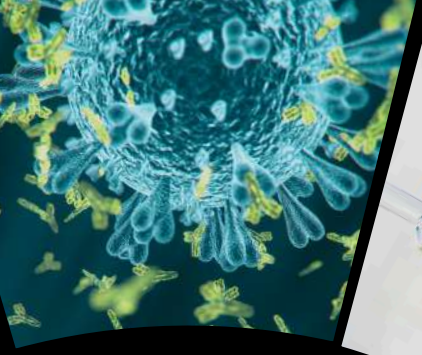
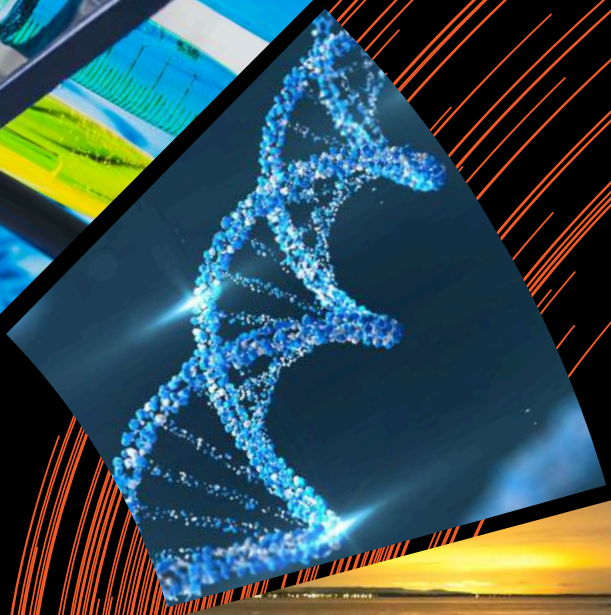
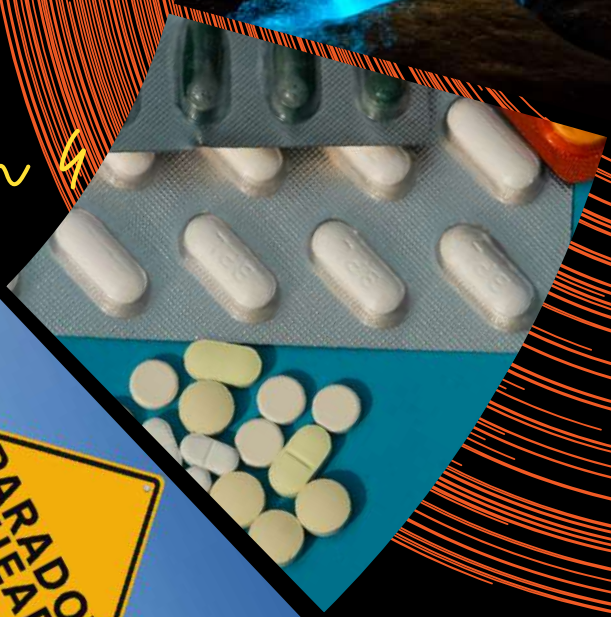




The Catalyst

2024

#Edition 4



"In Pursuit of Insight: The Endless Journey of Learning and Discovery."

INDEX

Dear Readers

Welcome to the eagerly anticipated fourth edition of The Catalyst. In a world that never stops evolving, we are committed to delivering the stories that illuminate the breakthroughs, challenges, and wonders shaping our future. This issue is not just a collection of contents but an invitation for you to explore the unknown and to get to learn more about the cutting-edge technologies and researches that are pushing the boundaries of human knowledge.

In this edition you will explore technologies that can revolutionize medicine like 3D-Bioprinting, Organ-on-a-chip and Personalized medicines. The edition also highlights the concept of CAR-T Cell therapy and how it made our nation proud recently. You can delve into various interesting contents as per your interest. Checkout the gore section if you want to know about the dark side of science and diseases section if you wish to know more about some rare disorders.

We are thrilled to feature an insightful interview with Dr. Mrinmayee Bapat, our star student, which offers a unique glimpse into the life of a rising scientist. We hope that you learn something new and insightful as we have curated a selection of content designed to inform and update. Furthermore, we sincerely hope each article will ignite your curiosity and help you deepen your scientific understanding.

Happy reading!

Warm Regards,
TEAM CATALYST

PRINCIPAL's DESK

DR. B. A. MEHRE

PRINCIPAL OF DR. AMBEDKAR COLLEGE, NAGPUR

We want that education by which character is formed, strength of mind is increased, the Intellect is expanded, and by which one can stand on one's own feet"
-Swami Vivekananda

History echoes to us that those who have courage to imagine the impossible are the few unique personalities who broke all human limitations of thought and action.

The biggest challenge we are facing today is to prepare students for a globalized world. In today's world, knowledge is not limited to the classroom. Genuine concern of our institution is to ensure students emotional growth along with intellectual excellence. It gives me an immense pleasure as Department of Biochemistry and Biotechnology. Dr. Ambedkar College, Deekshabhoomi, Nagpur is bringing out its first departmental magazine "Catalyst" exclusively meant for latent writing talents with invaluable potential.

I congratulate all the contributors and editorial board for this revolutionary creation. I am sure that the activities associated with the launch of the magazine will improve organizational skills and leadership qualities of student, which are essential for their career development.

"Education is the most powerful weapon which you can use to change the world."
-Nelson Mandela

HOD'S DESK

DR. U. J. DONGRE

HEAD & ASST PROFESSOR OF BIOCHEMISTRY AND BIOTECHNOLOGY DEPARTMENT

The moto to release such magazine is to percolate what research activities (UG and PG level), extracurricular activities, teaching and value added courses are going on in the department. This magazine gives you a basic idea about research and help students in their future perspectives.

Indeed, publishing such a nice magazine at departmental level by students and for the students explains the interest, enthusiasm, dedication, and involvement of all students for the subjects. Taking initiative of design and development of this magazine by students and for the students explains, that our teachers are on the right path of providing in-detail subject knowledge to the students and this magazine is an outcome of this.

So, I congratulate all organising team members of this magazine and all students of department of Biochemistry and Biotechnology for having such a great activity and also wish to carry and transfer this to upcoming students of the department. I am always here to help you at any level for such activities.

Thank You.

TEACHER'S CORNER

A motivating attribute-

To all the young achievers of catalyst:

As your teacher, I'm elated to see the outcome of tireless efforts in this magazine. Your varied abilities, diverse perspectives, and unwavering dedication are readily apparent on every page. You've developed a masterpiece that speaks volumes about your abilities, weaving your knowledge, creativity, and excitement into each word.

Remember that this magazine is a jubilation of your courage in sharing your thoughts with the world, as well as a platform for you to articulate your opinions. You have demonstrated the strength of collective expression and have something valuable to contribute to the production of this publication.

As you continue on your journey beyond this project, I urge you to never let your flames flicker. Continue to pique your interest, sharpen your talents, and embrace the challenges that lie ahead. Remember that the world needs your distinctive voices, novel viewpoints, and invincible desire to make a distinction.

Never fail to acknowledge the power of your influence. This catalyst magazine serves as a testament to the brilliance you possess—you are the future. Continue creating, envisioning, and pushing boundaries. We all look forward to your efforts, and I have no doubt that you will continue to astound us.

With pride and admiration,

Rita Lakkakul

Assistant Professor

Department of Biochemistry and Biotechnology,

Dr. Ambedkar College, Deekshabhoomi, Nagpur.

"Every magazine is a window into a world of discovery—flip through and find your inspiration."

Ignited MINDs

EXPERIENCE TO THE FULLEST

A working model competition was held by Dr. Ambedkar College, Deekshabhumi, Nagpur, in honor of National Science Day. Participating in the competition, the further mentioned students gave it their all. They attribute it all to their entire department, which helps students whenever they need it. All the student models were superb, *and the 3D bioprinter took home the top honor prize!*

from left to right - Harshita Hingenkar, Ms Rita Lakkakul, Diksha Dayma, Muskan Thakur, Divya Dhopte, Mayuri Deshmukh

Our model attempted to ensure that a fresh word of technology would spread among individuals through this competition. The model demonstrated how organs of the body can be created outside the body using a 3D bioprinter. The bioprinter works on the same idea as a 3D printer, but it only uses live cells to produce an organ. This has the potential to solve a number of problems in the healthcare industry and be beneficial. The notion is still being researched, which means that many doors have yet to open. We are grateful to our mentors, Ms Rita Lakkakul and Ms Nikita Mohod, for their guidance and encouragement throughout the event.

Our team presented a Waste Water Treatment Plant Model to address the environmental threat of waste water from the agro-chemical industry. The model aims to treat water that is released directly into water bodies without proper treatment, enhancing our scientific knowledge. The project was successfully completed with the guidance of mentors Dr. Suresh Suryavanshi sir and Dr. Bharat Kharat sir.

from left to right -Sarthak Gaikwad, Shravani Lunge, Saniya Dohane, Yash Dhurve

Our model aimed to tackle oil spills, which are harmful to marine life and ecosystems, by removing floating contaminants like oil and grease from water surfaces. Through collaborative effort and task division, we successfully completed the model under mentorship from Rohan Thaware Sir and Pradip Hirapure Sir.

from left to right -Akanksha Lade, Khushboo Patle, Twinkle Chauhan

Our model discussed the usage of Aspirin tablets, their conditions, and potential problems. It also detailed the manufacturing process. The model that we prepared was a combination of Chemistry and Biology. It was developed under the guidance of late Parag Panase sir, incorporating new concepts like prostaglandins, cyclohexane, and arachidonic acid.

from left to right -Shikha Gautam, Vaishnavi Thakre

3D-BIOPRINTER

The world is changing at a faster pace, resulting in change of techniques and technologies. This continuous changing technology brings about revolutionary innovations which keep the potential to change the world even more. The 21st century, evolving age of technology, has brought a fascinating way of putting imagination as 3 Dimensional reality. Well, now things about future prospects have reached so far that researches are going on,

'How to make a 3D printed organ?'

Well, this can be achieved using a technology known as **3D BIOPRINTING**. A 3D bio print is a process that utilizes viable cells, biological molecules, and biomaterials to print biomedical structures in three dimensions. A 3D bioprinter creates 3D structures, such as tissues and organs, by depositing biological material upon it layer by layer. Consider 3D Bioprinting as a cousin of 3D printing, as they both work on almost the same principle. The only thing that differentiates a 3D printer from a 3D Bioprinter is the material used for printing purposes, the 3D Bioprinter uses **BIOINK** which are typically laden by living cells. This Bioink also contains biomaterials which can mimic the extracellular environment to support cell adhesion, proliferation, and differentiation after printing. Let's dive deeper into the working and types of 3D bioprinting technology to develop a better understanding on the topic.

There are essentially three steps in the 3D bioprinting process:

- ***Pre-Bioprinting***
- ***Bioprinting***
- ***Post-Bioprinting***

1] Pre- Bioprinting : In this step, the preparations for formation of the desired model are needed to be done. These preparations include choosing materials required for cell sample, collecting cell sample *[stem cells or primary functional cells, as per requirement can be taken]* from patient, obtaining 2D images using CT scan or MRI. An important part here in this step is the multiplication of cells after selection, which is achieved by providing essential nutrients to cells. Tissue culture method can be used for the purpose of this multiplication of cells. Now the things escalate to the next part of the process that is Bioprinting.

2| Bioprinting : The printing process is carried out in the second stage to create a three-dimensional structure. Here the Bioink material is inserted in the 3D printer which then helps in printing of the desired structure according to the 2d tomographic image prepared previously. The bioprinter is given commands and instructions using the software available. This step is the most complex one, as it requires formation of structure without damaging the cells that are being used for printing.

3| Post Bioprinting : The last step of 3D bioprinting process aims to stabilize the previously printed structure. This can be accomplished by giving the tissues the right kind of chemical and physical stimulation to keep them growing. If this phase is skipped, the printed structure will be in poor condition and lack structural integrity.

Bioprinters are 3D printers that are limited to printing cell-free scaffolds; they cannot print living cells. Depending on the method the device uses, a variety of 3D bioprinters are available. Different kinds of 3D bioprinting processes exist, such as bioprinting by extrusion, bioprinting via inkjet, pressure assistance, laser assistance, and so on. All the methods follow the basic principle of bioprinting, but just have a slight difference in their working mechanisms. As mentioned previously a software programme is used to feed data into the bioprinter which when successful analyses the organ printing procedure at microscopic level.

This method has its uses and limitations. But as we can see technological advancements keep happening every other day, so this 3D Bioprinting technology can also prove its potential with time. Tissue engineering has spent decades developing functional organs that might partially or completely replace damaged organs. Due to its ability to precisely deposit live cells layer by layer, 3D bioprinting technology has been advancing in tandem with a promising bio-manufacturing approach. The only structures where this approach works in this sense are still simple ones like skin, cartilage, and bone.

So why can’t we make a 3D Bio printed heart?

This is because the other organs of the body have a higher degree of complexity, which makes it difficult to mimic the geometrical and anatomical properties of the organ. But as the work is in research this creates a possible room for 3D bioprinting to be interviewed as a boon in organ transplantation. Another aspect where 3D bioprinting technology can prove its way is cancer research. A major cause of death worldwide is cancer. Though treatments for cancer are available and are being constantly updated it still does not give a surety of curing a person. As cells differ from person to person the cancer is also different for every individual. This issue can be solved if we keep an approach of making personalized medicine for cancer. Well, this targeted drug therapy can be achieved by constructing a tumor model using 3D Bioprinting technology. This tumor model can be constructed by positioning the cells accurately and providing them a heterogenous microenvironment. Now imagine that you can see your own cancer live in front of your eyes!! Amazing right? This model makes it easy to understand the protein expression of cancer cells or the action of a particular drug on the cancer cells. Along with these there are many aspects where 3D bioprinting is being used or is in research to make it work as a help.

Accordingly, it can be concluded that 3D bioprinting provides a promising approach to make advancements in many healthcare sector problems. With the merging of various advanced microfabrication techniques, stem cells and advanced biomaterials it is anticipated that 3 D bioprinting technology will develop at a faster rate as they may be able to provide a tissue with required functionalities thought not the exact anatomical structure.


RESEARCH IS
FORMALIZED
CURIOSITY.
IT IS POKING AND
PRYING WITH A
PURPOSE.

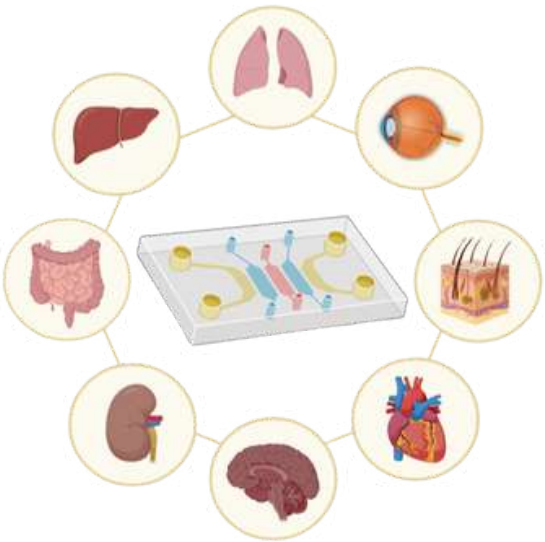
ORGAN ON A Chip

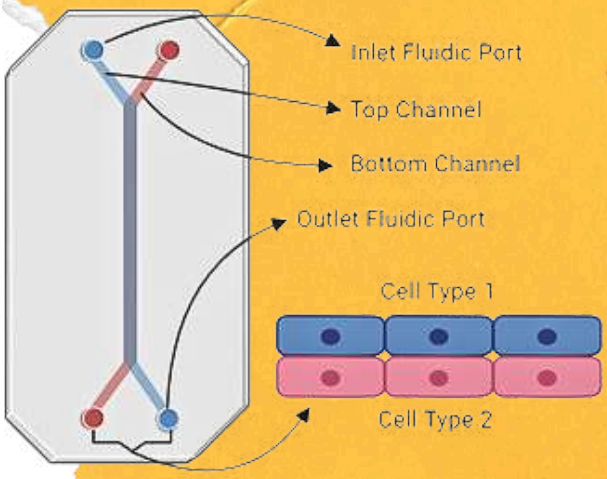
Every year, more than 50 million animals are used in tests to check the safety of drugs, vaccines, food additives, chemicals, cosmetics, and pollutants. These tests often end with the animals being euthanized, but they may not be accurate because animals and humans have different bodies and metabolisms. This can cause delays in drug development, which can take up to 10 years and result in drugs that are harmful or do not work.

Numerous substitutes have been introduced into the scientific community to address these problems. Organ-on-a-chip is one such substitute.

Organ-on-a-chip represents an impressive integration of cell biology, engineering, and biomaterials technology. It uses microfluidic technology to mimic the environment of a physiological organ. Entire human organs and blood vessel cells are lined with the hollow microfluidic channels of these microdevices, made of a transparent, flexible polymer and the size of a USB memory stick. Without involving people or animals, these three-dimensional, living cross-sections of human organs offer a look into their internal operations and the effects that medications may have on them. Microfluidic devices have been used to replicate a variety of organs, including the skin, bone, cartilage, brain, lung, heart, kidney, liver, prostate, and arteries.

Organs-on-a-chip differ in designs and approach such as Single channeled, Double channeled (Parallel), Double channeled (Sandwich), and Multi-channeled.

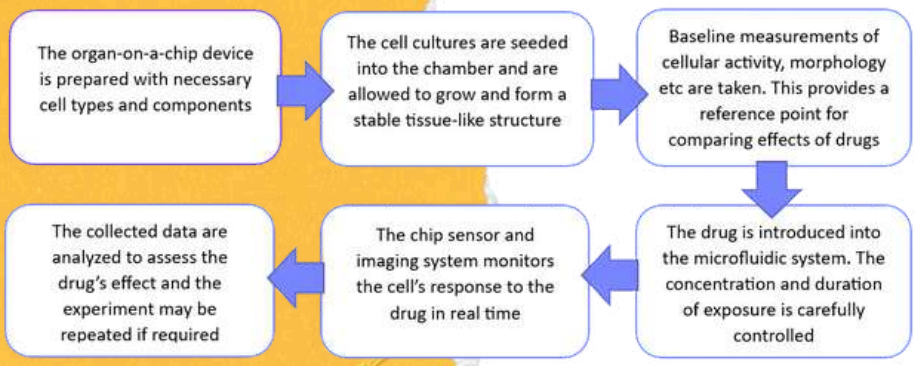




Each chip is composed of three elements constructed from transparent silicone rubber polymer: an upper channel, a lower channel affixed to a microscopic slide, and a permeable membrane situated between the two channels.

Upon assembly of the components, each channel is introduced with either organ cells or blood vessels, while the membrane facilitates the molecular exchange between the two, mirroring the processes occurring in human organs in vivo. It is crucial to sustain dynamic mechanical stress, fluid shear, and concentration gradients as fundamental factors within the chip.

How is a drug being tested on an organ on a chip?



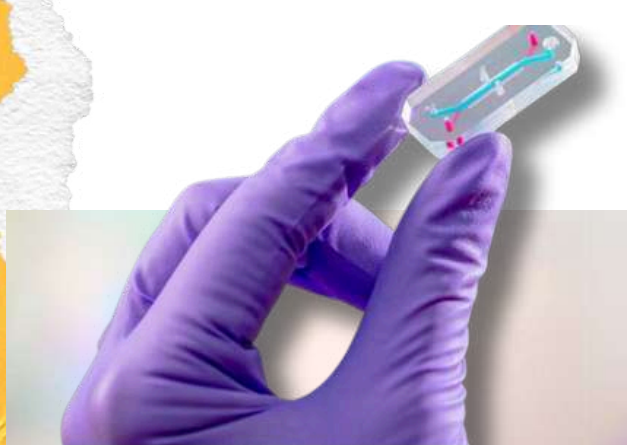
Keeping in mind the basic mechanism, many types of organ-on-a-chip systems are available in market:

·**Lung-on-a-chip:** imitates the air-blood barrier in the lungs.
·**Heart-on-a-chip:** imitates the heart's mechanical and electrical features.
·**Brain-on-a-chip:** imitates the blood-brain barrier and the brain's neural activity.

In the last few years, numerous businesses have emerged to develop and market organ-on-a-chip technology, such as MIMETAS, InSphero, and TARA Biosystems.

Future prospects:

1. Organ-on-a-chip tech is an exciting and fast-growing area that brings a lot of benefits compared to the old-school ways of developing and testing drugs.
2. It offers a more ethical and efficient way to test drugs and other substances, cutting down on the need for animal testing.
3. This technology is perfect for precision medicine, allowing for more tailored and effective treatments for various diseases in different people.



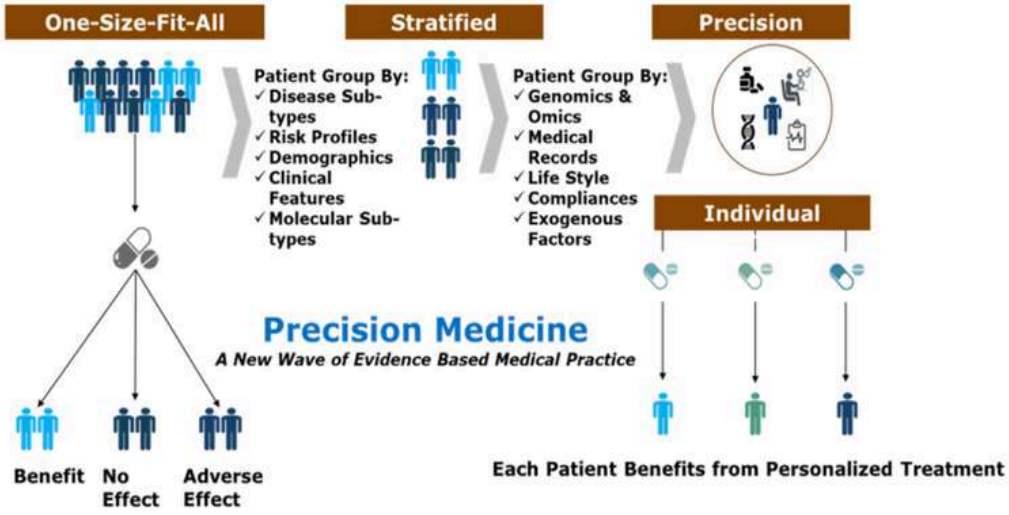
Precision medicine:

-A NEW PARADIGM IN **CANCER** CARE.

Imagine a society in which each patient's cancer therapy is as distinct as they are. Personalized and precision medicine (PPM) is revolutionizing the fight against cancer, offering hope where traditional methods fall short. By tailoring treatments to the genetic makeup of each tumor, PPM promises more effective and less harmful solutions. Cancer is a devastating illness that takes the lives of countless individuals every year. It's no secret that traditional treatments like chemotherapy and radiation have their drawbacks, especially because the disease varies so much from person to person. These treatments are only effective for certain subsets of patients because not all cancers of the same type share the same genetic alterations or mutations. This is where personalized and precision medicine (PPM) becomes critical, offering a solution to combat cancer's resistant nature.

The four primary cancer treatment methods—surgery, radiation, chemotherapy, and immunotherapy—are frequently combined to effectively tackle cancer. However, their effectiveness varies among patients due to their unique genetic makeup. Additionally, these traditional treatments are usually costly and come with undesirable side effects. Personalized and precision medicine (PPM) addresses these issues by tailoring treatment to the genetic, molecular, and cellular features of a patient's tumor. PPM allows for targeted treatments that can focus on particular cancer cells, like those found in HER2-positive breast cancer, and tumor marker tests can improve the accuracy of cancer diagnoses. Some cancers, like non-small cell lung cancer, can be influenced by changes in a gene known as anaplastic lymphoma receptor tyrosine kinase (ALK). In these situations, medications such as Crizotinib (Xalkori) and Ceritinib (Zykadia) can inhibit ALK, providing major advantages for patients with ALK-positive non-small cell lung cancer. A great example of the benefits of personalized medicine is Zach Witt, a 10-year-old who was diagnosed with anaplastic large cell lymphoma at just 5 years old. When his cancer came back during regular chemotherapy, genetic tests showed that ALK mutations were fueling his cancer. This made him a candidate for crizotinib as part of a clinical trial, and now he's cancer-free! Personalized treatments are also showing promise for colorectal cancer, breast cancer, lung cancer, certain leukemias, melanoma, and ovarian cancer.

The current approach to PPM in cancer treatment involves three main categories. To start off, gathering PPM data means figuring out the patient's disease state using different omics methods like genomics, transcriptomics, proteomics, and metabolomics. It's super important to sequence the patient's DNA to spot any genetic mutations that relate to clinical outcomes, and bioinformatics is essential for making sense of all that data. Next up, creating PPM therapy involves digging into biological data to find key biomarkers, mutations, or pathways linked to the disease or how well a treatment works. Systems biology comes into play for analyzing both preclinical and clinical studies, and we also develop predictive tools to understand how biological systems react to diseases and drug development.



Lastly, the application of PPM therapy involves integrating and evaluating the patient's clinical and genomic data to create an optimal treatment plan.

ITo wrap things up, personalized and precision medicine has really changed the game in cancer treatment, ditching the old "one size fits all" method. By honing in on a patient's unique genetic, molecular, and cellular traits, we can create targeted therapies and use predictive tools to gauge how well treatments and drugs will work. With around 73% of new oncology drugs being personalized, it's clear that PPM is the way forward in cancer care. The precision medicine field keeps evolving with cool innovations like cancer vaccines, monoclonal antibodies (mAbs), CAR T-cells, and organoids that help us understand the differences in tumors and how patients respond to treatments. As the need for PPM products and services rises, it's super important for companies to keep up with the changing regulations and check out the latest guidance documents. The Precision Medicine Initiative kicked off in 2015, leading the FDA to create a new way to evaluate PPM diagnostics and therapies. Plus, the 21st Century Cures Act of 2016 sped up the development of medical products by including patient feedback and updating clinical trial designs. Back in 2005, only 5% of new drug approvals were PPMs, but by 2017, that number jumped to over 30% (16 new therapies), showing real progress in the field. While PPM has potential to lower the risks and costs of drug development, especially in clinical trials—which are some of the priciest parts of the process—there are still bigger issues to think about. These include whether the investment is worth it, the risk of sensitive health info being misused, and how affordable these treatments are for different socio-economic groups. Developing a drug from the lab to the market can cost over $2.5 billion, which really highlights how risky, costly, and time-consuming.

The responsible use of precision cancer medicine is crucial for improving patient outcomes and quality of life by understanding specific disease mechanisms better. Coming up with solid evidence by using fresh clinical trial designs, pulling together molecular and clinical data from real-world databases, and doing a thorough analysis to find important connections between targets and agents is key to showing how valuable this approach is for different patient groups. Collaborative efforts between pharmaceutical and med-tech industries, alongside academia, will strengthen the foundation for future cancer therapeutics. Oncologists must understand both the power and limitations of current personalized medicine tests and treatments, enabling patients to make informed decisions. The advancement of precision medicine is promising, and its future success depends on careful regulation, responsible use, and effective collaboration among key stakeholders.

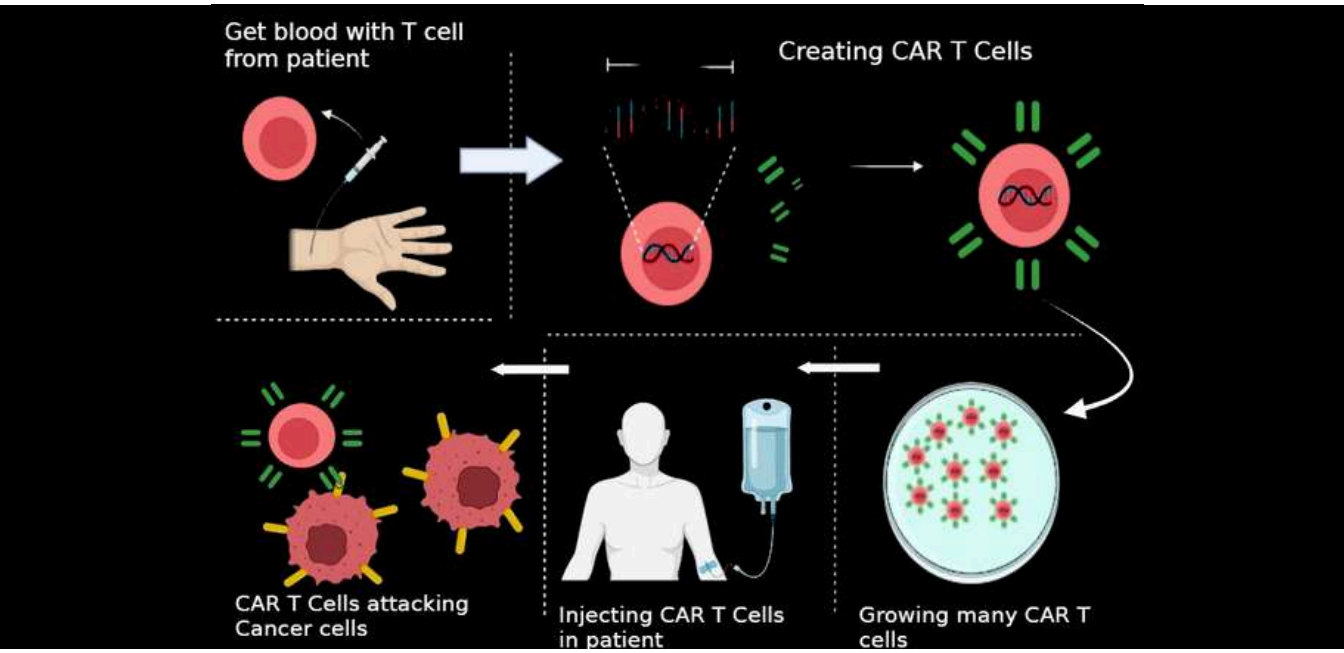
Car-T cell therapy

Reprogramming cells, targetting cancer.

Tumors can be caused by genetic and environmental factors and can metastasize to other areas. The immune system is crucial in detecting and eliminating foreign substances within the body, and combating infections and cancer. It comprises billions of individual cells and plays a vital role in preventing and treating various diseases. Lymphocytes, which are a type of white blood cell, play a vital role in our immune system.

There are three types:

- *B cells, which produce antibodies against infections*
- *T cells, which eliminate diseased cells and also cells, assist in antibody production*
- *Natural killer cells, eradicate viruses and fight contaminated cells.*



Immune cells collaborate to combat cancer. However, in some individuals, these cells may fail to identify and destroy cancer cells, allowing tumors to grow. This situation illustrates the tumor microenvironment as a battleground of conflicting immune responses: one side attacks the tumor cells, while the other supports them. This dual role of the immune system, both defending against and aiding tumors, is known as cancer immunoediting. When cancer cells begin to grow uncontrollably, it becomes challenging for the immune system to respond effectively. New treatments are being created for cancer patients thanks to advances in technology and science. One well-known treatment is cancer immunotherapy, which uses the body's defense to fight the disease. The concept that antibodies or immune cells can spot and eliminate cancer cells boosts the body's power to recognize and fight off those cancer cells.

One interesting treatment option is CAR T cell therapy! This method involves using T cells that have been modified with Chimeric Antigen Receptors, or CARs, to fight cancer.

CARs are special receptors that help T cells and other immune cells recognize and attack cancer cells. The main advantage of CARs in cancer treatment is their ability to multiply quickly and effectively. In CAR T cell therapy, T cells are modified to seek out certain proteins that are present in tumors.

The process includes taking T cells from a patient, modifying them to create CAR T cells, and then putting them back into the patient to help eliminate the cancer. The production of CAR-T cells and their application in cancer treatment involves several critical steps. Initially, blood is drawn from the patient through a process known as apheresis, which selectively extracts components such as plasma, platelets, or white blood cells, while the remaining blood is reinfused into the patient. Subsequently, in a controlled laboratory or pharmaceutical setting, DNA is introduced into the T cells to engineer chimeric antigen receptors (CARs), enabling these modified cells to target and combat cancer effectively.

The process of reengineering T cells results in the formation of chimeric antigen receptor T cells, commonly referred to as CAR T cells. These CARs are specialized proteins that enable T cells to identify antigens present on tumor cells. Following their modification, the CAR T cells are expanded in number. The genetically altered T cells from the patient are cultivated in a laboratory setting, typically requiring a turnaround period of three to four weeks. Upon reaching an adequate quantity of CAR T cells, the patient receives treatment at a hospital or specialized treatment center. The CAR T cells are preserved through freezing and subsequently administered to the patient in a clinical environment. Prior to the infusion of CAR T cells, many patients undergo a brief course of chemotherapy to reduce the existing T cell population in the body. This preparatory phase, known as "lymphodepletion," creates space for the CAR T cells to proliferate. The administration of CAR T cells occurs via an intravenous line or a central line directly into the bloodstream, with the entire procedure taking less than 30 minutes. Once introduced into the circulatory system, the CAR T cells begin to proliferate and function as "attacker" cells, seeking out, targeting, and eliminating cells that express the designated antigen.

There is a possibility that the CAR T cells can help prevent recurrence. Despite the fact that CAR T cells are able to eradicate all cancer cells in the body, they may also remain within the body for months afterward. CAR-T cell therapy is seen as a major breakthrough in medical science. While it has been available for some time in wealthy nations, many patients around the world cannot afford it due to its high price. India has played a key role in reducing these costs, making CAR-T cell therapy accessible to those in need. NexCAR19 is India's first locally developed CAR-T therapy, created through a partnership between academia and industry. It is the most affordable CAR-T therapy globally, putting India on the map for advanced cell and gene therapies. Developed by Prof. Rahul Purwar and his team at the BSBE Department of IIT Bombay, in collaboration with Tata Memorial Centre and ImmunoACT, NexCAR19 offers a cost of about $50,000, compared to $800,000 to $900,000 in the US and around $200,000 in China. Researchers continue to explore ways to enhance this technique further.

Timeline of biotechnology

let's take a trip:

20th century

THE ORIGIN

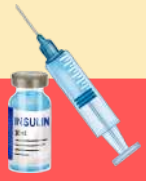
The history of biotechnology dates back thousands of years, to the earliest human societies that experimented with manipulating biological things for a variety of uses. Probably one of the first applications of biotechnology was in the production of bread and alcoholic drinks through the process of fermentation. Another early use of biotechnological concepts is the domestication of plants and animals.

1950s-1970s

THE INCEPTION OF MODERN BIOTECHNOLOGY

It is possible to trace the origins of modern biotechnology to seminal findings in genetics and molecular biology. The structure of DNA was clarified by James Watson and Francis Crick in 1953, offering the basic framework for comprehending genetic information. This discovery served as a catalyst for further technological advances.

Recombinant DNA technology emerged in the 1970s, marking a significant breakthrough in the study of gene manipulation and organism-to-organism gene transfer. A turning point in biotechnology was reached in 1973 when Stanley Cohen and Herbert Boyer created recombinant DNA technology, which created new avenues for gene therapy and genetic engineering.

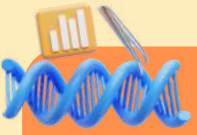


1980s-1990s

GENOMIC ERA AND COMMERCIALIZATION

With the founding of multiple biotech businesses and the launch of biopharmaceuticals like insulin made through genetic engineering, the 1980s saw the commercialization of biotechnology. During this time, genetic fingerprinting methods also became available, which completely changed the field of forensic science and paternity testing.

An important turning point in the history of biotechnology was reached with the completion of the Human Genome Project in 2003. The goal of this massive global project was to map and sequence the whole human genome, giving scientists crucial new information on the genetics of human health and illness. The genomic age was made possible by the Human Genome Project, which also made advances in pharmacogenomics, genetic diagnostics, and customized medicine possible.



2000s

CRISPR AND SYNTHETIC BIOLOGY ADVANCES

Synthetic biology, a discipline that aims to build unique biological systems and organisms for a variety of uses, has advanced quickly in the twenty-first century. Among other advancements, synthetic biology has promise for the development of biofuels, bioplastics, and customized medications.

Emergence of CRISPR-Cas9 gene editing technology is one of the most revolutionary advances in recent years. With the ability to precisely and effectively modify DNA sequences, CRISPR-Cas9 is revolutionizing genetic engineering and creating new opportunities for the treatment of genetic illnesses, the development of disease-resistant crops, and the comprehension of intricate biological processes.

PROSPECTS FOR THE FUTURE: TOWARD A BIO-BASED ECONOMY

In the future, biotechnology is expected to be crucial in solving some of the most important problems that humanity is currently experiencing, such as healthcare, environmental sustainability, and food security.

Technological developments in synthetic biology, gene editing, and bioinformatics have the potential to bring about the emergence of a bio-based economy, wherein biological systems and renewable resources are utilized to fulfil societal requirements. In summary, the development of biotechnology is a monument to human inventiveness and the unwavering quest of scientific advancement.

From antiquated fermentation methods to contemporary genome editing instruments, biotechnology has developed continuously, changing our perception of life and providing answers to some of the trickiest issues confronting society. The field of biotechnology has enormous potential to improve people's lives all over the world as we continue to solve biological riddles and explore the possibilities of genetic engineering.

The field of biotechnology, combines biology and technology, has transformed many facets of human existence, including agriculture and medicine. The development of biotechnology over time is a tribute to scientists' inventiveness and unwavering quest for knowledge. Let the stories of groundbreaking discoveries fuel your ambition to innovate and explore.

science DICTIONARY

TAXIS

A motion or orientation of a cell, organism in response to an external stimulus

HORRIPILATION

The erection of hairs on skin due to cold, fear or excitement

BORBORYGMUS

A rumbling or gurgling noise made by the movement of fluid and gass in the intestine

OBDORMITION

Temporary numbness in a limb, caused by constant pressure on server or lack of movement

PETRICHOR

A pleasant smell that frequently accompanies the first rain after a long period of warm , dry weather

FEBRILE DELIRIUM

An acute and transient confusional state with high fever

THE BIO-TECH *queen*

I believe in never giving up, no matter what the odds. My mantra is, "Failure is temporary. Giving up is permanent."

Dr. Kiran Mazumdar-Shaw

Howdy Readers,

I hope you are enjoying this edition so far!

In the second edition of The Catalyst, we have introduced you to a new career opportunity - "Entrepreneurship in Life Sciences." In that article, we gave you a glimpse of how to become an entrepreneur and how various start-ups are emerging in our field. The word entrepreneur itself is a motivation. Building something on your own from ideas and imagination is truly inspirational. Many of you must know about successful entrepreneurs by watching the television show **Shark Tank**.

In this edition, Team Catalyst is introducing you to a highly inspirational, successful Indian Female Entrepreneur — Dr. Kiran Mazumdar-Shaw, also known as *"The Biotech Queen of India."*

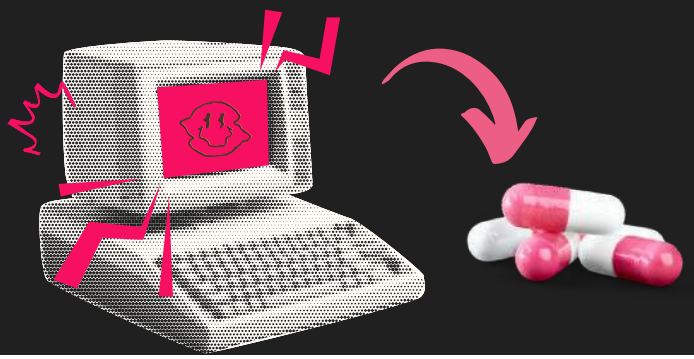
Kiran Mazumdar-Shaw is a well-known Indian billionaire and the founder of Biocon Limited and Biocon Biologics Limited. She has worked in biotechnology for over 40 years, starting her career in 1978. Her significant achievements in this field have earned her many awards, including the Padma Shri and Padma Bhushan. In 2020, she was named the EY World Entrepreneur Of The Year. Additionally, in 2019, she became a member of the United States National Academy of Engineering (NAE) for her work in making biopharmaceuticals more affordable and supporting the biotechnology sector in India. Dr. Kiran Mazumdar-Shaw is the first Indian woman to receive this honor.

Dr. Kiran Mazumdar-Shaw, whose father was a brewmaster with United Breweries in India, aimed to follow in his footsteps and work in brewing. She earned her brewing degree from the University of Ballarat in Melbourne in 1975. However, when she returned to India, she faced major obstacles, as companies were unwilling to hire women for brewing jobs. As a result, she worked as a consultant for several years until she met Leslie Auchincloss, the owner of Biocon Biochemicals, an Irish company. He saw her drive and invited her to join him in starting Biocon India in 1978, which specialized in making enzymes for various uses, such as in drinks and paper. Within a year, Biocon became the first Indian company to export enzymes to the U.S. and Europe. Despite ongoing doubts and discrimination against her as a female leader, Dr. Kiran Mazumdar-Shaw continued to push forward and successfully created a prosperous business.

Currently, Biocon stands as the largest biopharmaceutical enterprise in India, propelled by a commitment to innovation and research. Dr. Kiran's path, characterized by numerous challenges, serves as a source of inspiration for creative thinking and the pursuit of opportunities.

This article presents her extraordinary narrative, with the intention of motivating readers to accomplish remarkable achievements in their own lives.

COMPUTER AIDED DRUG DESIGN



Advancements in science and technology have led to the discovery of macromolecules involved in specific diseases, prompting chemists to design bioactive compounds.

Traditional way of drug designing:

There are different approaches to drug discovery. Serendipity, a chance-based method, was used to discover penicillin, a drug that saved millions during WWII. Another approach involves chemical modifications, like acetylating salicylic acid to create Aspirin, which enhances stability and reduces stomach mucosal irritation.

Drug designing has evolved, focusing on drug-receptor recognition. Emil Fisher compared interactions to a key and lock mechanism, with Daniel Koshland suggesting conformational changes during the interaction. X-ray structures confirmed this hypothesis. Following this, many new techniques were evolved.

Introduction to CADD :

Computer-aided drug design (CADD) is a computational technique used to discover, develop, and analyse drugs and biologically active molecules. It is a crucial technique in the development of new drug molecules. In this mainly two methodologies are involved:

1) Structure-based drug design:

Structure-based drug design (SBDD) is a scientific approach employed to develop novel pharmaceuticals through the analysis of the three-dimensional architecture of proteins that are implicated in disease. This helps researchers quickly identify potential drug molecules and understand their molecular interactions. Some common methods are

- Structure-based virtual screening (SBVS)
- Molecular docking
- Molecular dynamics (MD) simulations

2)Ligand based drug designing

Ligand-based drug design (LBDD) is a method used by scientists to create new drugs by identifying target proteins or enzymes and binding specific ligands. Quantitative structure activity (QSAR) is used to analyse these ligands' ability to bind to the target. This process involves design, synthesis, and testing cycles, where scientists modify compounds' chemical structures based on experimental data and computational predictions to improve efficiency and safety.

EXAMPLES OF DRUGS DEVELOPED THROUGH CADD

DRUG	DISEASE
Oxymorphone	Opioid analgesic
Saquinavir	AIDS
Captopril	Hypertension or high BP
Zanamivir	Affects influenza A and influenza B
Dorzolamide	Glaucoma and Ocular hypertension

The CADD methods have been successfully used in the COVID-19 drug discovery process. Selvaraj et al. (in the year 2020) solved the three-dimensional structure of SARS-CoV-2 guanine-N7 methyltransferase using the homology modelling method.

Latest discoveries through CADD:

- Vanderbilt University researchers have developed new drugs targeting Protease-Activated Receptor 4 (PAR4), a receptor involved in blood clot formation and inflammation-related diseases. They used computer simulations to identify drug candidates and virtually screened millions of compounds to find those that could effectively block PAR4. This breakthrough could potentially treat conditions like heart attacks, strokes, and Alzheimer's disease by preventing harmful blood clot formation.
- Scientists are utilizing quantum mechanics (QM) and machine learning to enhance drug discovery, enhancing predictions by understanding drug interactions with body proteins. This approach aids in designing effective treatments, making drug discovery faster, more reliable, and more efficient, making it a more accurate method for drug discovery.
- NTU's School of Biological Sciences in Singapore has developed a CADD method using artificial intelligence to predict multiple properties of drug molecules simultaneously. This AI-powered model can screen drug molecules 100 times quicker with minimal computational resources, eliminating the need for multiple specialized models. The research, published in “Nature Machine Intelligence,” is a significant advancement in drug development.

Advantages of CADD

- Saves time for efficient drug designs.
- Easier to edit designs, allowing for error correction and modification.
- Reduces error percentage from manual design.
- Reduces design effort by automating tasks.
- Easy to share files with CADD tools.
- Measures precision, skill, and accuracy level of designs.

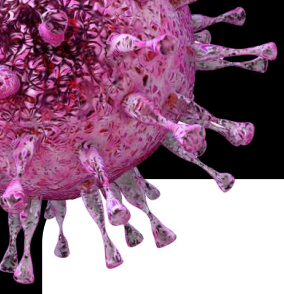
Microbial Intelligence

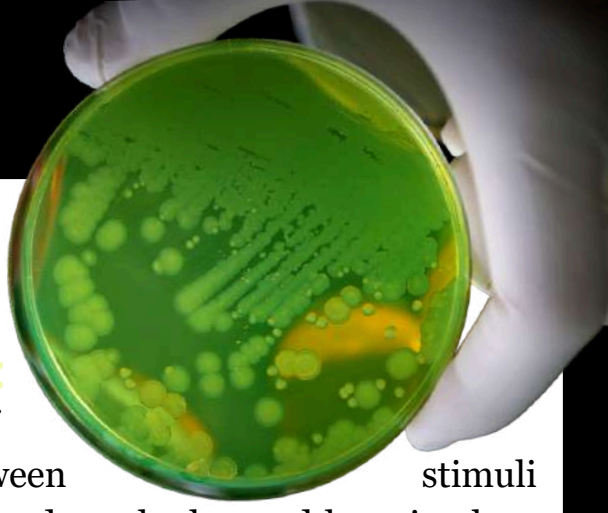
• DECISION MAKING :

Microbes have the ability to observe their environment, analyse data, and make precise choices through various networks and processes. Current research focuses on building genome-wide protein interaction networks to understand the molecules and connections that enable bacteria to make decisions. The chemotaxis of Escherichia coli is a key example of how microorganisms make decisions using plasma membrane receptors. The chemotaxis of *E. Coli* cells is determined by the amount of phosphorylated CheY, a downstream protein of the signalling cascade. This mechanism helps ***E. Coli*** cells interpret environmental information and decide whether to migrate towards or away from specific stimuli, increasing their chances of survival.

• PROBLEM SOLVING:

One of the key components needed for constructing an intelligent system is the ability to use knowledge to solve new issues. It is often acknowledged that more sophisticated organisms are able to deal with more challenging issues. Some microbial systems have demonstrated the ability to solve problems, which can be useful for their survival. These powers occ--asionally match or even exceed those exhibited by hu--mans. *Physarum polycephalum*, a huge amoeba-like cell made up of pseudopodia, is a slime mold that exhibits pri--mitive intelligence through problem-solving. Research has demonstrated that these microorganisms can link disparate food sources by means of their pseudopodia structures. More astonishingly, ***Physarum polycephalum*** may more effectively absorb nutrients by determining the minimum-length pathway between the two food sources.



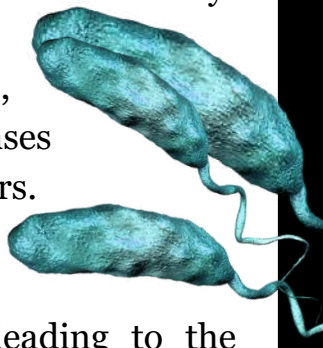


- **ASSOCIATIVE LEARNING :**

Associative learning is a crucial aspect of conditioning, involving associations between stimuli or events. It contributes to intelligence and can be learned by microbes, even without a nervous system. *P. aeruginosa* is an example of associative learning in the microbial realm. After surgery, human tissues emit substances like metabolites, interferon, and opioids into the intestine and luminal tissues. These substances, along with rapid drop in extracellular phosphorus levels, are recognized by ***P. aeruginosa*** and linked to patient vulnerability, leading to sepsis syndrome in humans. This connection has made *P. aeruginosa* the most common cause of infection-related death in hospitalized patients

- **QOURUM SENSING:**

Quorum sensing is a type of intelligence that allows bacterial cells to communicate and regulate group behavior based on population density. This self-awareness allows large networks of bacteria to adapt to different situations. Auto-inducers, signal molecules, are released into target cells, initiating transcriptional responses that alter the expression of different phenotypes and behaviors. Quorum sensing was initially identified in the gram-negative bacteria ***Vibrio.*** When the number of cells exceeds a certain threshold, the concentration of auto-inducer increases, leading to the transcription and expression of luciferase, resulting in bioluminescence in the cell population.



BIOLUMINESCENCE

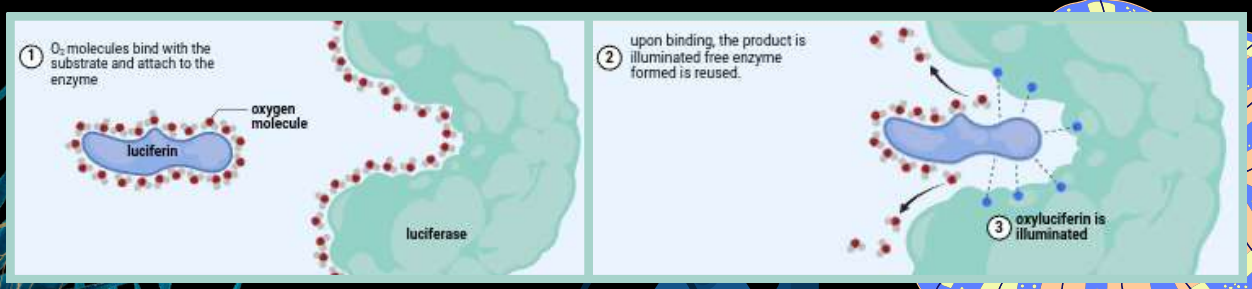
natures own pixie dust

Guys, have you ever witnessed nighttime jugnoo, or fire flies? The enthralling phenomenon known as bioluminescence is the reason of its yellow light, which makes it appear so captivating to behold. Scientific literature helps us understand it further. The phenomenon known as bioluminescence occurs when living cells exhibit luminosity, or the production of light. It is seen in fish, jellyfish, bacteria like phophoreum, and even fungi like mushrooms. So you must wonder, why do they physically exhibit bioluminescence? It offers numerous advantages to the organisms.

- Some animals discharge light-emitting chemicals into the water, including fish, squid, jellyfish, and crustaceans. These light particles, or clouds, can help confuse or dazzle predators. In order to hunt, hide, and communicate, bioluminescence is necessary as sunlight cannot reach the ocean's depths.

How is light produced?

The process of producing visible light through a chemical reaction involving enzymes, substrates, and cofactors is known as bioluminescence, also referred to as chemiluminescence. By assisting a substrate in reacting, the enzyme quickens the chemical reaction. The enzyme does not change into a new molecule throughout the process; rather, it is reused. The majority of marine species start the process by catalysing the oxidation of the substrate called luciferin with the enzyme luciferase.
It generates light and other byproducts when oxygen is present. The variety of hues and intensities observed in bioluminescent displays can be explained by the differences in the specific chemical makeup and manner of action between different species.



MIT research insights

STUDIES FROM 2017

MIT engineers have successfully induced a roughly 4-hour-long period of dim light emission from plants by embedding bioluminescence compounds (luciferase, luciferin, and coenzymes) into their leaves.Furthermore, they think that these plants can eventually be optimized to the point where they can light up a whole workspace.
The idea is to create a plant that can serve as an autonomous desk lamp, meaning it doesn't require an outlet. The Carbon P. Dubbs Professor of Chemical Engineering at MIT and the study's main author, Michael Strano, claims that the light is ultimately generated by the energy metabolism of the plant itself.According to the researchers, this technology might potentially be used to turn trees into self-powered street lights or to give low-intensity indoor lighting.The study's lead author, MIT postdoc Seon-Yeong Kwak, is published.

STUDIES FROM 2021

Engineers at MIT have created a new type of light-emitting plant by adding special nanoparticles to its leaves. This design allows the plant to be charged with an LED light. After just 10 seconds of charging, the plant glows brightly for several minutes and can be recharged many times. These plants shine ten times brighter than the first generation of glowing plants made by the team in 2017. To make what they call a "light capacitor," the researchers used a phosphorescent material that can absorb visible or ultraviolet light and then release it as a glow. They chose strontium aluminate, a compound that can be turned into nanoparticles, to act as the phosphor.

Before embedding the particles in plants, the researchers covered them with silica to protect them from damage.The hundreds of nanometer-sized particles can enter the plants through tiny pores called stomata that are found on the surfaces of the leaves. Particles gather in the mesophyll, a spongy layer where they form a thin film.This film can absorb photons either from sunlight or an LED. The researchers showed that after 10 seconds of blue LED exposure, their plants could emit light for about an hour.

UNSOLVED MYSTERY

MIT engineers have developed a novel technique to detect bioluminescent proteins deep within the brain, overcoming the challenge of light scattering in deep tissues. They engineered brain blood vessels to express a protein that dilates in response to light, which can then be detected via MRI. This method enables detailed imaging of brain activity and gene expression. Led by Professor Alan Jasanoff, the study showed that this technique, called BLUsH, could track changes in the brain and might aid in mapping gene expression and cell communication. This breakthrough, funded by various institutions, holds promise for advanced brain research

STUDIES FROM 2024

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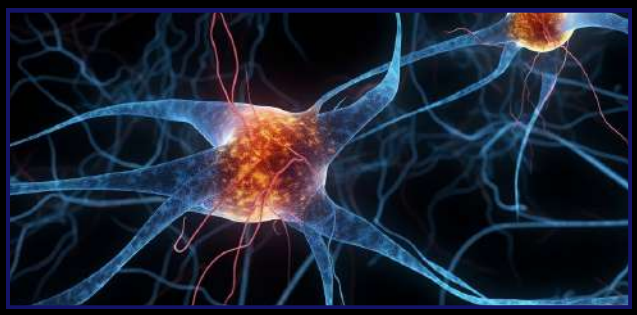


What is bioinformatics?

Bioinformatics is a scientific subdiscipline that uses computer technology to analyse and share biological data, including amino acid and DNA sequences, to improve health and disease understanding.

What are examples of bioinformatics?

The Human Microbiome and Human Genome Projects utilize bioinformatics technologies to analyse microbial and human genomes. Along with this, Proteomics studies protein composition, activities, and interactions in biological systems.

What is the workplace of a Bioinformatics Scientist like?

Bioinformatics scientists work in various settings, including academic institutions, government agencies, non-profit organizations, and private companies. They may work in research labs, departments of biology, computer science, or other related fields, working on projects related to cancer research, drug discovery, and genomic data analysis. They may also mentor or teach bioinformatics courses. Government institutions like the CDC and NIH may employ bioinformatics scientists on public health projects, national security, and environmental protection.

How to become a Bioinformatics Scientist?

A bioinformatics scientist requires a strong background in computer science and biology.

The general procedures you can take are as follows:

1)Become a Bachelor's Degree Holder: A bachelor's degree in biology, computational biology, or related disciplines is a good starting point, covering necessary knowledge in biology and genetics.

2)Learn to Program: Bioinformatics scientists require proficiency in programming languages like Python, Perl, and R, which can be learned through computer science programs, seminars, or online classes.

3)Become an Expert in Databases: Fluency in SQL, query, and database management is crucial for bioinformatics, which can be learned through online courses or workshops.

4)Obtain a Graduate Degree: A Master's or Doctoral degree in bioinformatics or computational biology is required for bioinformatics scientist positions. Graduate programs and real-world experience can be gained through hackathons and open-source initiatives.

5)Networking: Staying updated on bioinformatics advancements is crucial, as the field is constantly evolving. Reading scientific publications, attending conferences, and participating in online forums aswell. Networking with other professionals, such as attending events /joining organizations like ISCB, can help find jobs and collaborate.

why is blue colour rare?

Blue is frequently regarded as a favourite colour for many, yet it remains the least common pigment found in the natural world among the flora and fauna. Never occurred right? For example, no animal is blue and neither is the blue whale truly that vibrant. The question yet remains: why and how is it rare? To address this question, we can draw insights from evolutionary biology, incorporate elements of chemistry, and add a Spitz of physics. But for that, let's take the example of a butterfly. Butterflies display the most detailed and brightest patterns in nature. The wings of a butterfly are covered in minuscule scales. In the case of the blue morpho butterfly, the vibrant blue colouration is a result of the unique structure of these tiny scales. This brings up another question: how do these shapes show off the beautiful blue colour? The scales have small ridges at a molecular level. When light hits them, all other colours are absorbed, but blue has the right wavelength to pass through the ridges & deflect as the colour blue. Furthermore, now where does evolution come into play? It might be simpler for male birds to change their physical traits to show off that blue colour to attract mates, instead of using a tool like CRISPR to alter their genes! On a serious note, the creation of a blue pigment from scratch would necessitate advanced chemistry, a capability beyond that of birds. Consequently, this leads to the evolution of changes in their shapes to develop such structures.

SOME HAZARDOUS CHEMICALS IN THE LAB AND WHAT THEY DO TO YOU!

LAB chemicals

Dangerous things lurk all around researchers, from contagious bacteria to grumpy advisors. It's simple to overlook how lethal even basic lab chemicals may be when there are so many hazards around. But don't worry, we've got you covered with this list of often occurring hazardous compounds.

1. FORMALDEHYDE CH_2O

This widely used fixative may cause cancer in some. Because formaldehyde can result in dermatitis, sinusitis, and asthma, make use of the fume hood! Furthermore, avoid buffering formaldehyde with hydrochloric acid since they combine to create bis-chloromethyl ether, a strong carcinogen.

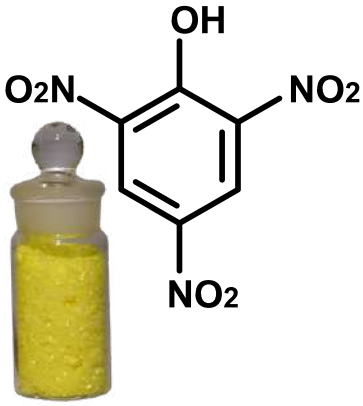
2. BENZENE C_6H_6

Numerous short- and long-term harmful health consequences and disorders, such as cancer and haematological damage, have been linked to human exposure to benzene. Because benzene-containing petroleum products, such as motor gasoline and solvents, are widely used, exposure can happen at work, in the community, and at home. Another important source of exposure to tobacco smoke is both active and passive inhalation. Due of its extreme volatility, most people are exposed to benzene by inhalation.

3. SODIUM HYDROXIDE NaOH

Interestingly, concentrated acid burns less painfully in the eyes than sodium hydroxide does. Proteins precipitate from acids and create a protective "scab" around intact tissue; nevertheless, fatty acids are saponified by strong bases, such as sodium hydroxide, which breaks down cell membranes. The base can continue burning through since the "scab" never forms. Put on your goggles!

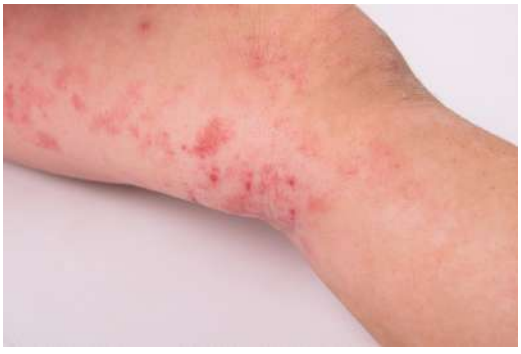
4. PICRIC ACID



Picric acid, a yellowish crystalline solid, was once used as an explosive in weapon manufacturing. Workers frequently developed pseudo-jaundice, a yellow discoloration of the skin and hair from close contact. Picric acid irritates the skin, mucous membranes, and eyes and is absorbed through the skin. It can cause allergic contact dermatitis, often appearing around the lips and nose. Symptoms include erythema, papules, vesicles, erythrocyte lysis, desquamation, and potentially serious damage to the liver and kidneys, such as hemorrhagic nephritis.

5. TETRAHYDROFURAN [THF]

One flammable solvent is THF. THF gradually yields explosive, shock-sensitive peroxides. The peroxides will concentrate in the residual solution if the THF evaporates. An explosion can occur from even the slightest bumping of a container holding concentrated peroxides. It is important to remember that hydrofluoric acid fumes can irritate the throat and eyes and present a risk for inhalation.



LABORATORY SAFETY SYMBOLS

CORROSIVE ACID WARNING SIGN

BIOHAZARD

FLAMMABLE MATERIAL SIGN

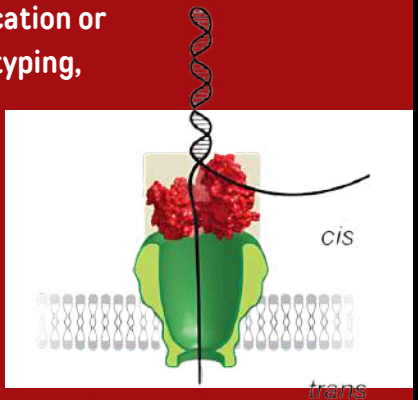
Laboratory EQUIPMENTS

pcr machine

Thermal cyclers, or PCR machines, automate the polymerase chain reaction (PCR) process, amplifying DNA and RNA sequences. Developed by Kary Mullis in 1983, they are crucial for genetic and diagnostic applications. A thermal cycler's thermal block is the main component, housing tubes for PCR reaction mixtures. It controls temperature fluctuations during cycles through denaturation, annealing, and elongation. Denaturation heats the reaction mixture to 94°C, breaking hydrogen bonds to create single-stranded templates. Annealing occurs at 54-60°C, allowing DNA primers to bind to complementary sequences on the template. This initiates DNA synthesis, facilitated by DNA polymerase like Taq polymerase. Elongation occurs at 72-80°C, allowing Taq polymerase to add nucleotides and extend DNA strands, forming double-stranded DNA molecules.

nanopore sequencing

Nanopore sequencing is a third-generation method of sequencing biopolymers, or polynucleotides in the form of DNA or RNA. By using nanopore sequencing, it is possible to sequence DNA or RNA molecules without having to use PCR amplification or chemical labelling. In addition to providing relatively low-cost genotyping, nanopore sequencing can be used for rapid testing, high mobility, and real-time results display. In terms of size, the nanopore sequencing machine is quite small. It uses a small chamber having a very tiny hole which has diameter in nanometres. A nanopore can either be solid or can be composed of a biological molecule. Through the sample inlet, DNA or RNA is introduced into this nanopore. When an electric field is applied, DNA or RNA starts moving to the other side of the chamber through the pore.



When a voltage is applied across the pore, this voltage in turn gives rise to current, which can be measured. Using the magnitude of the current across the pore, it is possible to identify the base composition of polynucleotides. It is due to the fact that the magnitude of the current depends on the base composition of the nucleic acids [A, T, G, C, U].

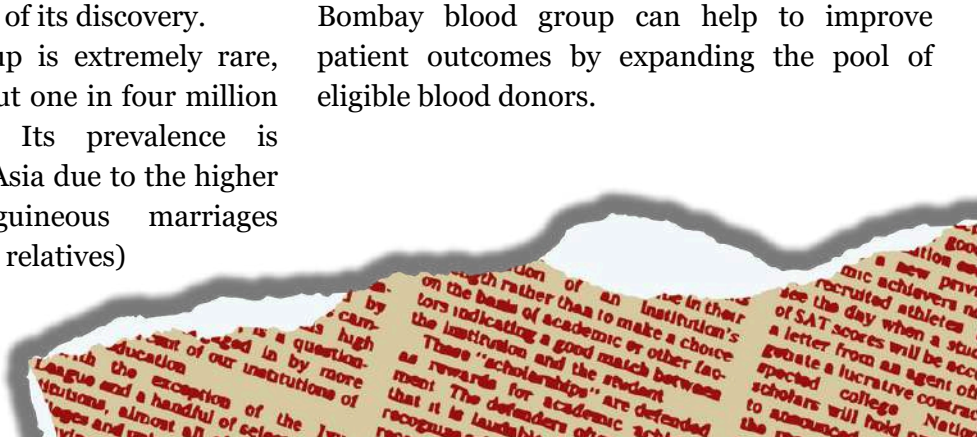
BOMBAY BLOOD GROUP!

Imagine a blood type so rare that only a handful of people in the world share it—so unique that it defies the conventional understanding of blood types taught in medical schools. A blood type that could make a simple transfer of blood seem like a life-or-death situation. The ABO blood group system, which divides blood into four primary types—A, B, AB, and O—is well-known to most individuals. This classification is based on whether red blood cells have antigens (A and B) on their surface or not.

A unusual kind of blood is the Bombay blood group, sometimes known as the HH blood group. It is distinct because the blood serum contains anti-H antibodies and the surface of red blood cells lacks H antigens. Because of this disease, the red blood cells of people with Bombay blood group (HH) do not express the A, B, or H antigens. It was first identified in 1952 when a patient at KEM Hospital in Mumbai was found to have a blood type that did not match the standard ABO or Rh systems. Despite being classified as type O initially, the blood did not match any available O blood. Dr. Y.M. Bhende's further investigations revealed this novel blood type, which was subsequently named the Bombay blood group after the city of its discovery.

The Bombay blood group is extremely rare, with an incidence of about one in four million individuals worldwide. Its prevalence is notably higher in South Asia due to the higher frequency of consanguineous marriages (marriages between close relatives) in these regions, which increases the likelihood of inheriting this rare blood type. In India, the occurrence is estimated to be about one in 10,000. The rarity of this blood group poses significant challenges for transfusion, as it requires blood from donors with the same Bombay phenotype. Based on ABO compatibility, people with the Bombay blood group can receive blood from any ABO type without experiencing an instant immunological response since they lack H antigens. Nevertheless, because their blood contains anti-H antibodies, they can only give to other individuals who have the Bombay phenotype. Blood donors of blood types A, B, or O may cause severe and even fatal transfusion reactions if recipients' anti-H antibodies identify the H antigen on their red blood cells as alien.

Proper blood typing and cross-matching are crucial to avoid complications during transfusions for individuals with the Bombay blood group. Blood banks and organizations that specialize in rare blood types maintain confidential databases of donors with this phenotype to ensure a stable supply of compatible blood. Raising the public's and healthcare professionals' knowledge about the Bombay blood group can help to improve patient outcomes by expanding the pool of eligible blood donors.



PROGERIA
-premature ageing

Progeria is a rare genetic disorder that causes rapid ageing in chidren. Despite appearing healthy at birth, children with the disorder show signs of premature ageing during their first year of life, slowing growth, and no weight gain as expected. They have typical intelligence but exhibit distinct physical characteristics.

Progeria comes from the Greek term "geras," meaning "old age." The most well-known form is Hutchinson-Gilford progeria syndrome (HGPS), which was first identified by Dr. Jonathan Hutchinson and Dr. Hastings Gilford back in the late 1800s. Unfortunately, it's a serious condition with an average life expectancy of about 14.5 years, though a few individuals with progeria can reach their early 20s. There's a medication called Lonafarnib that has been found to help slow the disease's progression.

- **Who is affected by progeria?**

As a rare genetic disorder, it has the potential to impact individuals regardless of their background. Typically, it arises from a new (de novo) genetic mutation, indicating that there is no prior biological family history of the condition.

- **How common is progeria?**

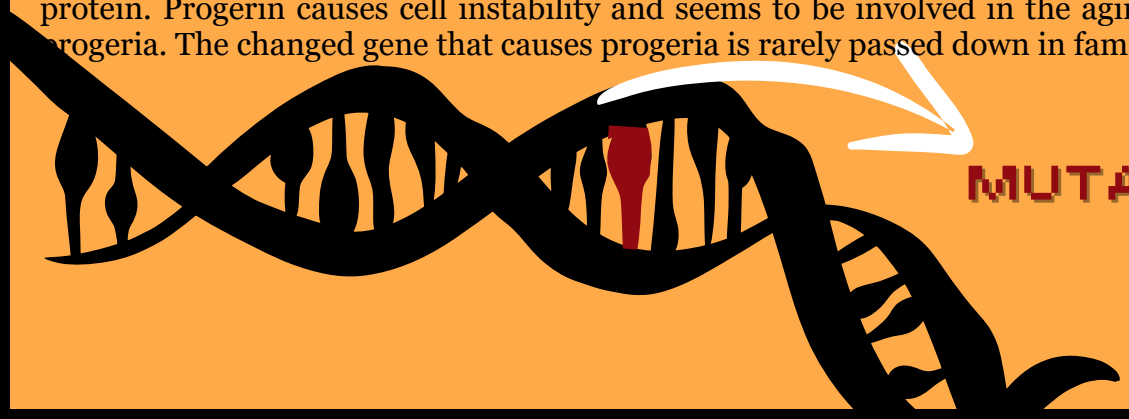
It is extremely rare, occurring in one out of every four million live births globally. Currently, 400 children and young adults worldwide suffer from progeria.

What are the symptoms of progeria?

The symptoms of progeria resemble those of human natural aging; however, they appear significantly earlier in life. Children with progeria exhibit signs and symptoms of fast aging beginning in the first two years of life, which include short stature, wrinkled skin, balding, stiff joints, loss of body fat etc.

- **Cause:-**

Progeria is caused by a single gene mutation. The lamin A (LMNA) gene produces a protein that is essential for maintaining the integrity of the nucleus, the center of a cell. When a mutation occurs in the LMNA gene, a defective lamin Progerin is a kind of protein. Progerin causes cell instability and seems to be involved in the aging process of progeria. The changed gene that causes progeria is rarely passed down in families.



- ***Complications:-***

Progeria is often linked to severe atherosclerosis, a condition where the arteries in the brain and heart become thick and stiff, causing blood flow restrictions and affecting the transport of oxygen and nutrients from the heart to other organs.

- ***How is progeria diagnosed?***

A child's condition is diagnosed through a physical examination and symptom inquiry, with genetic testing typically used to confirm the diagnosis.

Management and Treatment

- **How is progeria treated?**

  Progeria for now is a condition with no cure, but researchers are studying it using drugs like lonafarnib (Zokinvy™), originally developed for cancer. 1. The medication has been proven to enhance symptoms of progeria and boost the average lifespan of kids with the condition by two and a half years. Every child taking the drug has experienced progress in at least one of four specific areas, as follows:

- Weight gain.
- Increased flexibility of blood vessels.
- Improved hearing.
- Improved bone structure.

Physical therapy enhances children's mobility, balance, and posture, and reduces hip and foot pain, while occupational therapy focuses on eating, hygiene, and handwriting. Healthcare providers monitor and manage the condition as follows:

- ***Monitoring for heart disease:*** The child's doctor will check blood pressure, do echocardiograms, and may recommend low-dose aspirin and statins to help lower the risk of heart disease.
- ***Magnetic resonance imaging (MRI):*** The doctor will use imaging tests to look for strokes or to investigate headaches and seizures, which can happen often.
- ***Regular eye exams:*** The child might face eye issues like farsightedness or dry eyes, which can happen if their eyelids don’t close all the way.
- ***Hearing tests:*** The child could experience hearing loss that might be improved with hearing aids.
- ***Monitoring for skin problems:*** The doctor will examine Yod's skin for any problems like dark spots, hair loss, itching, or tightness that could affect movement and digestion.
- ***Monitoring of bone health:*** The child may have various challenges related to bone growth and development, as well as joint issues.

Solar Urticaria

Is the existence of vampires a possibility?

Even though there's no scientific proof backing it up, some people seem to have traits similar to vampires, like not being able to handle sunlight.. This condition is known as solar urticaria, a rare allergic reaction to sun exposure. The afflicted experience an itchy rash or hives that emerge on skin exposed to the sun. The severity of the reaction increases with the amount of skin exposed to sunlight. Unfortunately, there is no known cure for this chronic condition. Management typically requires staying out of the sun or wearing protective clothing, but some individuals may have to avoid sunlight altogether. It only takes a few moments of sunlight exposure to trigger an allergic reaction, which can result in blisters or hives, numerous tiny bumps that may merge into larger raised patches, pain, itching, redness, scaling, crusting, or bleeding. Additionally, other symptoms such as headache, fatigue, nausea, changes in heart rate, and breathing can be present, and exposure to sunlight can worsen these symptoms. In rare cases, solar urticaria can even lead to anaphylaxis, which can be life-threatening. Despite research, the exact cause of solar urticaria remains unknown. Many scientists and experts suggest that it is an immune system response to sun-affected cells. This response creates a negative immune response known as a histamine reaction, which leads to inflammation, redness, itching, and other symptoms. Therefore, while vampires may not exist, individuals with solar urticaria experience symptoms that are no less real and debilitating.

In the event that you experience mild symptoms of PMLE, it is possible to diagnose the condition yourself by asking a series of questions. Firstly, it is important to ascertain whether you have an itchy rash that appears only on skin exposed to the sun. Additionally, it is worth noting whether the rash appears within two hours of sun exposure and if symptoms tend to surface during the early spring, followed by a gradual reduction or complete disappearance within the following few days or weeks. It is important to note that symptoms can vary depending on the specific type of sun allergy. Actinic prurigo, or hereditary PMLE, exhibits similar symptoms, with an emphasis on the face, especially around the lips. Photoallergic eruption typically manifests as an itchy red rash or tiny blisters that may also appear on skin covered by clothing.

Due to being a form of delayed hypersensitivity reaction, skin symptoms may not begin until one to two days after sun exposure. Solar urticaria typically results in hives appearing on exposed skin within minutes of sun exposure. In most cases, doctors are able to diagnose PMLE or actinic prurigo based on a patient's symptoms, medical history, family history (especially with regard to American Indian ancestry) and a simple examination of the skin. Sometimes, additional tests may be required, including a skin biopsy, blood tests to rule out systemic lupus erythematosus or discoid systemic lupus erythematosus, and photo-testing. This involves exposing a small area of the skin to measured amounts of ultraviolet light to confirm whether skin symptoms are sun-related. If an individual has a sun allergy, the initial step towards treatment must always involve implementing preventative measures as described in the Prevention section.

This will serve to diminish sun exposure and mitigate the aggravation of symptoms. Treatment options will then vary depending on the specific type of sun allergy. In the case of PMLE, applying cool compresses to affected areas or misting the skin with sprays of cool water can alleviate mild symptoms. Alternatively, a non-prescription oral antihistamine such as diphenhydramine or chlorpheniramine, or a cortisone-containing cream, can also provide relief for itching. In more severe instances, a prescription-strength oral antihistamine or corticosteroid cream may be suggested If these remedies prove ineffective, phototherapy, a treatment that gradually exposes the skin to increasing doses of ultraviolet light, may be prescribed. Standard phototherapy may entail five ultraviolet light exposures per week over a three-week duration

However, if this is not effective, physicians may attempt PUVA, a combination of psoralen and ultraviolet light, antimalarial drugs, or beta-carotene tablets. For Actinic prurigo (hereditary PMLE), treatment options include prescription-strength topical corticosteroids, phototherapy with special ultraviolet rays, and potentially thalidomide for severe cases. Regarding photoallergic eruption, identifying and eliminating the medicine or skin care product that is causing the allergic reaction is the primary goal of treatment. Symptoms on the skin can typically be addressed with a corticosteroid cream. In cases of solar urticaria, mild hives can be alleviated with non-prescription oral antihistamines or an anti-itch skin cream containing cortisone.

COVID-19

Gateway to autoimmunity ?

Introduction

After the onset of COVID-19 globally, some studies discovered an intricate connection between COVID-19 and autoimmune diseases. Although the primary target of the SARS Covid-19 virus, was the respiratory system, Some pieces of evidence came into view which pointed out a complex interplay between COVID-19 and our Immune System.

What are Autoimmune diseases?

It is a well-known fact that our immune system is designed in order to protect us from invaders and maintain the overall balance of our body. In some cases, our immune system starts attacking our cells and tissues due to unexpected disturbances. This misdirected action can cause severe damages which includes inflammation, tissue damage, nerve damage etc. these are collectively termed as autoimmune diseases. There exists more than 100 types of autoimmune diseases.

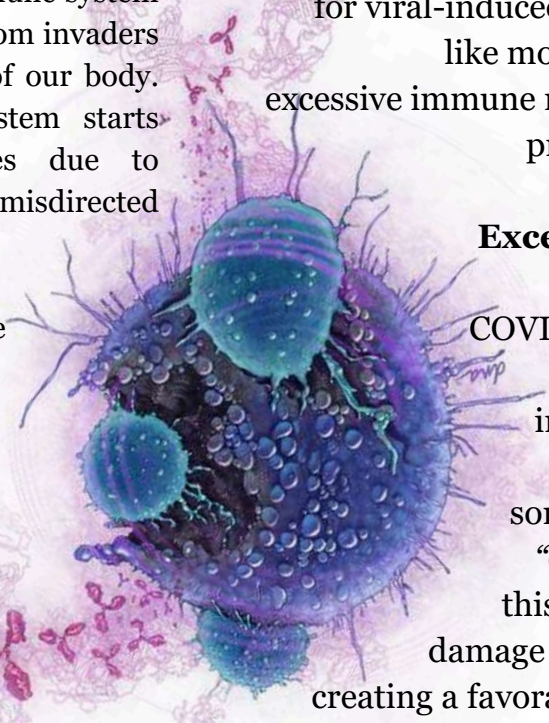
What are the Causes of Autoimmune Diseases?

This misdirected behaviour of the immune system is very unexpected and its exact cause is not known yet. Although research is still going on, there are some potential factors which could affect the immune system. These include genetic links and some environmental triggers. The environmental factors include various types of infections. Thus, viral infections like COVID-19 are said to be the triggers for autoimmunity.

How could COVID-19 induce autoimmunity?

Viral infections are considered to be a major trigger for dysregulation of immune system. Now emphasizing on COVID-19 connection, studies suggest that SARS-CoV-2 virus put some extensive stress on our immune system which can lead to excessive immune response, becomes a trigger for autoimmunity.

Some studies suggest that there are some mechanisms which are responsible for viral-induced autoimmunity like molecular mimicry, excessive immune response, genetic predestination etc.

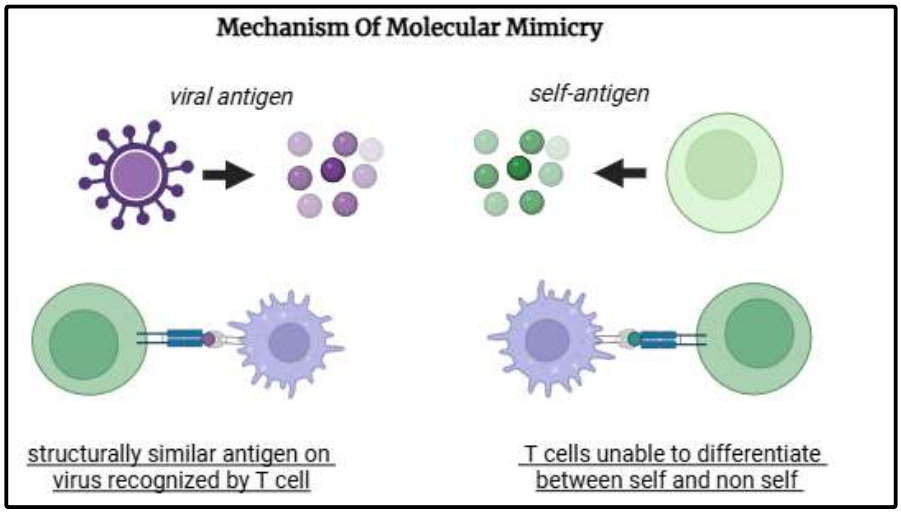


Excessive immune response :

COVID-19 can lead to an overactive immune response which leads to something called as *"Cytokine storm"*. this can cause tissue damage and is capable of creating a favorable environment for autoimmune reactions. Now let's take a brief look towards the mechanisms mentioned above.

Molecular mimicry

The T cells of our immune system have the ability to differentiate between self and non-self antigens. When a pathogen enters our body, it has some antigens present on its surface. Similarly, the cells in our body also have anti--gens on their surfaces, which are self-antigens. Sometimes the self antigens and pathogenic antigens are structurally similar, thus our T cells end up confusing among self and non-self antigens. This confusion leads to **cross-reactivity**, where T-cell reacts with pathogens as well as our own cells.



Genetic predisposition

Individuals with predisposition of genes for autoimmunity are more susceptible to autoimmune diseases after the COVID-19 infections. As, the attack by virus can trigger the underlying autoimmune gene, which were harmless until now.

Research aspects

Taking into consideration all the above aspects, it becomes important to monitor and understand all the mechanisms inducing autoimmunity following COVID-19. It could be a great challenge for aspiring researchers, as research is very essential to find preventive and therapeutic measures.

Star of the department

-A Strong Girl with Dreams

- B. SC. IN BIOTECHNOLOGY, DR. AMBEDKAR COLLEGE, NAGPUR UNIVERSITY, INDIA JULY 2012- JUNE 2015
- MS IN BIOLOGICAL SCIENCES, IISER PUNE, INDIA AUGUST 2015- JULY 2017
- PHD IN BIOLOGICAL SCIENCES, IISER PUNE, INDIA AUGUST 2017- FEBRUARY 2024
- POST-DOCTORAL FELLOW, IISER PUNE, INDIA MARCH 2024- SEPTEMBER 2024
- POST-DOCTORAL FELLOW, ARIZONA STATE UNIVERSITY OCTOBER 2024 ONWARDS

1) Introduce yourself and tell us something more about you.

Hi there, I'm Mrinmayee Bapat, and I recently completed my doctoral studies at the Indian Institute of Scientific Education and Research in Pune. I completed my undergraduate studies at Dr. Ambedkar College in Nagpur between 2012 and 2015. I was determined to get a PhD, so while I was in my second year of a bachelor's degree, I began looking for integrated master's and PhD programs. During that period, the teachers briefed us about the different master's entrance tests. I passed the JGEEBILS exam, was accepted to IISER Pune for my master's and doctoral programs, and just completed my PhD in February 2024. While I was seeking for post-doctoral fellowships outside of India, I kept working as a post-doc fellow in the same laboratory. And I'm glad to let you know that I'll be attending Arizona State University in the United States shortly.

2) What made you choose this field? Any story behind this?

I've never been good at maths, but I've always had a strong interest in biology. Even in school, biology has always piqued my interest. I was reading books on biology exclusively. Knowing that engineering or any other related profession was not for me, choosing this field was not difficult for me. Unlike my cousins, I was committed to doing something in basic science. In addition, my father completed his BSc and master's degrees. The gold medal he had won was for agronomy. I knew that I would do the same after hearing this. Additionally, I never went to any tutoring sessions because I preferred studying alone. I used to study after school in the past.During my BSc, I spoke with Deovrat Sir and Rohan Sir. That's when I first heard about the JGEEBILS exam. Together with the professors, we used to gather in the lab to work through questions from previous years. After passing the test, I continued to work in this field. I never pursued an MBBS because of the national level competition and the tuition classes we frequently have to engage in. I've never had a negative attitude towards bachelor's or master's degrees.

3) Your resume is so impressive and inspiring. Please tell us how you cracked various entrance exams ?

Within our group, there were ten or fifteen regular college students. Our habit was to push one another to go to lectures. Our teachers and I used to have discussions. We used to attend everything with such enthusiasm, whether it was practicals or classes. We used to check out books from the library and make notes every day. I was unaware of these admission examinations till Deovrat Sir informed us about them. Thankfully, past exam questions proved to be quite helpful in passing the test. You must read literature with sincerity and work through as many problems as you can. It is best to begin your studies at the beginning. The most crucial thing is to work through past year's questions because the exam format is essentially constant from year to year. I thought of Lehninger's books as the Bible. It's the easiest and finest book ever. In addition, Voet and Voet are beneficial to microbiology. You should read Sambrook if you wish to learn how to make reagents or if you want to study instrumentation. You must read Lehninger from cover to cover and adhere to its recommendations. It's not necessary to mug up.

4) You have done study and research both until now. Do you think practical skills are more important than theoretical knowledge?

I wouldn't say that, though. You must thoroughly understand theory before moving on to practice. It is advisable to acquire foundational knowledge prior to engaging in research papers and practicals. Students still don't understand the fundamental idea underlying the protocol and the instruments, despite having greater exposure to real-world expertise about utilizing complex instruments. You should read books first, then write research articles, and then pursue a PhD.

5) Tell us about your PhD work in brief.

In essence, structural biology is what our lab studies. The primary objective of structural biology is to determine a biomolecule's atomic-level structure, such as that of a protein. We perform X-ray crystallography and cryoelectron microscopy on proteins. For my project, I looked at the plant bacteria Spiroplasma. We are still studying these bacteria's cytoskeleton proteins. This bacterium is mobile even in the absence of flagella or cilia support. Our aim is to study proteins that cause motility both in vivo and in vitro. I was mostly interested in two of these proteins.

6) What advice would you like to give people considering to pursue PhD?

PhD is all about 3 P's Patience, Persistence and Passion. If you don't have passion then you wont be able to sustain the pressure it gives. PhD demands hard work and resilience, as it needs a long time to complete just one project. You have to consider all these points to decide if you want to pursue PhD.

7) Students are always in a dilemma of choosing their career path after their final year of bachelor's or masters. What should we consider or keep in mind while choosing this next step of career?

To make a sound decision, you should be sufficiently knowledgeable in all areas, such as genetics, molecular biology, cell biology, etc. Consider which sector most appeals to you and which will pique your interest and passion the most. If you wish to investigate the sector in a more diverse and unrestricted manner, pick your topic carefully.

8) What are your hobbies and how do you manage to keep those hobbies alive even in your hectic life as a researcher?

As such I don't have any hobbies but while progressing in life with PhD I started to like cooking. Whenever I get some time free from my project work I try to treat myself with good food. It is quite hard to manage time when you are a researcher because you never know when you will have free time from your ongoing task. Naturally, though, it's all about finding a balance and relishing life's educational journey.

9. Tell us some of your personal experiences that you would like to share with everyone and what challenges you faced during this journey and how you overcame them.

Everyone has a different path set to travel for their journey of life. Life is all about ups and downs and everyone face them at one point of time. When I was in my B.sc 2nd year my mother passed away. I was devastated but deovrat Begde sir and Rohan Thaware sir supported me a lot at that time. Again when I was in my masters final semester, I lost my father. But fortunately my PhD Guide – Dr. Gayathri Pananghat and all my lab mates were very supportive and nice, so I again collected myself. So yes I faced challenges, but at the end it's you who has to decide if you want to sit and cry about it or overcome and pursue high levels ahead.

10) Who has been your biggest mentor or source of support?

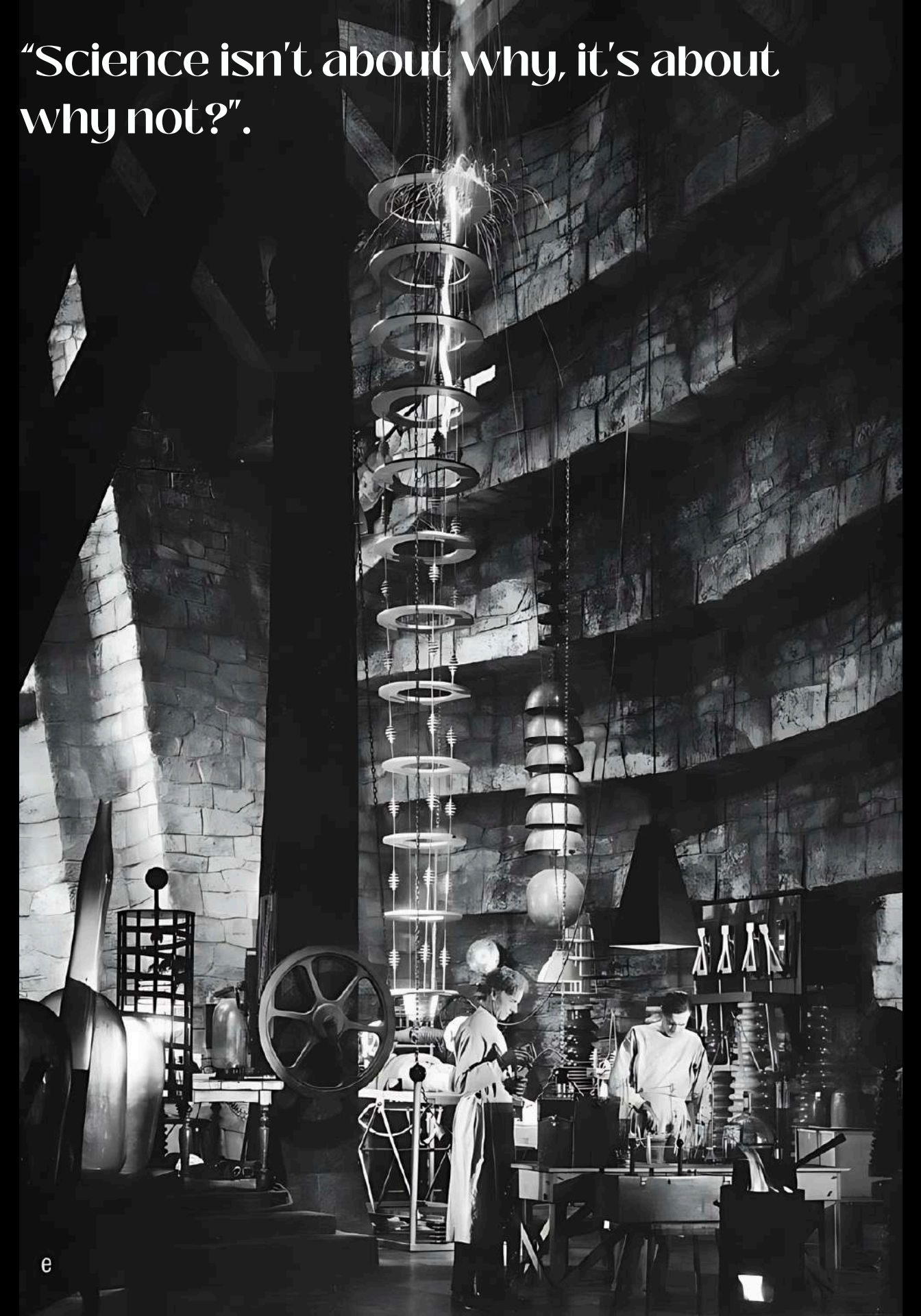
There is not just one particular person who has supported me, there are more than one. I would say my biggest support system were my parents who never stopped me from doing what I like, Deovrat begde sir and rohan thaware sir for always encouraging us and motivating us. My guide has always been supportive personally as well as academically.

11) How was your experience at Dr. Ambedkar college?

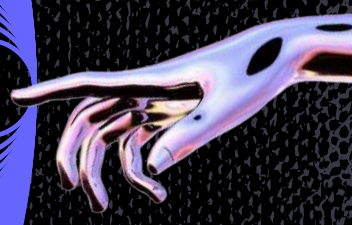
The experience was delightful. My friends and I used to often gather around the college and found great joy in our time there. The practical sessions and lectures in Biochemistry and Biotechnology were particularly engaging, providing an out-of-the-box thinking.
The teaching and non teaching staff were exceedingly supportive and consistently encouraged us, never once disheartening our efforts.

12) What message would you like to give to our dear readers?

Consider doing a PhD only if you have the determination to do so. It's not necessary to follow your group of friends in your career decisions. Take your time, make sure you have good study habits and be consistent with your goals. Solve tons of questions to practice for better results. And ofcourse do your best without stressing out.


“Science isn't about why, it's about why not?”.

into the world of paradoxes



<u>Paradoxes:</u> what are they? Have you ever heard of them before? Perhaps you have encountered some without realizing they were contradictions. To avoid adding to your confusion, let's first review this word.
The dictionary says a paradox is a claim or idea that, despite appearing self-contradictory or illogical, may have an underlying truth, which can be better understood by discussing amusing paradoxes.
Here is a list of all the paradoxes we will be exploring:

BOOTSTRAPPARADOX

A contradiction known as the bootstrap paradox arises when data, a person, or an object sent back in time creates an endless cycle in which the person or the object has no visible beginning. Put otherwise, it behaves as if it doesn't have a source. Another name for it is the Ontological Paradox.
To further comprehend this, let's look at an example. Assume you are a student with a strong passion for physics and reading about Einstein's special theory of relativity. You had some questions, but because Einstein is no longer with us, it's clear that you were unable to obtain the answers. Furthermore, you are finally able to create a time machine after years of research. You choose to go back in time to the era of Einstein. The theory paper was also brought with you. You are astounded to discover, upon visiting, that Einstein is merely a simple cook with no scientific training and had no idea about your doubts. When you see this, you become irritated and go back to the present. However, you have now forgotten your theory paper. Einstein now publishes those papers under his name and becomes well-known. The question now is, who wrote the theory of relativity in the first place? What is the theoretical paper's origin? This is where the paradox arises.

FERMI PARADOX

The conflict between the apparent high probability of advanced alien life and the lack of convincing proof of it is known as the Fermi paradox. Let's investigate this further. The theory suggests that extraterrestrials, or aliens, may have already visited Earth due to Earth's relatively young age and the possibility of interstellar travel. Enrico Fermi, the Nobel Prize-winning physicist, coined the term "paradox" in 1950, and astrobiologists have been left to explore the implications of this theory.The concept has been debated by scientists for decades. Fermi believed that a civilization with a modest amount of rocket technology and imperial incentives could colonize the entire galaxy. After his death in 1954, Michael Hart took the opportunity to dive deeper into the topic, publishing an article in 1975 in the Royal Astronomical Society Quarterly Journal that discussed why we haven't encountered any extraterrestrials on Earth.
Hart questioned whether intelligent aliens could have visited Earth at some point in history, arguing that the rarity of these encounters may be due to the absence of intelligent aliens. He also proposed four additional hypotheses:
The physical challenge “that makes space travel infeasible,” which may have its roots in astronomy, biology, or engineering, is the reason aliens have never visited Earth.
Aliens have just decided not to come here.
Beyond Earth, advanced civilizations emerged too recently for aliens to have contact with humanity.
Although we haven't seen them, aliens have visited Earth in the past.
Many other scientists arrived and added their hypotheses and viewpoints. There is still no solution to this issue.

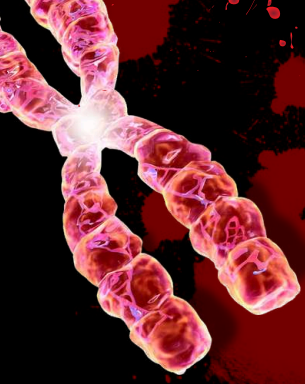
THE GRANDFATHER PARADOX

When the past is changed in any manner, a contradiction known as the grandfather paradox or consistency paradox arises.
Is it possible to travel back in time? Rene Barjavel, a French science-fiction author and journalist, explored the concept of time travel in 1943. He questioned the consequences of a man killing his grandfather and traveling back in time to a moment before his parents' birth. Barjavel argued that without a grandfather, an individual would not exist, and therefore, no one could travel back in time and murder their grandfather.

The grandfather paradox has been a central theme in philosophy, science, and the entire Back to the Future trilogy. Some argue that time traveler's modifications create a new, distinct history, but the paradox remains valid.
However, the paradox only implies that time travel is impossible. There is nothing in it about turning around.

THE BLACK HOLE INFORMATION PARADOX

In the realm of physics, what may seem like paradoxes are often just intriguing puzzles waiting for a solution. One of the most significant enigmas we face is the black hole information paradox. According to quantum mechanics, for various reasons that extend beyond the scope of this discussion, information—such as the mass and spin of particles or the atomic structure of a carbon molecule—can never truly be obliterated. Imagine incinerating two distinct letters; while reconstructing them from the ashes would be nearly impossible, it's not entirely out of the question. The unique characteristics of the smoke, heat, and residual ash would still hold traces of the original letters.
The dilemma arises with black holes, which consume matter and, after an incredibly long duration, emit it as Hawking radiation. However, unlike the remnants of burnt letters, Hawking radiation offers no clues about its origins; it is uniform and indistinguishable, suggesting that black holes might erase information from the universe entirely.
Physicists are making strides toward unraveling this mystery, and Stephen Hawking himself posited that the information from particles swallowed by black holes eventually finds its way back into the cosmos. If this is not the case, we may need to fundamentally reassess many principles of contemporary physics.



THE SERIAL KILLER GENE?

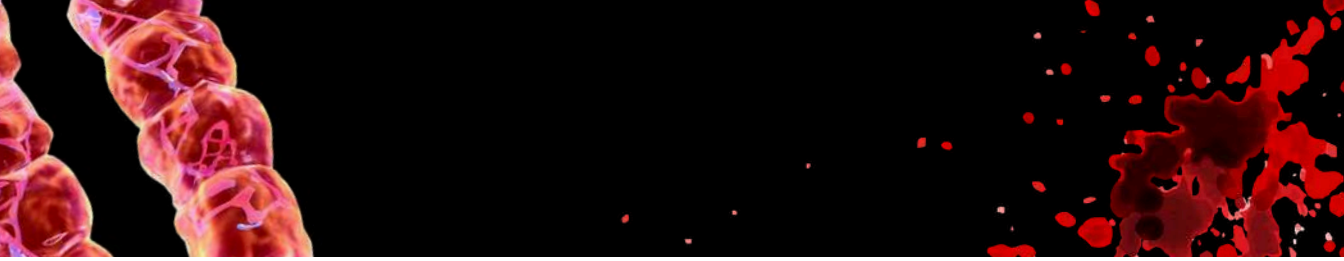
A gene responsible for someone's hideous actions seems fictional and scarcely credible right??

An individual who cannot effectively metabolize the MAOA gene, which is crucial to produce key neurotransmitters like dopamine, serotonin, and noradrenaline, may experience significant consequences. Reduced serotonin levels have been linked to heightened aggressive and impulsive behaviours. This suggests that a deficiency in the enzyme responsible for the breakdown of MAOA-L can result in elevated aggressive tendencies in the individual.

MAOA-L = one variant of gene for LOW levels of MAOA
MAOA-H= one variant of gene for HIGH levels of MAOA

neurotransmitter	level	behavior
Dopamine	High	Increased likelihood of feelings of aggression of reward when aggression is carried out.
Serotonin	low	Lack of inhibition over impulsive behavior
Noradrenaline	high	Overaction to perceived threats

The reality is, our bodies are accustomed to a certain balance, and when that balance gets disrupted, it can lead to serious issues.
While we have gained a simple understanding of how MAOA works, there are other genes also which come into play such as CDH14, COMT, SCL6A4, and DRD4. These when coupled with environmental factors which when triggered along with childhood abuse can lead to biochemical changes rather observed in a serial killer. Specialists contend that no singular "gene" can definitively determine whether a person will engage in criminal activity. Instead, numerous genetic elements are linked to criminal conduct. Characteristics such as psychopathy, neuroticism, impulsivity, manipulative tendencies, and a diminished ability to empathize increase the likelihood of violent behavior; individuals who possess these genetic traits are more prone to exhibit aggressive actions.



And it is to be noted that it is a sheer notion to have the gene and label one with “serial killer”, because there is a huge difference between having the gene being expressed and dually, blaming one's actions on just your “genetic makeup”. The case discussed below is why this note was necessary. As notorious as it sounds, these findings were presented in the courtroom as concrete evidence to defend a murderer named Abdemalek Bayout in 2010. The convicted Italian admitted to stabbing a man to death, but his lawyers continued to argue of him being “mentally ill” and thereby decreasing the years of imprisonment. The argument put forth suggested a fault in his genetic makeup. The judge at the end was deluded and decreased the confinement by a year, making Bayout’s sentence 8 years.

Now let us understand the chronology of the evolution of studies in this particular finding.
Psychologists wrongfully suspected that the genetic cause of such behavior was associated with the Y chromosome observed in males. An intricate experiment was designed around this belief by Court Brown in
1965. As mentioned, he was interested solely in the Y chromosome, hence, he targeted 314 such individuals with Kleinfelter syndrome (XYY genotype).
Since then, till now the world of genetics has evolved and taken a turnover, where research has been focused on,

- The normal XY genotype
- Breeding of animals which indicated aggressive behavior as a TRAIT, passing from one generation to the offspring and not just in males
- And finally in the past 50 years, finding the gene MAOA was brought into light.

In addition to the inherent aggression linked to possessing the gene, external stimuli play a crucial role, particularly environmental factors and the extent of emotional abuse experienced during childhood.
Moreover, research indicates that substance abuse and exposure to violence collectively contribute significantly to an individual's aggressive behavior.

Have you ever heard of ALIEN HANDS?

Have you ever seen an alien? Or maybe a part of an alien body?
But what if it was your own body? Yes, your hand can sometimes be alien to you, losing all control this being a medical finding is called alien hand syndrome(AHS). This rare disorder was seen in a 55-year-old woman in New Jersey. Due to AHS, Karen Byrne's left hand would sometimes act involuntarily on its own. The corpus callosum—a portion of Karen's brain—was removed by medical professionals in an effort to treat her infantile epilepsy.
As a result of the surgery, Karen lost control of her left hand, which she used for everything from slapping herself to strangling someone. Once she stated that “it would take things out of my handbag and I wouldn't realise, so I would walk away, I lost a lot of things” acc to BBC.

A similar case was seen in a 13-year-old girl whose right arm was affected by AHS. Doctors prescribed a drug called clonazepam which helped reduce her symptoms., but unfortunately this did not work with her, and they had to try another path for diagnosis.
Alien Hand syndrome: what really went wrong?
Alien hand syndrome is a pretty rare medical issue that was first noted back in 1908. It's an unusual neurological condition that usually impacts just one hand or limb, often the left one, but it can also show up in the legs.
There is complete loss of control of one limb, and it does action on it and act as an alien. Your hand performs activities and movements without your intention as if it's trying to prove the proverb “Don't let your left hand know what your right hand is doing”. People who are impacted with AHS refer to it as an alien hand, as it is someone's else hand and not their own.

The patient is unable to explain the root of such movement, and may consider the limb to move on its own will. The key term is 'sense' of lack of ownership, which can occur in this disorder.

Three different brain regions may be affected by alien hand syndrome:

•Frontal lobe region

•Callosal region

•Posterior region

Individuals diagnosed with Parkinson's disease are generally at an elevated risk of developing this condition, with approximately 30% of them experiencing AHS.

Causes of AHS:

Experts do not completely understand how the brain can experience confusion between a person's will and action. AHS doesn't have any universal cause, but it always caused by some kind of damage in your brain which disrupt your moment and control.

Causes of AHS include:

- Aneurysm
- Stroke
- Neurodegenerative disease: Such as Parkinson's disease or Alzheimer disease.

Who can get affect with AHS:

AHS is a disorder, anybody can get it, when someone has a brain injury AHS can be affected. Many AHS cases are in adults rather than in children. Cases of people above 50–60 years are there, but a 13-year-old girl case has also been reported. Hence, it mostly occurs in men and women but can also occur in few children.

Symptoms of AHS:

The symptoms of AHS are as we discussed above are involuntary action and movements of limb (mostly left hand) and can also show symptoms in lower limbs but in rare case.

People with AHS, their hand does things of its own without any ownership and in extreme cases people also slap and try to suffocate/choke themselves as reported.

Treatment of AHS:

Expert suggest that there is no such treatment for alien hand syndrome.

MRI and CT scans can also help to impose the damage or injury area of the brain that can help in reduction of symptoms.

Doctors may also sometimes advise going for physiotherapy or occupational therapy.

Study shows that certain task and exercise can improve symptoms of AHS and even brain training may help to improve the symptoms of AHS, but it cannot be cured completely. It has been reported that AHS can last up to days or even several years.

THE LITTLE ALBERT'S EXPERIMENT

The quest for knowledge has occasionally driven researchers to engage in ethically questionable practices. These practices resulted in the infamous *'Gruesome Experiments'*, which involve serious harm or suffering on human or animal subjects without considering ethical guidelines or welfare. These experiments have historically caused significant suffering and led to widespread public outcry, resulting in changes in ethical standards governing research.

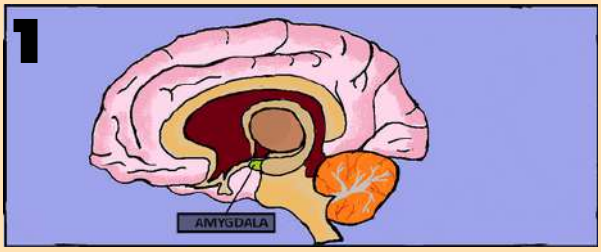
One such experiment was the Little Albert's experiment.

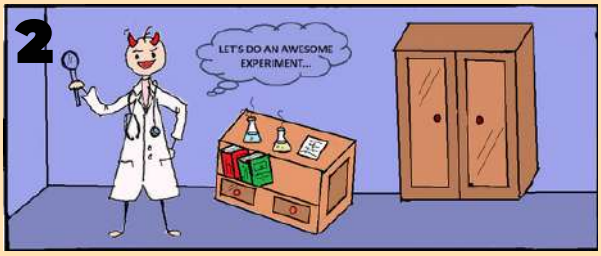
 # He mainly addressed the following questions in his study:

- *Can emotional responses be conditioned?*
- *Are conditioned emotional responses transferable to other similar stimuli?*
- *How persistent are conditioned emotional responses?*
- *What impact does the removal of conditioned stimulus hold?*

Fear is a basic emotion that protect us by triggering a chemical and emotional reactions called the "fight or flight" response. The Amygdala, an almond-shaped structure of the brain is considered the hub for fear processing.

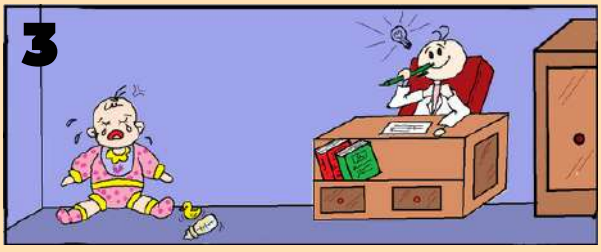
In the year 1920, John Broadus Watson and his graduate student Rosalie Rayner conducted experiments at Johns Hopkins University with this objective in mind.





Young children naturally dislike loud noises. Watson aimed to demonstrate, using the theory of conditioning, that he could make a child afraid of something he wouldn't normally be afraid of.

Douglas Merritte, also referred to as "Little Albert," was the infant he selected for the experiment. His mother, Arvilla Merritte, was a wet nurse who worked at the university hospital and was paid $1 for her baby's involvement.

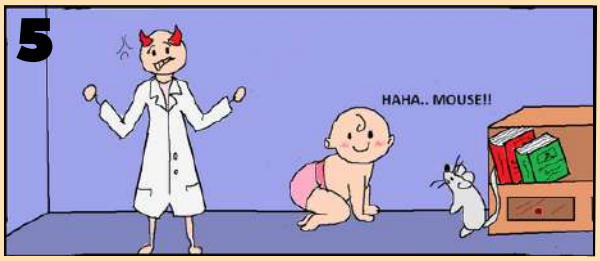


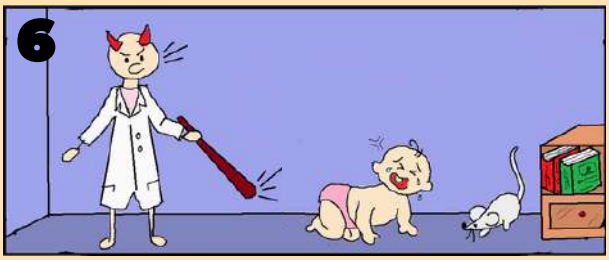
The Little Albert experiment faces considerable criticism in contemporary discussions due to its ethical ramifications. The research was carried out without obtaining informed consent from Little Albert's mother, and the researchers made no effort to alleviate the fear they had induced in the child. Furthermore, the long-term psychological impact on Little Albert was neither evaluated nor addressed, highlighting serious ethical issues regarding the treatment of the subject.

Though ethically flawed, the experiment is seen as a key study in psychology. It showed clear evidence of how emotional responses can be conditioned and highlighted how people can learn fear. This experiment is often referenced in talks about behaviorism and the ethics involved in psychological studies.

Albert was put through a series of tests by Watson where he was first briefly exposed to a mouse, rabbit, fuzzy dog, etc. He showed no fear towards them.

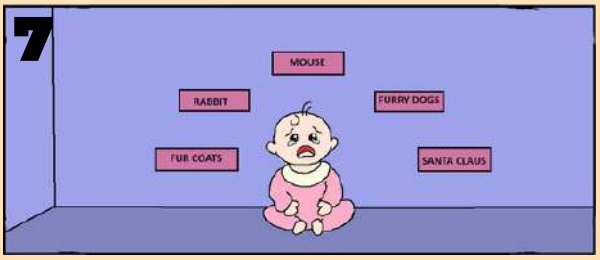
Albert was then placed in a small room with a white mouse. Without fear, he began to approach the mouse. But whenever Albert tried to touch the mouse, Watson made a loud noise from behind which startled the child.

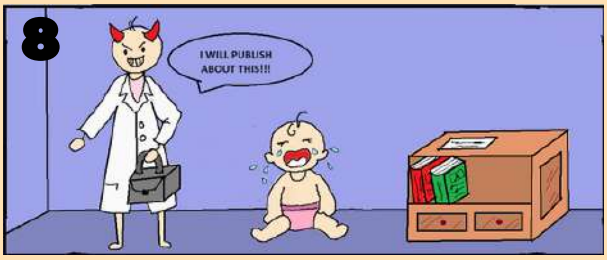




Albert became afraid of the mouse as a result of Watson's continuous repetition of this approach. Albert appeared to have a more generalized fear, as seen by his uneasiness at the sight of objects like a fuzzy dog, a bunny, and even Watson portraying as Santa Claus!

Watson then decided to share his research in a publication. He didn't attempt to 'decondition' Albert's fear. It was still uncertain how easy this conditioned fear might be overcome or how long it would last.





Articles

written by the
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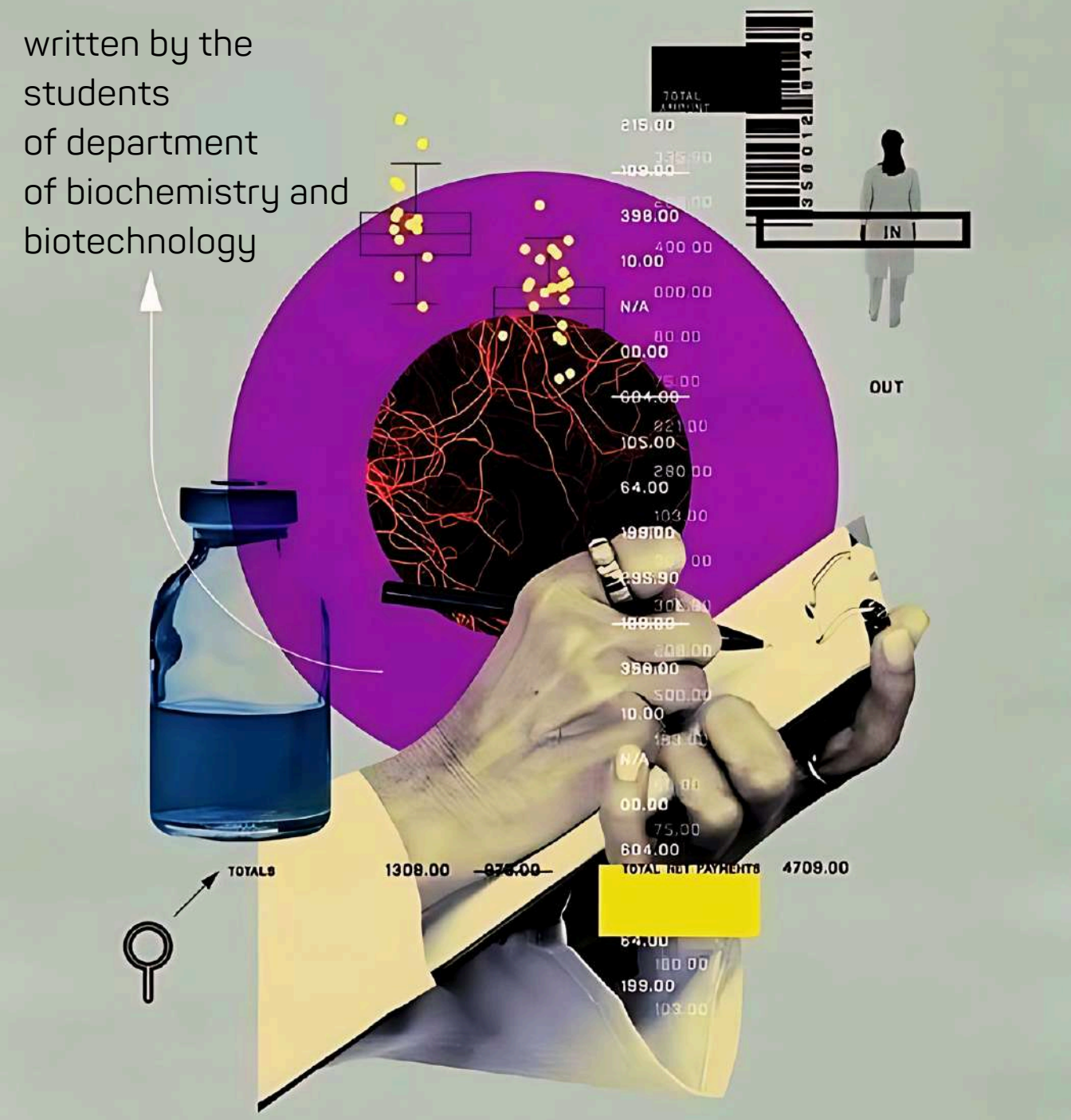
of department
of biochemistry and
biotechnology



MINDSET

The driver behind a learner's motivation and achievement

BiFC

BiFC is a recognized method in the fields of biotechnology and molecular biology, crucial for studying and directly visualizing protein-protein interactions in living cells. This technique is based on the concept of split fluorescent proteins, which involves dividing a fluorescent protein into two non-fluorescent components.

Discovery:

In 1998, Hu et al. discovered a technique using green fluorescent protein (GFP) fragments from jellyfish Aequorea victoria. They split GFP into N-terminal and C-terminal fragments and fused them to two proteins of interest. When these proteins interacted, the fragments reassembled, resulting in fluorescence emission. This technique can be visualized and detected using fluorescence microscopy, a powerful tool for studying protein interaction in living cells with high spatial and temporal resolution.

Methodology:

Two proteins of interest fuse to split fluorescent protein fragments, allowing them to interact and reconstitute the functional fluorescent protein. Fluorescence is only observed when proteins of interest physically interact within the cell, resulting in the formation of functional fluorescent proteins.

Applications of BiFC:

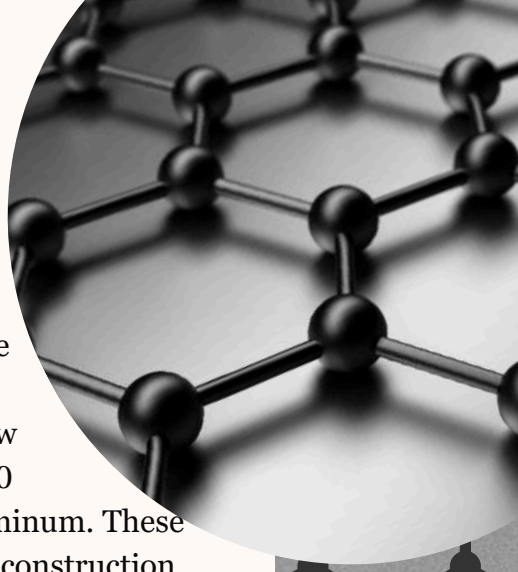
1) Studying protein-protein interactions: Enables researchers to observe and analyze interactions that clarify the intricate network of molecular interactions fundamental to various cellular processes, such as signal transduction, gene expression, and protein trafficking.

2) Real Time imaging: Enables real-time imaging of protein interactions in live cells, providing dynamic insights into protein complexes. Hence, changes in proteins can be monitored in response to different cellular conditions.

3) Subcellular localization: The localization within cells helps researchers understand where and how protein function within the cell.

- Sanika Gotmare
2nd year

GRAPHENE - “A MIRACLE MATERIAL”



One of nature's key components, pure carbon, forms the backbone of ‘Graphene’, a material sourced from graphite that shows up in regular items such as pencil lead.

Graphene is remarkable due to its strength, flexibility, low weight, and outstanding resistance. It's believed to be 200 times stronger than steel and five times lighter than aluminum. These properties make graphene super useful in energy, construction, healthcare, and electronics sectors. A great example is magnetic graphene, which could change the game in electronics by making devices more user-friendly and accessible to everyone.

“Graphene is the polymer of the future.” Graphene is an allotrope of carbon, consisting of a single layer of atoms arranged in a hexagonal lattice. Its name is derived from the suffix "-ene" and the graphite allotrope of carbon contains numerous double bonds. Each atom in a graphene sheet is connected to its three nearest neighbours by σ-bonds and a delocalized π-bond, contributing to a valence bond that extends over the whole sheet. This bonding is also seen in carbon nanotubes, polycyclic aromatic hydrocarbons, and fullerenes.

The hexagonal lattice structure of isolated single-layer graphene can be directly seen with TEM.

 # USES AND APPLICATIONS OF GRAPHENE:

1) Graphene in health: Graphene has potential applications in health and medicine, including developing stronger, more flexible, and lighter hearing aids, as well as creating bones and muscles for surgical procedures. Graphene oxide, obtained through oxidation, could aid in disease diagnosis and treatment, as it possesses extraordinary mechanical properties.

2) Graphene in the energy sector: Graphene could significantly enhance energy efficiency in rechargeable battery manufacturing by preventing overheating, making devices tougher and lighter.

3) Graphene in construction: Graphene's role in construction significantly upgrades insulation, increasing a building's resistance to corrosion, moisture, and fire, which makes it more robust and sustainable overall.

-Vedant Kharapkar
2nd year

CAFFEINATED ENERGY DRINK CONSUMPTION

A GROWING PROBLEM AND HEALTHY ALTERNATIVES

The global consumption of energy drinks is increasing, but concerns remain about their contents and potential health risks. These drinks contain taurine, sugars, sweeteners, herbal supplements, and moderate to high amounts of caffeine. Caffeine is safe in moderation, but excessive intake can lead to addiction. Young people are drawn to energy drinks due to their temporary effects, as advertised in marketing, which claims to increase alertness, improve mood, and enhance mental and physical energy.

High levels of caffeine consumption have been linked to various negative health outcomes, with studies indicating that around 50 to 80% of adolescents and young adults regularly consume caffeinated beverages.

Energy drinks may seem like a quick fix for fatigue, but they have been linked to numerous health benefits, even if they contain ingredients that have not been thoroughly tested for their effects on the body.
The escalating consumption of alcohol combined with energy drinks is linked to various alcohol-related issues and complications among younger populations, particularly junior and senior high school students and college individuals. It is important to analyze the profiles of energy drink consumers, the volume consumed, and the contexts in which they are used, as excessive intake has been tied to recent incidents of mortality.

 # How to quit energy drinks?

To combat energy drink dependency, one can effectively replace these drinks with healthier alternatives, including:

- Drink water: Staying hydrated helps to keep the body running. Eat carbohydrates and protein: It provides the muscle with energy and helps build them
- Take vitamines: Naturally occuring vitamines and minerals ,such as magnesium helps body to produce energy
- Be active: When you exercise, your serotonin and endorphine level increases shortly after, which helps to feel better

-Aasawari kasare
2nd year

WORD PUZZLE

Q	C	E	T	Y	B	I	O	C	O	N	N	E
F	H	G	N	N	J	H	L	L	T	V	M	C
V	R	B	T	R	T	T	F	K	N	V	I	V
D	O	B	H	Y	H	B	F	N	A	F	C	N
G	M	V	T	A	N	N	F	K	F	J	R	M
L	O	N	A	F	A	R	N	F	A	C	P	B
H	S	C	G	T	N	Y	R	H	A	F	F	X
H	O	J	G	G	G	T	G	H	J	Y	L	F
B	M	J	G	G	N	T	D	G	I	J	U	B
J	E	N	R	G	L	B	H	G	B	M	D	J
E	S	J	T	G	S	G	R	G	L	R	I	F
G	F	B	H	J	J	R	H	G	D	F	C	Y

HINTS:

- **A PACKAGE OF DNA WITH PART OR ALL OF THE GENETIC MATERIAL OF AN ORGANISM**
- **MEDICATION AGAINST RAPID AGING DISORDER**
- **SYSTEM FOR STUDYING ORGAN BEHAVIOUR IN VITRO**
- **COMPANY OF THE BIOTECH QUEEN OF INDIA**

Answers : 1)Chromosome 2) Lonafarn 3) Microfluidic 4)Bioccon

RIDDLE ME THIS !

I speak without a voice, I tell the truth in lies.
I exist in contradiction, where logic meets demise.
What am I?

_____

I grow without permission, yet I am not alive. I invade the body's fortress, where healthy cells strive.
What am I?

_____

I am a tiny scissor, sharp and precise, Editing genes with a cut so nice. I borrow from bacteria to defend and attack, What am I in the lab, altering DNA's track?

_____

I glow in the dark without a spark,
A living light, nature's mark.

_____

I attack my own cells, though they mean no harm,
A body's defence sounding a false alarm.

_____

I'm yellow and explosive, with a bitter past,
Once a dye and a danger, my reactions are fast.

_____

Answer: 1) Paradox 2)Tumor 3)CRISPR-Cas9 4) Bioluminescence 5)Autoimmunity 6)Picric Acid

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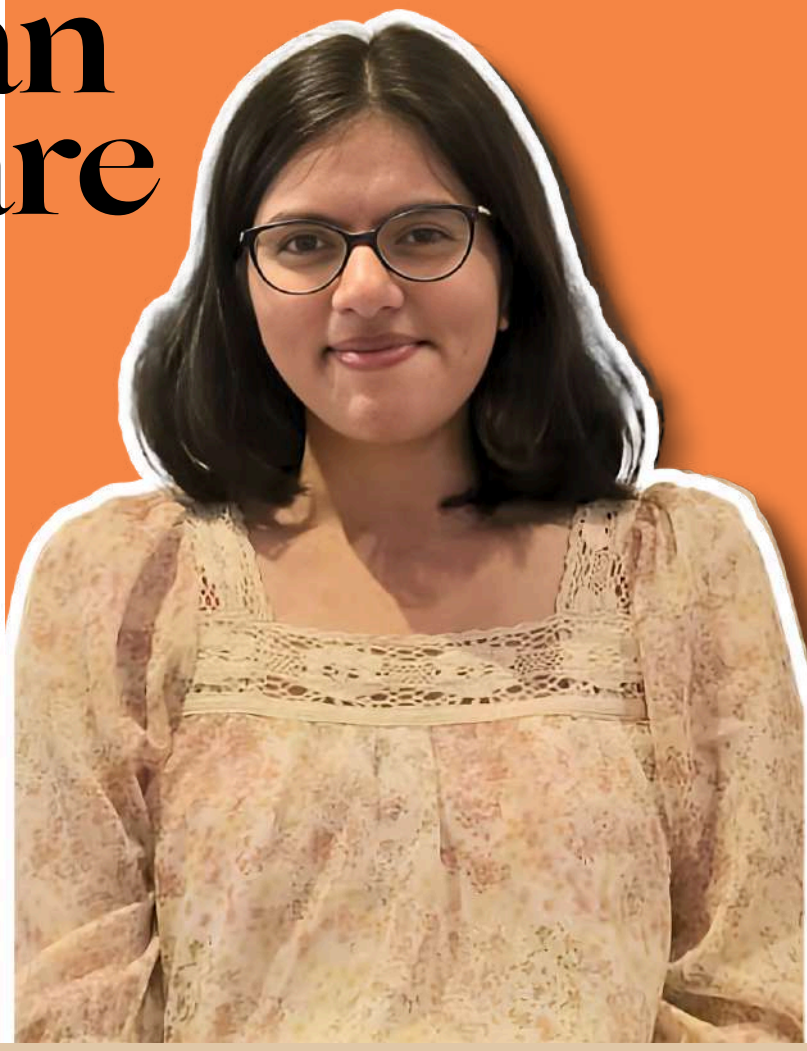
Kanchan Deoghare

our "OG" super senior



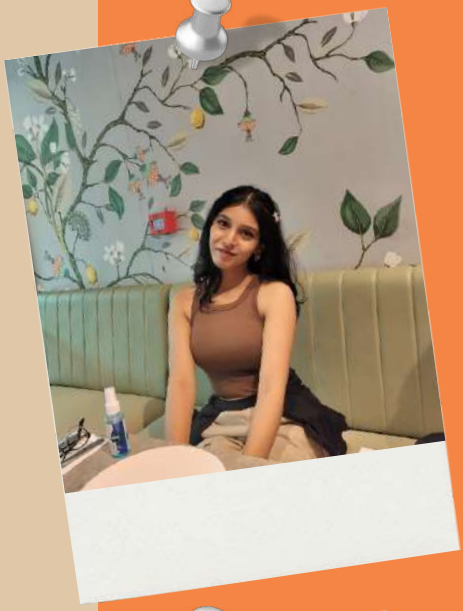
Meet the member of "The Catalyst" who is truly a catalyst, inspiring us to carry forward this legacy. Dear Kanchan Deoghare, we want to take a moment to express our deepest gratitude for everything you've done for "The Catalyst" magazine and the team.

Your unwavering support and guidance have been instrumental in helping us elevate this magazine to new heights. We truly appreciate your kindness and the helpfulness you've consistently shown us.
Thank you for always being there to lend a hand and for believing in us.
Your contributions have shaped us in profound ways, enabling us to reach the 4th edition of The Catalyst. We've had the privilege of meeting many amazing seniors, and you stand out as one of the very best.

Wishing you continued success and happiness in all your future endeavors.

With heartfelt gratitude,
your juniors,
The Catalyst.

Along with our "OG" Kanchan Deoghare, we express our appreciation to our seniors:
●Janvi Wane (contributed in edition 1 and 2),
●Nandini Purohit (contributed in edition1 and 2),
●Prashansha Kori (contributed in edition1),
for their contributions to the previous edition of the magazine. We wanted to take a moment to express our appreciation for your valuable inputs to the editions. Your insights and efforts have certainly made a difference. We recognize the time and energy you dedicated, and it's been beneficial for all of us.



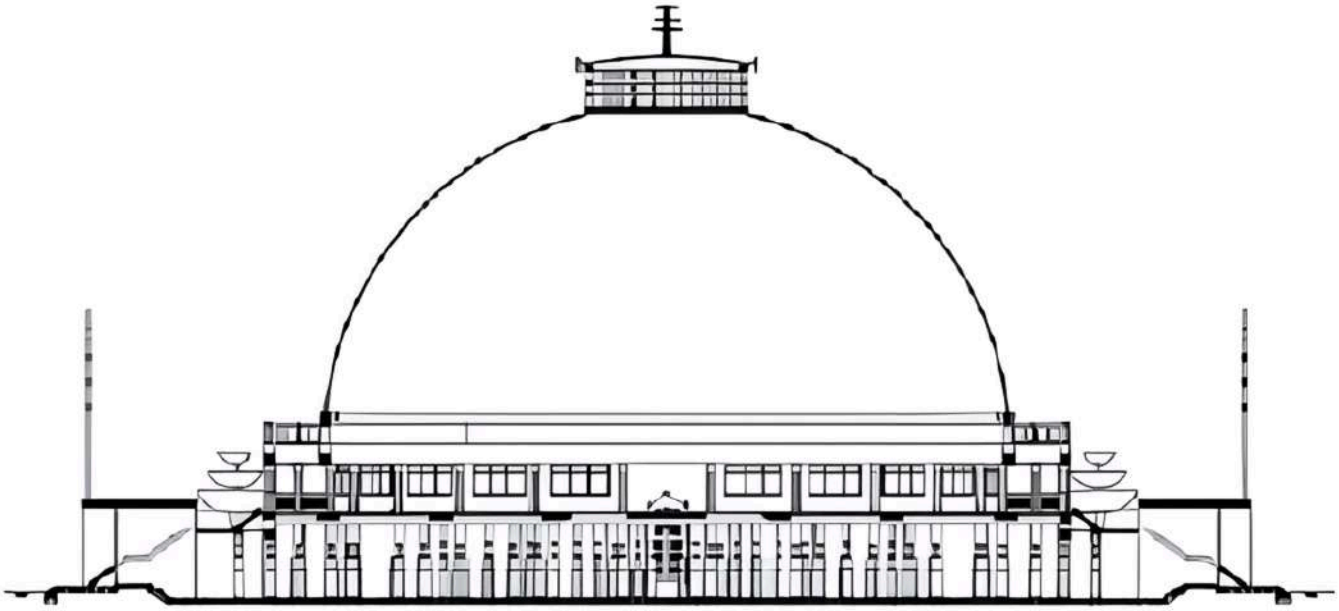
The completion of this magazine would not have been possible without the support and assistance of many. We extend our sincere appreciation to our esteemed Principal, Dr. Mrs. B. A. Mehere Ma'am, and the college for providing us with the necessary resources and facilities to create this magazine. We are grateful for the unwavering support and guidance of Dr. Utpal Dongre sir, the Head of the Biochemistry and Biotechnology Department.

We would like to express our heartfelt thanks to the coordinator of The Catalyst, Dr.Deovrat Begde Sir. We are truly grateful for the time and effort you dedicated to mentoring us throughout this process. We extend our thanks to Ms. Rita Lakkakul Mam for her words of encouragement. Furthermore, we also thank Mr. Pradip Hirapure Sir and Mr. Rohan Thaware Sir for their continual guidance and support.

Not only that, but we extend our appreciation to Dr. Mrinmayee Bapat for her invaluable time and guidance. Finally, we thank all the students who contributed to this magazine; your efforts and contributions were paramnount to its success.

THE CATALYST IS GROWING!

Team catalyst invites you to take an exciting journey through knowledge with us. Stay tuned for further editions. And follow us to stay updated! We look forward to your curious minds!



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