 kilo tons of e-waste, however on a smaller scale than Pakistan's e-waste generation. India has regulations for the management of e-waste but in Pakistan, e-waste recycling is not very efficient.

E-waste recycling is known to take place in several districts in Lahore. E-waste is frequently broken down and repurposed in enclosed spaces with inadequate ventilation. Faisalabad, Gujranwala, and Peshawar also engage in e-waste recycling, disassembly, and rehabilitation.

Recycling of E-waste:

Recycling is one of the finest options for proper management of the e-waste stream and for recovering precious metals. Both formal and informal recycling methods can be used to recycle e-waste. Recycling of paperwork is preferred because it promotes worker safety and makes use of cutting-edge technology for e-waste processing. It can get back as much as 80% of the materials and 15% of the energy found in e-waste. Just about in the waste stream, 5% of the resources are lost. There is evidence suggests that 95% of the metals (gold, silver, copper, nickel, iron, zinc, and with current technology, aluminum is feasible. The majority of these extraction methods take place in affluent nations where stringent rules guarantee the management of environmental pollution.

Steps of Formal Recycling:

1) Collection
2) Dismantling of waste manually
3) Shredding of the waste and then processing it.
4) Processing by metallurgy.
5) Recycling by CRT (Cathode Ray Tube).

6) Recycling of plastic materials present in E-waste.

Formal recycling is expensive and only developed nations afford to carry formal recycling properly. In developing countries, e-waste is commonly recycled informally.

Steps of Informal Recycling:

1) Dismantling of e-waste
2) Extraction of precious metals
3) Recovery of copper from the cables

As informal recycling is carried out by simple and basic processes and tools, it is more dangerous for the environment as well as human health as compared to the impacts of formal recycling.

How E-waste recycling can be Improved:

Many developed countries export their e-waste to developing countries and Pakistan is a significant importer of e-waste because of the need for second-hand accessories and for having great value in third-world countries.

There should be proper legislation on e-waste in developing countries so the impacts of e-waste can be reduced. In the case of informal handling of e-waste, stakeholders should be responsible for the production of harmful impacts.

For improving problems related to e-waste the system in Pakistan should be partly or completely formalized. In the process of partial formalization of waste, necessary material is dismantled manually and harmful material is returned to the developed country from where the waste is imported for complete formalism of e-waste.

Conclusion:

Complete formal recycling of e-waste can also be introduced in Pakistan but it's not too effective in countries like Pakistan as compared to informal and partially formal recycling.

There is a need to fill the gaps in the legislation at both national and international levels for suppressing the harms of e-waste recycling. All the important stakeholders should participate in formal and informal recycling of waste and Corporate Social Responsibility CSR should be efficient and improved for handling electronic waste in developing as well as developed countries.

MICROPLASTICS CAN BREACH THE BLOOD-BRAIN BARRIER, CAUSING DEMENTIA-LIKE CONDITIONS

Iman Fatima

0444-BH-ENV-20

fatimaiman8989@gmail.com

Introduction:

Microplastics appear as one of the world's environmental main concerns. Plastic pollution is increasing day by day and is of great concern because plastics are non-biodegradable and it takes thousands of years for the breakdown of

plastics resulting in microplastics that are disposed of in the oceans every year. These microplastics are ultimately affecting humans causing a lot of diseases. Microplastics are defined as plastics having a size less than 5mm. Microplastics mainly come into existence as a result of the breakdown of larger plastics by mechanical degradation. These microplastics are directly and indirectly affecting human life and the environment as well. The latest research was made on microplastics in April 2023 according to which microplastics are rupturing the blood-brain barrier.

Microplastics breaching the blood-brain barrier:

According to the latest research of 2023, microplastics can breach the blood-brain barrier which may cause dementia-like conditions in humans. Microplastics are becoming a major concern nowadays. In the last year, scientists have discovered that these minute particles can easily enter the bloodstream and can accumulate in the organs with time. According to the new research of 2023 that confirms that these plastic particles can breach the brain-blood barrier which is the protective layer that protects the brain from toxins and causes madness in humans.

Effects of microplastics in humans and movement of microplastics in the human body

The microplastics can have adverse effects on the human body and this may cause the conditions of Alzheimer's disease. Microplastics can cause several neurological disorders in humans. The microplastics can enter the food chain via food packaging, inhalation from textiles, and synthetic rubber tires. Scientists have found that these microplastics have both behavioral changes as well as the changes in immune system. The in vitro experiments showed that microplastics have adverse effects on human health mainly causing inflammation and stress and neurotoxicity as well in humans.

The methodology used by the researchers to identify the microplastic effects

The researchers realized the microplastic's effects on the brain-blood barrier by giving the micro and nano plastics to the mice from polystyrene which is the type of plastic commercially used for food packaging and the last they examined the mice.

According to a scientist at the University of Debrecen in Hungary named Oldamur Holloczki, "With the help of computer models, we discovered that a certain surface structure was crucial in enabling plastic particles to pass into the brain".

How the problem of microplastics can be solved?

Not only solid foods but also liquids play an important role in the microplastic's entrance into the body. According to one research, anyone who is drinking water 1-2 liters from plastic bottles

will end up ingesting about 90000 plastic particles a year. To limit the potential effects of microplastics it is important to limit exposure and restrict the use so that the effect of it can be minimized. Various actions have been taken to the production of microplastics.

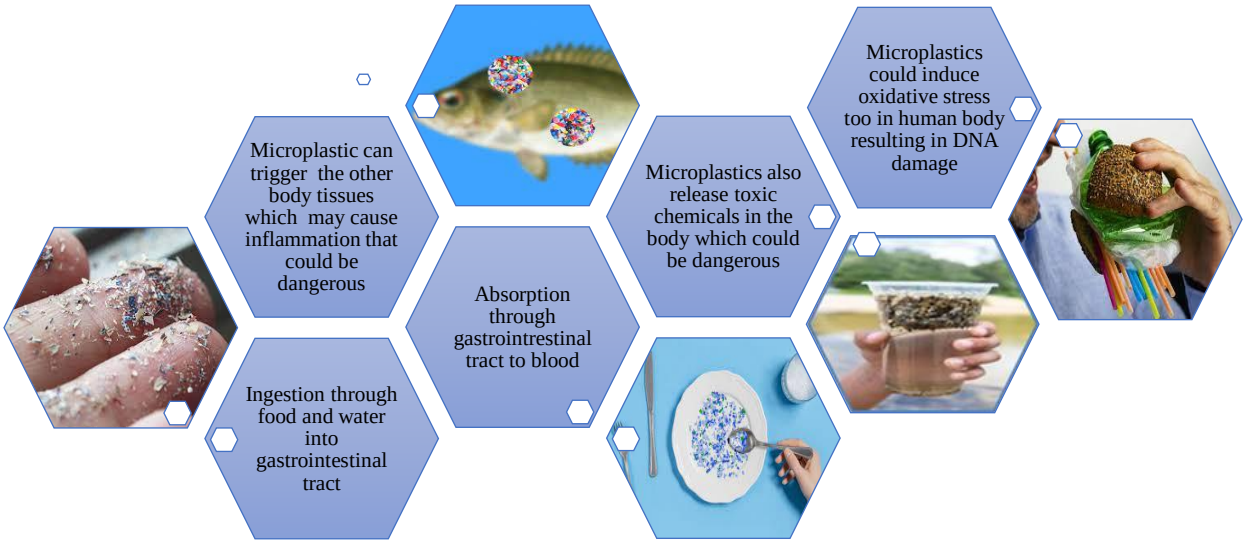
- The UK government banned the use of microbeads used in face scrubs and shower gels in 2018.
- In 2021 North American multinational additives manufacturers began developing alternatives to petroleum-based microplastics.
- The best way to reduce the microplastics is to reduce them at the source.
- The least priority of plastics should be disposal.

Conclusion

Shortly, the need of hour is to limit the use of plastics which is increasing day by day. It is very important to limit the exposure and restrict the use. There is a need for further research on it according to the scientists. It is observed that during the last 80 years, plastic pollution increased by 1.5 million tons to 367 tons. According to the latest research microplastics are causing the conditions of madness in humans. So, there is a need to control the microplastics so that their effects can be reduced.

Note:

It cannot be right to manufacture millions of objects like plastics that are used by humans in a matter of minutes and then are with us for millions of years as they are non-biodegradable and everything starts with us and we can stop it.



intermediate

TRANSFORMING PLASTIC WASTE INTO BLACK GOLD: A SUSTAINABLE SOLUTION TO A GROWING CRISIS

M. Yousaf Riaz

0279 -1 - 22

The Rising Tide of Plastic Pollution

Plastics have become an inescapable facet of modern life, offering unparalleled convenience and utility. Yet, this convenience comes at a tremendous environmental cost. Plastic pollution has surged to alarming levels, posing a significant threat to our planet. Even if we were to cease all plastic production today, the dilemma of dealing with the vast quantities of existing plastic waste would persist.

This seemingly indestructible material can take up to four and a half centuries to decompose fully. Shockingly, a recent survey reveals that a staggering fifty percent of the total plastic produced from 1950 to 2021 was manufactured in just the last thirteen years. The problem is growing at an exponential rate, necessitating innovative solutions.

Turning Waste into Wealth

In the face of this mounting crisis, a revolutionary solution has emerged: the conversion of plastic waste into a valuable resource known as "Black Gold." Studies have shown that challenging-to-decompose plastics, such as polyethylene (used in items like plastic bags) and polypropylene (commonly found in thermos plastics), can be transformed into a liquid oil through a process called pyrolysis.

This thermal decomposition method subjects plastic waste to high temperatures, breaking down the long hydrocarbon chains within the plastic to yield a liquid oil, often referred to as pyrolysis oil. This remarkable substance falls on the spectrum between Diesel and Kerosene, and with further refinement, it matches their output efficiency. In essence, pyrolysis oil can be used as a potent alternative fuel for motor vehicles, offering a sustainable solution to our dependence on fossil fuels.

The Pyrolysis Process

The pyrolysis process involves sealing plastic waste within a container to prevent the entry of oxygen, which would hinder combustion. A heat source is then applied to induce the thermal decomposition of the plastic mixture into hydrocarbon gases. These gases are subsequently condensed using a cooling jacket, resulting in the formation of pyrolysis oil. This raw form of crude oil, once purified and subjected to an appropriate catalyst, can be seamlessly integrated into conventional motor engines. Remarkably, this process operates in reverse to the polymerization process used to create plastics like polyethylene, where hydrocarbon fuels are used to form plastic polymers.

At present, this conversion process operates on a relatively small scale, with one kilogram of

plastic waste producing one kilogram of fuel. However, the potential for scaling up this process is immense. With the right investments and support from government bodies, it could yield significant output. By embracing pyrolysis on a larger scale, nations can not only contribute to global efforts to combat plastic pollution but also secure substantial economic benefits. In the context of Pakistan, a nation grappling with environmental challenges, this solution holds particular promise.

Empowering Pakistan's "Clean Green" Vision

Pakistan has embarked on an ambitious journey toward environmental sustainability with its "Clean Green Pakistan" campaign. This initiative seeks to tackle various environmental issues, including the mounting plastic waste crisis. By adopting pyrolysis as a viable means of converting plastic waste into valuable resources, Pakistan can make substantial strides toward achieving its environmental goals. In the long run, this approach could also lead to a substantial reduction in the nation's dependence on imported crude oil.

Currently, Pakistan spends a substantial $6.7 billion on oil imports, a significant drain on its economy. Embracing pyrolysis as a means of recycling plastic waste at scale could result in annual savings of up to $335 million. These funds could be reinvested in vital sectors such as healthcare, education, and infrastructure, ultimately fostering economic growth and stability.

Looking Towards a Sustainable Future

The conversion of plastic waste into pyrolysis oil offers a ray of hope in the face of the plastic pollution crisis. By addressing the dual challenges of plastic waste and fossil fuel dependence, this innovative solution aligns with global sustainability objectives. As we stand at the intersection of environmental stewardship and economic prosperity, it is crucial for governments, industries, and individuals alike to embrace this transformative technology.

To fully realize the potential of pyrolysis, it is imperative that governments worldwide prioritize and incentivize investments in research, development, and implementation of this technology. Collaboration between public and private sectors, coupled with public awareness campaigns, can drive the adoption of pyrolysis as a practical solution to the plastic waste predicament.

In conclusion, the journey from plastic waste to "Black Gold" is not just a theoretical concept but a tangible pathway to a more sustainable future. As nations grapple with the escalating plastic crisis and the imperative to reduce their carbon footprint, pyrolysis represents a beacon of hope—a chance to tackle two pressing issues with one ingenious solution. It is time for the world to recognize the potential of this innovative technology and unite in our commitment to produce "Black Gold" from

plastic waste, paving the way for a cleaner, greener, and more prosperous future for all.

DARK MATTER: UNVEILING THE INVISIBLE UNIVERSE

Ahsab Zaka
0176

Introduction

The existence of dark matter has been one of the most intriguing puzzles in the field of astrophysics for several decades. While it does not interact with light or other electromagnetic radiation, its presence is inferred through its gravitational effects on visible matter. Dark matter constitutes a significant portion of the universe, and unraveling its mysteries is crucial to our understanding of the cosmos. In this article, we will explore recent research, opinions, and the future scope of studying dark matter.

Evidence for Dark Matter

Over the years, numerous observations have provided substantial evidence for the existence of dark matter. One of the earliest indicators was the study of galactic rotation curves. Astronomers noticed that the visible matter in galaxies, such as stars and gas, was not sufficient to explain the observed rotational velocities. The additional gravitational influence of dark matter was necessary to account for these observations.

Furthermore, the study of galaxy clusters revealed gravitational lensing effects caused by the presence of massive, unseen matter. The bending of light around these clusters provides compelling evidence for the existence of dark matter on large scales. Additionally, the cosmic microwave background radiation, the afterglow of the Big Bang, also supports the notion of dark matter by revealing patterns in the distribution of matter in the early universe.

Recent experiments have focused on directly detecting dark matter particles. Various underground detectors, such as the Large Underground Xenon (LUX) experiment and the XENON1T experiment, have been constructed to search for weakly interacting massive particles (WIMPs), one of the leading candidates for dark matter. Although no conclusive detection has been made thus far, these experiments have placed stringent constraints on the properties of potential dark matter particles.

Nature Of Dark Matter

The nature of dark matter remains elusive, leading to a multitude of theories and opinions within the scientific community. Some researchers propose that dark matter consists of yet-undiscovered particles, such as WIMPs or axions, which interact weakly with ordinary matter. Others suggest modifications to the laws of gravity on cosmic scales, such as Modified Newtonian Dynamics (MOND), as an alternative explanation for the observed phenomena attributed to dark matter.

Another intriguing possibility is that dark matter could be composed of exotic objects like primordial black holes or ultra-compact minihalos. These objects would not only explain the gravitational effects but also open up new avenues for studying the interactions between dark matter and visible matter.

Future Prospects

Advancements in technology and observational techniques are key to unraveling the mysteries of dark matter. Researchers are continually refining existing experiments and designing novel detection methods. Upcoming projects, such as the XENONnT experiment, the Super Cryogenic Dark Matter Search (SuperCDMS), and the Large Synoptic Survey Telescope (LSST), hold promise for shedding light on the nature of dark matter.

Furthermore, particle accelerators like the Large Hadron Collider (LHC) are crucial for exploring the properties of potential dark matter particles. By colliding particles at high energies, scientists hope to produce and detect new particles that could be associated with dark matter. The ongoing research at the LHC and future upgrades, such as the High-Luminosity LHC, will provide valuable insights into the properties of dark matter particles.

Additionally, the study of astrophysical phenomena, such as the formation and evolution of galaxies and galaxy clusters, can offer valuable clues about the distribution and behaviour of dark matter. Sophisticated computer simulations and high-resolution observations from telescopes like the James Webb Space Telescope (JWST) and the upcoming Nancy Grace Roman Space Telescope (formerly WFIRST) will provide a deeper understanding of the complex interplay between dark matter and visible matter.

Conclusion

Dark matter continues to captivate the minds of scientists and researchers worldwide. While its existence is well established through compelling observational evidence, the precise nature of dark matter remains a profound enigma. Through ongoing research, theoretical explorations, and technological advancements, we inch closer to unravelling the mysteries of the invisible universe. By comprehending dark matter, we will unlock a deeper understanding of the cosmos, rewriting our current understanding of the universe and its formation. The future holds great promise for unveiling the secrets of dark matter and charting new frontiers in astrophysics.

DIY PROJECTS

Saadan Hassan

0165

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1. Home-made Crystals

Crystals can be a unique decoration for any environment and are an absorbing project to undertake. Made of common household items, many surfaces can be coated with these crystals to give them a unique look.

Items needed:

- Magnesium Sulphate (Epsom salt) - (This can be substituted with table salt)
- Water-beaker
- Food Coloring (Optional)

Procedure:

The water must be very hot, preferably boiling, for the crystals to form. First, we mix magnesium sulfate or table salt into the water, until no more of the salt can dissolve. A supersaturated solution has been formed. To color the crystals, you can add food coloring at this stage. The liquid can now be poured into its final destination. For example, it can be poured into a mug, and an empty eggshell can be placed in the mug as well, which will cause the crystals to grow on the eggshell, giving it a unique look.

Once the supersaturated solution has been placed in its destination (or left in the beaker), it must be placed in an area to cool. If using Magnesium Sulphate (Epsom Salt), it must be placed in a fridge for a few hours, as fast as possible, before the solution temperature falls too low. If using table salt, it can either be placed out in the sun or in the fridge.

2. Handheld Vacuum

D.C. Motors are useful in a variety of applications. From converting electrical power to mechanical movement and vice-versa, such technologies have limitless possibilities for small-scale implementation. And home-made vacuums are one example of such projects.

Items Needed:

- 1.5 Liter Bottle
- DC Motor
- Battery Plug
- Hot Glue
- Cutter

Procedure:

Cut a square into the side of a 1.5-liter bottle, close to the center point of its height. Using a bit of hot glue, fix the motor inside the bottle such that the rotating end faces the neck of the bottle. Attach a fan to the end of the motor so that it can produce a force to push or pull the material. Wrap both wires extending from the battery connector to the two terminals of the motor. Connect a battery to the battery plug and watch the air being sucked up by the rotating fan!

3. Homemade Potato Battery:

Items Needed:

- 2 large potatoes
- 2 copper nails or pennies
- 2 zinc-coated nails or galvanized nails
- 3 alligator clip wires
- LED light bulb
- Small knife or wire stripper
- Sandpaper (optional)
- Salt (optional)

Procedure:

Take one potato and insert a copper nail or penny into one side and a zinc-coated nail into

the other side. Make sure the metals do not touch inside the potato. Repeat the same process with the second potato, using the same types of metals and keeping them separated.

If the nails have a coating on them, you can use sandpaper to remove it to ensure better conductivity. Connect one end of an alligator clip wire to the copper nail of one potato and the other end to the longer leg of the LED bulb. Connect one end of another alligator clip wire to the zinc-coated nail of the same potato and the other end to the shorter leg of the LED bulb. Repeat the steps with the second potato and LED bulb. Connect the third alligator clip wire to the copper nail of one potato and the zinc-coated nail of the other potato. When you complete the circuit, the LED bulb should light up, demonstrating how a potato can generate electricity through a chemical reaction.

4. Homemade Lava Lamp:

Items needed:

- A clean plastic bottle or glass jar
- Vegetable Oil
- Baking Soda
- Food Coloring

Procedure:

Add a couple of inches of baking soda to the bottom of your bottle or jar. Fill the rest of the bottle or jar up with vegetable oil until it is almost full. Use a funnel if you have one. Notice how it stays separate. In a separate cup, add a fourth cup or so of vinegar and food coloring. Mix them. Slowly pour the vinegar and food coloring solution into the oil. Finally, if you have a flashlight, turn off the lights and watch your lava lamp in action!

MYTHOLOGY

Ammar Nizami

0120

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1. **Myth: We only use 10% of our brain**

Fact: This is a common misconception. In reality, humans use a significant portion of their brains throughout the day. Advanced imaging techniques, such as functional magnetic resonance imaging (fMRI), have shown that different regions of the brain are active during various tasks and activities. While it is true that not all parts of the brain are active simultaneously, there is no scientific basis for the claim that we only use 10% of our brain.

2. **Myth: The Great Wall of China is visible from space**

Fact: Contrary to popular belief, the Great Wall of China is not visible from space with the naked eye. Astronauts have confirmed this, and satellite images from space also debunk the myth. The wall is relatively narrow and blends with the surrounding landscape, making it difficult to distinguish from space without the aid of telescopic lenses or high-resolution satellite imagery.

3. **Myth: Bats are blind**

Fact: Bats are not blind; in fact, most bat species have excellent vision. However, some species of bats rely heavily on echolocation, a biological sonar system, to navigate and locate prey in the dark. This has led to the misconception that bats are blind. While their vision may not be as acute as some other animals, however, they are far from being blind and can see quite well.

4. **Myth: Cracking your knuckles leads to arthritis**

Fact: The belief that cracking your knuckles leads to arthritis is a widespread misconception. Studies have shown that knuckle cracking does not increase the risk of developing arthritis. The sound produced when cracking knuckles is caused by the release of gas bubbles in the joint fluid, and it does not have any long-term negative effects on joint health.

5**. Myth: A penny dropped from a tall building can kill a person**

Fact: This myth is often perpetuated, but it is not true. A penny dropped from a tall building does not have enough mass or aerodynamic properties to cause fatal injuries. While it could potentially cause minor discomfort if it were to hit someone, the chances of it being lethal are extremely low. Falling objects can be dangerous, but for something as light as a penny, the risk of serious harm is negligible.

6. **Myth: The color red anger bulls**

Fact: Bulls are not enraged by the color red. They are color-blind to red but are sensitive to the movement of the matador's cape. The red color is traditionally used in bullfighting because it is visually striking.

7. **Myth: Sugar causes hyperactivity in children**

Fact: Numerous scientific studies have shown no direct link between sugar consumption and hyperactivity in children. The perception that sugar leads to hyperactivity is likely due to the excitement associated with consuming sugary foods.

8. **Myth: Shaving makes hair grow back thicker and darker.**

Fact: Shaving does not affect the thickness or color of hair. When hair grows back after shaving, it may appear thicker or darker temporarily due to the blunt edge of the cut hair, but it does not alter the actual hair growth.

9. **Myth: The tongue has specific taste zones.**

Fact: The idea that different taste sensations are experienced in specific areas of the tongue (e.g., sweet at the tip, sour on the sides) is a common misconception. In reality, taste buds are distributed across the entire tongue, and all taste sensations can be detected in all areas.

10. **Myth: Lightning never strikes the same place twice.**

Fact: Lightning can strike the same place multiple times. Tall structures, such as skyscrapers and lightning rods, are often struck repeatedly during storms. Lightning follows the path of least resistance and can strike the same location if it provides the most efficient route.

Note:
It is important to separate scientific facts from common myths and misconceptions. By relying on scientific evidence and research, we can gain a better understanding of the world around us.

UNVEILING THE MYSTERIES OF SPACE: NASA'S LATEST BREAKTHROUGHS AND EXCITING PROJECTS

Ali Arif Khawaja

0295

Before I get to the purpose of this article let's first answer the question: **What is science?**

In the modern world or 21st century, we have seen exponential growth of technology and its use in our daily lives. It has made our life so easy and things that seemed to take an eternity now are a question of mere seconds.

Secondly, accessing information is one of these major steps that have seen a huge upgrade in processing speeds. Smartphones and daily appliances have made communication and tasks significantly easier.

That was about how science has made everything seem so easy on the eye and has also brought us great comfort. Like traveling, for example. We go from one place to another in a flash as compared to days, months, and weeks in the past. We go to the airport check in our luggage and get seated and the next thing you know the wheels are touching down at the destination. That is science!

What is NASA?

Well, to begin with, it stands for National Aeronautics and Space Administration. It was formed to invest more time and resources into research and development in the world surrounding our precious earth. It is responsible for science and technology related to air and space. The space age started in 1957 with the launch of the soviet satellite Sputnik.

We all know something about what NASA does but most of us are not aware of how vast their work is. They send astronauts into the solar system to study it and send information back to the Earth. In addition to this, they are sent to the moon and Mars to discover their habitat and understand it better. Moreover, they release space probes and study the solar system and beyond. The agency also shares what it learns with the inhabitants of Earth in an attempt to make the world a better place.

What has NASA done?

When NASA started, it began a program of human spaceflight. The Mercury, Gemini, and Apollo programs helped astrologists and people to understand better how space travel works.

These missions laid the groundwork for further space travel.

NASA has also developed space probes which have visited every planet in the solar system and many celestial bodies. This has enabled in better interpretation of the weather patterns and made it possible to predict the future in terms of these conditions.

NASA has also developed cutting-edge technology to upscale the progress they have made. This includes telescopes that have shot numerous pictures and given researchers back home more ideas on the landscape that surrounds these planets. Not just the Milky Way, but many other galaxies have been mentioned to underline the vastness of our beautiful space.

The concept of a black hole

First of all, let us define the black hole. A black hole is a place where gravity pulls so much that even light cannot get out.

Just a few months back the latest telescope called the Hubble telescope sent back images of the black hole which gave the impression of a black hole tossing up a galaxy between a tussle with two other black holes.

Hubble Telescope

Scientists came to know about the ultraviolet waves that have been emitted from various planets. The Hubble telescope was the first telescope that could capture readings of ultraviolet waves and also get their images.

Its purpose was to observe the distant stars and galaxies and view their conditions. It has been designed to explore the universe in visible, infrared, and ultraviolet wavelengths. It is not the first space telescope invented, but is one of the most versatile and largest ones out there.

It is also the only telescope to be maintained by astronauts during its flight. All of its five major components have been replaced by various space missions. It completed 30 years in April 2020 and is predicted to last until 2030 to 2040.

Hubble Telescope data transmission

It downloads information twice daily using a 18m radius antennae which then sends the information to NASA headquarters. In a day it can download 140 GB of data.

James Webb Telescope

Currently, NASA has released the James Webb telescope in orbit. This particular telescope can see the universe about 100 million years after the Big Bang. Its purpose is to find the first stars that formed galaxies after the Big Bang. Moreover, it gives us an idea of what stars developed planetary structures.

So far, it has found traces of water vapors on a red-hot planet approximately 10 light years from Earth. This particular planet is also almost twice the size of Jupiter (the largest planet in the solar system).

The breakthrough of this telescope is that it was able to see never-before-seen images of waves being emitted from galaxies or stars. While the Hubble telescope could not look beyond the

debris and rubble, the James Webb telescope was able to provide images of the binary system that formed the Nebula (It is a cloud or dust in the night sky that is visible either as a bright patch or dark Silhouette).

Concluding the discussion

To end, I would like to add a few science words. In short, I think it has helped shape us into who we are today, and quite frankly the growth shown by civilization over the last 50 years is simply phenomenal. NASA and its projects will tell the untold mysteries about our magical world.

PETO'S PARADOX – THE STUDY OF CANCER

Mohammad Omer
0118

Your body mutates every minute, every gene in your DNA incorporates a new alteration as you read through this paragraph. The large number of cells coexist in the body on the idea of division of labor, each cell behaves as a part of a community rather than as an individual. Therefore, the welfare of the collective cells is put forward by each cell before its own personal gain, unfortunately, this is not always true.

Cells that put their personal interest and start using resources for their own benefit, form cancer cells. The immune system of the body kills cancer cells every minute, the continuous action of the caretaking cells is why cancer does not persist and is removed as soon as it starts to form. Yet, the main reason why some individuals even have cancer is merely BAD LUCK.

Cancer cells mutate if they are given the chance. The first mutation may be their formation among the cells, and the next may be to disguise themselves, hiding from the body cells which may dismantle them. The next, perhaps, is their way of multiplying, and the next is to canal the resources towards themselves, all these lead to an incontrollable multiplication of cells which harm the body.

Cancer cells are basically a defect in the gene of a DNA, an antagonist pairs up in the gene which may fix the defect caused in the respective gene, however, these sometimes fail, and the mutation is sometimes so rigorous and rapid that cancer cells become fatal. But **what is Peto's paradox?** A common notion that might seize a common man's mind is: that the larger the body size the larger the chance of one getting cancer. The negation of this idea is presented by Peto's paradox, which explains that larger and long-lived animals like whales and elephants have an extremely minute chance of getting cancer as compared to smaller organisms like dogs.

There are two main reasons for this:

A. **Evolution or mutation:** The size of cells is almost the same in all multicellular organisms however, the difference occurs in the number of cells occurring in respective bodies. A larger number of cells means that a larger number of genes in the DNA. Animals

like whales having a larger amount of DNA require a greater number of mutations in their cells as compared to smaller animals with fewer genes, like mice which have a greater probability of dying from cancer. Secondly, the larger number of DNA results in more caretaking genes incorporated into them. A higher probability of the detection of harmful mutating cells is efficiently catered by these genes in larger organisms.

B. **A Tumor for a Tumor:** Cancer cells are a tumor formed on a specific part of a body. These may originate from any cell of the body may that be nerve cells, muscle cells, or erythrocytes, and hence become uncontrollable. The interesting thing about cancer is the cancer-killing tumor, which cancer forms itself. A tumor forms on a part of the body, and the recurring mutation in the tumor fuels its persistence. Yet, sometimes during the mutation a cell may step out of its "harmful" community and term itself as an individual same as its ancestors did. This new independent cell forms its copies on the already formed tumor. The new tumor takes resources from the mass of tumor cells over which it forms, weakening the pre-existing group of dangerous cells. In elephants and whales, many small tumors form at multiple, different parts of the bodies which are ultimately disposed of by the "hyper tumors".

This suggests why animals with a larger body mass have a reduced chance of getting cancer while smaller animals frequently die due to this mysterious blob of treacherous cells.

QUANTUM COMPUTING: UNLEASHING THE POWER OF QUANTUM MECHANICS

Ahsab Zaka
0176

Quantum computing is a rapidly developing field that has the potential to revolutionize the way we compute. Quantum computers use the principles of quantum mechanics to perform calculations that are exponentially faster than classical computers. This could lead to breakthroughs in a wide range of fields, including cryptography, drug discovery, and materials science.

What is Quantum Computing?

Classical computers store and process information in bits, which can be either 0 or 1. Quantum computers, on the other hand, use quantum bits, or qubits, which can exist in a superposition of both 0 and 1 at the same time. This property allows quantum computers to perform calculations that are impossible for classical computers.

The Power of Quantum Computing

The power of quantum computing comes from the fact that qubits can be entangled. Entanglement is a phenomenon where two qubits are linked together in such a way that they share the same fate. This means that if you measure one qubit, you will instantly know the state of the other qubit, even if they are separated by a great distance.

Entanglement allows quantum computers to perform calculations that are exponentially faster than classical computers. For example, a classical computer would need to search through an entire database to find a match, while a quantum computer could search through the entire database in parallel.

Potential Applications of Quantum Computing

The potential applications of quantum computing are vast and far-reaching. Some of the most promising applications include:

- **Cryptography:** Quantum computers could be used to break current encryption standards, which would have a major impact on cybersecurity.
- **Drug Discovery:** Quantum computers could be used to simulate the behavior of molecules, which could help researchers develop new drugs more quickly and efficiently.
- **Materials Science:** Quantum computers could be used to simulate the behavior of materials, which could help researchers develop new materials with improved properties.
- **Finance:** Quantum computers could be used to solve complex financial problems, such as portfolio optimization and risk management.

The Future of Quantum Computing

The field of quantum computing is still in its early stages, but it is rapidly developing. In the coming years, we can expect to see significant progress in the development of quantum computers. As quantum computers become more powerful, they will have a major impact on a wide range of industries.

Research and Opinions

There is a lot of research being done in the field of quantum computing, and there are several different opinions on the future of this technology. Some experts believe that quantum computers will eventually become mainstream, while others believe that they will remain a niche technology.

It is still too early to say for sure what the future of quantum computing holds. However, there is no doubt that this technology has the potential to change the world.

The Future Scope of Quantum Computing

The future scope of quantum computing is vast and far-reaching. Some of the potential applications of quantum computing include:

- **Artificial Intelligence:** Quantum computers could be used to develop new AI algorithms that are more powerful and efficient than current AI algorithms.
- **Climate Change:** Quantum computers could be used to simulate the behavior of the climate, which could help researchers develop more effective ways to mitigate climate change.
- **Space exploration:** Quantum computers could be used to develop unprecedented new navigation systems and communication technologies for space exploration.

The potential applications of quantum computing are endless. As quantum computers become more powerful, we can expect to see even more innovative and groundbreaking applications of this technology.

Conclusion

Quantum computing is a promising new technology with the potential to revolutionize the way we compute. The field is still in its early stages, but it is rapidly developing. In the coming years, we can expect to see significant progress in the development of quantum computers. As quantum computers become more powerful, they will have a major impact on a wide range of industries.

THE COLLAPSE OF THE SUBMARINE TITAN

M. Mohid Sajid

0028

The man in this world was sent about 10,000 years ago and Allah Almighty has blessed man with many powers the most important power is knowledge and if there is a little blend of wonder with the knowledge it leads to the ultimate form of Supreme Power called "WISDOM".

The concept of sea ships:

From the start of life on earth, human beings have started to get better, stronger, and wiser. These traits are built in for human beings. The aspect of using the intellect and revolutionizing with every fraction of a second is the most primitive characteristic of us humans. If we glance at our past, all the advancements are based on some natural phenomena i.e., the concept of the bird gave us the idea of an aeroplane, the communication system was based on the pigeons, and the horsepower of our engines is derived from the concept of horses and so on. Similarly, by the concept of cetaceans, the human mind got the idea of underwater submarines. First, a British mathematician **William Bourne** got the idea of the submarine in 1578 but practically the first submarine was built by a Dutch inventor **Cornelis Drebbel** in 1620.

With time, these concepts of sea voyages were advanced which ultimately led to the great inventions of sea ships like Titanic, Santa Maria USS Maine, etc.

Titanic history:

Titanic was a British passenger liner, operated by the White Star Line that sank in the North

Atlantic Ocean on 15 April 1912 after striking an iceberg during her maiden voyage from Southampton to New York City. Of the estimated 2,224 passengers, more than 1,500 died, making it the deadliest sinking of a single ship up to that time. It remains the deadliest peacetime sinking of an ocean liner or cruise ship as it claimed to be one of the strongest and safest ships for a five-star travelling experience but it got wrecked during her first journey.

The idea of Ocean Gate:

With time, a wrecked location not only holds a mystery within it but also submerges emotions, memories, feelings, and the charm of the affected ones. A visit to such a wreck can allow us to reimagine and feel the chaos of that incident and ultimately a thrillful, unique, and antique visit in one's life. To make the people feel the same rush of fear and thrill an American company named Ocean Gate was founded in 2009 by Stockton Rush and Guillermo Söhnlein.

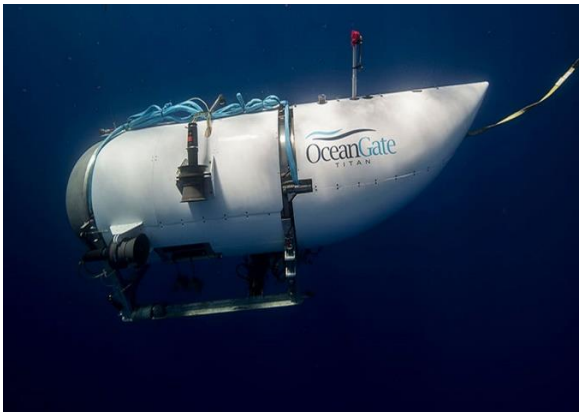
Their motive was to prepare a submarine that would take the people fond off the historical and mystery places to visit almost 12,500 feet down to the wrecked site of the sunken Titanic cruiser ship.

Unique factor of submarine Titan:

The founders were willing to prepare a submarine that had different, lighter, and more unique body material than the ritual submarines. In all the successful submarines "Titanium**"** is the metal mostly used for making the outer body of a submarine as the element Titanium can bear the maximum external water column pressure when the submarine is under about 6,000 psi of water pressure. However, the founders used the material carbon fibre in the middle joint of the Submarine Titan**.** Although it is stronger than the Titanium element maybe it is not able to retain its strength with time.

However, the first successful mission of Ocean Gate to the Titanic wreck was in 2021 and then in 2022. These were successful visits to the Titanic wreck an expenditure of $250,000 per person.

This is the visual of the submarine Titan:



The collapse of Titan:

On June 18, 2023, during its scheduled expedition to view the sunken Titanic, 5 passengers were included in the submarine along with the CEO of Ocean Gate Stockton Rush, and out of these 5 explorers **Shahzada Dawood** and his son Suleiman from Pakistan were also on board. It used a modified Logitech F710 wireless game controller as a control steering device

It is assumed that the submarine reached half of its depth to Titanic but due to an increase in the water pressure column, the submarine collapsed and pinched down from that Carbon fibre joint within no time it also got demolished by the

water pressure and unfortunately all 5 passengers of this voyage died along the mysterious wrecked bodies of Titanic passengers. May their souls Rest in Peace!
It has been confirmed by a Remotely Operated Underwater Vehicle that the destroyed fragments of the submarine were found about 1,600 feet down from the bow of the Titanic.

Causes of implosion:
According to Ocean Gate, Titan had several backup systems intended to return the vessel to the surface in case of emergency, including ballasts that could be dropped, a balloon, thrusters, and sandbags held by hooks that dissolved after a certain number of hours in saltwater. Ideally, this would release the sandbags, allowing the vessel to float to the surface. But, after all these emergency backups the Titan could not withstand the pressure hull which led to implosion.

Out of all the causes of the implosion of the Titan the most accepted one is that the centre joint of carbon fibre instead of titanium caused the submarine to implode from that point when there was a significant increase in the water pressure due to the depth of the ocean. Perhaps, I think that it is one of those mysteries that we will never solve. One of the mysteries we read about.

THE URGENT NEED FOR ACTION: COMBATING AIR POLLUTION FOR A SUSTAINABLE FUTURE

M. Yousaf Riaz

Pollution has become an everyday concern, with air pollution being one of the most significant threats we face. It adversely affects the air we breathe, posing serious risks to both human and environmental health. In this article, we will explore the different forms and sources of air pollution, the dire consequences it has on our well-being, and the urgent need for sustainable solutions. Moreover, we will delve into the personal opinions and beliefs surrounding this critical issue.

Understanding Air Pollution: Types and Sources

Air pollution can be categorized into two main types: visible and invisible. Visible air pollution, such as smog, is easily observable, while invisible pollutants like sulfur dioxide and carbon monoxide can be more toxic. These pollutants stem from both natural and man-made sources.

The Causes and Consequences of Air Pollution

Human activities are major contributors to air pollution. Combustion of fossil fuels, emissions from industries, agricultural practices, and improper waste management all release harmful chemicals into the air. The devastating effects of air pollution are far-reaching, resulting in respiratory and heart conditions, cancer, premature births, and even the impairment of brain development in children. Moreover, air pollution contributes to global

warming, sea level rise, and the depletion of the ozone layer.

Personal Perspective: The Urgency of Taking Action

Air pollution is not just a scientific or environmental issue; it is a matter of personal concern and moral responsibility. As individuals, we must recognize that our actions contribute to this crisis. We need to acknowledge the urgency of the situation and take immediate steps to address it. The consequences of inaction are dire and will have long-lasting impacts on future generations.

Sustainable Solutions: Empowering Change

1. **Utilizing Public Transportation:** Encouraging the use of public transportation and carpooling can significantly reduce air pollution. By choosing these eco-friendly options, we can contribute to cleaner air and minimize our carbon footprint.

2. **Adopting Better Household Practices:** Replacing traditional heating methods with gas logs, avoiding the burning of waste or dry leaves, and using eco-friendly cleaning products are simple yet effective ways to reduce indoor air pollution. These small changes in our daily lives can have a substantial positive impact.

3. **Conserving Energy:** The excessive consumption of energy leads to the burning of fossil fuels and increased air pollution. By adopting energy-saving habits such as turning off lights and fans when not in use, we can significantly decrease our energy consumption and contribute to a cleaner environment.

4. **Embracing the Concept of Reduce, Reuse, and Recycle:** Every individual has the power to make a difference by reducing waste, reusing materials, and promoting recycling. By making conscious choices and minimizing our consumption, we can mitigate pollution and its environmental impacts.

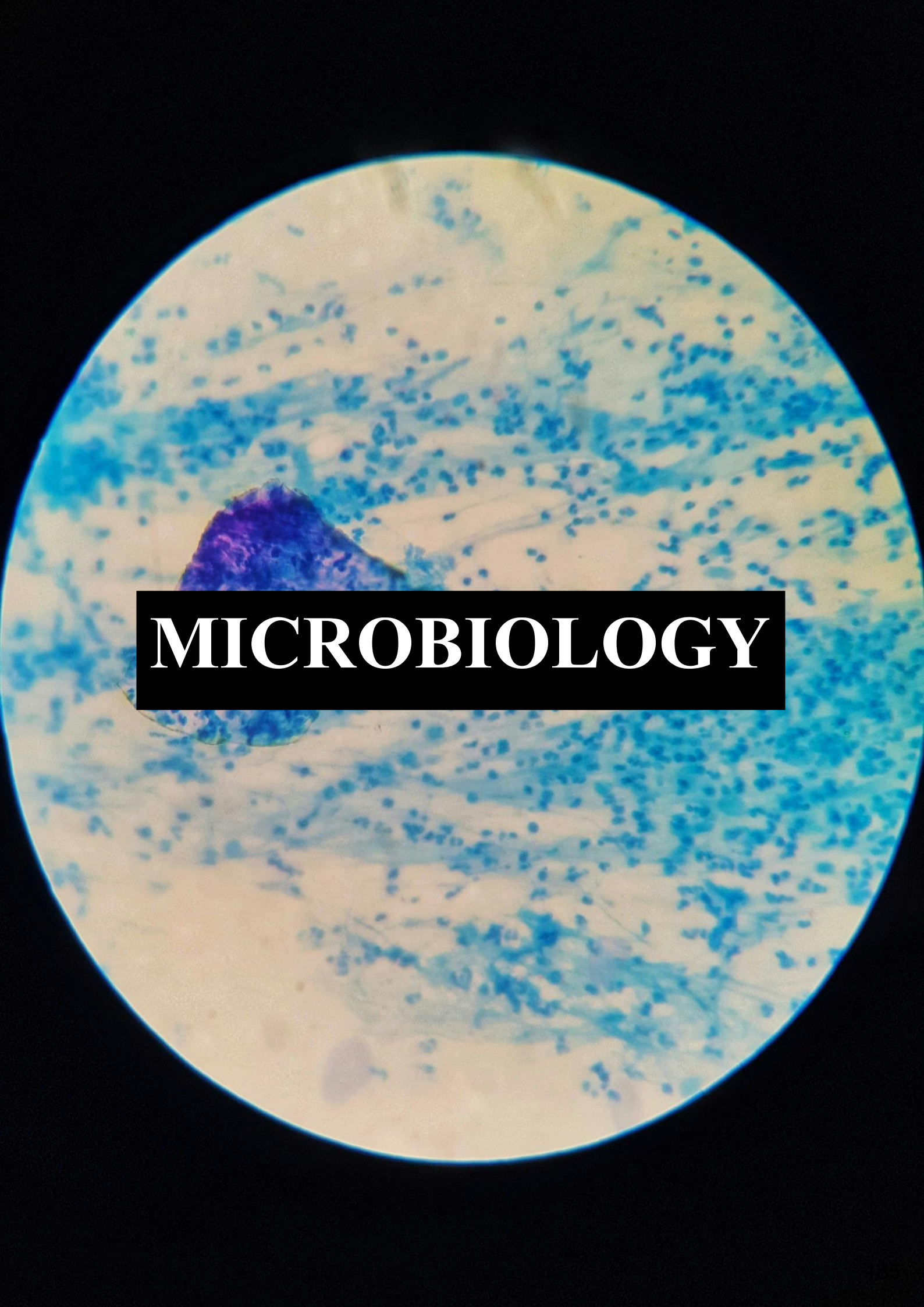
5. **Prioritizing Clean Energy Resources:** Governments and individuals must prioritize the transition to clean energy sources such as solar, wind, and geothermal. Investing in renewable energy technologies and providing incentives for their adoption are crucial steps toward reducing air pollution.

6. **Supporting Green Building Practices:** Constructing environmentally responsible and resource-efficient structures can significantly minimize the carbon footprint of buildings. By employing sustainable materials, energy-efficient designs, and proper insulation, we can contribute to a healthier and cleaner environment.

Conclusion

The fight against air pollution requires collective action and a deep-rooted commitment from individuals, governments, and organizations worldwide. The consequences of inaction are too severe to ignore, as they impact not only our health but also the future of our planet. By embracing sustainable solutions and making conscious

choices in our daily lives, we can pave the way towards a cleaner and healthier world for ourselves and generations to come. It is our responsibility to take action now and ensure a sustainable future for all.


MICROBIOLOGY

MICROBIOLOGY TIMELINE 2023

February

- 9th World Conference on Applied Micro Biology and Beneficial Microbes.

March

- International Conference on Dental Science and Advanced Dentistry (ICDSAD)-Science Leagues

April

- International Conference on Cosmetic and Classical Dentistry

May

- Recent Developments in Cryo-electron Microscopy

June

- International Conference on Medical, Biological, and Pharma Sciences with Scopus publication.

July

- International Conference on Pro-Biotics and Gut Nutrition

August

- 11th World Congress and Expo on Applied Micro-Biology

September

- 18th International Conference on Virology, Emerging Diseases and Vaccines

RESURRECTION OF DYING ORGANS THROUGH ORGAN-EX TECHNOLOGY

Arooj

Organ transplant is considered to be the only option for patients suffering from end-stage organ failure. According to the World Health Organization, only 10% of patients could get organ transplants because of the unavailability of donor organs as well as limiting ways to preserve them. In Pakistan alone, 135000 patients need organ transplants every year and thousands of people lose their lives due to end-stage organ failure.

A neuroscientist named Nenad Sestan and his team accidentally introduced a revolutionary technology that could help extend the life of human organs, reanimate the dying organs, and expand the availability of donor organs for transplant. Nenad Sestan used a mixture of proteins, nutrients, and some drugs to recover brain function in pigs. His intention was not to reanimate the brain but to study its wiring but his experiment gave rise to a revolutionary technology.

Normally, when the heart stops beating, a cascade of biochemical reactions activated by lack of blood flow, nutrients, and oxygen begins to disrupt body cells and organs. So, the organ must be harvested for transplant and preserved at low temperatures to slow down its metabolism and cellular death. However, the Organ Ex technology expands the donor pool. Multiple organs can be reanimated even after several hours of the donor's death with the help of this technology. The process includes the passage of sapphire blue solution- Ogan Ex through the circulatory system of the dead organism. Organ Ex solution contains amino acids, metabolites, vitamins, and a drug cocktail of 13 different chemical compounds that promote cellular health, delay cell death, and suppress inflammation. Sapphire blue solution gets mixed with the host's blood with the assistance of a perfusion device like an ECMO heart-lung device. The perfusion device delivers an Organ Ex solution by keeping the shredding of capillaries. Not only does Organ Ex circulate blood and oxygen and reverse rigor mortis better than ECMO, but tissues in organs like the heart, lungs, liver, kidneys, and pancreas remain intact, cells don’t die, and remain metabolically active. Organ-Ex also prevents porcine cells from tripping inflammatory switches that lead to the death of cells, activates genes that are involved in DNA repair and metabolism, and suppresses those that are involved in injury and death. In the final step, the single-cell RNA sequencing provides a real real-time snapshot that shows the recovery of molecular processes in a cell like DNA repair and maintenance of cell structure and integrity.

The discovery of Organ Ex technology opens a window for transforming our understanding of when and how our cells, tissues, and organs die. It also helps reveal different ways to keep the dead cells viable for longer periods. Its potential

applications extend the life of organs in patients as well as lengthen the availability of donor organs for transplant. In addition, it may assist doctors in counteracting the effects of aging on the human body and help treat organs that get damaged by ischemia during stroke or heart attacks.

Since the technology is not yet under clinical practice, scientists are trying to test Organ Ex-treated organs in recipient pigs to estimate how well these organs perform in living cells. The purpose of using pigs is that the size of their heart is the same as that of human beings. Once this technology passes the clinical trials in pigs as well as human beings, it will play a very important in saving the lives of organ failure patients. In addition to medical benefits, this technology is also economical for patients of developing countries like Pakistan as it just requires a flow of cell-protective fluid (Organ-Ex) through the circulatory system of the host to restore blood circulation and cell functions.

PSYCHOBIOTICS: UNLOCKING THE MIND-GUT CONNECTION

Mariyam Siddique

Introduction

Our mental health and the trillions of bacteria that live in our gut are connected by a new thread that is being woven by the developing field of psychobiotics in the complex tapestry of human health. The probiotics known as "psychobiotics," which may have advantages for mental health, have gained attention at the nexus of microbiology and psychology. This article will delve into the interesting world of psychobiotics, examining their methods of action, prospective applications in mental health, and the fascinating breakthroughs in research that have sparked hope for new treatments.

Mind-Body Connection

The gut microbiome, a huge and varied population of microorganisms found in the human gut, is referred to as such. These tiny occupants are crucial for the regulation of the immune system, metabolism, and digestion. Recent studies have, however, shown an even more intriguing function for the gut microbiome: its impact on the brain.

A bidirectional communication pathway between the gut and the brain is known as the gut-brain axis. Numerous routes, including neurological, hormonal, and immunological signals, are used by this connection to function. New research reveals that the composition and activity of the gut microbiome have a significant impact on how the brain, emotions, and behavior. This discovery opened the door for the investigation of psychobiotics as a viable strategy for improving mental health.

Unveiling of Psychobiotics

Probiotics, which are live bacteria with demonstrated health benefits when ingested in sufficient doses, are a subset of psychobiotics. The ability of psychobiotics to influence mental health through altering the gut-brain axis sets them apart. Numerous kinds of bacteria, especially those from the genera Lactobacillus and Bifidobacterium, are among these helpful microbes.

How Psychobiotics Function

Psychobiotics affect mental health in a variety of ways that are not fully understood. But numerous crucial routes have surfaced:

The production of neurotransmitters in the gut, including serotonin and gamma-aminobutyric acid (GABA), has been observed with some psychobiotics. Mood and anxiety levels may be impacted by these neurotransmitters.

1. **Immune System Modulation:** Psychobiotics can control how the immune system reacts, which lowers inflammation, which has been connected to mood disorders including depression
2. **Gut Barrier Function:** Psychobiotics assist in maintaining the integrity of the gut barrier, which prevents the leaking of hazardous substances into the bloodstream, which can have an impact on brain health.
3. **Brain Communication:** Psychobiotics can communicate with the brain by acting on the gut-brain axis, which affects mood and behavior.

Mental Health Applications

- There are a variety of conditions for which psychobiotics may be used, and these uses are diverse: A few psychobiotics may help with the symptoms of depression and anxiety, according to preliminary investigations. These bacteria may serve as supplementary therapies or preventative measures by affecting the immune system and neurotransmitter synthesis.
- Management of Stress: Psychobiotics may improve people's ability to handle stress. They may lessen the likelihood of stress-related mental health issues by modifying the body's stress response.
- Current studies are looking into how the gut microbiota may play a role in neurodevelopmental disorders like autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD). The use of psychobiotics may open up fresh possibilities for treating symptoms and enhancing the quality of life in people with ASD or ADHD.
- Cognitive Function: As the aging population raises concerns about cognitive decline, psychobiotics may be able to maintain and improve cognitive

function while also perhaps lowering the risk of neurodegenerative illnesses.

Various Obstacles and Future Directions

Although the potential of psychobiotics in mental health is promising, several issues need to be resolved:

- The effects of psychobiotics may vary depending on the strain, therefore not all probiotics will have the same positive effects on mental health. Finding the strains that work best for various circumstances is a difficult undertaking.
- Dosage and Length of Treatment: Research is still being done to determine the ideal dosage and length of psychobiotic therapy.
- Regulatory authorization: Regulatory authorization for the use of psychobiotics in the treatment of mental illness is pending additional studies and clinical trials because they are not yet universally acknowledged as therapeutic medicines.
- Due to the very idiosyncratic nature of the gut microbiome, different persons may respond differently to the same psychobiotic. Individualized methods of psychobiotic therapies

Conclusion

The new discipline of psychobiotics is evidence of how our awareness of the complex relationship between our gut and mental health is constantly expanding. As scientists work to understand the intricate relationships between the gut and the brain, psychobiotics hold promise as a cutting-edge strategy for improving mental health. While there are still obstacles to overcome, the possibility of using these advantageous microbes to treat depression, anxiety, and other mental health issues provides a ray of hope for a time when the mind-gut connection will be used to improve human mental health. The potential for psychobiotics in mental health is limitless as we set out on this path of discovery; they present fresh vistas for investigation and the hope of better times to come.

PLANT-BASED BIOPLASTIC – AN EMERGING FUTURE

Shazel Ilyas

0602-BH-MB-20

Plastic has become a part of our daily lives. This modern and ever-revolutionizing world cannot sustain itself without using plastic in construction, packaging, transportation, electrical, and electronic appliances, and for nearly every aspect of our life. It is evident from the fact that worldwide production of plastic was 359 million tonnes in 2018 and it produced 29 million tonnes per annum of waste.

The need for the synthesis of bioplastics came when humans began to suffer from the disastrous effects of conventional plastic i.e., greenhouse gas emissions, water pollution, land pollution, danger to aquatic life, and contamination of our food. As bioplastic is made from natural and renewable resources, it is not toxic and provides almost similar applications. PHA, PHB, and PLA are commonly used bioplastics. It is not widely available for commercial use because of its high cost. A lot of work is still needed to overcome the low biomass and cultivation difficulties.

There is an increasing shift in the use of single-use plastic products which means that such plastic products are disposed of after one use. Plastic is made from essential polymers later mixed with additives called plasticizers. These additives are poorly bonded to the chemical chain of polymer and it is released under suitable conditions. It later becomes part of our environment and enters through skin, food, or water into the body.

Di-2-ethylhexyl phthalate (DEHP) is frequently used as a plasticizer. It bounds by non-covalent interactions with the plastic and leaches out after repeated use, cooking, or heating. This toxic substance is produced by around 2 million annually. It is more commonly known as an endocrine disruptor (ED). It brings hormonal changes to the body which also poses serious complications to the progeny of the organism. It is also related to the cause of testicular and ovarian toxicity, endometriosis, renal toxicity, neurotoxicity, and hepatotoxicity. It is equally harmful to humans and animals.

Keeping in view these harmful side effects, biologists came forward to produce safer, biodegradable, and eco-friendly bioplastic. It is claimed that it is non-toxic and better than conventional plastic. Currently, bioplastic is synthesized by either using microorganisms, plants, or algal sources.

Production of bio-plastic

The production of bioplastic from plants is a relatively cheaper idea but it should not affect food security. That's why work is in progress to genetically produce such plants which not only provide food but also a precursor for bio-plastic. There are two methods used to produce plastic from plants i.e., fermentation or turning plants into plastic factories.

Researchers have produced a genetically engineered plant, *Arabidopsis thaliana.* It contains certain enzymes that are used by the bacteria to produce plastic. These plants are harvested and later plastic is extracted by using a solvent. But this process is not very energy efficient, which also results in the emission of greenhouse gases.

Types of Plant-based Bioplastic

Currently, there are different types of bioplastics synthesized from plant sources. Let's enhance our understanding by looking at each of them

PLA (Polylactic acid)

This is a low-molecular-weight biodegradable polyester. It is usually prepared by using starch-rich plant sources which are later polymerized. It has benefits over conventional plastic due to its mechanical strength, thermal stability, and good barrier properties.

It has vast medical applications in tissue engineering, wound treatment, drug delivery systems, and orthopedic devices.

PHA (Polyhydroxyalkanoates)

Polyhydroxyalkanoates are biopolymers that are synthesized from living sources such as bacteria or genetically engineered plants. They are stored as water-insoluble inclusions in the cytoplasm of their cells. PHAs are also known as ‘’green plastic’’ as they are safe for the environment too. It is used for animal nutrients, biofuels, industrial fermentation, and various purposes of bioplastic.

Cellulose-based Bioplastic

Cellulose is a biopolymer that is naturally found in plants. It is an excellent alternative to petrochemical-based plastic as it also has good mechanical strength and is environmentally friendly. Waste paper from any paper source can be converted into bioplastic.

Advantages

As these plastics are biodegradable, they are completely degraded by the action of microorganisms and become a part of the soil. For example, when cornstarch-based bioplastic is decomposed, these cells absorb water and swell up. Now this can be easily degraded by bacteria. During the production of PLA, about two-thirds less energy is used than conventional plastic and it accounts for 25% less greenhouse gas emissions.

Disadvantages

One of the most significant risks of using plant-based bioplastic is that it competes with our food supply and is a threat to food security. Corn is an excellent source for producing biofuels and bioplastic but if we continue this practice, we will not have enough corn to eat. Similarly, most of the agricultural land will be wasted in growing transgenic plants instead of food crops. There is not sufficient biomass produced from plants and it takes a long duration for production.

Bioplastic is always commercialized as safe and sustainable plastic. However, several researches have revealed that it is also toxic and contains harmful chemicals. It causes more ozone depletion than regular plastic.

Future Prospects

The future of bioplastic-based products is very promising. Due to its sustainability and biodegradability, its demand is increasing. The price of fermentative PHA production per unit polymer is estimated to be $2/kg prices which is twice the price of polyethylene. Even though bioplastics are expensive they are still considered as a viable option to improve environmental sustainability. Ongoing research and technological advances aim to improve its

various qualities to make it useful in other applications. Apart from this, conventional plastic should also be changed into bioplastic and become a part of the circular economy.

ROLE OF MICROBES IN GLOBAL WARMING

Sana Muqadus
1292-BS-MB-22

GLOBAL WARMING:

An unusual rapid increase in Earth's surface temperature over the past century primarily due to Greenhouse gases released by anthropogenic activities, is global warming.

Damages of Global warming have direct and adverse effects on both Flora and Fauna.

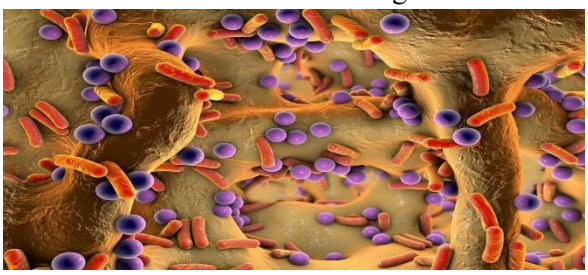
- As Global warming is increasing day by day, wildlife is in danger because its increase causes climatic change which it difficult for animals to survive in such kind of environment. There are severe threats for humans also.
- Many scientists believe that greenhouse gases, pollution, Deforestation, and per capita carbon emissions including Volcanoes are some major causes of Global warming.
- Volcanos are affected in the sense that they spew too much Carbon Dioxide in the air that remains stuck in the atmosphere and increases the temperature of Earth resulting in global warming. It's dangerous because it disturbs the overall ecology of the planet.

Facts and figures:

Here is some data to understand the reality of Global warming:

- Today the average temperature of the world as compared to the start of the Industrial Revolution is 1.5 °C higher. But now there is a gradual increase in this number and if affecting the planet's health.
- 6 billion Tons of Carbon Dioxide was emitted in 1950 which had quadruped in volume till 1990. But after 40 years, it reached 22 billion Tons. Remaining unchecked, today Carbon dioxide emissions have reached a whopping 35 billion Tons.

- The Global Annual temperature increased at an average rate of 0.8°C



per decade since 1880 and over twice that of 0.18°C since 1981.

Note:

According to research, the last 2 years 2021 and 2022 are not ranking among the five warmest years on record.

Causes:

- Carbon Dioxide is the major greenhouse gas that is contributing to the increase of Global warming.
- Nitrogen Oxide is a critical greenhouse gas. It is a major cause of ozone depletion. Car exhausts are a major cause of its production. It is also a major pollutant for death worldwide.
- Somehow, Plastic is also responsible for almost 4 % of the world's total greenhouse gas emissions. Some companies like Coca-Cola, PepsiCo, Nestle, and Unilever are contributing to Global warming by Plastics.

Problems:

- ✓ Sea-Level rise
- ✓ Erosion
- ✓ Flooding
- ✓ Risks to Infrastructure
- ✓ Increase in Ocean Acidity
- ✓ Increase in Wild-fire
- ✓ Heat Waves
- ✓ Insect Outbreaks
- ✓ Tree Diseases

Microbial Ecology:

The relationship of microbes with each other and their environment is known as microbial ecology.

Microbes are involved in many environmental processes. They play a great role in environmental changes. This may include nitrogen fixation and the carbon cycle. They play an efficient role in the consumption and production of powerful greenhouse gases such as Carbon dioxide and Methane.

Role of microbes in global warming:

As it is the modern era of advancements, scientists and researchers are trying their best to use microorganisms to reduce global warming. Some uses of microbes in this effect are as follows:

- ✓ **E-coli:**

  Some efficient systems are developed to use a modified form of E. coli to consume Carbon dioxide and either store it or produce biofuels and foodstuffs from it. However, work on increasing the bacterial efficiency keeps going to

consume more atmospheric carbon dioxide.

- ✓ **Methanotrophs:**
  Methanotrophs are bacteria that use methane for their food due to the presence of the enzyme Methane monooxygenases. It is used as an energy source they possess high effects and are efficient in consuming mechanism 40 to 60% of the methane produced is consumed by methanotroph S in wetland environments. Now they are used as biocatalysts in agricultural soils and landfills ultimately leading reduction in atmospheric methane levels.
- ✓ **Rhizobia and azotobacter:**
  These bacteria can convert atmospheric nitrogen into a form that plants can use this process is called nitrogen fixation and it is critical for plants' growth and the ecosystem's health.

Conclusion:

No doubt greenhouse gases are increasing Earth's temperature day by day but this increase is gradually disturbing Earth's ecosystem health. So, to keep a balance, some microbes interact with the environment with their activities involved in the reduction of these gases to keep Earth healthier. They are contributing to maintaining ecosystem balance. With their small effort, they are trying to keep safe this large planet.

INVITRO MEAT PRODUCTION

Laraib Sohail

Introduction

Animal tissue culture meat is quite eminent in the field of research and developmental projects yet still not the participant of commercial race. Advanced research-based steps are being taken to get high-quality yields. This step has been taken regarding overcoming the meat supply shortage and environmental protection. The idea for cultured meat production was reported by British statesman Frederick Edwin in **1930.** He exclaimed, **"It will no longer be necessary to go to the extravagant length of rearing a bullock to get its steak. From one 'parent steak' of choice tenderness, it will be possible to grow as large as desired".**

Intricate cells and tissues growth *invitro*

The structural complexity of meat comprising various tissue types and intricate cellular patterns render the process of getting *in vitro* meat access difficult. Meat from different sources endure varied muscular and fiber patterns and thus the task varies accordingly. Complete understanding of replicating different types of lab-grown meat products and for better formulation and identification of adipocyte and skeletal cells or fat tissues. At present, "stem cells" have made it possible to grow meat in a lab, owing to their unique attributes.

“Cultured meat production from stem cell technology”

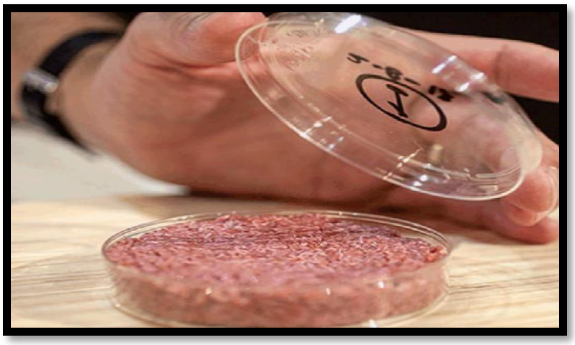
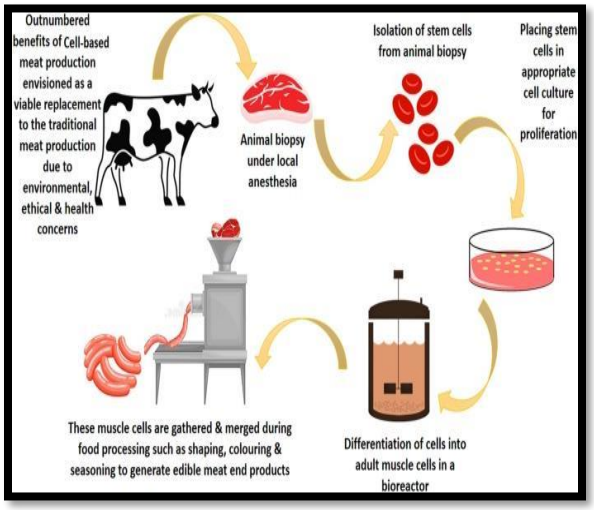


Fig Lab-grown food burger created at Maastricht University

Stem cells are grouped under unspecialized cells in the body possessing their ability to self-generation. The two main stem cells are grouped as **“embryonic cells and stem cells”.** ESCs are obtained during the early developmental stage (blastocyst), can be cultured in the laboratory, and get differentiated into any cell type in the body (pluripotent).On the other hand, adult stem cells(ASC), observed in adult tissues, are far rarer and have limited ability to differentiate into many specialized tissues (unipotent or multipotent). Owing to their potential to differentiate into various types precisely adipocyte tissues and skeletal muscle, stem cells from different development stages have been suggested as viable cells for meat culturing. ASCs as **satellite cells** are potentially linked with skeletal muscles, which get to differentiate into myofibrils and myotubes and tend to specialize as skeletal muscle fibers this suit best for skeletal muscle engineering. Another type, induced pluripotent stem cells(iPSCs), is derived from reprogramming cells being separated from somatic tissue to a pluripotent state. Quite recently in **2018,** the stable culture of bovine ESCs was potentially reported for differentiating into skeletal muscle development necessary cell types.

Fig Stem cells isolation from animal source



and *invitro* meat cultivation

Multipotent adult stem cells, **Mesenchymal cells (MSC),** tend to present in many tissues, playing a key role in muscle development, and serving as good starter cells. Post selection process, stem cells are either taken from muscle tissues or directly from embryos, differentiating into muscle cells, and transferred to a **scaffold,** where they grow into larger tissues. During this process, the cells are provided with an ideal growth environment as well culture medium, and its selection is quite critical.

Concerned technological challenges

The cultured meat production process is branched into three parts: cell collection, cell culture, and cultured meat production; where every step presents its methodical challenge. Cell collection refers to obtaining living cells, cell culture refers to maintaining mass-producing culture media and the processing method refers to meat culturing. Many non-profit meat culturing organizations report challenges in mass-producing culture mediums. Heading towards the cell cultivation efforts by meat cultivating industries, numerous hurdles are being faced including the development of cell lines that could be maintained for indefinite propagation, making culture media cheaper, enduring cell lines with palatable features, and many more. Maintenance of scalable bioprocesses along with reduction in the cost of biomanufacturing on a large scale is also causing hindrances in the way forward.

When talking about the issue of culturing challenges are even bigger. The complexity of recreating tissue structure with bioprinters and interlinked cost of tissue structuring and requirement for cultivation equipment. Tissues endure complex patterns in the body on nanoscales making the bioprinting systems face replicating difficulties. Additionally, a delivery system for nutrients and oxygen transport to cells is inevitable as passive diffusion tends to be ineffective in tissue depth of about **100 micrometers,** or an alternate perf-usable system is needed to perfuse through cultured tissue configure.

Nutritive value

From a nutritive point of view, cultured meat comprises natural polymers to organize in the cell environment, and aim to sustain cell-induced contractions and tissue alignments. The fat content in meat is markedly influenced by livestock species or breed type and they co-cultured adipocytes derived from stem cells to synthesize saturated and unsaturated fatty acids. Cultured meat is a rich source of dietary minerals such as selenium, zinc, and iron and also ensures a good source of **bioactive compounds such** as **taurine** (free amino acid) for critical metabolic activities. Its nutritive value is adding to its worldwide acceptance.

GUT MICROBIOTA AND HUMAN HEALTH

Shazel Ilyas

0602-BH-MB-20

You must have come across the word ‘’Microbiome’’ very often. With advancements in research on the interaction of microorganisms and humans, this concept is the talk of the town. Let’s dive deep into understanding the fascinating microbial world and its impact on our lives:

Microbiome refers to the populations of different microorganisms living in and on different parts of the human body including bacteria, fungi, viruses, etc. The number and diversity of these microbes vary according to their location site. Most commonly several genera of bacteria are present on the skin, ear, upper respiratory tract, urinogenital tract, and gastrointestinal tract

Out of all these sites, the major colonization of bacteria in the human body is the gastrointestinal tract. The stomach has a highly acidic environment, which is why less than 10 viable bacteria are present per milliliter of the gastric fluid. Only the acidophilic bacteria can survive here.

The large intestine specifically the colon hosts the largest bacterial community in the body. More than 1,000 bacterial species have been identified in human feces. About 10^{12} organisms are present per gram of human feces including bacteria, fungi, viruses, and protozoans. The predominant bacterial groups present here are gram-negative cocci, *Lactobacilli, Firmicutes, Bacteroidetes,* and *Enterobacteriaceae.*

These gut bacteria are present as commensals or opportunistic microorganisms. These microorganisms play an important role in several metabolic processes, digestion of food, immunity, maintaining overall health, and producing several metabolic byproducts. For example, *Escherichia coli* produces vitamin K and B-complex in the large intestine. This type of vitamin K produced by bacteria is called menaquinone. Essential amino acids and short-chain fatty acid (SCFA) byproducts i.e., butyrate, propionate, and acetate are also produced by this gut microbiota.

Role of Gut Microbiota in Disease Development

An astonishing relationship has been found between the gut microbiota and the development of several metabolic diseases. The changes in the composition of these microorganisms have assisted in the onset of obesity, type 2 diabetes, inflammatory bowel diseases (IBD), several types of autoimmune diseases and dermatitis, metabolic heart diseases, and non-alcoholic liver disorders.

For instance, the patients having inflammatory bowel disease have a smaller number of *Bacteroidetes, Firmicutes*, and other bacterial diversity. Eventually, they produce less amount of short-chain fatty acids including butyrate. These short-chain fatty acids (SCFAs)are regarded as anti-inflammatory, anti-cancer, anti-diabetes, anti-obesity, and regulate immune and cardiovascular activities. These SCFAs are also responsible for strengthening the intestinal cells, which makes the gut barrier and makes it impermeable.

Bacteria	Basic features	Associated physiologic changes	Associated disease states
***Lactobacillus* spp.**	Gram-positive facultative anaerobe rod-shaped	SCFA production; anti-inflammatory and anti-cancer activities	Attenuate IBD
***Bacteroides* spp.**	Gram-negative obligate anaerobe rod-shaped; variable motility	Activate CD4 + T cells	Increased abundance in IBD
***Clostridium* spp.**	Gram-positive obligate anaerobe rod-shaped; spore-forming	Promote the generation of T_H17 cells	Several spp. are pathogenic causing tetanus, botulism, gas gangrene, or pseudomembranous colitis
Escherichia coli	Gram-negative facultative anaerobe rod-shaped	TLR-activation	Increased abundance in IBD gastroenteritis, UTI, and meningitis

Table 1: An overview of different bacterial genera that are a part of gut microbiota and their role in physiological changes and diseases.

Importance of Gut Microbiome

These bacteria live in a symbiotic relationship with host cells. They acquire nutrients from the human body and in return provide essential metabolic byproducts. They play a vital role in maintaining human health at several levels. Some of their advantageous roles are discussed as:

Nutrient Metabolism

The gut microorganisms i.e., *Bacteroides, Roseburia, Bifidobacterium, Fecalibacterium*, and *Enterobacteria* use carbohydrates present in our diet as their energy source. These carbohydrates are fermented to produce other metabolites. It also includes the production of short-chain fatty acids

Some species of *Bacteroides* help in carbohydrate metabolism. *Oxalobacter formigenes, Lactobacillus species*, and *Bifidobacterium species* degrade the oxalate produced in the intestine, which reduces the risk of kidney stone formation.

The proteinases and peptidases produced by bacteria help metabolize the protein present in our diet. Vitamin K and B-complex are also synthesized by them. These bacteria produce a diverse range of organic acids which are helpful in high energy-yielding metabolic processes.

Xenobiotics and Drug Metabolism

The gut microbiome plays an essential role in the activation, inactivation, toxicity, acceptability, and response to a specific drug/medication. Xenobiotics are substances that are foreign to the human body. They can be endogenous i.e., diet, drugs, environmental pollutants, antibiotics, and exogenous i.e., the substances which are produced within the body after metabolism. These xenobiotics need to be removed from the body otherwise they can be toxic and carcinogenic. Human gut microbes and the liver produce enzymes that degrade and reduce the effect of these xenobiotics.

Immunity

These bacteria are helpful in the maturation of our immune system. Exposure to these microorganisms helps our immune system to distinguish between harmful and harmless species. The gut microbiota assists T cells and B cells in balancing the immune response. An exaggerated immune response results in inflammation and auto-immune disorders. These bacteria provide de intestinal barrier which prevents the entry of pathogenic microorganisms and their toxins into the bloodstream.

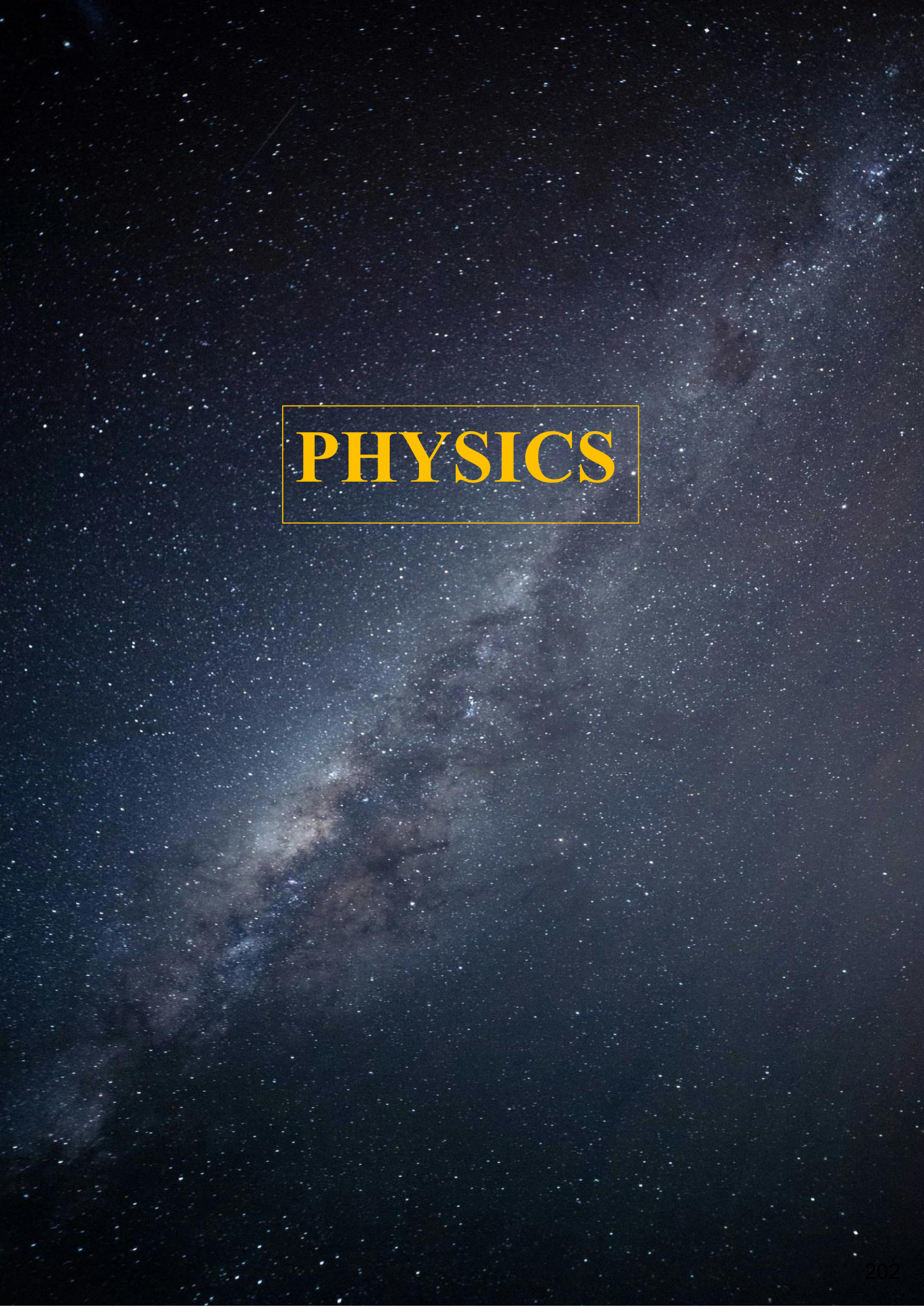
Mental Health

It is proven with extensive research that our brain and gut are related to each other. The gut is also called the ‘’second brain’’ because it plays a major role in our mood and irritability. The changes in our feelings and moods are largely related to the microbiota present in our gut. They are also responsible for managing our mood, pain, depression, and anxiety. Owning a poor diet and sedentary lifestyle, our gut microbiota is not healthy. It results in inflammation which affects our mental well-being.

Conclusion

The fetus is sterile in the mother’s womb. Our microbiota establishes right after birth either through the mother’s vagina or immediate handlers. As we age, this microbiota is

strengthened by our gender, diet, lifestyle, environmental factors, stress, and antibiotic treatment. The most important and regulatory microbiota in this regard is the gut microbiota. Trillions of bacteria present here are responsible for controlling almost all of our functions. Metagenomic studies are carried out for a deep understanding of this gut microbiome. Our healthy growth and survival are largely dependent on the composition and diversity of our gut microbiota.


PHYSICS

PHYSICS TIMELINE 2023

September 1, 2022

- James Webb Space Telescope released its first full-color images of the universe.
- A team of physicists at the University of Chicago developed a new type of quantum computer that is significantly faster than previous models.
- Researchers at the University of California, Berkeley, published a study in the journal Nature that showed that it may be possible to use quantum entanglement to teleport information.

October 2, 2022

- The Nobel Prize in Physics was awarded to Alain Aspect, John Clauser, and Anton Zeilinger for their groundbreaking work on quantum entanglement.
- A team of physicists at the European Organization for Nuclear Research (CERN) announced that they had discovered a new subatomic particle, which they named the pentaquark.
- Researchers at the Massachusetts Institute of Technology (MIT) published a study in the journal Science that showed that it may be possible to use light to control the behavior of electrons in materials.

November 3, 2022

- Physicists at the Large Hadron Collider (LHC) announced that they had observed a new type of particle decay that could help to shed light on the nature of dark matter.
- A team of researchers at the University of Maryland developed a new type of material that could be used to create more efficient solar cells.
- Physicists at the University of California, Santa Barbara published a study in the journal Nature that showed that it may be possible to use light to create artificial intelligence systems that are more efficient and powerful than current models.

December 4, 2022

- A team of physicists at the University of Oxford developed a new type of quantum sensor that is significantly more sensitive than previous models. The new sensor is based on a phenomenon called "quantum entanglement," which occurs when two quantum particles are linked together in such a way that they share the same fate, even if they are separated by a large distance.
- The researchers used quantum entanglement to create a new type of sensor that can detect even the smallest changes in magnetic and electric fields. This new sensor could be used in a wide range of applications, including medical imaging, navigation, and environmental monitoring.

January 5, 2023

- A team of physicists at the Massachusetts Institute of Technology (MIT) announced that they had developed a new type of material that could be used to create batteries that are much more energy-dense than current models.

- Researchers at the University of Cambridge published a study in the journal Nature that showed that it may be possible to use quantum mechanics to develop new types of drugs that are more effective and less harmful than current treatments.

February 6, 2023

- A team of physicists at the European Organization for Nuclear Research (CERN) announced that they had discovered a new type of Higgs boson, which could help to shed light on the nature of dark matter.
- Researchers at the University of Stanford published a study in the journal Science that showed that it may be possible to use light to create a new type of computer chip that is much faster and more energy-efficient than current models.

March 7, 2023

- A team of physicists at the University of California, Los Angeles (UCLA) announced that they had developed a new type of solar cell that is significantly more efficient than current models.
- Researchers at the University of Chicago published a study in the journal Nature that showed that it may be possible to use quantum mechanics to create new types of materials that are stronger and more durable than current materials.

April 8, 2023

- A team of physicists at the University of Oxford announced that they had developed a new type of quantum computer that is significantly more powerful than previous models.
- Researchers at the Massachusetts Institute of Technology (MIT) published a study in the journal Science that showed that it may be possible to use light to create a new type of microscope that can resolve images at the atomic level.

May 9, 2023

- A team of physicists at the European Organization for Nuclear Research (CERN) announced that they had discovered a new type of particle that could be the first evidence of dark matter.
- Researchers at the University of California, Berkeley, published a study in the journal Nature that showed that it may be possible to use quantum mechanics to create new types of sensors that are much more sensitive than current sensors.

June 10, 2023

- A team of physicists at the University of Maryland announced that they had developed a new type of battery that is significantly more energy-dense and longer-lasting than current batteries.
- Researchers at the University of Cambridge published a study in the journal Science that showed that it may be possible to use light to create a new type of quantum

July 11, 2023

- A team of physicists at the University of Chicago discovered a new way to manipulate quantum particles that could lead to the development of more powerful and efficient quantum computers. The new technique is based on a phenomenon called "dynamic sympathetic resonance," which occurs when two quantum systems are coupled together and begin to oscillate in sync.
- The researchers used dynamic sympathetic resonance to create a new type of quantum gate, which is a basic building block of quantum computers. This new gate is much faster and more efficient than traditional quantum gates, and it could be used to build quantum computers that are capable of solving problems that are currently intractable for classical computers.
- The discovery of dynamic sympathetic resonance is a significant breakthrough in the field of quantum computing. It has the potential to revolutionize the way we solve complex problems, and it could lead to the development of new technologies that have a profound impact on society.

August 12, 2023

- New type of solar cell developed: A team of researchers at the University of California, Berkeley, developed a new type of solar cell that is significantly more efficient than current models. This new solar cell could help to reduce our reliance on fossil fuels and accelerate the transition to clean energy
- Researchers at the University of California, Berkeley, published a study in the journal Science that showed that it may be possible to use light to create a new type of transistor that is much faster and more energy-efficient than current models.

FROM STRINGS TO DIMENSIONS: A MULTIVERSE MANIFESTO

Laiba Muskan (0539-BH(E)-PHY-19)

Abdul Rehman (0535-BH(E)-PHY-19)

The concept of the multiverse has evolved as one of the most mind-boggling and awe-inspiring ideas in the field of contemporary physics, where mysteries abound and the frontiers of human comprehension are continuously stretched. It calls into question our fundamental beliefs about the world, asking us to consider a universe considerably more complicated and interwoven than we could have imagined. To begin this cosmic voyage, we must first explore the universe of string theory and the dimensions it reveals, as these are the foundations of the multiverse manifesto.

String Theory: The Weaving of Reality

String theory dubbed the "Theory of Everything," proposes that the fundamental building elements of the world are microscopic vibrating strings rather than particles. When these strings are joined in various ways, they produce the particles and forces that control the universe. String theory proposes the presence of extra spatial dimensions hidden from our everyday awareness, in addition to the known three dimensions of space and one dimension of time.

The Extra Dimensions: Hidden Worlds

String theory proposes the possibility of additional dimensions—six or more—along with the traditional three dimensions of space. These additional dimensions are compressed or twisted up to a microscopic scale, rendering them invisible at our macroscopic level. Consider them to be delicately folded dimensions concealed inside the fabric of our world.

The Multiverse Emerges

This is when the multiverse enters the picture. The many ways in which these additional dimensions may be compacted result in a large panorama of possibilities, each corresponding to a separate world with its own physical rules. The multiverse is created by the different ways we may "fold" the additional dimensions in string theory, resulting in a plethora of worlds, each with its own set of physical constants and attributes.

Many Worlds, Many Possibilities

Each world in the multiverse may have its own set of physical laws and constants, as well as diverse types of matter and energy. Because of the amazing diversity of universes, somewhere out there, in one of these parallel realms, the conditions may be just ideal to support life as we know it, while in others, the rules of physics may be completely foreign. This notion has far-reaching ramifications for our view of reality.

The Anthropic Principle: Our Cosmic Address

When we ponder why we find ourselves in a world capable of supporting life, the anthropic principle comes into play. It implies that our existence as observers is inextricably linked to the conditions of the cosmos, we live in. In other words, we are here because the characteristics of the cosmos allow for our existence. The multiverse provides a framework within which the anthropic principle makes sense, by explaining why our world appears to be fine-tuned for life.

Challenges and Possibilities

While the notion of the multiverse is intriguing, it is still a theoretical framework with its own set of problems. It is currently beyond our technical capabilities to test and prove the presence of other worlds in the multiverse. Critics claim that the multiverse concept lacks empirical proof and may be more philosophical than scientific.

Nonetheless, the multiverse manifesto reminds us of the extraordinary power of human imagination and our never-ending drive to unravel the secrets of the universe. It pushes us to think beyond our observable universe's borders, testing the limits of what we can grasp.

Finally, the multiverse manifesto challenges us to consider the richness and variety of the cosmos, from the complex realm of string theory to the hidden dimensions that weave the fabric of our reality. It piques our interest in the existence of parallel universes, each with its own set of physical rules and possibilities. While the multiverse is still a theoretical idea, it adds to our knowledge of the universe we live in and reminds us that reality is considerably more complex and interwoven than we can ever comprehend. We go from threads to dimensions in our quest to fathom the mysteries of the universe, discovering the infinite fabric of existence itself.

QUANTUM TELEPORTATION: BEAMING INFORMATION ACROSS THE UNIVERSE

Laiba Muskan (0539-BH(E)-PHY-19)

Abdul Rehman (0535-BH(E)-PHY-19)

Teleportation has always been a fascinating topic in science fiction. For decades, authors, filmmakers, and dreamers have been captivated by the concept of traveling from one area to another without crossing the gap in between. While the teleportation of people or objects remains a fantasy, there is a real and remarkable phenomenon known as quantum teleportation that allows the instantaneous transmission of quantum information across vast distances, all thanks to the fascinating principles of quantum mechanics.

The Enigma of Quantum Entanglement

Quantum teleportation is inextricably linked to quantum entanglement. The unique behavior of quantum particles such as electrons or photons is at the heart of entanglement. When two particles get entangled, their characteristics become

coupled in ways that are difficult to explain using traditional physics.

Consider two entangled particles, **A** and **B**, which are separated by a large distance. When particle **A** is measured, its quantum state becomes directly reliant on the measurement result, and this change is mirrored in particle **B**, regardless of their distance. This immediate link, which Albert Einstein famously referred to as "spooky action at a distance," is the cornerstone of quantum teleportation.

The Quantum Bit (Qubit) and Information Transfer

To comprehend quantum teleportation, one must first understand the idea of quantum bits, or qubits. Information in traditional computing is stored in bits, which can have values of 0 or 1. Qubits, on the other hand, may exist in a superposition of states, which means they can represent both 0 and 1 at the same time. Because of this feature, qubits are perfect for encoding and conveying quantum information.

The transmitter, receiver, and an entangled pair of particles are the three key components of quantum teleportation. Let's go over the steps:

Step 1: Entanglement Creation The transmitter (Alice) and receiver (Bob) each have one particle of an entangled pair in the first stage. Because of entanglement, these particles have associated characteristics. Alice also possesses the quantum information she wishes to transport, which she wishes to be received by Bob.

Step 2: Measurement and Entanglement Alice measures both her particle and the quantum information she wishes to transport. This measurement compresses her particle's state, which is immediately mirrored in Bob's entangled particle, regardless of their physical separation.

Step 3: Transmission of Classical Information Alice uses traditional communication means to inform Bob of the results of her measurement. Because it utilizes classical information transfer, which cannot surpass the speed of light, this transmission does not contradict the rules of relativity.

Step 4: Bob's State Reconstruction Bob executes various quantum actions on his entangled particle depending on the communicated information after receiving Alice's classical information. These processes essentially change his particle into a perfect clone of Alice's quantum information.

There you have it: quantum teleportation in action. Alice's quantum information has been transported to Bob's particle without any physical particles flowing between them. It's a mind-boggling phenomenon that demonstrates quantum physics' weird but powerful nature.

Applications and Challenges

While quantum teleportation is an intriguing notion with far-reaching ramifications, it is critical to understand its limits and practical applications.

The demand for carefully regulated settings to preserve the delicate state of entanglement is a considerable problem. Minor interactions with the surrounding environment might cause the entangled particles to become disrupted, rendering quantum teleportation unfeasible.

Quantum teleportation, on the other hand, has interesting applications in quantum computing, where it may be used to transport quantum states across various components of a quantum computer. This is critical for the development of increasingly complicated and powerful quantum circuits. Furthermore, quantum teleportation is important in the growing subject of quantum cryptography, providing the possibility for secure communication systems that are potentially unbreakable due to quantum entanglement's unique features.

The Ongoing Quest

Quantum teleportation is not a commonplace technique. It is still the subject of considerable study and testing as scientists try to overcome technological hurdles and realize its full potential. The concept of constructing a quantum internet, in which quantum information may be safely transferred between distant places, remains a pipe dream.

To summarize, quantum teleportation is an enthralling and mind-expanding notion that exhibits quantum physics' remarkable powers. While we may not yet be teleporting objects or people across the universe as in science fiction, real-world applications of quantum teleportation are emerging and hint at a future in which quantum information can be beamed across the universe, revolutionizing computing and secure communication as we know it. Who knows what other amazing discoveries and technological improvements await us in the domain of quantum teleportation as we continue to probe the depths of quantum physics?

EXPLORING THE MULTIVERSE: UNLOCKING THE MYSTERIES OF PARALLEL UNIVERSES

Muddasira Sarwar

0403-MPHIL-PHY-21

Introduction:

The concept of a multiverse has captivated the imagination of physicists and cosmologists for decades. It proposes the existence of a vast ensemble of parallel universes, each with its own set of physical laws and conditions. The multiverse theory arises from deep inquiries into quantum physics and cosmology and holds the potential to revolutionize our understanding of the cosmos. In this article, we delve into the fascinating world of the multiverse, exploring its origins, theoretical foundations, and implications for our understanding of the universe.

Origins of the Multiverse Theory:

The idea of a multiverse finds its roots in the fundamental principles of quantum mechanics. According to the famous Schrödinger's equation, particles can exist in a superposition of states until measured, implying the existence of multiple possibilities. This concept was further developed by the physicist Hugh Everett in the 1950s, who proposed the many-worlds interpretation of quantum mechanics. Everett suggested that every quantum event spawns multiple universes, with each outcome occurring in a separate universe.

Types of Multiverses:

There are several proposed mechanisms that could give rise to a multiverse. One prominent idea is the inflationary multiverse, which stems from the theory of cosmic inflation. Inflation suggests that the universe underwent a rapid expansion in its early stages, leading to the formation of "bubbles" within which different universes can exist. Another concept is the string theory landscape, which posits that the fabric of reality encompasses a vast number of possible configurations, each representing a different universe.

Implications for Cosmology:

The multiverse theory has profound implications for our understanding of the cosmos and the fundamental constants of nature. It suggests that the physical laws and constants we observe in our universe may not be unique but rather one among many possible combinations. This raises the question of why our universe possesses the specific values it does. Some physicists argue that the anthropic principle, which states that the properties of the universe must be compatible with the emergence of intelligent life, could provide an explanation for these observed values.

Probing the Multiverse:

While direct observational evidence for the multiverse remains elusive, scientists are exploring various avenues to test and validate the theory. One approach involves studying the cosmic microwave background radiation, the afterglow of the Big Bang. By analyzing the patterns and fluctuations in this radiation, researchers hope to find evidence of the inflationary multiverse. Another avenue is through particle physics experiments, such as the search for exotic particles or the detection of gravitational waves, which may provide indirect clues about the existence of parallel universes.

Philosophical and Ethical Considerations:

The multiverse theory also raises profound philosophical questions about the nature of reality and our place within it. It challenges our traditional notions of uniqueness and raises the possibility of infinite variations of ourselves and our choices. Additionally, the ethical implications of the multiverse theory are thought-provoking. If there are multiple universes, each with its own history and outcomes, how do we define notions of responsibility, free will, and moral accountability?

Future Prospects:

While the multiverse theory is still in the realm of theoretical speculation, it represents a fascinating avenue for scientific exploration. Continued advancements in cosmology, quantum physics, and particle physics may provide the tools necessary to probe and understand the multiverse better. As our technological capabilities improve, we may uncover observational evidence or develop new theoretical frameworks that shed light on the existence and nature of parallel universes.

Conclusion:

The concept of a multiverse stretches the boundaries of our imagination and challenges our perception of the universe. While still a subject of active scientific investigation, the multiverse theory offers a promising framework for understanding the mysteries of quantum mechanics, cosmology, and the fundamental nature of reality.

JAMES WEBB TELESCOPE SHATTERS THE FOUNDATION OF ASTROPHYSICS

Fizza Imran

0744-BH-PHY-20

James Web revolutionizes the Astronomy

James Webb Space Telescope, which is considered to be the successor of the Hubble Telescope, is the most powerful telescope that is ever built to analyze space. It aims to get information about the early universe. Due to its high-resolution infrared cameras, it can see the galaxies made at the beginning of the universe. It uses infrared light. As the light goes farther, it spreads in those portions which the human eye cannot see. This property is called *Red Shift.* When the light strikes and comes back, we get the approximate age of the object with which the light struck. The more redshift means the farther the light has traveled.

JWST can look into 13.5 billion years back. Astronomers agree on the fact that the universe is 13.7 billion years old. This means that JWST cannot see the universe right after the Big Bang but is very close to that. It discovered 500 to 700 million years old galaxies. They are found to be very large, developed, and mature galaxies. Due to such massiveness, they cannot be compared even with the 99.9% model. JWST has detected 6 such galaxies that came into existence half a billion years after the Big Bang and they are 10 times bigger than our Milky Way galaxy. The question that arises here is, *how do these galaxies become so large just after the Big Bang?* Because we know that it's a slow and gradual process that happens over billions of years. Galaxies need time to accumulate matter and grow into the majestic structures we see today. It takes billions of years to create a galaxy like our Milky Way galaxy with 100 billion stars that are billions of years old. However, the shocking discoveries of James Webb have changed our understanding of the universe. "We might have to re-write our

textbooks of astronomy because all we knew till today was a lie", says theoretical physicist Michio Kaku. Researchers are trying to find out its answer but nothing authentic is found yet!

Moreover, JWST has revealed the supermassive black hole at the center of the Nascent Galaxy. It came into existence after 570 million years of the Big Bang and is 10 million times heavier than our Sun which makes it brighter and easier to detect. It is 55 million light years away. Astronomers were expecting comparatively small black holes at the start of the universe but such results have left them surprising. In this regard the Space Telescope Science Institute that manages JWST has given a statement, "*It is still difficult to explain how it formed so soon after the universe began*". They suggest that the universe might be twice as old as we previously believed.

Webb has captured breathtaking images of the iconic "Pillars of Creation". They lie in the heart of what astronomers called *Messier 16* or *Eagle Nebula*. This is known for active star-forming regions. The so-called pillars of creation are 6500 light years away. James Webb's infrared image shows the whole scene in high definition. Glowing, bright, red, wavy lines at the edge of some pillars reveal the area where the stars are ejecting materials as they form. This will surely help researchers to find a better understanding of the formation and evolution of stars by identifying counts of newly formed stars and the quantity of dust and gas in that region.

Another beautiful thing that James Webb has done is capturing the ever-first exoplanet, a rocky world about the size of the Earth. More specifically it completes an orbit in 2 days and it's a 99.9% diameter of the Earth known as *LHS 475b.* It lies 41 light-years away in the constellation of Octans. Webb's data has not yet explained whether this exoplanet exhibits an atmosphere. Webb is bringing us closer and closer to the study of Earth-like exoplanets. JWST has found traces of water vapors in the atmosphere of a huge superhot gas exoplanet that is 400 light years away from the Earth. This gas giant exoplanet named *WASP-18b* is 10 times more massive than the largest planet Jupiter of our galaxy, the Milky Way. This finding suggests the potential for habitable conditions beyond our solar system. It has also uncovered the existence of organic molecules in the atmosphere of distant exoplanets that open up exciting avenues for exploration in search of extraterrestrial life. So cool it is to hear. Astronomers believe that there is more to come about exoplanets so keep in touch with Webb's advancement.

James Webb has the potential to revolutionize our understanding of the universe through its groundbreaking discoveries. It can help answer the biggest questions about the ultimate reality of the universe and our place in the cosmos.

NANOTECHNOLOGY; A PATHWAY TO FUTURE ENERGY SUSTAINABILITY

Mr. Muhammad Kashif Raza

kashifraza3110@gmail.com

For more than 200 years, fossil fuel has been the primary source of energy, enabling the Industrial Revolution and technological advancement of society as a whole. Shortly, fossil fuels, particularly oil, will continue to play a significant role in the global economy.

As consumption reaches its peak and consumer demand rises, the world must either discover new energy supplies or substantially improve existing energy technologies. The world has come to comprehend that using fossil fuels excessively threatens the planet's ecosystems. The advancement of green energy is one of the most pressing global challenges due to the demand for alternative, clean energy sources, and the preservation of the environment. There is no dispute that for the globe's economy and climate to have an environmentally friendly future, renewable energy must account for a sizable share of renewable energy consumption.

Nanomaterials have the potential to completely transform techniques for storing energy, rendering them superior, accessible, and sustainable. Thanks to their special nanoscale features, they can significantly improve many energy storage systems, eventually leading to a more environmentally friendly future.

The natural reconfiguration tendencies of two-dimensional shapes (2D) nanomaterials, which drastically limits the way they can be used, undercuts the rapidly expanding interest in these materials. New porous hetero-structures combining mono-layered mesoporous substrates with two-dimensional nano-sheets can significantly increase the selection of innovative substances in battery-based electrochemical energy technologies.

Many additional two-dimensional materials, including nanosheet-like structures, such as transition metal oxides (TMO), dichalcogenides, and transition metal carbides (TMCs) or transition metal nitrides i.e., MXene have gained more attention as graphene was initially experimentally separated in 2004.

Unlike conventional materials, nanostructures have many more tiny molecules or atoms on their interfaces. This boosts excitability and the easy availability of working spots for energy-related instances, such as the electrochemical processes in batteries and fuel cells.

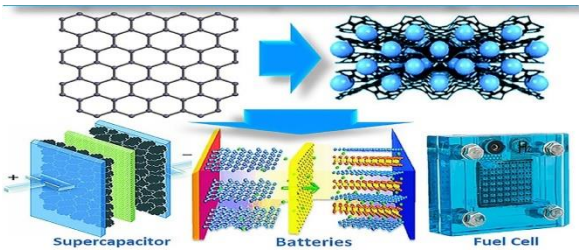


Figure 1: (A hasty approach to the significant applications of 2D nanomaterials in Energy sustainability, storage, and conversion)

Due to the use of lithium-ion batteries in portable and light electric products, backup energy storage components, and hybrid electric automobiles, the demand for these batteries has significantly expanded.

Researchers are striving to enhance the energy density, power density, durability, and reliability of lithium-ion batteries through the integration of nanomaterials into all of these different elements. These properties are essential for their wide adoption in a variety of applications, including portable electronics, electric vehicles, and grid storage of energy.

Despite having a low particular power rating (372 mA h/g) and a poor rate capability due to a low Li+ transfer factor, materials made from carbon are still the preferred anode materials used in commercial lithium-ion battery technology. With a very high hypothetical power rating of 4200 mA per gram (based on Si and related to compound $Li_{22}Si_4$), silicon is thought to be the material with the greatest potential for future anode materials.

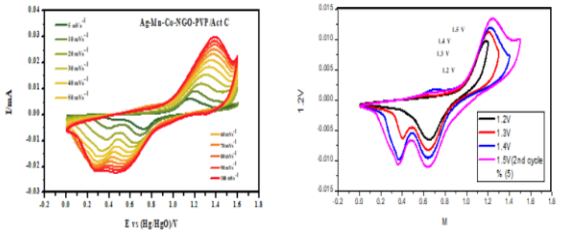


Figure 2: (Sample of a nanomaterial Ag-Mn-Co-NGO-PVP/Act-C, the material's electrochemical properties i.e Cyclic Voltammetry-CV was studied in August 2023 at nanomaterial lab IOP-GCU Lahore)

The given figure shows the electrochemical properties of the proposed sample of material. The CV characterization for this nanomaterial was done for an Asymmetric Hybrid Supercapacitor and other storage devices. These peaks show the sample's behavior for different scan rate that was provided voltage to this process to check the cyclic stability of this device.

Understanding the characteristics, structure, and functioning of nanomaterials at the nanoscale is essential.

- Scanning Electron Microscopy or SEM, creates high-resolution photographs of the material's topography by scanning a sample's surface using electron beams.

- Transmission Electron Microscopy or TEM, high-resolution photographs of the interior structure of nanomaterials are created employing TEM, which transfers electrons across a thin sample.

- X-ray Diffraction or XRD, the diffraction pattern created when X-rays interact with a material's crystal structure can be determined by X-ray Diffraction.

- Fourier Transform Infrared Spectroscopy or FTIR, analyses a sample's functional groups and chemical bonds through measuring an infrared light's absorption, reflection, and transmission. It

addresses the chemical makeup of nanoparticles and their surface functional groups.

- Raman Spectroscopy, analyses chemical movements' inflexible dispersion of photons to reveal a sample's structure and chemical bonds. describes the chemical makeup, flaws, and structural characteristics of tiny particles.

- UV-visible spectroscopy, determines how much ultraviolet and visible light is absorbed or reflected, giving data on semiconductor changes and optical characteristics. Through it, the bandgap, absorption spectra, and optical characteristics of nanomaterials are determined.

These methods provide a thorough understanding of the characteristics, composition, and behavior of nanomaterials, allowing scientists to modify their properties for particular uses in industries including energy conversion and storage electronics, energy catalysis, and pharmaceuticals.

In conclusion, one can say, that nanomaterials are the little titans altering our technological environment in the field of materials science. Despite their tiny size, they are incredibly powerful, holding the potential to advance energy, medicine, and other fields. A world of whispered miracles, where nanoparticles dance with atoms, is hidden from observation. They hold the pathway to energy revolutions, medical wonders, and a sustainable future with their quiet influence. Scientists go across the nano-realm like pioneers in the world of Lilliput. Here, nanoparticles put on their innovation capes and pave a sustainable route while revolutionizing energy technologies.

What might appear to be a whisper at the nanoscale becomes a roar of innovation when seen from a macro perspective. Scientists use nanomaterials to create marvels, much like painters do on miniature canvases. These minute strokes have the potential to transform the energy landscape, enlighten the medical field, and build a sustainable future. There is a journey into the nanoscale that lies beyond the horizon of ordinary materials. In this context, nanomaterials take on the role of cosmic explorers, laying the foundation for a new era in energy, medicine, and sustainability. The blueprint for tomorrow's legacy resides inside the tiny structures of nanomaterials. Their pioneering attitude inspires the quest for sustainable energy, revolutionary healthcare, and an innovatively driven world.

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SUPERFLUIDS: THE QUANTUM MARVELS THAT CLIMB WALLS WITH FRICTIONLESS GRACE

Bisma Ishaq

1409-BS-PHY-21

The Royal Swedish Academy of Sciences has decided to award the *1996 Nobel Prize in Physics* to Professor David M. Lee, Professor Douglas D. Osheroff, and Professor Robert C. Richardson, for their discovery of superfluidity in helium-3. Superfluids are extraordinary states of matter characterized by their frictionless flow, and ability to climb a wall without resistance. In these *quantum fluids*, there is no energy loss as they move, even at temperatures close to absolute zero. *Helium-3 and helium-4* exhibit distinct behaviors due to their unique properties, offering captivating insights into the mysteries of quantum mechanics.

Breaking Boundaries: Superfluids and Their Exceptional Phase Transitions Setting Them Apart from Ordinary Liquids

Helium-4 and helium-3 are notable liquids, with helium-4 becoming superfluid *below* **2.17 Kelvin** (-271.98°C). When the temperature sinks on a cold winter's day water becomes ice. These ***phase transitions*** can be described with classical physics. The situation becomes different when the temperature sinks and approaches *absolute zero, -273.15°C.* When a liquid becomes superfluid its atoms lose all their randomness and move in a coordinated manner. This causes a lack of all inner friction: It can overflow a cup, flow out through very small holes, and exhibit a whole series of other non-classical effects, and these very cold liquids are termed as *quantum liquids* contributing knowledge for describing matter at the microscopic level.

Whirlpools and Resistance: The Intriguing Dual Nature of Superfluids

Quantized vortices in a superfluid are the result of the fluid's response to rotation. These swirling

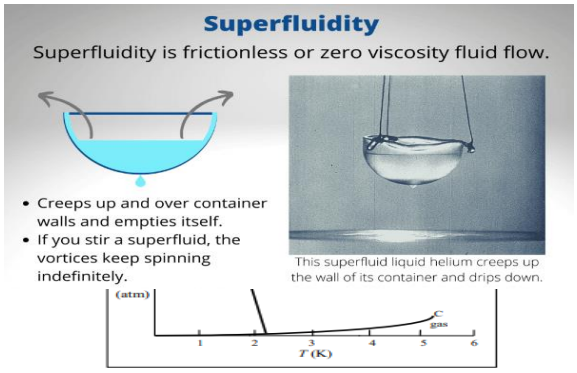
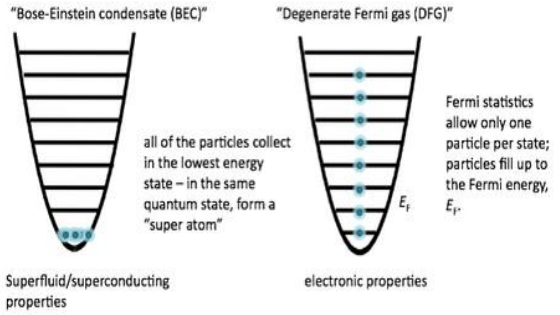


Fig. 1: The phase diagram of ^{4}He.

entities possess central cores with reduced density, each exhibiting a stable *quantization of angular momentum* around a central axis, reflecting the inherent quantum behavior. Their presence within superfluids underscores the **harmonious** interplay between the subatomic world and the macroscopic stage of superfluidity, unveiling the elegance of nature's underlying quantum choreography.

Unlocking the Quantum Mysteries: Bose-Einstein Statistics and Bosons in Superfluids

In the core of superfluid liquid lies the enigmatic behavior of particles known as bosons, which obey the principle *of Bose-Einstein statistics*. These statistics dictate that at ultracold temperatures, these bosons condense into the lowest quantum state with integer spin, forming a collective entity with *quantum coherence*. Helium-4 is an example of ***a bosonic superfluid***. Without the slightest resistance, particles move in harmonious synchrony, revealing a symphony of quantum waves and vortices.



Fermions, particles with half-integer spin, like electrons can also form superfluids, but their behavior is distinct. Helium-3 is an example of a ***fermionic superfluid***. This statistic allows particles to fulfill electronic properties, such as *forming Fermi energy* distinguishing it from bosonic superfluids.

Exploring the Cryogenic Versatility: From Quantum Phenomena to Cutting-Edge Applications

One of the most practical uses of superfluids is in cryogenics, where they serve as the cornerstone for the development of marvelously efficient *coolers designed for the coldest of experiments*. These superfluid coolers enable to reach temperatures within *a hair's breadth of absolute zero.* Superfluid helium-4, plays a pivotal role in this domain. Its unique properties, such as zero viscosity and exceptional heat transport capabilities, make it an ideal coolant for experiments in particle physics and astrophysics.

Charting Uncharted Waters: The Versatile Navigation with Superfluid Gyroscopes

Superfluid helium exhibits zero viscosity and infinite thermal conductivity, making it a perfect medium for gyroscopic applications. These superfluid gyroscopes are employed in spacecraft to maintain *stable orientations* and directions during maneuvers in *microgravity environments.* These gyroscopes enable precise *navigation in outer space*, exemplifying the captivating synergy between quantum physics and advanced navigation technology.

Quantum Computing Potential Unleashed: Harnessing Superfluids for Next-Gen Techniques

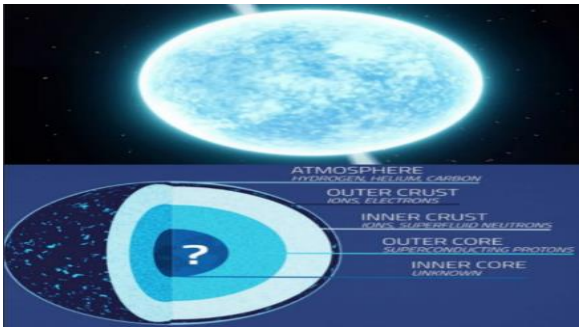
Superfluids have emerged as pivotal contenders in the quest for quantum computing. Their quantum coherence properties, in the form of Bose-Einstein condensates, of a fer platform *for quantum bit (qubit) storage and mani*pulation. The ultra-cold temperatures create an environment to maintain delicate quantum states, for the stability of qubits. Additionally, the absence of viscosity reduces unwanted interactions and decoherence, enhancing their potential as a quantum computing medium.

The Enigmatic Role of Superfluidity in Astronomical Objects: Unveiling Cosmic Matter at the Quantum Frontier

Superfluidity, a captivating quantum phenomenon, finds a place of intrigue within the depths of *astronomical objects*, unveiling the extraordinary behavior of matter under extreme cosmic conditions. *In the cores of massive stars, superfluid neutrons arise*, shaping the dynamics of stellar evolution and the dramatic events of *supernovae.* Deep within the enigmatic realm of neutron stars, the superfluidity of neutrons becomes paramount, influencing their cooling processes and manifesting as *pulsar glitches*. Theoretical quark matter superfluid within the core of quark stars or strange stars(while yet to be confirmed) promises to redefine our understanding of the *densest objects in the universe*. The presence of superfluids in these cosmic arenas serves as a testament to the profound interconnectedness of quantum physics and astrophysics, inviting us to explore the quantum frontier within the cosmos.

Superfluids: A Versatile Frontier in Physics and Beyond

From simulating exotic condensed matter systems to unveiling the mysteries of high-temperature superconductivity, Superfluids are poised to play a pivotal role, from zero viscosity to coherence preservation, they promise groundbreaking applications in quantum sensors, ultra-sensitive detectors, and perhaps even the realization of fault-tolerant quantum computers. This territory is a path toward a future where quantum technologies revolutionize our world.



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Unraveling the Fabric of Time: A Journey Through the Physics of Time Travel

Abdullah Imran

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In the halls of academia, the concept of time travel has long been a favorite topic of discussion, sparking curiosity and imagination across various departments. While often relegated to the realms of science fiction, the physics of time travel is an intriguing subject that transcends disciplinary boundaries, inviting scholars from diverse backgrounds to explore its possibilities and paradoxes. In this article, we embark on a multidisciplinary journey through the fascinating world of time travel, drawing on insights from physics, philosophy, and even literature to shed light on this enigmatic concept.

The Foundations: Einstein's Theory of Relativity

Our voyage begins with the groundbreaking work of physicist Albert Einstein, who reshaped our understanding of the fundamental nature of the universe. Einstein's theory of relativity, consisting of two main branches - Special and General Relativity, serves as the cornerstone for any discussion of time travel.

Time Dilation: The Relativistic Time Warp

Special Relativity, formulated in 1905, introduced the concept of time dilation, a phenomenon where time moves at different rates for observers in relative motion. This profound discovery shattered our intuitive notion of time as an absolute entity and paved the way for contemplating the physics of time travel.

To grasp time dilation, envision a scenario where two observers, one stationary and the other in motion, experience time differently. If you were traveling at a significant fraction of the speed of light, your time would pass more slowly relative to the stationary observer. This relativistic effect has been experimentally confirmed and has practical applications, such as the synchronization of global positioning system (GPS) satellites.

The Twin Paradox: A Thought Experiment

Now, let's dive into the famous thought experiment known as the Twin Paradox, a mind-bending illustration of time dilation. Imagine two twins, one stays on Earth while the other embarks on a journey through space at near-light speed. Upon their reunion, the traveling twin would have aged significantly less than the twin who remained on Earth. This paradox not only showcases the real-world implications of time dilation but also invites us to question the nature of time itself.

Wormholes: Bridges Through Spacetime

From Special Relativity, we transition to General Relativity, which introduces the concept of wormholes, also known as Einstein-Rosen bridges. These hypothetical tunnels through spacetime capture the imagination of physicists and science fiction enthusiasts alike. Wormholes, if they exist, could serve as shortcuts through the vast fabric of spacetime, potentially connecting distant points in both space and time. The physics of wormholes relies on the intricate equations of General Relativity, which describe how massive objects warp spacetime. To traverse a wormhole, one would need to manipulate the spacetime curvature around its entrance and exit. However, the challenges are immense, as theoretical requirements for stable wormholes involve exotic forms of matter with negative energy density, substances that remain purely theoretical at this point. As Quran says in **Surah Ar-Rahman (55:33)** on portals:

يَا مَعْشَرَ الْجِنِّ وَالْإِنسِ إِنِ اسْتَطَعْتُمْ أَن تَنفُذُوا مِنْ أَقْطَارِ السَّمَاوَاتِ وَالْأَرْضِ فَانفُذُوا ۚ لَا تَنفُذُونَ إِلَّا سُلْطَانٍ

O company of jinn and mankind, if you can pass beyond the regions of the heavens and the earth, then pass. You will not pass except by authority [from Allah].

This verse emphasizes that beings, whether from among humans or jinn, cannot traverse the realms of the heavens and the earth except by the permission and authority of Allah (God).

The Grandfather Paradox: A Time Travel Conundrum

As we venture deeper into the physics of time travel, we encounter the perplexing Grandfather Paradox. This age-old dilemma proposes that if time travel were possible, one could travel back in time and inadvertently alter the course of history, potentially preventing their existence. For example, you might travel back in time and prevent your grandfather from meeting your grandmother. The resolution of the Grandfather Paradox remains a subject of lively debate among physicists and philosophers. Some suggest that the universe would "self-correct," preventing changes to the timeline, while others propose that alternative timelines or parallel universes might be created to accommodate the changes.

Quantum Mechanics: The Quantum Leap in Time

Stepping beyond the confines of classical physics, we enter the realm of quantum mechanics. Quantum physics introduces intriguing possibilities for time travel, as it challenges our conventional understanding of causality and the nature of reality. Quantum entanglement, a phenomenon where particles become interconnected in such a way that their properties are correlated, offers a tantalizing glimpse into potential time-manipulating devices. Some researchers have explored the idea that manipulating quantum entanglement could lead

to the creation of a quantum "time machine." However, the practicality and feasibility of such a device remain highly speculative and controversial within the scientific community.

Interdisciplinary Explorations

While the physics of time travel provides a captivating framework, it is important to recognize that this topic transcends the boundaries of physics alone. Philosophers ponder the implications of time travel on the nature of free will and causality, while writers and filmmakers have crafted compelling narratives that explore the moral and existential dilemmas posed by time travel. Moreover, scholars from various departments can collaborate to approach time travel from diverse perspectives. Historians might investigate how time travel narratives reflect cultural attitudes toward the past and future, while ethicists can engage in discussions about the responsible use of time-altering technologies.

Conclusion: The Multidisciplinary Quest

In our multidisciplinary journey through the physics of time travel, we have glimpsed the profound implications and paradoxes that arise when we contemplate the manipulation of time. While time travel remains a subject of speculation and intrigue, it serves as a testament to the enduring human spirit of exploration and curiosity. As we continue to probe the mysteries of time, we find ourselves at the intersection of scientific inquiry, philosophical reflection, and creative imagination. Whether we ultimately unlock the secrets of time travel or not, our collective exploration of this concept underscores the profound interconnectedness of knowledge across disciplines, making it a topic that truly resonates with everyone, from physicists to philosophers, historians to dreamers.

PSYCHOLOGY

PSYCHOLOGY TIMELINE 2023

- **January:**

  Scientific studies have confirmed that smiling, even when forced, can trigger the brain to release pleasure-inducing chemicals like endorphins, leading to an enhanced mood.

- **February:**

  A cognitive quirk known as the "Halo Effect" causes people to assume that physically attractive individuals possess other positive qualities, such as intelligence or kindness, even when no evidence supports these assumptions.

- **March:**

  The "Zeigarnik Effect" suggests that our minds remember incomplete or interrupted tasks better than completed ones, contributing to our tendency to dwell on unfinished matters.

- **April:**

  The belief in the effectiveness of a treatment, even if it's inert, can sometimes result in genuine symptom improvements. This highlights the profound influence of the mind on physical well-being.

- **May:**

  Individuals experience discomfort when their beliefs or actions conflict with each other. Typically, they are more inclined to adjust their beliefs than to admit they were wrong, revealing the human drive to preserve a positive self-image.

- **June:**

  People have a natural inclination to seek and remember information that supports their existing beliefs while disregarding or discounting contradictory information. This phenomenon plays a significant role in the spread of polarization and misinformation.

- **July:**

Although not conclusively proven as initially claimed, some research suggests that listening to Mozart's music may temporarily enhance spatial-temporal reasoning skills.

- **August:**

The "mere-exposure effect" demonstrates that individuals tend to develop preferences for things they encounter repeatedly, be it familiar faces or brand logos.

- **September:**

The "Flynn Effect" reveals that over time, the average IQ of a population tends to rise, underscoring the role of intellectual stimulation and access to education in cognitive development.

YOUR LIFE WAS A LIE: AN INSIGHT INTO FALSE MEMORIES.

Hajra Asad

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Have you ever experienced locking the door, but when you go check again, it is not locked? Have you ever told your friends about that one time when you were lost at the mall during your childhood, and later found out from your parents that such a thing never happened? What if someone told you that in that famous romantic movie that you love so much, the actor had said, "I will think about it", instead of, "I will wait for you"- and this was shocking since you had spent your whole life believing the latter. Have you ever been scolded by your mother for not turning the stove off, even when you remember that you did turn it off? Well, if the answer to all the above questions for you was in the affirmative, do not worry; I assure you that neither have you gone mad nor is it a supernatural activity. This is what false memories can do to you. It is just the power of your mind manipulating you, or the mind itself is manipulated.

According to the American Psychological Association, false memory, illusory or pseudo memory, is the distorted recollection or an imaginary fabrication of an event. The research instituted by Sigmund Freud and Pierre Janet, followed by the work of Elizabeth Loftus, greatly contributed to the study of false memories. There can be various causes for the creation of false memories, as our memory is malleable, and is bound to changes making it unreliable. The notable causes

that have been pointed out by psychologists for this phenomenon are misinformation, misattribution, inference, OCD, and emotions. Some people might get convinced that the false information they are being fed, is true, creating a false memory-for example, someone telling you that your friend stole a book when in reality she had not. Sometimes, the mind may combine details from different events to create a single event and that leads to a false memory-like you're seeing a red mask, and a robbery later on, and after a few days, your mind combines the events to tell you that the robbers were wearing a red mask. The different questions that you may be asked by people, followed by them prompting you for details, in a way create false memories by inference-for example, your mother asking you whether your brother had broken the vase, and you agree, even while knowing that he had not. People with OCD are not very confident about their memory and are likely to fall prey to its distortion, thereby creating false memories.

According to research, negative emotions often lead to false memories. All these examples revolve around insignificant events in a person's everyday life. However, false memories may dangerously disturb the normal functioning of a person's life. False Memory Syndrome is a condition in which a person's identity and relationships are vastly influenced by the

existence of false memories. It is termed as a syndrome since the orientation of a person's life is distorted, and he believes the influential memories to be true. One interesting thing to note regarding this syndrome is that the false memories of people suffering from this syndrome are usually recognized through memory recovery. This technique is used as a way for people to find suppressed memories, which lie in their subconscious minds; these memories may be usually traumatic, like childhood sexual abuse. So far, the examples were concerned with a single individual; however, even more, intriguing is the fact that the masses can believe in the same false memory. This concept is identified as the Mandela Effect. A famous example of this effect is Fiona Broome, who was also the same person known to have coined this term in 2009. She was at a conference talking to others about how she remembers Nelson Mandela dying in prison in the 1980s. Shockingly, Nelson Mandela died in 2013 and was not in prison. However, many people around her believed to have the same memory in context with the press coverage and his widow's speech. Another example that will surely shock you is from the movie Snow White and the Seven Dwarfs. You would be astonished to hear that instead of "Mirror, mirror on the wall"; the phrase originally was "Magic mirror on the wall".

To sum up, it is evident that false memories are not rare. The bottom line is that everyone has them, although they may be trivial for some, while disturbingly significant for others. It is certain to give you a good laugh once you think about all the false memories you have.

DID YOU GET TRICKED? (HOW COMPANIES MAKE YOU BUY MORE THAN YOU WANT)

Asif Sultan

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Have you bought anything in the last 30 days? I bet you have. And if you think you were thoughtful and clever with your spending, think again. Because you might have been *tricked* into buying things you don’t want.

Oxford Languages defines marketing as the activity or business of promoting and selling products or services, including market research and advertising. The history of modern marketing goes back at least two centuries. Some studies have found instances of advertising even in the ancient world (Matić, 2014). As the field of psychology advanced, marketers incorporated its principles into their messages to attract buyers.

One of the most important findings about how people make money-related decisions came at the turn of the century. The Israeli-American psychologist Daniel Kahneman made history when he received the Nobel Memorial Prize in Economics. His *prospect theory* suggested that we are not completely rational when making

decisions (Kahneman & Tversky, 1979). Earlier, Tversky and Kahneman (1974) also detailed several cognitive biases—systematic errors in thinking—that cloud our judgments. Later, another Israeli-American psychologist, Dan Ariely, wrote his famous book *Predictably Irrational*, where he explores how people think, mostly about financial decisions. Another notable name in the field is Robert Cialdini, famous for his book *Influence: The Psychology of Persuasion.*

Companies are increasingly using the findings of these and other psychologists in their marketing and sales. To make better decisions, you have to be vigilant. Here are the five most interesting "mind hacks" you should be aware of when making purchases.

1. Novelty

Our brains love novelty. When we come across new stimuli—anything we perceive through our senses—or we expect a reward, our brain releases dopamine, which makes us feel good (Costa et al., 2014; Salimpoor et al., 2011).

Companies exploit this by signalling novelty with their products. Visit any website that sells clothing items and you will see the label "NEW." And we just don't want to miss out on new stuff due to loss aversion (I'll explain it later.)

2. Priming

If I say "Pakistan," what comes to mind: the map of Pakistan, the spectacular crescent star flag, or maybe the melodious national anthem? It's called priming. This is how our mind makes sense of the world: by grouping ideas into categories.

Simply put, priming is the phenomenon in which the first idea affects subsequent ideas. Research suggests that positively framed messages work more effectively in product advertising (Chang, 2008). Visit an online clothing shop, and you are likely to see visuals that activate your ideas about luxury, glamour, and a sense of pride. Colours and fonts are also used to induce specific moods and emotions.

3. Decoy effect

This is probably the sneakiest and cleverest hack. If you look at Netflix's pricing page. The premium package is priced at PKR 1,100. But if you look at the features; the only difference between the Premium and the Standard packages is that you get 4K streaming with the Premium. It doesn't seem reasonable for an average customer to pay Rs. 300 extra just for this one feature. And that's exactly the point. The premium package is just a decoy—an item that's not attractive to the customer compared to the other ones. In comparison, the standard package looks much more attractive, and you feel like you are saving Rs. 300.

This is called the decoy effect. It works because our brain makes sense of the world by making comparisons (Ariely & Wallsten, 1995; Mao & Oppewal, 2012).

4. Loss aversion

"A bird in the hand is worth two in the bush," as the old saying goes. The pain of losing is more powerful than the joy of acquiring something (Kahneman & Tversky, 1979).

Ever wonder why we get free trials with almost every online service? Say I get a one-month trial from Netflix. It serves two purposes, and both are linked to loss aversion. First, it reduces the risk of losing money if you don't like Netflix. There's no risk in trying. Second, when I have used Netflix for a month and have enjoyed binge-watching Breaking Bad, I wouldn't want to lose access. I will start watching "Better Call Saul". Suddenly, this daily dose of entertainment became a basic need for me. So I won't cancel my subscription at the end of the month and keep paying.

5. Scarcity

One of the ways we evaluate the worth of an item is by judging its availability. Rare seems more valuable, and we rush to seize what's rare. Zhao and Tomm (2018) suggest that scarcity causes myopic and impulsive behaviour, leading to bad choices.

Companies use two types of scarcity to push customers to purchase if they are indecisive. One is the limited quantity. Words like "limited stock" or "only 5 items left" are common on e-commerce websites, which create a sense of urgency to buy the products that are still available.

The second type of scarcity is time. You'll see limited-time offers such as "Eid sales" or Daraz's famous 11.11 sale. A potent way to create maximum scarcity is by using both quantity and time scarcity together.

Although it sometimes becomes almost impossible to make your decisions free of these "mind hacks" and biases, the best way to be wise with your money is to be mindful and aware of these tricks that organizations use. Ask yourself if you are purchasing only because you feel excited about it. If yes, you are most likely making an emotional decision. Think twice.

FROM CONFLICTS TO CLOSENESS: HOW TO MAINTAIN HEALTHY RELATIONSHIPS IN COLLEGE/UNIVERSITY

Adeel Sarwar
1436-BH-PSY-20

Many potential factors contribute to relationship failure among college and university students. Factors that have been identified in research studies include ineffective communication, personality differences, jealousy & infidelity. We will look at these, one by one but it's worth noting that relationships are complex, and many of these factors may interact with one another in unpredictable ways.

Communication is a key factor in any relationship, and college and university students are no exception. Effective communication is essential for any successful relationship, but it

can be especially challenging for young adults who are still developing their communication skills. Differences in communication styles or a lack of practice in active listening can lead to misunderstandings, feelings of being unheard or unsupported, and a breakdown in trust between partners. Research has shown that poor communication skills, such as ineffective listening or difficulty expressing emotions, can lead to relationship problems and ultimately relationship failure.

Therefore, Effective communication is one of the most important factors in building and maintaining a healthy relationship and reducing conflict. This includes being honest and open with your partner, actively listening to their needs and concerns, and expressing your thoughts and feelings respectfully and assertively. Regular check-ins and discussions can help address any potential issues before they become more serious. Research has shown that couples who communicate effectively are more likely to report higher levels of relationship satisfaction and lower levels of relationship distress. (Amato & Booth, 1995; Baucom, Epstein, Rankin, & Burnett, 1996).

Secondly, Differences in personality traits, such as extroversion/introversion, agreeableness, and neuroticism, can also impact relationship outcomes among college and university students. Research has shown that couples who are too similar or too dissimilar in their personalities may be at increased risk of relationship failure. Every individual has a unique personality, which can affect their behaviour, values, and communication style in a relationship. For example, one partner may value independence and alone time, while the other may prioritize constant communication and togetherness. These differences can lead to conflicts and misunderstandings between partners, which can ultimately lead to decreased relationship satisfaction and even relationship termination.

Some couples thrive on differences and find ways to complement and balance each other. However, it's important for young adults to be aware of their personality traits and preferences, as well as those of their partners, and to work together to find common ground and build a strong foundation for the relationship. Communication, empathy, and willingness to compromise can help bridge personality differences and promote relationship satisfaction.

Jealousy is a common emotion in romantic relationships, and it can stem from a variety of sources, such as a lack of trust, insecurity, or fear of losing one's partner. In college and university settings, jealousy can be exacerbated by factors such as a highly social environment, increased opportunities for partner interactions with others, and the pressure to establish a social identity. Jealousy can lead to a range of negative outcomes, such as increased anxiety, decreased relationship satisfaction, and infidelity. Infidelity involves a breach of trust in a committed relationship. Infidelity can cause significant emotional distress and can lead to feelings of betrayal, loss of trust, and reduced relationship

satisfaction. Infidelity is also associated with an increased risk of relationship termination. Addressing these issues often requires open and honest communication between partners, a commitment to rebuilding trust, and a willingness to work through the underlying issues that may be contributing to the problem. Moreover, Trust is a critical component of healthy relationships. Research has found that perceived trust is a strong predictor of relationship satisfaction and commitment. Honesty and integrity have also been linked to relationship satisfaction and trust.

Seeking support from friends, family, or mental health professionals can help couples cope with stress and maintain healthy relationships. Research has shown that social support is a protective factor against relationship dissatisfaction and divorce. Additionally, seeking couples therapy has been found to improve relationship satisfaction and reduce relationship distress.

It's important to note that while these factors can contribute to relationship failure, they are not deterministic. Many relationships can overcome these challenges with effective communication, empathy, and a willingness to work together to find solutions. Addressing these issues often requires a commitment to understanding oneself and one's partner, as well as a willingness to make compromises and adapt to changing circumstances. By doing so, individuals can build strong, healthy relationships that can withstand the challenges posed to relationships of college and university life.

SELF ACTUALIZATION_ A PARADOX

Rafia Qadir

1412-BH-PSY-19

Since humankind has evolved, it is trying to figure out its impetus. The diverse nature of Homo sapiens and their tribes lead to the diverse concepts of ultimate purpose. Even different individuals of the same clan comprehend the very idea subjectively, based on their concerns and needs. According to Maslow, the highest of human needs is self-actualization which refers to the individual's desire for self-awareness and self-fulfillment. Here arises the paradox of the unachievable nature of self-actualization, because not even a single human being is free from the gradual and continual process of evolution. A man seeks a point P i.e., say the peak of stability of his life. In the course of the very journey, he unconsciously takes over the core thought of reaching point P instigating another pursuit of another level. Ultimately, the whole process rules out the pre-existing notion of the truth which defined the reality of self-actualization in his life. Thus, the question remains unanswered till the end. The conclusions make the concept vague and unauthentic, which in turn questions the life elements of free will and enthusiasm, with which, one opts to seek the highest of needs i.e., the need for self-

actualization. After realizing this reality, one might submit himself to the stimuli offered by mother nature; inculcating the idea that "whatever is going to happen will happen." The acceptance and realistic tendencies of such individuals can lead them to become the self-actualized version of themselves, proving the paradoxical truth.

The achievement does not come fluently on its own, rather one has to go through events of all types ranging from painful to pleasure-giving, says theorists. The theory asserts that self-actualization is the ultimate need that requires primary and pre-potent needs to be met first. And the journey demands resilience. Being resilient means having the ability to recover from difficult life events. Being resilient also entails getting back up and carrying on after suffering a setback. Thus, opposing the fact that self-actualization cannot be achieved until or unless pre-potent needs like safety and self-esteem are met, which does not fit in the case of many popular personalities. There are numerous examples of individuals living in states of poverty, loneliness, and low self-esteem who nonetheless seem to self-actualize through their work. This is proof of setting another paradox implying that hardships prove as hurdles to achieving basic needs, which is necessary to reach the pinnacle of all the needs called self-actualization, but we have several cases of self-actualized people who got it as a result of their trauma and sufferings. For instance, Vincent van Gogh; whose life and suicide suggest a deep well of unmet needs, and Anne Frank, whose universally acclaimed diary was written in, and facilitated by, conditions of extreme danger, these blatant exceptions do not render Maslow's theory insensitive. He observed that in certain people, the hunger to be productive is so great that it overrides other needs, even those that are thought of as pre-potent in most people. Although he chose to refrain from saying so, he was open to the idea that self-actualization can still happen in the context of unfulfilled needs. In some cases, trauma imparts resilience which proves to be an aid to produce the work of art. It is an aftermath of traumatic experiences that instils a sense of safety and well-being as a defence mechanism. Resilience is a trait most people have; however, this trait is glowing in most who have survived childhood trauma. Individual, situational, and career characteristics, support, and a sense of safety from parents, friends, family, school, and community are all factors that foster resilience after traumatic exposure. Additionally, several psychosocial elements support resilience that work on many different levels and are important both before and after trauma. Mindfulness, relaxation techniques, exercise, and cognitive strategies (ranging from distraction to reframing), are the integral components to impart resilience after trauma and PTSD. That, in turn, leads to a very debatable topic i.e., self-actualization.

In conclusion, the intricacy of the human mind encourages reflection on a variety of phenomena that appear to be persistent and systematic in their

occurrence but cannot be understood without research. Even after meticulously examining them, an ample portion of these remains vague. Self-actualization is one of those complicated concepts that are difficult to grasp. The topic disproves the current hypothesis to experimentally support the exact hypothesis. Similar to the angle of 360 degrees, it appears as both infinity and zero at the same time. The cycle, therefore, continues, with the failure, to discover the ultimate truth, succeeding each time.

STOCKHOLM SYNDROME: THE DARK SIDE OF SURVIVAL (A PSYCHOLOGICAL RESPONSE TO CAPTIVITY)

Muhammad Abdullah.

1500-BH-PSY-20

"I am not proud of that today, but I did what I had always done... tried to survive an impossible situation."
(Jaycee Lee Dugard in her memoir; A Stolen Life)

Stockholm syndrome is a perplexing and intriguing psychological phenomenon that has garnered significant attention within the field of psychology yet remains one of the least explored topics due to its complexity. It describes the intricate situation in which a hostage or captive develops an emotional bond with their captor, often displaying feelings of loyalty, trust, and even affection towards them. The name "Stockholm syndrome" was first coined after the 1973 bank robbery in Stockholm, Sweden. The hostages, who were held captive for six days, developed positive emotional bonds with their captors during their ordeal. Since then, this syndrome has been observed in various situations of captivity, such as prisoner of war camps, cults, and abusive relationships.

Early research on Stockholm syndrome was conducted by psychiatrist Frank Ochberg and his colleagues in 1982. They studied the case of Patty Hearst, a woman who was kidnapped by a radical group in 1974. During her captivity, Hearst participated in several illegal activities with her captors and even defended them in court after her rescue.

Another well-known case of Stockholm syndrome occurred in 1991 when 11-year-old Jaycee Lee Dugard was kidnapped by a couple, Phillip and Nancy Garrido. Dugard was held captive for 18 years, during which time she developed a bond with her captors. In her memoir, Dugard wrote about how she felt guilty for wanting to escape and eventually came to view her captors as her family.

The psychological mechanisms underlying Stockholm syndrome are multifaceted and not entirely understood. However, it is believed to be a coping mechanism that the hostage develops to survive and cope with the stress and trauma of

captivity. In a state of helplessness, the hostage may begin to view their captor as a source of safety and protection, even identifying with the captor's beliefs and values even after being rescued.

Several factors can contribute to the development of Stockholm syndrome, as identified by various studies. The degree of control that the captor exerts over the hostage is one of the significant factors, as those who feel they have little or no control over their situation may begin to rely on their captor for basic needs and survival, leading to feelings of gratitude towards the captor. Additionally, the degree of perceived threat or danger that the hostage experiences is another significant factor, as those who feel that their life is in danger may become more susceptible to developing feelings of dependency and attachment towards their captor.

Furthermore, the personality traits of the hostage can also play a crucial role in the development of Stockholm syndrome. Individuals who are more prone to anxiety, low self-esteem, and a need for approval from others may be more likely to develop Stockholm syndrome in response to captivity. Individuals who experience Stockholm syndrome may exhibit a range of psychological symptoms, including anxiety, depression, and post-traumatic stress disorder (PTSD). They may also experience confusion and ambivalence towards their captors, feeling both positive and negative emotions towards them.

It is essential to note that Stockholm syndrome is not a disorder or mental illness, but rather a complex psychological phenomenon that occurs in certain situations. Nevertheless, it can have long-lasting effects on the victim's mental health and well-being, making treatment for Stockholm syndrome challenging. Treatment strategies such as cognitive-behavioural therapy (CBT) and other forms of psychotherapy may focus on helping the individual understand the psychological mechanisms behind their feelings and develop coping strategies to deal with the trauma of captivity. Support from family can also play a crucial role in the individual's recovery, as the lack of social support can be an important factor exposing individuals to be more susceptible to this condition.

Stockholm syndrome has also been used to explain the psychological mechanisms underlying domestic abuse, particularly in cases where victims remain in abusive relationships despite opportunities to leave. This identification with the abuser is similar to how hostages develop positive emotional bonds with their captors. The abusers mostly engage in intermittent positive reinforcement, alternating between abuse and kindness, which can create a sense of unpredictability and lead the victim to cling to the hope that the abuser will change their behaviour. This hope, coupled with feelings of loyalty and attachment, can make it difficult for the victims to leave the relationship, even if they recognize the abuse as harmful. However, it is

important to note that not all victims of domestic abuse develop Stockholm syndrome, and there may be other psychological factors at play.

In conclusion, Stockholm syndrome is a multifaceted psychological phenomenon that manifests in cases of captivity. A comprehensive comprehension of this syndrome can aid us in providing optimal support to individuals who have undergone traumatic experiences and captivity, along with developing efficacious treatment strategies for their recovery. Moreover, additional research on this syndrome is necessary to formulate effective preventive measures for those vulnerable to developing Stockholm syndrome.

THE PRODUCTIVITY GUILT TRAP: UNDERSTANDING AND OVERCOMING THE PRESSURE TO ALWAYS BE PRODUCTIVE

Mariyum Shehzadi

1490-BH-PSY-20

Nowadays productivity has become a buzzword that everyone seems to be chasing. There's a flip side to this relentless pursuit of productivity that often goes unnoticed – productivity guilt. Productivity guilt is the feeling of shame and anxiety when we think we're not doing enough. It cultivates the mindset of feeling bad when we are somehow unable to give our best. This guilt may lead to a cycle of paralysis where we end up doing nothing at all.

People usually get entangled in the web of productivity guilt, when they overtax themselves by creating lengthy to-do lists for each day or establishing unrealistic goals. However, what happens is that people end up constantly switching their attention from one task to another, which wears them out. As a result, they become demotivated and get caught up by intrusive thoughts of guilt or not being productive enough. This is how productivity guilt sabotages our maximum working potential.

The saying "Excess of everything is bad" holds when it comes to glorifying the idea of productivity and hustle. According to Hustle's survey about the mental health of entrepreneurs, 65 % reported that they are going through the phase of burnout and 59 % have gone through anxiety.

Productivity can turn into toxic productivity when it hinders your body's inherent capacity to work efficiently. Shame and additional guilt of not giving enough adds up stress. This stress can lead to other physical and mental health problems, including depression, headaches, somatic problems, difficulty focusing, etc. So, the vicious circle of negative emotions and the body's incapacity to function effectively keeps on going.

Let me help you to tackle this;

- **Setting realistic goals**

To overcome productivity guilt, it's important to set realistic goals and expectations for yourself. Break down your tasks into manageable chunks and prioritize the most important ones. Learn to say no to tasks that are not essential or can be delegated to others. And remember, it's okay to shift to the next day or week if you are exhausted.

- **Take breaks**

Take breaks and practice self-care. It's essential to take time to recharge yourself and avoid burnout. Remember, productivity guilt is not a badge of honour. It's a sign that you need to take a step back, reassess your priorities, and make positive changes in your work and personal life.

Researchers have made it clear that taking breaks is necessary to keep yourself energized. Even moving away from your working desk for a short span can boost productivity.

- **Differentiate busyness and productivity**

It's important to remember that productivity is not the same as busyness. Being busy doesn't necessarily mean you're being productive. Being too busy can hinder your productivity and prevent you from achieving your goals.

Here are some key differences between being busy and being productive:

i. Busy people keep indulging in everything offered to them, but this just serves to burn them out. Whereas, productive people believe in smart and quality work.

ii. Busy people often take pride in multitasking and believe it would be beneficial for them, but the reality is that the brain is not designed this way. People who are productive focus intently on one task at a time.

- **Focus on quantity over quality**

Shift your focus from quantity to quality. Productivity isn't about how much you can do in a day; it's about how effectively you can complete tasks. Prioritize your tasks, set realistic goals, and focus on doing your best work, rather than trying to do everything at once.

- **Celebrate your achievements**

Acknowledge small wins and make time to celebrate them. Try to appreciate yourself for what went well rather than getting depressed over what went wrong. The most important thing is, to allow yourself to be your biggest cheerleader

- **Focus on progress, don't chase perfection**

Recognize that progress is better than perfection. Identify your small wins, where you getting better rather than chasing societal standards of success. Develop the habit of self-catharsis to recognize your areas for improvement. Then, concentrate on making little progress towards your ultimate aim. Your dopamine levels may also be increased by using this strategy.

In conclusion, productivity guilt is one of the prevailing issues of this fast-paced and achievement-orientated society which can have drastic effects on mental health. But, embracing a balanced approach to life, one that acknowledges the importance of both productivity and personal fulfilment, can lead us to live more authentically and joyfully. Let go of the guilt, trust in your abilities, and allow yourself to flourish with a newfound sense of unshakable confidence. Remember, you are more than your productivity, and you deserve a life filled with happiness, purpose, and contentment.

THE NEUROSCIENCE OF EMPATHY - UNRAVELING EMPATHY

Fatima Saleem.

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Picture this: a moment of shared laughter with a friend, the quiet nod of understanding in a time of sorrow, or the surge of compassion when witnessing someone's struggle. These instances are not just fragments and the basis of human connection; they are windows into the intricate patterns of our brains – patterns illuminated by the complex and captivating field of neuroscience, unravelling the secrets of empathy. This empathy is the capacity to understand and share the emotions and perspectives of others with the way they see it and not how we look at it. Empathy is a significant component that may serve as a basis for good interpersonal relationships, healthy communication, and overall societal harmony. Persisting in interpersonal connections empathy serves to bridge the emotional gaps, nurture and solidify existing relations, and make genuine understanding thrive. Empathy allows one to step in the shoes of the other and watch the world with their eyes.

Empathy, as perceived and mostly regarded as being entirely emotional and psychic, does have complex neural connections and enchanting brain chemistry that involves various brain chemicals and delicate regions working in harmony. These neuronal networks work to process and respond to the experiences of others. In this regard, neural mirroring through the Mirror Neurons plays a key role in responding through empathy and understanding other people and their perspectives. Neural Mirroring is the simultaneous firing of the Mirror Neurons when an individual performs an action and observes the same action being performed by someone else. This in turn, not only helps in the imitation of that action but also helps in the thorough comprehension of what the other person might be feeling and experiencing, commonly regarded as empathy. Neuroimaging techniques and elaborative research have revealed several brain structures responsible for contributing to empathetic behaviour. Functional Magnetic Resonance Imaging (FMRI) and Diffusion Tensor Imaging (DTI) showed heightened

activity in brain regions such as the amygdala and the anterior insula when individuals are exposed to empathetic interactions or emotionally charged situations. This deep human capacity is therefore not localized to a single brain area but runs neurons throughout the brain circuits.

Being Empathetic or simply having an affinity with other people comprises both cognitive empathy and affective empathy. Cognitive empathy is also referred to as "metalizing" or "perspective taking" which is the intellectual capacity to understand and mentally stimulate the experiences of others and see the world from their vantage point. Different brain regions including the medial prefrontal cortex and temporoparietal junction help develop cognitive empathy by making it possible to predict and understand the emotional state of others. Affective empathy also called "emotional empathy" involves emotional resonance in which one genuinely feels the emotions the other person might be feeling. Affective empathy helps have a deeper sense of compassion and sympathy but sometimes can also lead to distress and unwanted mental fatigue in response to having felt the emotions and stressors of others to such a profound level.

This might be incredibly startling for you to know that while empathy and being overly solicitous help maintain relationships and emotional bonds, it may also lead to its dark side or what we call "compassion fatigue" which is a purely psychological phenomenon that occurs when individuals particularly caregivers, healthcare professionals and people in emotionally-demanding roles experience emotional exhaustion and sometimes even to decreased empathetic responsiveness due to prolonged exposure to sufferings and distress of others. People who continue to overwhelm themselves with the sentiments and aches of others may suffer from empathy fatigue and tend to have emotional numbness, irritability, insomnia, headaches, and overall life dissatisfaction. Overactivity in the anterior insula and amygdala due to repeated and continuous exposure to distress may also lead to emotional fatigue. Sensitization to such cognitive fatigue may impact the overall mood and mental contentedness. Mitigation techniques involving setting self-care and healthy boundaries, seeking support and help from family, health care professionals, and friends, and prioritizing whom to give your selfless love and devotion to can help lessen the overall impact of empathy fatigue.

Several psychological disorders including Borderline Personality Disorder (BPD) and Autism Spectrum Disorder (ASD) are characterized by disruption in receiving and giving empathy. In BPD the individual fluctuates between intense emotional responsiveness and intense emotional detachment. In ASD too, the individual struggles to form meaningful social connections and interpersonal relations due to the lack of the ability to interpret and understand social and emotional cues. Anti-social personality disorder comprising Psychopath is another

condition referring to a lack of remorse and guilt in response to the sufferings and pain of others.

Research regarding empathy has now surpassed the idea of mere probing and has now led to the development of the design of virtual agents and robots with empathetic abilities. These robots with the help of AI agents will be able to develop cognitive as well as affective empathy which will in turn allow the users to communicate emotionally and obtain emotional resonance in return.

Delving deeper into the understanding of empathy makes us realize that the phenomenon of empathy plays a key role in making and developing sound and healthy relationships and environments. But empathy, as it may seem, is not a mere practice but is profoundly related to overall life satisfaction, brain chemistry, and fostering and maintaining harmonious relationships. Empathy, in short, is the thread that weaves us all into the fabric of humanity and could be harnessed to survive in this ever-evolving world.

NEUROMARKETING

Author: Faraz Imran (Ex-Ravian)

Neuromarketing has caught my attention as a thrilling emerging discipline that sits at the intersection of marketing and neuroscience. It's like a bridge between the art of marketing and the science of the human brain. The idea behind neuromarketing is to bring insights from neuroscience into the realm of marketing to crack the code of consumer behaviour. Companies are on a mission to dive into our subconscious minds to uncover the triggers that steer us toward making purchasing decisions. This involves measuring brain activity, tracking eye movements, and even gauging skin responses. It's not about wielding a magical tool that makes us buy things we don't need, despite what brands might wish for. Instead, it's a quest for understanding, enabling brands to fine-tune their strategies and offerings to build strong connections with customers and boost their revenue.

Neuromarketing brings something distinctive to the table compared to traditional marketing. Rather than relying solely on what people tell us, which might not always be the most accurate reflection of their thoughts, it taps into the unconscious workings of the brain. This allows for a more unbiased understanding of consumer behaviour. We often say one thing and think another, and this is where neuromarketing shines. By directly exploring the inner workings of consumers' minds, it provides a clearer, more objective view for brands to craft their marketing plans. Research suggests that a significant chunk; up to 85% of our buying decisions is made without us even consciously realizing it.

So, how do brands manage to influence us to buy more of their products? Let me illustrate with a couple of examples. Our brains work in two

modes: System 1 and System 2. System 1 is like a quick, automatic response that doesn't require much thought. Think of it as when someone asks your name – you don't need to ponder to respond. On the other hand, System 2 is more deliberate and analytical. It kicks in when you have to solve a challenging problem, like calculating a complex multiplication. When we're faced with a multitude of decisions, like during a supermarket spree, our mental energy gets drained, pushing us to rely more on System 1. This is why those tempting snacks are often placed right where you pay at the checkout – they trigger impulsive decisions when we're mentally worn out. Brands also have a knack for keeping us on a perpetual hunt for the next big thing. The excitement of a new purchase fades quickly, making us yearn for the next experience. This phenomenon is called the hedonic treadmill. Imagine getting the latest FIFA game – the joy of having it diminishes as the next version looms, driving us to want the "coolest" one again.

Real-life examples of neuromarketing in action are eye-opening. Every time you click on a Google ad, you're contributing to Google's profit. They dug deep into the psychology of colour, testing 50 different shades of blue to see which one prompted more clicks. It might sound minor, but adopting that specific shade resulted in a whopping $200 million revenue boost for Google. Then there's Amazon, a giant in the corporate world. They realized that a mere 100-millisecond delay in their website's loading time could cost them 1% of sales – that's a billion-dollar loss stemming from just a tiny fraction of a second. This brings home the saying "Time is money."

Neuromarketing's future implications are a puzzle waiting to be solved. How will this evolving field shape our choices as consumers? Will our awareness of these tactics affect how we respond to them?

While we anticipate what's next, it's a great time to delve into the intricacies of our brains and behaviour. Armed with this knowledge, we can play a significant role in navigating the marketing landscape with better insight and making more conscious and well-informed decisions for our benefit.

BREAKING THE SILENCE: THE STIGMA OF SEEKING MENTAL HEALTH (THE INVISIBLE BATTLES FOUGHT BEHIND CLOSED DOORS)

Fatima Saleem

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“There’s a crack in everything, that’s how the light gets in”

~Leonard Cohen

Mental health refers to the emotional, psychological, and cognitive well-being encompassing one’s emotional stability,

cognitive function, and the ability to cope with the challenges of life; its ups and downs. It is one of the basic components of being healthy and living a life you are content with. Just like when you have a lenient fever or get diagnosed with any lethal disease such as cancer you seek help from a physician or a specialized person, similarly, one should have the liberty to seek mental health and emotional well-being independent of the fear of being prone to the stigmas attached with getting help. Seeking help for mental health refers to the intentional act of reaching out to mental health professionals, resources, support systems, and centres to address and manage emotional and psychological issues including mere stress and situational anxiety to bigger forms of mental health disruption like depression, anxiety, insomnia, narcissism or other Neurodevelopmental disorders such as Autism, Obsessive Compulsive disorder (OCD), Attention-Deficient Hyperactivity Disorder and many more.

The term "Mental Health Stigma" refers to unfavourable attitudes, prejudices, and ideas that society holds about people who struggle with or have conditions related to their mental health. It can be difficult for those afflicted to receive support, seek assistance, and fully participate in society without fear of discrimination or biases, which can also result in prejudice, social isolation, and social discrimination. The stigma around mental health historically has its roots in misinformation and fear. Diverse cultures have frequently linked mental health problems to supernatural causes for ages, perceiving those who suffered as being possessed or cursed. Such ideas stoked fear and encouraged cruel procedures like exorcisms. Asylums first appeared throughout the Middle Ages, although they frequently served as settings for cruelty and neglect only. New insights into mental disease emerged throughout the Enlightenment, but social exclusion and incarceration continued. Though scientific discoveries at the turn of the 20th century deepened our understanding of mental health, stigma persisted. Today, initiatives to eliminate stigma are still essential because they dispel long-held myths and promote greater inclusiveness and empathy.

The stigma associated with seeking treatment for mental health problems is influenced by several factors; stereotypes and misconceptions present people as helpless or unstable. People may hesitate to seek assistance out of fear of being stigmatized. The stigma is strengthened by societal expectations of emotional fortitude and independence. A lack of knowledge about mental health issues also supports discrimination and unfavourable attitudes. The stigma surrounding mental health is heavily influenced by societal views, cultural norms, and media representations. Social attitudes frequently emphasize independence and emotional fortitude while viewing asking for assistance as a sign of weakness. Cultural influences may play a role because some cultures stigmatize or see mental

health problems as a source of shame. Stereotypes are frequently reinforced by sensationalized or erroneous media portrayals of mental illness. For instance, in Hollywood, people with mental health issues are occasionally portrayed as dangerous or unstable which in turn makes it immensely difficult to normalize discussions related to issues about mental health.

For several reasons, eradicating stigma around mental illness and increasing awareness are essential. It promotes open dialogue and lessens the stigma and secrecy that can surround mental health issues. It encourages compassion and empathy, creating a helpful environment for people who require assistance. It ensures that people feel secure seeking treatment by eradicating preconceptions and discrimination, which ultimately improves mental health outcomes and lessens the cost of untreated disorders on people and society. In the US, campaigns, educational initiatives, and advocacy activities are carried out by groups like "NAMI" (National Alliance on Mental Illness) and "Mental Health America" to lessen the stigma surrounding mental illness. "Time to Change" is a well-known campaign in the UK that aims to combat prejudice and stereotypes. Organizations in Pakistan like "Umang" and "Rozan" are attempting to break down stigma by spreading awareness and offering mental health help. To remove barriers, facilitate conversations, and advance understanding of mental health issues, these efforts combine public awareness campaigns, school programs, and community engagement.

You may be surprised to know that, Junaid Jamshed, a well-known musician and popular figure in Pakistan, is one example of people who were the first ones to raise awareness regarding the importance of mental well-being and its apparent treatment. He sought assistance after going through a personal crisis and was honest about his battle with depression. His willingness to talk about his experience with mental illness broke through stigma, inspired others to get help, and started vital discussions about mental health in the nation.

In conclusion, the stigma surrounding mental health continues to prevent a great number of people from being happy and recovering. Encouragement of empathy, education, and candid dialogues are crucial in the fight against this pervasive problem. We can build a more accepting society where seeking mental health care is viewed as a sign of strength, not weakness, by collaboratively fighting preconceptions and prejudices. It’s high time that the world becomes a better place for people who are already struggling and highlights the sense that even in imperfections and vulnerabilities there is room for understanding, compassion, and healing which would ultimately break the barriers of stigmatization leading to a healthier, progressive and comparatively tender society.

PSYCHOLOGY OF PROCRASTINATION: THE THRILL OF THE DEADLINE

Muhammad Abdullah

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"To tell the chronic procrastinator to 'just do it' would be like saying to a clinically depressed person, 'cheer up'." ~ Joseph Ferrari

Procrastination, or the notorious habit of putting things off until the last possible moment, has long intrigued psychologists and researchers. It's a behaviour that many of us are familiar with, but what if there's more to it than simply poor time management or a lack of discipline? Recent research suggests that procrastination might have a deeper psychological and even neurological basis, shedding light on why some individuals seem to thrive under the pressure of a looming deadline.

At its core, procrastination involves the postponement of tasks that need to be accomplished, often in favour of more immediate and potentially less important activities. For years, it has been viewed as a counterproductive behaviour linked to self-control issues and a tendency to avoid discomfort or effort. However, a study published in the journal 'Psychological Science' challenged this conventional wisdom.

The researchers from the study proposed a rather intriguing theory: that procrastination is, in part, driven by a subconscious attraction to the excitement and challenges that come with completing tasks at the last minute. This hypothesis suggests that for some individuals, the adrenaline rush and heightened focus experienced when racing against the clock may be a motivating factor behind procrastination.

To understand the neuroscience behind this phenomenon, we must consider the brain's reward system. When we complete tasks, our brain releases dopamine, a neurotransmitter associated with pleasure and reward. This process reinforces the behaviour, making us more likely to repeat it. In procrastinators, this reward system is triggered more strongly when facing a looming deadline. The prefrontal cortex, a region of the brain responsible for executive functions such as planning and decision-making, also plays a crucial role. Studies using functional MRI (fMRI) have shown that procrastinators often exhibit heightened prefrontal cortex activity as the deadline approaches. This increased activity might indicate a sort of "deadline-induced focus" that intensifies concentration and cognitive effort.

Beyond the neuroscientific explanations, the psychology of procrastination offers valuable insights into why individuals engage in this behaviour. It's not merely a matter of succumbing to the allure of excitement; there are intricate psychological factors at play. One key element is the human tendency to favour immediate rewards over delayed ones, a phenomenon known as temporal discounting. Procrastinators often

prioritize short-term comfort or pleasure over long-term benefits, which can lead to the postponement of tasks that require effort or don't provide immediate gratification.

Another psychological facet of procrastination is the interplay between fear of failure and perfectionism. Many procrastinators harbour a fear of not meeting their high self-imposed standards, which can lead to avoidance behaviour. The anticipation of falling short of expectations can be paralyzing, causing individuals to delay starting a task indefinitely. Additionally, some tasks are inherently aversive, perceived as boring or unenjoyable, and procrastination serves as a coping mechanism to avoid these unpleasant experiences. This aversion can be linked to the psychological concept of "task aversion," where individuals instinctively avoid tasks that induce discomfort.

Understanding the psychological dimensions of procrastination is crucial for addressing this behaviour effectively. Procrastinators often grapple with inner conflicts and emotional struggles that require nuanced therapeutic interventions. By recognizing the psychological patterns that underlie procrastination, psychologists can tailor strategies to help individuals overcome this common yet challenging habit and move toward more productive and fulfilling lives.

While the prospect of harnessing the excitement of procrastination may sound appealing, it's important to note that procrastination remains a double-edged sword. The thrill of racing against time can lead to bursts of creativity and innovative problem-solving but can also result in lower-quality work due to time constraints and added stress. For individuals who rely on procrastination-induced excitement, the downside becomes apparent when it comes to consistent productivity. Tasks that don't offer the same rush might be continuously postponed, leading to missed opportunities, increased stress, and a reduced overall quality of life.

Understanding the connection between procrastination and excitement can help individuals better manage their time and productivity. By recognizing when they are most likely to procrastinate and why, individuals can take steps to minimize the negative consequences. Strategies such as setting self-imposed deadlines, breaking tasks into smaller, more manageable parts, and seeking external accountability can help strike a balance between harnessing the excitement of procrastination and maintaining consistent productivity.

In conclusion, while procrastination has long been viewed as a behaviour stemming from poor self-control or avoidance, emerging research suggests that it may have deeper psychological and neurological roots. The thrill of the deadline, driven by heightened excitement and challenge, can motivate some individuals. However, it's crucial to strike a balance between harnessing this excitement and maintaining consistent

productivity to achieve long-term success and well-being. Understanding the brain's role in procrastination sheds light on the complexity of human behaviour and the ongoing quest to unlock our full potential.

Statistic

TIMELINE OF STATISTICS DEPARTMENT

Jan:

One of the most important trends in 2023 will be the continued empowerment of the entire workforce to put analytics to work. This is giving rise to new forms of augmented working, where tools, applications, and devices push intelligent insights into the hands of everybody to allow them to do their jobs more effectively and efficiently.

Feb:

AI allows businesses to analyze data and draw out insights far more quickly than would ever be possible manually, using software algorithms that get better and better at their job as they are fed more data. This is the basic principle of machine learning (ML), which is the form of AI used in business today. AI and ML technologies include NLP, which enables computers to understand and communicate with us in human languages

March:

Cloud is the platform that enables data-as-a-service technology to work. It means that companies can access data sources that have been collected and curated by third parties via cloud services on a pay-as-you-go or subscription-based billing model. This reduces the need for companies to build their own expensive, proprietary data collection and storage systems for many types of applications.

April:

When digging into data in search of insights, it's better to know what's going on right now – rather than yesterday, last week, or last month. This is why real-time data is increasingly becoming the most valuable source of information for businesses. Working with real-time data often requires more sophisticated data and analytics infrastructure, which means more expense, but the benefit is that we're able to act on information as it happens. This could involve analyzing clickstream data from visitors to websites to work out what offers and promotions to put in front of them, or financial services, it could mean monitoring transactions as they take place around the world to watch out for warning signs of fraud.

May:

Data governance will also be big news in 2023 as more governments introduce laws designed to regulate the use of personal and other types of data. In the wake of the likes of European GDPR, Canadian PIPEDA, and Chinese PIPL, other countries are likely to follow suit and introduce legislation protecting the data of their citizens. Analysts at Gartner have predicted that by 2023, 65% of the world's population will be covered by regulations similar to GDPR.

June:

Augmented reality (AR) and virtual reality (VR) are expected to become more prevalent in 2023. This will lead to the development of new consumer interfaces that are more immersive and engaging

July:

Big Data for Climate Change Research: Big data is expected to play a significant role in climate change research in 2023. It will help scientists better understand the impact of climate change on our planet. Backing up the views and predictions of climate change organizations (IPCC, 2018) like the UN Intergovernmental Climate Change (IPCC) with solid data will put the raging climate change debate to rest. In the aftermath, nations will finally work together to execute the requisite actions needed to save the planet

August:

While fully autonomous driving is still a long way from truly taking off, there have been significant and notable developments in the field. For instance, Apple conducted more testing on their self-driving cars and saw an improvement in disengagement rates, from 8.35 disengagements per 1,000 miles in 2019 to 6.91 disengagements per 1,000 miles in 2020 (9to5Mac, 2021). In October 2020, Waymo introduced full-level autonomous driving vehicles that customers can use to hail a ride (Unite.ai, 2020). At the start of 2021, Walmart expanded its use of driverless trucks to deliver items from a Walmart Supercenter to a Walmart pickup point (Walmart, 2020).

September:

Digital transformation goes hand in hand with the Internet of Things (IoT), artificial intelligence (AI), machine learning, and big data. With IoT-connected devices expected to reach a staggering 25.44 billion devices in 2030 from 10.07 billion in 2021 (Statista, 2021), it's easy to see where that big data is coming from.

APPLICATIONS OF STATISTICS IN REAL-LIFE SCENARIOS (SPORTS, FINANCE, MEDICINE AND BEYOND)

Affan Shakoor

Introduction:

Statistics is a powerful tool used to analyze and interpret data, making it an indispensable aspect of modern life. From sports to finance, medicine, and various other fields, statistics plays a pivotal role in providing valuable insights, guiding decision-making, and shaping our understanding of the world. In this article, we will explore how statistics is applied in real-life scenarios, specifically focusing on sports, finance, medicine, and several other domains.

Sports Analytics - Gaining a Competitive Edge

In recent years, Statistics have revolutionized the world of sports. Sports analytics has revolutionized how athletes, coaches, and teams approach the game. Statistics enable the evaluation of player performance, strategizing for opponents, and understanding game dynamics. With the advent of advanced data collection methods, like player tracking systems and wearable technology, sports teams can analyze vast amounts of data to gain a competitive edge. For instance, in basketball, statistics help teams optimize shot selection and identify the most efficient offensive plays. Similarly, in soccer, analytics assist in player positioning, passing accuracy, and defensive strategies.

Finance and Investments - Managing Risk and Returns

In the world of finance, statistics plays a critical role in understanding market trends, assessing risks, and making informed investment decisions. By analyzing historical data, financial professionals can estimate asset returns, evaluate portfolio performance, and develop risk management strategies. Statistical models like the Capital Asset Pricing Model (CAPM) help investors understand the relationship between risk and expected returns. Additionally, statistics is used for financial modeling, such as Monte Carlo simulations, to assess the uncertainty surrounding investment outcomes.

Medicine and Healthcare - Improving Patient Outcomes

In medicine and healthcare, statistics plays a pivotal role in clinical trials, disease diagnosis, and treatment effectiveness studies. Researchers utilize statistical methods to analyze patient data, identify risk factors, and assess the impact of interventions. It helps in identifying potential correlations between genetic factors and diseases, enabling personalized medicine approaches. Moreover, statistical techniques aid in evaluating the safety and efficacy of new drugs, medical devices, and therapies.

Market Research - Understanding Consumer Behavior

Market research heavily relies on statistical analysis to gather and interpret data about consumer preferences, buying patterns, and market trends. Surveys and opinion polls are statistically designed to provide reliable and representative data. Through statistical methods like regression analysis and conjoint analysis, market researchers can predict consumer behavior and tailor marketing strategies accordingly. This data-driven approach aids businesses in launching successful products and improving customer satisfaction.

Quality Control and Process Improvement - Ensuring Product Excellence

In manufacturing and production industries, statistics are crucial for quality control and process improvement. Statistical process control (SPC) helps monitor production processes, identify variations, and maintain product consistency. By analyzing production data, companies can detect defects early, reduce waste, and enhance overall efficiency. Additionally, Six Sigma, a statistical methodology, is employed to streamline processes and minimize errors in manufacturing.

Social Sciences - Understanding Human Behavior

In psychology, sociology, and other social sciences, statistics is fundamental for analyzing survey data, conducting experiments, and drawing meaningful conclusions about human behavior and attitudes. Social scientists use statistical methods to examine correlations, infer causation, and test hypotheses. These insights contribute to a deeper understanding of social phenomena and aid in making evidence-based policy decisions.

Environmental Science - Analyzing Climate and Ecological Data

Environmental scientists utilize statistical analysis to study climate patterns, assess pollutant levels, and monitor ecological changes. Statistical models are employed to predict environmental trends, such as temperature rise and sea-level change. Data analysis helps identify environmental threats and supports conservation efforts and sustainable policies.

Economics - Evaluating Economic Indicators

Economics heavily relies on statistics to analyze economic indicators, such as inflation rates, GDP growth, and unemployment. Econometrics, a branch of economics that uses statistical methods, helps economists build models to understand complex economic relationships and forecast economic outcomes. These insights aid policymakers in devising effective monetary and fiscal policies.

Weather Forecasting - Predicting Meteorological Events

Meteorologists rely on statistical models to predict weather patterns and assess the likelihood of extreme weather events. Through historical weather data and numerical weather prediction models, meteorologists can provide accurate forecasts and warnings, thus helping communities prepare and respond to weather-related emergencies. Weather forecasting combines historical data with real-time information to generate accurate predictions, helping communities prepare for potential disasters.

Education - Enhancing Learning Outcomes

Statistics is utilized in education to analyze student performance, evaluate teaching methodologies, and make improvements to the educational system.

Educational researchers use statistical techniques to study the impact of various factors on student achievement, such as class size, teaching methods, and resource allocation. This data-driven approach aims to optimize learning outcomes and improve the overall quality of education.

Conclusion

Statistics serves as a powerful tool in various real-life scenarios, enabling data-driven decision-making, enhancing our understanding of complex systems, and guiding progress in diverse fields. From sports to finance, medicine, market research, and beyond, the applications of statistics continue to shape and improve our daily lives. As data collection and analytical techniques advance further, the impact of statistics will undoubtedly continue to grow, transforming the way we approach challenges and opportunities in the future.

STATISTICS 101

Ayesha Noor

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In this article, "Statistics 101" refers to an introduction to statistics in everyday life. Statistics is a method for transforming data into a set of equations that might help in problem-solving. We canuse this science to understand the past and forecast the future. We can use statistics to examinedata from various fields to track evolving patterns, and then utilize the results of this study to form inferences and forecasts. In this blog, we quickly go over the development of statistics from ancient times to the present to comprehend how they affect our daily lives.

I. INTRODUCTION:

"*Statistics*" gradually evolved between the 17th and 18th centuries, and a lot of work was finished and published at the end of the 19th. One of the founding figures of contemporary statistics, *Sir Ronald Fisher*, demonstrated how statistics can be used to evaluate extremely complex data sets and created many of the techniques that are still in use today. Additionally, he established the *Rothamsted Statistics Department*, where *Genstat* was created. Today, statistics are used in a wide range of academic disciplines, including science, engineering, agriculture, medicine, and the arts. It is commonly utilized in politics, with one well-known instance being when American statistician *Nate Silver* successfully predicted the outcomes for all 50 states in the 2012 U.S. presidential election using a forecasting system, he derived from one of *Fisher's theories.*

II. SOME PRACTICAL APPLICATIONS OF STATISTICS

Even though we may not be aware of it, statistics play a significant role in our daily lives. Hereare a few illustrations.

Census:

A census is performed to gather data about a population's members. Although a survey of exact, tiny populations can also be referred to as a census, the phrase is most often used to refer to national data.

For instance, we may conduct a census of pig farmers in Thailand's northern region, musicians in Europe, or Japanese citizens 80 years of age and older. The yearly economic census is one instance that has an impact on trade. Data are gathered from various firms, compared, and then summarized. When trends are measured and estimates and projections are made using this knowledge, firms and policymakers can plan their operations for several years in advance.

Sampling:

Since it is not always feasible to gather data from the entire population, a smaller sample is frequently taken. For instance, the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO) gather statistics on human health and agricultural goods in various nations every few years. These government institutions strive to understand the characteristics of the entire population by using smaller, random samples.

Prediction:

Regression-based prediction is a technique for forecasting based on historical data. Both the independent (predictor) and dependent (target) variables are recorded by researchers. The relationship between the variables is then demonstrated using a best-fit model, where one variable predicts the values of the other. In the 2011 film "Moneyball," a striking example is presented. In this fictionalized account of actual events, Billy Beane uses predictive analytics to significantly raise the performance of his underachieving major league baseball team, making them one of the best in the country.

III. THE VALUE OF STATISTICS IN EVERYDAY LIFE

More information about our daily lives is being gathered than ever before in the twenty-first century. We can readily examine and interpret ever-larger datasets thanks to the advancement of computing power. Many study domains are placing an increasing emphasis on statistical analysis since it enables us to completely comprehend concepts and communicate them to a wider audience than simply our colleagues. We'll demonstrate this idea in a few instances.

Medical sciences:

As I type this in March 2020, the global media is providing us with regular updates on the outbreak of the Coronavirus Covid-19 and its fatality rate. News stories on health and disease frequently reference statistics demonstrating the terrible impact on people. The number of persons with the sickness or who have passed away as a result, if all that is reported in the news, is intriguing information, but it might not have much bearing on your life. People are better able to understand how a sickness may affect them personally when data are included. For instance, according to the WHO[i] (2018), there were 422 million cases of diabetes worldwide in 2014, up from 108 million cases in 1980. According to data from the WHO, diabetes was the seventh-leading cause of death in 2016. According to this research, a good diet, frequent exercise, and keeping a normal body weight can prevent between 85 and 95 percent of diabetes cases.

Social Sciences:

Social science statistics are both a science and an art. Histograms, pie charts, and other graphs are used to visually show and compare data. Within a company organization, it is used to keep an eye on and enhance the quality of both processes and products. The development of social science theories relies heavily on statistical analysis, which is used to thoroughly examine data from the real world to test the theories' plausibility. In political science, statistics are used to assess and forecast data on presidential elections, political parties, public opinion, and voting, social media use for policy promotion, etc. Candidates for the presidency and the prime ministerial position undertake polls to develop their marketing plans. Numerous political consultants have created models to forecast election results. The uses are endless.

Agriculture:

Research and development in biology and agriculture have traditionally depended heavily on statistics. New statistical analysis techniques have been created as a result of the dataset's expanding size and complexity. For instance, genomic selection is the process of choosing superior individuals based on breeding values anticipated from the analysis of DNA marker loci in plant and animal breeding. A very large number of markers and numerous observations are used in statistical analysis. Breeders may now evaluate the effectiveness of genomic selection and utilize that information to direct phenotypic selection.

Large datasets are difficult to evaluate manually, but in recent years, the advent of statistical tools has improved the convenience of data processing. The majority of basic statistics courses instruct students on how to utilize one or more statistical software programs to helpwith analysis and interpretation. The use of statistical software for data analysis is a necessity in all study fields. How can you pick the best statistical method implementation programmed for you or your company out of the wide choice of free and paid options available?

Reference:

- World Health Organization. 2018. Diabetes. Available from: https://www.who.int/news-room/fact-sheets/detail/diabetes (October 30th, 2018).
- http://www.biosci.global/customer-stories-en/statistics-in-daily-life/

Data Visualization Enhancing Understanding through Graphs and Charts

Ahmed Saleem,

1539-BH-Stat-20

Introduction

Data visualization is a powerful tool that plays a pivotal role in conveying complex information in a clear and concise manner. In an era dominated by vast amounts of data, the ability to present information visually through graphs and charts has become essential for making informed decisions, identifying patterns, and communicating insights effectively. This article explores the importance of data visualization, its benefits, and how it enhances our understanding of data-driven concepts.

The Power of Visual Representation

Visual representation is a powerful communication tool that uses graphical elements to convey information, data, or ideas. It leverages the human brain's ability to process visual information more efficiently and effectively than textual or verbal information alone.

- **Enhanced Understanding:** Visuals can simplify complex concepts by presenting them in a visually appealing and easily digestible format. They can break down intricate relationships, processes, or structures, making it easier for the audience to grasp the key points.
- **Improved Memory Retention:** Visuals have been shown to enhance memory retention. When we see images or charts alongside textual information, it creates dual coding in our brain, reinforcing the memory of the content. This can lead to better recall and understanding of the information presented.
- **Engaging and Captivating:** Visuals can capture attention and engage the audience more effectively than plain text. Whether it's an infographic, an illustration, or an interactive chart, visually appealing content can keep people interested and encourage them to explore further.
- **Universal Language:** Visual representations can transcend language barriers and cultural differences. They provide a common ground for communication, enabling people from diverse backgrounds to understand and interpret the information.
- **Data Analysis and Insights:** Visualizations are essential in data analysis and decision-making processes. They can help identify patterns, trends, and outliers in large datasets, making it easier to draw meaningful conclusions and make informed decisions.
- **Storytelling:** Visuals can be a powerful tool for storytelling. Whether it's in presentations, advertisements, or educational materials, combining visuals with narratives can evoke emotions and create a deeper connection with the audience.
- **Persuasion and Influence:** Well-crafted visual representations can be persuasive and impactful. By presenting data or arguments in a visually compelling manner, it can sway opinions and influence decision-making.
- **Accessibility:** Visuals can make information more accessible to individuals with certain disabilities. For example, infographics can be helpful for people with dyslexia, as they rely less on reading and more on visual understanding.

In short, the power of visual representation lies in its ability to make information more understandable, memorable, and engaging. Whether it's in education, data analysis, communication, or storytelling, visual representations play a crucial role in enhancing communication and understanding across various domains.

Simplicity and Clarity

Data visualization simplifies complex datasets, making it accessible to a wider audience, regardless of their technical background. Instead of poring over rows and columns of raw data, charts and graphs distill information into easy-to-understand visuals, allowing viewers to quickly discern essential information. This

simplicity and clarity are particularly valuable when communicating with stakeholders or the general public.

Identifying Patterns and Trends

Graphs and charts offer an efficient means of identifying patterns and trends in data. Through visualization, one can observe the rise or decline of trends, detect anomalies, and recognize correlations that may otherwise go unnoticed in raw data. This enables data analysts, researchers, and decision-makers to draw meaningful conclusions and take appropriate actions based on these insights.

Comparison and Contrast

Data visualization facilitates comparisons between different data sets or categories. Whether it's comparing sales figures, demographics, or performance metrics, charts and graphs enable side-by-side evaluations, helping to spot differences, similarities, and outliers. This ability to contrast data aids in understanding relative performance and assists in making data-driven decisions.

Storytelling with Data

Data visualization goes beyond presenting numbers; it tells a compelling story. Visual representations can depict the progression of events, historical data, or forecasts. By combining text with graphs and charts, data storytelling becomes engaging and persuasive, allowing viewers to understand the context and implications of the data being presented.

Enhanced Decision-making

In business, research, or any data-driven domain, making informed decisions is crucial. Data visualization empowers decision-makers to absorb critical information rapidly, enabling them to assess situations accurately and devise appropriate strategies. Whether it's devising marketing campaigns, budgeting, or resource allocation, data-driven decisions backed by clear visualizations result in more effective outcomes.

Encouraging Data Exploration

Interactive data visualizations open doors to exploration and discovery. Users can interact with the graphs and charts, filter data, and delve deeper into specific aspects of the dataset. This interactivity fosters a deeper understanding of the data and encourages users to ask more questions, leading to further insights and revelations.

Conclusion

Data visualization is an indispensable tool for understanding complex data and communicating insights effectively. By leveraging the power of visual representation, simplicity, and storytelling, graphs and charts allow us to identify patterns, compare data sets, and make informed decisions. As data continues to grow exponentially, the importance of data visualization will only become more pronounced, helping us navigate the vast sea of information and uncover valuable knowledge for better decision-making and problem-solving.

Interpretation of Big Data Using Statistics

Muhammad Khubaib Younis,

1315-BH(E)-Stat-20)

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1. Introduction:

In the modern digital landscape, the phrase "Big Data" has become synonymous with the exponential growth of data generated across various domains. This colossal influx of information presents both challenges and opportunities for extracting meaningful insights. Enter the realm of statistics – the art and science of analyzing and interpreting data. This article embarks on a journey through the intricate process of interpreting big data using statistical methodologies, shedding light on its significance, techniques, challenges, and real-world applications.

1. **The Essence of Statistical Interpretation in the Era of Big Data:**

Amidst the sea of raw data, the true value lies not merely in its magnitude, but in the potential knowledge and actionable insights hidden within. Big data, characterized by its volume, velocity, and variety, calls for a systematic approach to navigate its complexities. This is where statistical interpretation takes center stage.

2. **Understanding the Techniques:**

Descriptive Statistics:

Descriptive statistics offer a preliminary understanding of the data. Measures like mean, median, and standard deviation provide insights into the central tendencies and dispersion of the data points. Histograms and box plots visually represent data distributions, aiding in identifying outliers and patterns.

Inferential Statistics:

Inferential statistics enable us to draw broader conclusions from a sample that represents a larger population. Techniques such as hypothesis testing and confidence intervals help validate assumptions and make predictions with a certain level of confidence.

Regression Analysis:

In the realm of big data, understanding relationships between variables is paramount. Regression analysis reveals how one variable depends on one or more predictor variables. It helps identify patterns and predict outcomes, essential in fields like economics, marketing, and social sciences.

Cluster Analysis:

With the diverse range of data types within big data, identifying patterns and grouping similar data points becomes crucial. Cluster analysis helps uncover inherent structures, enabling businesses to segment customers and customize strategies.

Autocorrelation:

Autocorrelation in big data aids interpretation by identifying temporal dependencies and patterns within vast datasets. Analyzing how past data points relate to present ones helps uncover hidden trends and cyclic behaviors. This insight is crucial for making accurate predictions, optimizing processes, and understanding complex relationships within the data.

Time Series Analysis:

For data with a temporal dimension, time series analysis is pivotal. This technique uncovers trends, seasonality, and cyclic patterns, enabling predictions and informed decision-making over time.

3. **Challenges on the Path to Interpretation:**

Volume and Velocity:

The sheer volume of data generated daily can overwhelm conventional statistical tools. Additionally, the rapid velocity at which data is produced demands real-time or near-real-time analysis, necessitating advanced computational resources and techniques.

Variety and Complexity:

Big data is characterized by its diverse nature, encompassing structured, unstructured, and semi-structured data. This variety requires adapting statistical techniques to handle different data types, integrating tools like natural language processing and image analysis.

Veracity and Data Quality:

Data quality issues are prevalent in big data scenarios. Inaccurate or incomplete data can lead to skewed insights. Ensuring data veracity through data cleansing, validation, and quality control processes is paramount.

Value Extraction:

Extracting meaningful value from the data deluge is a challenge. Statistics plays a vital role in filtering noise, identifying significant patterns, and transforming data into actionable insights that drive informed decision-making.

4. Realizing the Transformative Impact:

The synergy between big data and statistical interpretation has catalyzed transformative changes across diverse domains:

Healthcare Revolution:

Statistical analysis of medical records, genomic data, and patient outcomes has led to personalized medicine, disease prediction models, and drug discovery, revolutionizing healthcare delivery.

Business Insights:

Businesses harness statistical interpretation to comprehend customer behavior, enhance marketing strategies, optimize supply chain operations, and predict demand patterns, leading to increased competitiveness and growth.

Financial Insights and Risk Management:

Financial institutions leverage statistical models to predict market trends, assess risk, and optimize investment portfolios, enhancing financial decision-making in an unpredictable market environment.

Urban Planning and Smart Cities:

Statistical analysis of urban data aids in designing efficient transportation systems, managing resources, and making informed decisions for urban development, ultimately leading to the creation of smart cities.

5. The Path Forward: Embracing the Power of Interpretation:

Interpreting big data through statistical methodologies is not a destination; it's a continuous journey. As data continues to flood in, the role of statistics becomes even more crucial. To effectively navigate this journey, organizations and individuals must:

Invest in Skill Development:

Equipping professionals with the necessary statistical skills is vital to extract accurate insights and drive innovation.

Adopt Advanced Tools:

Embracing advanced statistical software and technologies enables efficient analysis of big data and facilitates real-time decision-making.

Focus on Data Quality:

Ensuring data quality through rigorous data validation and cleaning processes is fundamental to generating reliable insights.

6. Conclusion:

In the era of big data, interpreting information goes beyond deciphering raw numbers; it's about unveiling patterns, discovering correlations, and transforming data into actionable wisdom. Statistics serves as the compass guiding us through the intricate labyrinth of information. With the right techniques, challenges addressed, and real-world applications understood, we can harness the true potential of big data and statistical interpretation, propelling us toward a future enriched with informed decisions and transformative advancements.

The Role of Regression Analysis in Predictive Modeling

Ashir Zaheer

Introduction

Predictive modeling is a powerful tool used across various fields to forecast future outcomes based on historical data patterns. Among the multitude of techniques available, regression analysis stands out as a fundamental and widely used approach. In this article, we will delve into the importance and role of regression analysis in predictive modeling, exploring its key components, advantages, and applications.

Understanding Regression Analysis

Regression analysis is a statistical method that examines the relationship between a dependent variable (the outcome we want to predict) and one or more independent variables (the factors that influence the outcome). It aims to establish a mathematical equation that best describes this relationship and can be used to make predictions for new data.

Simple Linear Regression

Simple linear regression is a statistical method used to model the relationship between two variables: a dependent variable (usually denoted as "y") and an independent variable (usually denoted as "x"). The goal is to find a linear equation that best fits the data, allowing us to make predictions for the dependent variable based on the independent variable.

The equation for simple linear regression is typically written as:

$$y = mx + b$$

where:

y is the dependent variable (the one we want to predict)

x is the independent variable (the one we use to make predictions)

m is the slope of the regression line, representing the relationship between x and y

b is the y-intercept, which indicates the value of y when x is 0.

To find the best-fitting line, the method of least squares is commonly used, which minimizes the sum of the squared differences between the observed y-values and the predicted y-values on the regression line.

In simple, Simple linear regression is a straightforward and commonly used technique in data analysis and predictive modeling

Multiple Linear Regression

Multiple linear regression is an extension of simple linear regression, where instead of having just one independent variable (x), there are multiple independent variables (x_1, x_2... x_n) used to predict a single dependent variable (y).

The equation for multiple linear regression can be expressed as:

$$y = b_0 + b_1 .x_1 + b_2 .x_2 + ... + b_n .x_n$$

where:

y is the dependent variable

x_1, x_2... x_n are the independent variables

b_0 is the y-intercept (the value of y when all independent variables are 0)

b_1, b_2... b_n are the regression coefficients for each independent variable, representing their respective contributions to the dependent variable.

Similar to simple linear regression, multiple linear regression aims to find the best-fitting line by minimizing the sum of the squared differences between the observed y-values and the predicted y-values based on the given independent variables.

Multiple linear regression is a powerful tool in statistics and data analysis, allowing us to understand how multiple independent variables collectively influence the dependent variable and make predictions based on their relationships. It's widely used in various fields, including economics, finance, social sciences, and machine learning.

Non-Linear Regression

Nonlinear regression is a statistical method used to model relationships between variables when the data doesn't follow a linear pattern. In contrast to linear regression, where the relationship between the dependent and independent variables is assumed to be linear, nonlinear regression allows for more complex and flexible relationships.

The general form of a nonlinear regression model is:

$$y = f(x, \beta) + \varepsilon$$

where:

y is the dependent variable

x is the independent variable(s)

β represents the parameters of the nonlinear function f()

ε is the error term, representing the discrepancy between the model's predictions and the actual data

The function f() can take various nonlinear forms, such as exponential, logarithmic, polynomial, sinusoidal, or any other curve that best fits the data.

Finding the optimal values for the parameters (β) in nonlinear regression typically involves using optimization algorithms to minimize the sum of squared errors or maximize the likelihood of the data fitting the model.

Nonlinear regression is useful when dealing with complex relationships in data, and it is commonly applied in various fields, including engineering,

physics, biology, economics, and environmental sciences, where linear models might not be sufficient to capture the underlying patterns in the data.

Advantages of Regression Analysis in Predictive Modeling

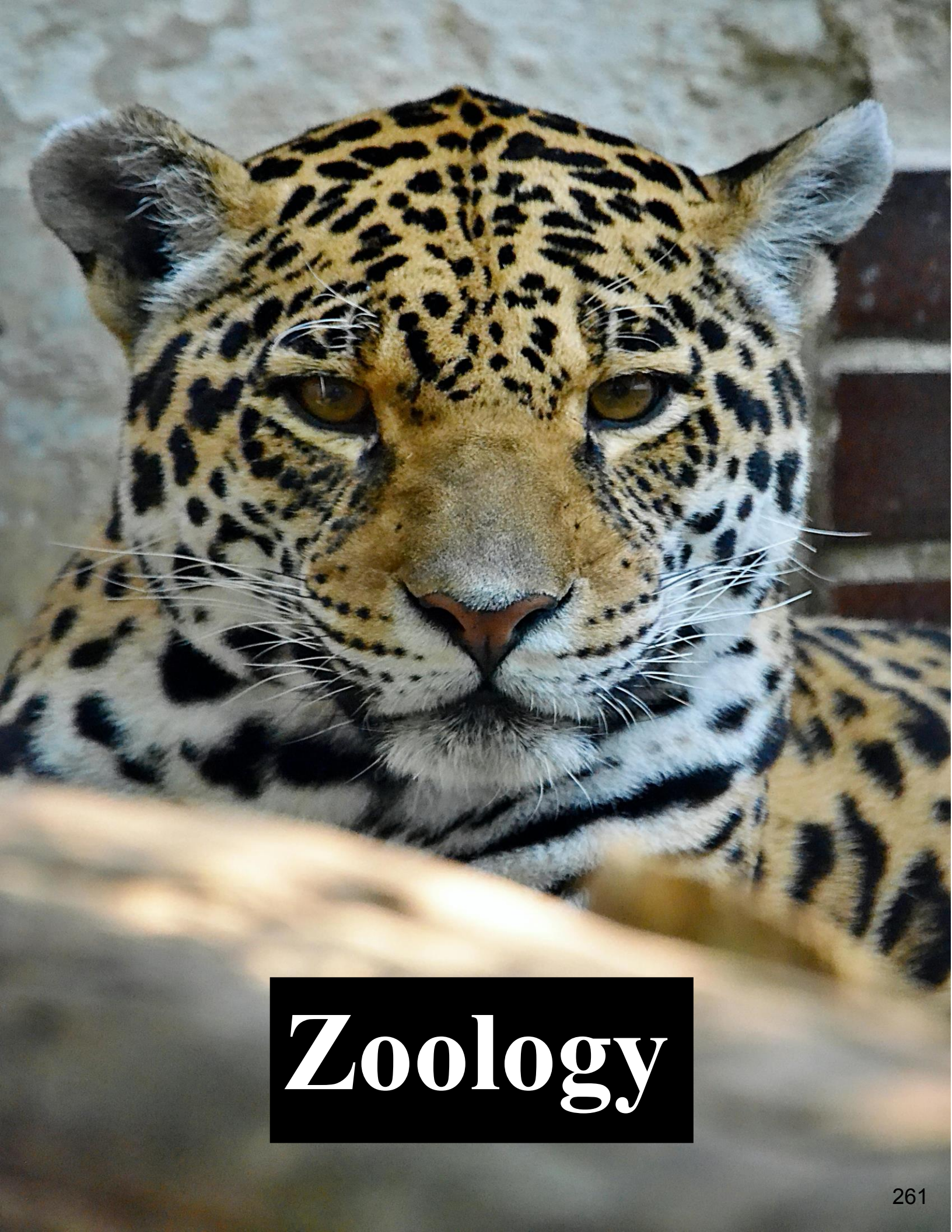
- **Interpretability:** Regression models offer a clear understanding of the relationships between variables, allowing analysts to interpret the impact of each independent variable on the dependent variable.
- **Flexibility:** Regression can handle various types of data, including continuous, binary, and categorical variables, making it a versatile tool in predictive modeling.
- **Feature Selection:** Regression analysis can aid in identifying the most relevant features that significantly influence the outcome, helping reduce dimensionality and improve model performance.
- **Assumptions Testing:** Regression analysis provides various diagnostic tools to test assumptions like linearity, homoscedasticity, and normality, ensuring the validity of the model.

Applications of Regression Analysis in Predictive Modeling

- **Economics and Finance:** Regression models are commonly employed in predicting stock prices, analyzing economic trends, and forecasting financial indicators.
- **Marketing and Customer Behavior:** Marketers use regression to understand customer behavior, predict purchase likelihood, and optimize pricing strategies.
- **Healthcare and Medicine:** Regression helps predict patient outcomes, assess risk factors for diseases, and understand the impact of medical treatments.
- **Environmental Science:** Regression models can forecast climate changes, assess environmental risks, and predict species' population dynamics.
- **Social Sciences:** Regression is utilized in fields like psychology, sociology, and education to understand social phenomena and predict behavioral patterns.

Conclusion

Regression analysis is a cornerstone of predictive modeling, playing a vital role in various domains. Its ability to establish relationships between variables, handle different types of data, and offer interpretability makes it a preferred choice for analysts and researchers alike. As technology advances, regression analysis continues to evolve, making it an invaluable tool in predicting and shaping the future based on the insights gleaned from past data.



Zoology

Zoology Timelines 2023

January, 2023

The Portuguese man-of-war (Physalia physalis) is among the most recognizable members of the neuston, relying on long tentacles and a powerful sting to paralyze prey in the open sea.

February, 2023

Previously, it was thought that a complex ecosystem would need five to ten million years to evolve after an extinction. However, the researchers found that the specimens in the Guizhou region evolved much quicker than that by using radiometric dating to date the rocks where the fossils were discovered. All of this has implications for our understanding of how quickly life can respond to extreme crises. It also necessitates a re-evaluation of early Triassic Ocean conditions," says Perrot, whose research focuses on earth sciences and geochronology.

March, 2023

Yellow-bellied marmots halt aging while they hibernate. If you picked up a hibernating yellow-bellied marmot, it would feel “like a cold, fuzzy rock,” With its metabolism slowed dramatically, the squirrel’s body temperature drops to a near-freezing 41 degrees Fahrenheit.

April, 2023

Researchers create embryo-like structures from monkey embryonic stem cells. Investigators now report on the creation of embryo-like structures from monkey embryonic stem cells. The investigators also transferred these embryo-like structures into the uteruses of female monkeys and determined that the structures were able to implant and elicit a hormonal response similar to pregnancy.

May, 2023

Junk food may impair our deep sleep. In a new study, researchers have investigated how junk food affects sleep. Healthy participants consumed an unhealthier as well as a healthier diet in a randomized order. After the unhealthier diet, the quality of the participants' deep sleep deteriorated, compared with those who had followed the healthier diet.

June, 2023

Catnip repels mosquitoes. Catnip and silver vine leaves host a cocktail of chemicals called iridoids, which induce a cat's endorphin "high" as they play. But iridoids also repel mosquitoes. After a cat simply rubs against or rolls in the plant, its fur becomes coated in these chemicals, warding off the blood-sucking insects.

July, 2023

The secret to an elephant trunk's dexterity is its skin. Using its trunk, an elephant can smell, communicate, store water, gather food, and eat. The appendage can forcibly tear foliage from branches or nimbly pick up a blade of grass. The key lies in the animal's wrinkly skin.

August, 2023

'Immortal jellyfish' thwart aging by being born again. The biologists from the University of Oviedo in Spain compared the species to one of its jellyfish relatives, revealing that the so-called immortal jelly has twice as many genes that repair and protect DNA. With these genes, the jellyfish can produce more restorative proteins. Telomeres, or chromosome-protecting bits of DNA, typically shorten with age. But the immortal jellyfish has genetic mutations that slow this shrinking.

September, 2023

Bull sperm traveling in groups have better luck. In a study of bull sperm, researchers from North Carolina A&T State University and Cornell created a fluid-filled environment that mimicked the conditions of a cow's cervix, uterus, and oviduct. Their analysis revealed bull sperm that swim in groups are better equipped to navigate a cow's reproductive system than sperm traveling alone.

October, 2023

Caterpillar spit breaks down plastic. Wax worms—the caterpillar larval stage of the wax moth—might revolutionize our response to plastic waste.

November, 2023

Springtails always land on their feet. To escape danger, they hurl themselves into the air, traveling at a speed of 280 body lengths per second. As they fly, they perform rapid twists and flips—and, like tiny gymnasts, they stick the landing.

December, 2023

Snakes have Clitorises, after all, Study Finds. Researchers visualize the snake clitoris in detail for the first time, finding evidence that the organ may be evolutionarily important for snake sex.

THE BLIND INDUS DOLPHIN

Muhammad Haris

0732-BH-E-ZOO-20

Introduction

In the flow of the Indus River, where history and ecology come together, amazing creatures navigate a world shrouded in darkness. The blind Indus dolphin (***Platanista minor***) is a species of freshwater cetacean that has fascinated researchers, conservationists, and nature lovers alike for centuries.

The Indus River Dolphin also known as *Bhulan* in Urdu and Sindhi, is a species of toothed whale in the family Platanistidae. It is endemic to the Indus River Valley of Pakistan and northwest India. This dolphin was the first cetacean to be discovered swimming sideways. He is distributed patchily into five small subpopulations, separated by irrigation dams.

From the 1970s until 1998, the Ganges dolphin (*Platanista gangetica*) and the Indus dolphin were considered separate species. However, in 1998 their classification was changed from two separate species to a subspecies of one species. However, recent studies have shown that they are separate species. It is designated as the **national mammal of Pakistan** and the national aquatic animal of the Indian state of Punjab.

Figure 1; The long jaws and deep brain pan of the Indus River dolphin are visible from this skull cast.

I. The Blind Indus Dolphin: A Unique Species

Physical Characteristics

The blind Indus dolphin, distinct from its marine cousins, boasts unique physical characteristics. Its most striking feature is its blindness, with small, non-functional eyes that lack lenses. These eyes, vestiges of its evolutionary past, tell a story of adaptation to life in the murky waters of the Indus. The dolphin's body is elongated and streamlined, designed for agile movement in its aquatic realm. A pronounced hump on its back and a large, triangular dorsal fin are key features that set it apart. Its skin is typically a pale greyish-brown, blending seamlessly with the river's muddy waters.

Figure 2; Dolphin’s leaping

Habitat and Range

The blind Indus dolphin is an exclusively freshwater species, found solely in the Indus River system, which flows through Pakistan and India. Historically, they roamed widely, from the Himalayan foothills to the Arabian Sea. However, due to habitat degradation and fragmentation, their current range is more restricted.

Figure 3; Ranges of the Indus River dolphin and Ganges River dolphin

II. The Challenges Facing the Blind Indus Dolphin

Habitat Degradation

The Indus River has undergone extensive modification due to human activities. The construction of dams, irrigation canals, and barrages has drastically altered the river's flow dynamics, leading to the degradation of the dolphin's natural habitat. Reduced water flow, disrupted migration patterns, and diminished prey populations have all contributed to the species' decline.

Water Pollution

The Indus River faces severe pollution challenges, stemming from industrial and agricultural runoff, sewage discharge, and the use of pesticides. The accumulation of toxins and heavy metals in the water has dire consequences for the health of the blind Indus dolphin, making them more susceptible to diseases and reproductive issues.

Fisheries Bycatch

Commercial fisheries operating in the Indus River inadvertently capture these dolphins in their nets. Such entanglements result in injuries and fatalities among the already dwindling population.

III. Conservation Efforts for the Blind Indus Dolphin

The Indus River dolphin is listed by the IUCN as endangered on their Red List of Threatened Species and by the U.S. government National Marine Fisheries Service under the U.S. Endangered Species Act. It is the second most endangered cetacean in the world. As of 2017, it is estimated that only about 1,800 individuals remain (up from 1,200 estimated in 2001). A demonstrable increase in the main river population of the Indus subspecies between 1974 and 2008 may have been driven by permanent immigration from upstream tributaries, where the species no longer occurs. Today, the species is only found between the Jinnah and Kotri barrages of the Indus.

Research and Monitoring

Dedicated researchers and conservationists have embarked on extensive studies to unravel the mysteries of the blind Indus dolphin. These efforts aim to better understand their behavior, habitat preferences, and the various threats they face. A deeper understanding forms the basis for more effective conservation strategies.

Habitat Restoration

Conservation initiatives have prioritized habitat restoration as a critical component of preserving the species. Activities include the removal of illegal fishing nets, efforts to improve water quality, and the establishment of protected areas along the river where the dolphins can thrive free from human interference.

Public Awareness

Raising public awareness is a cornerstone of conservation efforts. Local communities, along with national and international organizations, have engaged in educational programs to foster an understanding of the importance of preserving the blind Indus dolphin and promoting responsible use of the river's resources.

Policy and Legislation

To safeguard the blind Indus dolphin, policies and legislation have been put in place. These measures include stricter regulations on fishing practices, the creation of legal frameworks for the conservation of this endangered species, and the enforcement of penalties for those who violate conservation laws.

IV. The Significance of Preserving the Blind Indus Dolphin

Biodiversity

The blind Indus dolphin is an integral part of the complex Indus River ecosystem. Its presence serves as an indicator of the river's overall health. By preserving this species, we also protect other aquatic life and ensure the continued existence of a diverse range of species within the region.

Cultural and Ecological Significance

The blind Indus dolphin holds cultural and spiritual significance for indigenous communities residing along the Indus River. It has been revered for centuries, and its well-being is deeply intertwined with the traditions and beliefs of these communities.

Economic Impact

A thriving population of blind Indus dolphins can have economic implications as well. The presence of these unique creatures can attract eco-tourism, which can benefit local economies and provide employment opportunities for the communities living along the river.

Conclusion

The blind Indus dolphin, with its unique adaptations and indomitable spirit, symbolizes the intricate dance of life in one of the world's most challenging environments. It is a species that has not only survived but thrived in the face of adversity. As we navigate the complexities of our modern world, it is our responsibility to ensure that this remarkable creature continues to grace the waters of South Asia.

The plight of the blind Indus dolphin serves as a stark reminder of the consequences of habitat degradation, pollution, and overexploitation of natural resources. By addressing these issues and embracing a sustainable approach to river management, we can secure a future for not only the blind Indus dolphin but also countless

other species that call this unique ecosystem home.

The blind Indus dolphin is more than a symbol of resilience; it is a call to action. It beckons us to recognize our role as stewards of the environment and to safeguard the biodiversity that enriches our world. In doing so, we ensure that this enigmatic creature's journey through murky waters continues for generations to come, inspiring wonder and reminding us of the beauty and fragility of life on Earth.

ALL ABOUT THE FEEDING HABITS OF TOOTHLESS OCEAN GIANTS, BALEEN WHALES

Qudsia Noor

The earth has always been full of wonderful creatures from giants like dinosaurs to microorganisms. It is said that most mysterious creatures inhabit waters and many of them are still undiscovered due to the great depths of oceans. In similar waters are found the world's largest mammals, the Baleen Whales. We are well familiar with whales. Some people may fear them because of their gigantic sizes and associated mythical stories of hunting and killing. But the fun fact is that there exist a class of whales with throat size 4 to 8 inch and no teeth. These are Baleen whales, the world's largest group of mammals, and the ocean giants. Now you must be wondering, what they eat and how.

Being the world's largest mammals, the diet of these whales must be by their huge size to meet up their needs. These mightiest creatures feed on the smallest species found in the seas and oceans. Zooplankton, phytoplankton, krill, shrimps, crustaceans, and small fish are among their favorites. Different species of them eat different diets. Right whales often eat zooplankton and Blue whales mostly eat krill. Nature has its way of making the survival of these huge animals possible.

Figure 1. A humpback whale feeding

Baleen whales lunge feed. They spend about 4 to 6 months feeding in the summer. Most of the time, they travel and hunt in groups. They make their prey gather at a point and then invade them with their mouth open at 90 degrees, gulping a large amount of water along with the prey. Food intake increases during the feeding season. While in winter they do not eat much and spend their time in migration and breeding. It is estimated that a whale can eat 4% of its body weight every day in the feeding season. For example, a blue whale can eat 3600 kg of krill each day and it takes 1000 kg of the food to fill its stomach fully. Gray whales can eat 1089 kg of food daily during the feeding season. Excess energy is stored in the blubber layer in the form of fat. Gray whales can gain about 16 to 30 %

weight in their feeding season. It is important because this energy can be used in the future when there is little food.

The throat of these whales is not large and is considered the smallest when compared to the body mass. There are 90 known species of whales on earth out of which only sperm whales (that are not baleen) technically have large enough throats to swallow a human. Baleen whales are never able to swallow larger food or humans even if they get stuck into their mouths. They have the smallest throats about 4 to 8 inches in diameter which is one of the main reasons for feeding on small organisms. An interesting fact is that the size of the aorta of a blue whale, which is 9 inches, is larger than its throat.

Figure 2. bubble net of humpback whale

Different species of baleen whales use different methods to herd their prey. Most of the whales work in groups to gather their prey, and humpback whales weave a bubble net. They dive deep down and start to move spirally while blowing bubbles through their blowholes. These bubbles while coming to the surface make a tubular net, and then the whale surfaces right in the middle with its mouth wide open to gulp the entrapped prey. Besides being a unique way and strategy to capture food, the view looks mesmerizing too it has been captured by drones many times.

In their mouth is a baleen that comprises baleen plates in place of teeth. These plates are present in rows in their upper jaw and are the reason for their name. Baleen is used as a sieve to retain the prey and filter water out. Over the baleen plates are bristles that resemble the teeth of a comb and are very hard. There may be 150 to 400 baleen plates on each side of the mouth of a baleen whale depending on the species. Baleen wears and tears similarly to human nails and hair. New ones keep on replacing the old ones. Once the food is trapped in baleen the whale pushes the water out of the mouth as its throat pouch deflates. There is a unique flap and fat at the back of the mouth to

Figure 3. baleen in the mouth of a whale

eat without choking on water. According to a report in the New York Times this structure was never seen in any animal before. Then the throat groove contracts and the water is forced the leave the mouth from the sides. The tongue is used as an accessory organ to push food towards the throat for swallowing. In this way, water is pushed out and trapped food is taken in.

Due to the presence of baleen and small throat, baleen whales can only rely on small food. One could have never imagined that the largest mammals on earth feed on such small creatures, yet they are enough to provide nutrition to their huge bodies. Baleen whales are not harmful at all and considered friendly. One can go swim with them and they are often seen interacting with people. No reported cases have been found of deaths by them. Only a few reported cases of injury are found that occurred due to the negligence of a diver who went too close to these whales during diving. Apart from this, people are always eager to see these mesmerizing huge whales when there is a chance.

BLACK VULTURE – NATURE-FRIENDLY BIRD

Ahmad Nawaz

0623-BH-E-ZOO-19

Among the species of vultures, the American black vultures are the only ones that are most abundant in the New World. The scientific name of the black vulture is *"Coaragyps atratus"*. Like other vultures, the American black vulture also has a featherless head and neck. The head and neck of the black vulture are **black and grey**. The overall body colour of the black vulture is black with the special white patches present on the wingtips. The white patches can be seen when the vulturespreads its wings and flies. The black vulture is theonly species that is considered a **socialbird** because they are loyal to their family. They share their food with their family and relatives and after the fledging of the young chicks they feed them for months so they are friendly large birds. These black birds are social because they form family units with their kin and extend their family. It is observed that the average lifespan of a blackvulture is **10 years** and some of them live upto **25 years.** Tropical and temperature zones are the main areas where these black vultures live. These large black birds are mainly distributed from **Southern Canada** to the south of **South America.** They are also distributed in some parts of us. Some of the species that live in the north range usually migrate to the southern areas during the **fall season.** They return to north-range areas in the **spring season.** According to their distribution, it is noticed that black vultures prefer an open habitat environment.

Most of the vultures are carnivores but the black vultures are mainly **scavengers** and carnivores. They eat up the carcasses of the larger animals and sometimes eat the leftovers of the small dead mammals. So,they are **nature-friendly birds.** Black vultures usually hunt their prey in the late morning with the help of their sight. In the dietand nutrition of the black vulture, they Mainly hunt and eat domestic ducks, newborn calves, small birds, and mammals. Itis an interesting feature of black vulturesthat they **kill the babies of the herons** in their nest colonies in addition these species also eat rotten vegetables, fruits, and young turtles.

The American black vultures are

monogamous species in which both male and female pair mates are present. During the season of the breeding the male and female form an aerial courtship display. In this display, both males and females chase eachother and circling flight and after that, they alight on the land for mating. Some of the pairs of black vultures spread their wings jumped in front of each other and made **yapping noises** to attract the other mates. The breeding season of the southern black vultures starts early in **January.** The breeding seasons of the northern black vultures start from **March to June.** It is a very interesting fact that black vultures do not build their nests. These vultures use natural cavities such as caves, trees, and hollow logs for laying their eggs. After breeding these species only lay two eggs in natural cavities. The **incubation period** of these eggs is **438 to 45 days.** These eggs are incubated by both parents by taking turns every day. After hatching the parents feed thechick with liquefied food. After two weeks When a chick becomes young, it is fed with solid food. The chick is fed by the parents**20 times a day.** After **10 to 14 weeks** the chick fledged and depends on the parents foreight months.

According to **IUCN** the population of the black vulture is about **20 million** and **IUCN** included this species in the red list because their population is increasing day by day. **8%** of the species lives in **Mexico** and **9%** of this species lives in **North America.** Black vultures also play an important role in the ecological niche of the environment as they eat up dead animals and remove them. The nutrients are also recycled by these blackvultures and used by the plants. This means that the black vulture is a **nature-friendly bird**.

SYDNEY FUNNEL WEB SPIDER

Rimsha Ashraf

0810-BH-Z-19

Spiders are the beautiful creatures of nature. The most prevalent and diversified group of terrestrial predators on the planet is the spider inhabiting six out of seven continents. There is a huge variety of amazing spiders on this planet. Some spiders are like mirrors known as mirror spiders belong to the genus thwaitesia, some are called peacock parachute spiders having purplish blue colored metallic legs, some are called zebra siders, some are called ladybird spiders, and so on. Among the most intelligent

The beauty of the mirror spider reflects silver plates on the abdomen

successful and beautiful creatures, the spiders are also denigrated as being nasty

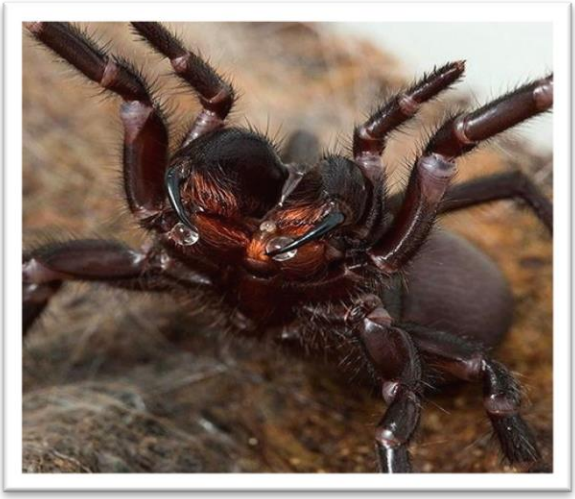
and frightful. They are also called poisonous arthropods belonging to the class arachnid. There are approximately more than 45,000 species of spider out of which 40 different species could be fatal to people because of their venomous nature. The world's largest and most dangerous spiders are found in Australia and South America named as Sydney funnel-web spider. These spiders appeared 400 million years ago. All spiders can produce silk which is used for birds to bind their nests. These spiders are named so because they produce long silk threads and funnel into the burrow to form funnel-shaped webs and due to their presence in the Sydney region of Australia. These aggressive black spiders have a solitary nature and females live in funnel-shaped burrows, in rocks throughout their lives. These burrows are 30cm-60cm deep in the ground. The males are more active and are Nocturnals. Since 1920, several fatalities caused by these ferocious spiders have been documented in the Sydney region of Australia. A total of 13 fatalities were caused by the Sydney spider, and it killed seven children at that time. Out of 45000 species, 2000 species of Sydney web spider are present in Australia.

The males leave their webs only when they become mature. The venom of the male spider is five times more poisonous than the female funnel-web spider which is why all bites, serious sicknesses, and deaths in people are due to the venom of the male spider if left untreated. Atrax Robustus is one of the most dangerous species of Sydney funnel-web spider globally due to the presence of the unique component Robustoxin in its venom. Scientists have been perplexed by the fact that these toxins are so fatal to people. Although this spider's fangs are merely an inch long, its jaws are highly developed. The Sydney spider can bite down with its heavily muscled jaws with such ferocity that its teeth can penetrate the skull of a small animal and inject venom into the victim's brain.

Sydney funnel web spider: showing its impressive venomous fang

One interesting thing is that this creature has substantially much larger fangs than the fangs of a brown snake. Fangs are deep red in color and body color is black shiny and dark brown. They extend their hind legs and expose their teeth while fighting. This is usually done to show their aggressive

behavior to predators. The body size, shape, body color, and web pattern vary from species to species. The body size ranges from 5cm to 10 cm and females are Larger than male Sydney funnel-web spiders The chemical neurotoxin Atratoxin found in the venom of Sydney funnel-web spider targets the nervous system of humans and monkeys. It has also adverse side effects on different body organs. The venom from the Sydney funnel-web spider can incur death in just 15 minutes without treatment. Their sharp fangs can pierce objects like soft-soled shoes, fingernails, and toenails. Bites from the Atratoxic venom cause breathing difficulty, swelling around the bite and in the mouth, unconsciousness, cramps, abdominal pain, hives on the body, shivering, and vomiting. One amazing thing is that antivenom is present and is prepared from the spider's venom which helps in faster recovery of the victim. The antivenin was prepared in 1980. Each year 30-40 bites have been recorded. Sydney funnel-web spiders prey upon small vertebrates such as beetles, cockroaches, lizards, and snails. Unlike some jumping spiders, the funnel web spider does not jump but moves fast and sometimes jumps. One interesting thing is that Sydney web spiders use energy to produce their venom, so they use it very carefully and bite only when they are threatened. The deadliest Sydney spider venom is like water droplets. Discussing their life span the female Sydney funnel web spiders may live up to 20 years or longer but males have shorter life spans. Despite their deadliest nature, the Sydney funnel-web spiders are kept as exotic pets by some people.



Deadliest Sydney spider venom droplets

THE IMPACT OF CLIMATE CHANGE ON ANIMAL BEHAVIOR

Ammarah

Introduction:

Human activities are causing rapid and significant transformations in environments worldwide. The destruction of natural habitats, the introduction of non-native species, pollution, climate change, and overharvesting are altering the living conditions of various species (Blowes et al., 2019; Ceballos et al., 2015). These changes have both direct and indirect impacts on species, including interactions with other affected species and changes in non-living environmental factors (Gilman et al., 2010; Tylianakis et al., 2008a). The resulting impacts on population dynamics

can affect the structure, function, and stability of ecosystems. Ecosystem stability is the ability of an ecosystem to resist change or return to its original state following a disturbance (Ives & Carpenter, 2007).

Changes in the environment often affect populations through the behavioral responses of individuals, especially in the early stages of environmental change, before evolutionary changes occur (Tuomainen & Candolin, 2011; Wong & Candolin, 2015). These responses can be direct, such as moving away from disturbed areas, or can result from changes in physiology or life history traits, such as increased stress levels or reduced size at maturity. These behavioral changes can also impact other species in the community, creating cascading effects that propagate through species interactions (Bartley et al., n.d.; Hoover et al., n.d.; Palkovacs et al., n.d.; Tylianakis et al., 2008b). These indirect effects can often have a greater impact on species than the direct effects of environmental change (Ockendon et al., 2014). Feedback among species and time lags can further complicate the impact of these behavioral responses, resulting in complex changes to the species community.

The effects of behavioral responses of individuals on ecosystem function and community structure vary depending on the species' abundance and traits, with certain species having a more significant impact than others, such as dominant species (Avolio et al., 2019), keystone species (Paine, 1966; Power et al., 1996), ecosystem engineers (Jones et al., 1994; Wright et al., n.d.), and foundation species (Ellison, 2019). Such species are known as 'biotic multipliers' (Urban et al., 2017; Zarnetske et al., 2012). Studying these species and their behavioral responses can provide valuable insights into the mechanisms underlying the effects of environmental disturbances on ecosystems (Urban et al., 2017).

The purpose of this article is to present an overview of our current understanding of how changes in the behavior of ecologically significant species impact species interaction networks, ecosystem structure, function, and stability. A conceptual framework is provided to establish a connection between behavioral responses and species interactions, communities, and ecosystems, while also discussing the variables that influence these connections. The focus is on the critical role of behavioral responses from biotic multipliers in mitigating the effects of environmental change on ecosystems. The article then outlines the effects of different environmental changes on species behavior and how they influence species interactions and community composition. The article also describes how alterations in individual behavior and species interactions can impact ecological processes, including biogeochemical cycles, biodiversity, ecosystem stability, and services. Finally, the article concludes by identifying critical research areas and priorities for the future.

Climate Change Affects on Animal Behavior:

A group of researchers from the University of Helsinki and Lancaster University conducted a study to determine the behavioral traits of animal species that are most affected by human-induced environmental changes. They collected data on over one hundred animal species, including fish, birds, crustaceans, mammals, insects, amphibians, and lizards, and analyzed which changes in the environment had the most significant impact on their behavior. The researchers studied the sensitivity of the animals to human-induced environmental changes, ranging from the largest to the smallest organisms (Gunn et al., 2022).

The University of Helsinki and Lancaster University jointly conducted a research study on over one hundred animal species to identify which behavioral traits are most sensitive to environmental changes caused by humans. The study comprised a variety of organisms ranging from fish, birds, crustaceans, mammals, insects, amphibians, and lizards. The researchers found that all behavioral traits, such as aggression, activity, boldness, sociability, and exploration, underwent significant changes due to human-induced environmental changes (Gunn et al., 2022).

"The biggest change was seen in the animals' activity in exploring their environment. Animals have a strong response to all forms of environmental change, but climate change engendered the greatest change in animal behavior," says Postdoctoral Researcher Petri Niemelä from the Faculty of Biological and Environmental Sciences, University of Helsinki (Gunn et al., 2022).

Along with climate change, the researchers also considered other types of environmental changes caused by humans such as changes in the levels of carbon dioxide and nutrients, introduction of non-native species, and other biotic changes caused by human activities. They also examined the direct impact of human activities such as urbanization and other disturbances (Gunn et al., 2022).

Alterations in the behavior of animals, such as their level of activity, are frequently the first signs of change initiated by climate change (Gunn et al., 2022).

"Behavioral change can serve as a buffer with which animals avoid the immediate negative effects of environmental change. For instance, such change can compensate for low reproductive success or increased mortality caused by environmental change. By changing their behavior, animals can also gain more information on the altered environment."(Gunn et al., 2022)

In September 2021, a study was published in the OIKOS international journal series as an open-access publication by researchers from the University of Helsinki and Lancaster University. The study was based on a survey of more than a thousand scholarly, peer-reviewed publications, from which data were collected on a little over a hundred animal species for analysis (Gunn et al., 2022).

Conclusion:

More research is needed, but existing studies have shown that climate change will have an impact on animal health and welfare. Global

warming, extreme weather events, and droughts caused by climate change may lead to heat stress, high air temperatures, and other factors that could adversely affect the health and welfare of animals. These effects may be caused by direct or indirect mechanisms. It is necessary to develop and employ tools and techniques to create an animal disease surveillance system that incorporates relevant climate conditions. To improve the prevention of diseases, as well as the mitigation and adaptation responses of animals to heat stress, it is important to create and implement a methodology that connects climate data with disease surveillance systems. To mitigate the impacts of climate change on animal behavior, we must take action to reduce our greenhouse gas emissions and limit global warming. This can be accomplished through a variety of means, including transitioning to renewable energy sources, improving energy efficiency, and implementing policies that incentivize conservation and sustainable resource use. By working together to address this urgent challenge, we can help to protect the rich biodiversity of our planet and ensure a sustainable future for all (Lacetera, 2019).

EDITORIALS

ASSOCIATE EDITORS' NOTES

BIOTECHNOLOGY

I am humbled to address you as Associate Editor of the Scientific Ravi. In this role, I am entrusted with the responsibility to present the most compelling narratives in science. Scientific journalism bridges the complex gap between a seasoned scientist and curious minds through data which is more relevant and accessible. The Scientific Ravi embodies the essence of scientific journalism and its profound impact on the university community and the broader audience beyond these walls. I have had the privilege to work with my advisor Dr. Muhammad Tayyab Akhtar, collaborators and the editorial team who worked hard to ensure that every piece of article acquired the highest accuracy and quality.

Aqsa Khalid

Associate Editor

BOTANY

Frequently, students seek a platform to express their creative thoughts and share their viewpoints. Fortunately, Scientific Ravi has not only granted me this opportunity but has also done the same for countless other passionate writers. Serving as an associate editor at Scientific Ravi was a genuinely honourable experience. In this particular edition, you'll come across compelling articles that delve into new discoveries, cutting-edge techniques, and fascinating insights across various Botany subfields. I am hopeful that everyone will derive great enjoyment from the articles by botany students. Lastly, I would like to extend my gratitude to my teachers for believing in me for this prestigious work.

Syeda Shehwar Zahra

Associate Editor

CHEMISTRY

As the associate editor for Scientific Ravi's chemistry section, I'm honoured to introduce this issue by exploring the intricate world of molecules and reactions. Chemistry, often called the "central science," connects the physical and fundamental forces shaping our universe. I'm grateful for my supportive team and extend special thanks to my advisor, Dr. Mushtaq, and editor, Mr. Shahzaib Ali. My Alma Mater, Govt. College University, holds a special place, providing invaluable lessons, opportunities, and cherished memories.

Nehal Fatima

Associate Editor

COMMERCE AND FINANCE

As a GC University student, I'm at the nexus of knowledge and exploration. This institution fuels intellectual growth and personal development. This magazine showcases diverse talents and groundbreaking ideas from our campus. It's a testament to our commitment to academic excellence, reflecting the depth of research and creative spirit our students bring. Join me on this journey of discovery. Happy perusing!

Naila Arshed Javad

Associate Editor

COMPUTER SCIENCE

Computer science is a dynamic and vital field, driving rapid innovation. It's reshaping our world profoundly. As practitioners, we hold a duty to apply our expertise for the greater good. This means crafting tech solutions for real-world issues, nurturing the next wave of computer scientists, and championing ethical tech use. Together, we forge a future where computer science fosters equity, sustainability, and prosperity for all.

Ashna Baig

Associate Editor

ECONOMICS

Since I took the responsibility of an Associate Editor, it has been a year of exciting and trying moments. Thanks to the countless blessings of Almighty Allah, he chose me for this job. From the very start, the journey has been the amalgam of a consistent learning process, experiences, and excitement to work on new dimensions. Besides the contribution to this holistic magazine of the university, the journey has added valuable traits to my personality, as I discovered new horizons of communication and leadership. The invaluable contribution of my teachers has been the key element of my professional growth. I would like to particularly thank my eternal mentor Dr. Alvina Sabah Idrees for putting trust in my abilities. As I reflect, it has been a wonderful interaction with all the authors who sent their writings to get published. I alongside my Advisor have put in a lot of effort in reviewing the articles thoroughly, and I want to assure you that we have tried our best to get full transparency in the process. I pray for the timely publication of the magazine and aspire that merit and excellence be its core features. May Allah Almighty have His mercy and blessings upon us. Ameen.

Wajahat Usman

Associate Editor

ELECTRICAL ENGINEERING

As the Associate Editor of Scientific Ravi Magazine, I oversee the Electrical Engineering section. In a world of rapid change, this initiative is a vital tool for staying abreast of new technologies, ensuring that our readers remain informed and empowered for the future.

Abdur Rehman Ijaz

Associate Editor

ENVIRONMENTAL SCIENCE

As I sit down to pen this editorial note, I am truly privileged, honoured, and overwhelmed with gratitude that I got an opportunity to be recognized as one of the associate editors of “The Scientific Ravi”. With your continued support, we are excited about the journey ahead. Here's to many more exciting issues and memorable moments. Happy Reading!

Hamdia Mahmood

Associate Editor

INTERMEDIATE

Being the youngest member on board, I can safely say it was the most unexpected and transformative part of my journey within GCU. The Scientific Ravi serves as an amalgamation of multiple aspects, a tapestry or stained-glass window that annually depicts the tireless efforts of the students and faculty. I thank Miss Mina and our editor, Mr. Shahzaib whose constant guidance served as the foundation of the Magazine.

M. Yousaf Riaz

Associate Editor

MICROBIOLOGY

Exploring the world of microbes has been a privilege. Microbiology reveals the hidden impacts of these tiny entities. They're both allies and challenges, emphasizing our interconnectedness. Let's celebrate these stories and stay curious.

Mariyam Siddique

Associate Editor

PHYSICS

Education is the foundation of a civilized society and the key to unlocking our full potential. Excellence is the pursuit of the highest standards in all that we do, and determination is the unwavering commitment to achieving our goals, no matter what obstacles we may face. Physics is essential for many fields and solving the world's problems. As an associate editor of a physics journal, I am committed to promoting excellence in physics research and education. I believe that education, excellence, determination, and exceptional work are essential for success in any field. I am committed to these values, and I am proud to be a part of the academic community.

Talha Shehzad

Associate Editor

PSYCHOLOGY

As the Associate Editor of the long-established “Scientific Ravi,” I had a chance to integrate my love for understanding the complexities of the human mind and behavior and for enhancing my literary abilities. I have tried my best to gather and draft articles that would help the readers view the subject of Psychology in a rather rational and reasoned way. I feel immensely honored to be a part of this prestigious magazine and the esteemed traditions of Government College University.

Fatima Saleem

Associate Editor

STATISTICS

It is with great enthusiasm and pride that we, the Statistics Department, welcome you to the latest edition of our university magazine, The Ravi magazine. Statistics, often called the science of uncertainty, holds a significant role in our lives. Join us on this thrilling journey through the world of statistics. We can't wait to share our passion for data and its remarkable impact on our world.

Rimsha Ali

Associate Editor

ZOOLOGY

I am immensely proud to be the Associate Editor of the Scientific Ravi magazine, where I honed my thinking and writing skills by curating articles from fellow Zoology Department students. Witnessing a decline in reading interest among students, I encouraged them to write and engage with literature. My gratitude goes to my advisor, Professor Dr. Atif Yaqub, and Editor Mr. Shahzaib Ali for their unwavering support. Thanks to all contributing students, our collective efforts aim to empower young zoologists.

M. Haris

Associate Editor

COURAGE TO KNOW