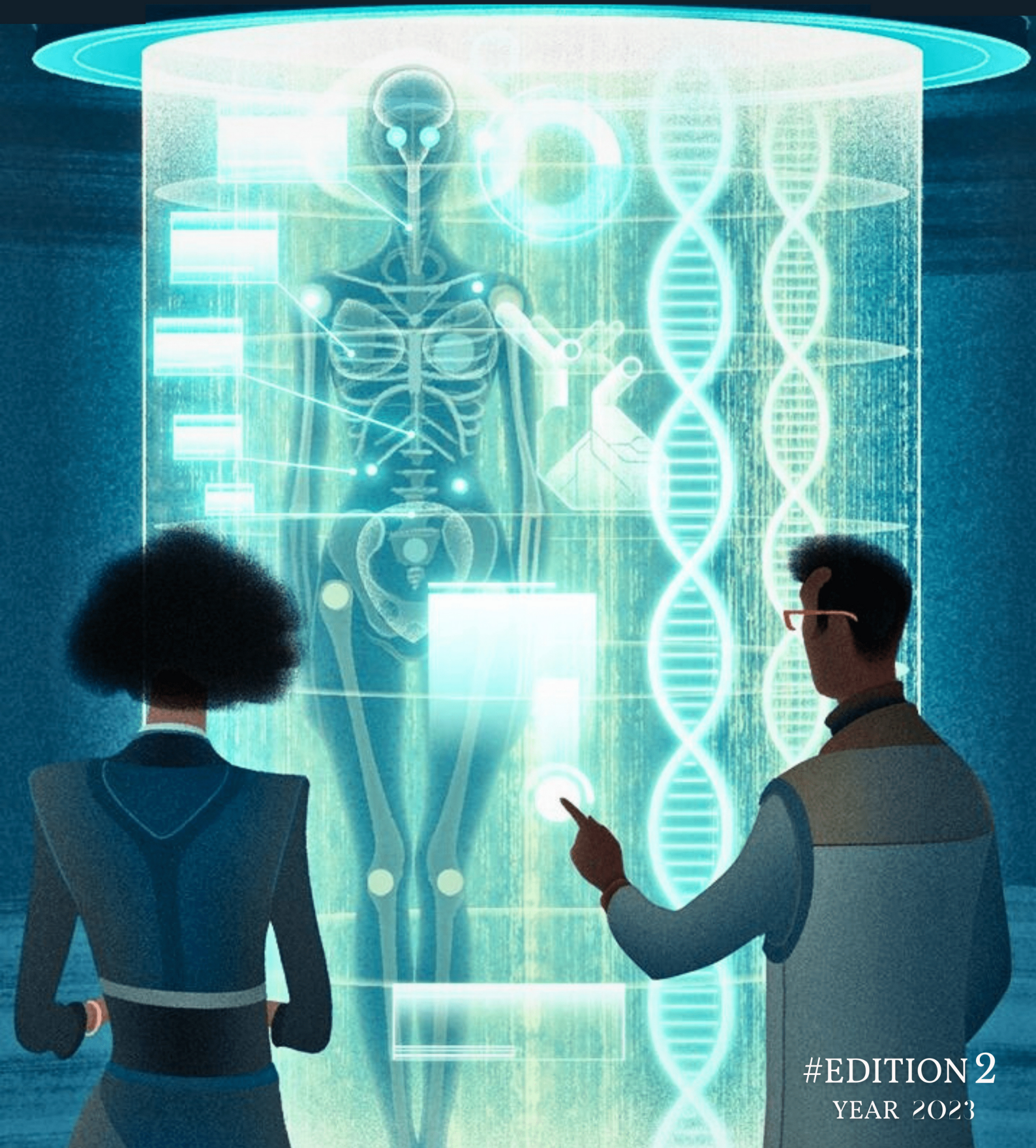


THE CATALYST



#EDITION 2
YEAR 2023

CONTENTS



1. Breakthrough Discovery	05
2. Food Science	17
3. AI in Life Science	23
4. X-ray Crystallography	31
5. Academic Insights	33
6. Worth Your Read!	45
7. Acknowledgement	48

Dear Readers,

We are pleased to present to you the second edition of our Departmental magazine 'The Catalyst'. Its first edition of this year. In this issue, we have written a collection of articles that cover a broad range of topics related to our subjects and life sciences.

As the contributors of this magazine, we want to take a moment to express our gratitude for your support and readership. Our team works hard to deliver high-quality content that informs, entertains, and inspires you.

One of humanity's gifts is science. It significantly contributed to raising humanity's quality of living. Science is everywhere and has complete power over every aspect of our existence. Every aspect of our existence centres around science. As it is said by Edward Teller, "The science of today is the technology of tomorrow".

The vast area of study known as "life science" which looks at every living thing on earth. Life sciences seek to understand every aspect of living on Earth, from bacteria to begonias to beluga whales.

The theme of this issue is Artificial Intelligence in life sciences. The field of life sciences is one where artificial intelligence (AI) is having a major impact due to its rising popularity in recent years. A variety of new innovations and discoveries have resulted from the fusion of AI and life sciences, and this combination is revolutionising how we handle medical research and patient care.

We also have an exclusive interview with a scientist, who shares their insights on the current state and future of our field and research.

We hope you enjoy this edition of magazine and find the articles informative and engaging. As always, we welcome your feedback and suggestions for future editions.

Thank you for your support.

Team Catalyst
#beinnovative
#thecatalyst

HOD'S DESK



DR. U J DONGRE

HEAD & ASST PROFESSOR OF
BIOCHEMISTRY AND
BIOTECHNOLOGY DEPARTMENT

It is my great honor and pleasure to put forward a message to publish a departmental magazine for the year 2022-23. It is my immense pleasure to release this magazine containing updated information about Biochemistry and Biotechnology which will definitely upgrade and help students to pursue their career in these subjects.

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

Indeed, publishing such a nice magazine at the 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 organizing team members of this magazine and all students of the 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 there to help you at any level for such activities.

Thank You.

The day science begins to study non-physical phenomena, it will make more progress in one decade than in all the previous centuries of its existence.

-Nikola Tesla

The important thing is not to stop questioning. Curiosity has its own reason for existence. One cannot help but be in awe when he contemplates the mysteries of eternity, of life, of the marvelous structure of reality. It is enough if one tries merely to comprehend a little of this mystery each day.

-Albert Einstein

There is no royal road to science, and only those who do not dread the fatiguing climb of its steep paths have a chance of gaining its luminous summits.

- Karl Marx

Speculation and the exploration of ideas beyond what we know with certainty are what lead to progress.

- Lisa Randall

BREAKTHROUGH DISCOVERY 2022



The prestigious Noble Prize rewards the discoveries that have conferred the greatest benefit to humankind. In preceding year, the Noble Prize in Physiology or Medicine was given to Svante Pääbo for his discoveries concerning the genomes of extinct Hominins and Human Evolution. Let's have a glance at the magnificent work done by this great Geneticist and how he discovers various new aspects of Human Evolution.

Svante Pääbo is a Swedish geneticist and Nobel Laureate who specialises in the field of Evolutionary Genetics. In 1997, he became founding director of the Department of Genetics at the Max Plank Institute for Evolutionary Anthropology in Leipzig, Germany. Since 1999, he has been an honorary professor at Leipzig University and he currently teaches molecular evolutionary biology at the university.



Pääbo also engaged several critical collaborators with expertise on population genetics and advanced sequence analyses. And at last his efforts were successful.! Nobel laureate Pääbo has accomplished the seemingly impossible and publish the first Neanderthal genome sequence in 2010. Through this research, it was demonstrated that the most recent common ancestor of Neanderthals and Homo sapiens lived around 800,000 years ago. Comparative analyses showed that DNA sequences from Neanderthals were more similar to sequences from contemporary humans originating from Europe or Asia than to contemporary humans originating from

Dr. Pääbo's groundbreaking research attempts to answer questions about human evolution. He was able to sequence the genome of Neanderthal, a species of humans that existed on the earth and went extinct around 30,000 years ago. He also discovered Denisova – a previously-unknown hominin. (Hominins are extinct members of the human lineage.) Dr. Pääbo's research led him to the conclusion that “gene transfer had occurred from these now extinct hominins to Homo sapiens following the migration out of Africa around 70,000 years ago”. Dr. Pääbo's research has resulted in the rise of a new scientific discipline called paleogenomics, which is the study and analysis of genes of ancient or extinct organisms.

The question of our origin and what makes us unique has engaged humanity since ancient times. Being a science student, we all are aware of the Concept of Evolution and Neanderthals. Neanderthals are an extinct species of hominids that were the closest relatives to modern human beings. Neanderthals, developed outside Africa and populated Europe and Western Asia from around 400,000 years until 30,000 years ago, at which point they went extinct. About 70,000 years ago, groups of Homo sapiens migrated from Africa to the Middle East and, from there they spread to the rest of the world. Homo sapiens and Neanderthals thus coexisted in large parts of Eurasia for tens of thousands of years.

But we were not aware about our relationship with this extinct Neanderthals. To know more about Neanderthals and their relationship with modern human, Genomic information was required. Svante Pääbo, early in his career, became fascinated by the possibility of utilizing modern genetic methods to study the DNA of Neanderthal. But, there were extreme technical challenges because with time DNA becomes chemically modified and degrades into short fragments. After thousands of years, only trace amounts of DNA are left, and what remains is massively contaminated with DNA from bacteria and contemporary humans.

The journey of Dr. Pääbo for sequencing the entire genome of Neanderthals started in 1990. Firstly, he decided to analyze DNA from Neanderthal mitochondria. We know that, Mitochondria has its own DNA. Though it contains only a fraction of the genetic information in the cell, but it is present in thousands of copies, increasing the chance of success. With his refined methods, Dr. Pääbo managed to sequence a region of mitochondrial DNA from a 40,000-year-old piece of bone. At Max Planck Institute in Leipzig, Germany Pääbo and his team steadily improved the methods to isolate and analyze DNA from archaic bone remains. The research team exploited new developments, which made sequencing of DNA highly efficient.

Africa. This means that Neanderthals and Homo sapiens interbred during their millennia of coexistence. In modern day humans with European or Asian descent, approximately 1-4% of the genome originates from the Neanderthals.

About the discovery of Denisova :

In 2008, a 40,000-year-old fragment from a finger bone was discovered in the Denisova cave in the southern part of Siberia. The bone contained exceptionally well-preserved DNA, which Pääbo's team sequenced. The results caused a sensation: the DNA sequence was unique when compared to all known sequences from Neanderthals and present-day humans. Svante Pääbo had discovered a previously unknown hominin, which was given the name 'Denisova'.

Through his groundbreaking research, Svante Pääbo established an entirely new scientific discipline, paleogenomics. Pääbo's discoveries have generated new understanding of our evolutionary history. For his remarkable achievements and outstanding research work in the field of Genetics, Svante Pääbo was awarded with the Nobel Prize in Physiology or Medicine, in year 2022. A big thanks to Svante Pääbo's discoveries, now we understand that archaic gene sequences from our extinct relatives influence the physiology of present-day humans.

SCIENCE SUMMIT 2023

We all know the importance of India's presidency in G20. But, being a Science students..have you ever wondered what role G20 plays in the field of Science and Technology..?
G20 has a special Science Summit also known as S20. Let's understand more about S20 in this article.



Science20 (S20) is one of the youngest engagement groups of the G20 which was established in year 2017. The role of S20 in furthering the agenda of G20 is crucial. Science will have to play a key role if we are to achieve the economic growth required to pull millions of people out of poverty while ensuring that development is inclusive and sustainable. S20 is, therefore, an ideal platform to achieve this goal. G20, along with S20 and other working groups, will be presided over by India in 2023. The theme of S20 for 2023 will be "Disruptive Science for Innovative and Sustainable Development." Within this broad theme, the deliberations to be held in different parts of India over the course of the year (Agartala, Lakshadweep, and and Bhopal). S20 India has the following three focal points :



1. Universal Holistic Health
2. Clean Energy for a Greener Future, and
3. Connecting Science to Society and Culture.

The consultations will also include an Inception meeting in Puducherry and a Summit meeting in Coimbatore and this year The Indian Institute of Science (IISc) will be the Secretariat for S20.

India, being a culturally rich country, is uniquely placed to drive the agenda of S20 forward. Historically, this land has served as an incubator for ideas in different spheres of human life: political, social, economic, cultural and also scientific. With its intellectual heritage and current progress in science and engineering, combined with a tradition of innovation with sustainability, India now has an opportunity to become a leader in disruptive science for development.

Thus, S20 summit is emblematic of India's journey in forging a new path for advancement.



To know more about S20 and events related to this Science Summit, visit : <https://s20india.org/>

108th INDIAN SCIENCE CONGRESS



The Indian Science Congress Association (ISCA) is India's premier scientific organization headquartered in Kolkata, West Bengal. The Society was founded in Kolkata in 1914. In this association, scientists get together to discuss about scientific journals, publications and to promote science.

The Association was formed with the following objectives :

- To advance and promote the cause of science in India;
- To hold an annual congress at a suitable place in India;
- To publish such proceedings, journals, transactions and other publications as may be considered desirable;
- To secure and manage funds and endowments for the promotion of Science including the rights of disposing of or selling all or any portion of the properties of the Association;
- To do and perform any or all other acts, matters and things as are conducive to, or incidental to, or necessary for, the above objects.



The speciality of this association is that not only scientist but also college professors take part in discussions. A characteristic of this association is that not only scientists but also university professors participate in the discussions.



The 108th Indian Science Congress was held from January 3 -7, 2023 at R.T.M. Nagpur University, Nagpur, Maharashtra, India. It was inaugurated by Prime Minister Narendra Modi and the theme for this year was "Sustainable Development with Women Empowerment".

A major highlight was the mega-expo "Pride of India," which celebrated important contributions to society, primarily made by Indian science and technology. The organisation of such a scholarly event provides us with a wealth of knowledge about science and technology, which motivates us to learn more about it.

Life Science is a large umbrella that encompasses an array of branches. There are more than 30 branches of Life Sciences. Let us have a glance at some “Emerging Fields in Life Sciences”

Bioinformatics

Synthetic
Biology

Quantum
Biology

Nano
Biotechnology

System
Biology

Emerging Fields
in
Life Sciences

Food
Biotechnology

Astrobiology

Marine Biology

Epidemiology

Science
Communication

Apart from Biochemistry and Biotechnology, above mentioned are some new interesting fields in which you can build a strong career. Let us learn more about 'Astrobiology' in upcoming article.

How to read a Research Paper ?

Reading scientific literature is mandatory for researchers and clinicians. The moment it comes to read a research paper, scientific paper or any review article..most students and researchers find it boring and time-consuming. But, once you learn how to read a research paper, this process will seem interesting and you'll gain much knowledge than ever before. So, let's learn – “How to Read a Research Paper” in FOUR easy steps.

After opening any research paper, first **SCAN** the article without taking any notes; focus on the Title, Headings and Subheadings given. Read key words and abstract carefully.

1

The step two is **RE-READING** the paper. The second reading should be done Critically and Creatively. Critical reading involves asking appropriate questions like – What problem is the study trying to solve?. Creative reading can be done by taking relevant notes.

Examine all graphs, tables and the data given in the research paper. Try to **INTERPRET** the information mentioned with theoretical portion. Go through the References and try to gain more information about the subject.

3

Try to **SUMMERIZE** whole paper in two or three sentences. In this way, we get a clear idea about the paper. Read other research papers related to topic to get a clear vision about the research question.

Now, if you want to try above Four steps for reading a research paper; Search these :-
Google Scholar and PubMed Central

DNA HARD-DRIVE



In a recent breakthrough Microsoft and researchers at the University of Washington developed the world's first DNA storage device that carries out the entire process automatically.

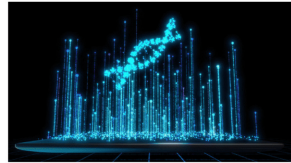
Using the device, researchers encoded the word hello into DNA and converted it back to readable data. The device first converts the digital files into binary code consisting of ones and zeros orbits the system then uses a specialised software that encodes the bids into DNA sequences using strands of the dna's four letter alphabet ATCG Angie the device then synthesises the DNA and stores it as a liquid.

Humans use technology to store an incredible amount of data and we may reach a limit soon if we don't find new technologies. If we don't discover better data storage technologies, we may soon experience a severe bottleneck in our storage capacity, which might crush innovation and restrict business development.

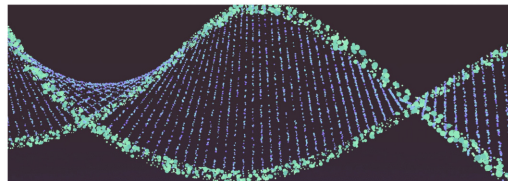
Every day, Google processes 3.5 billion searches, 4.3 million YouTube videos are viewed per minute, an average of 156 million emails are sent, and more than 350 million pictures are posted to Facebook. In 2020, 1.7 gigabytes of data were predicted to be produced every second. 410 trillion megabytes of data, or about 7.8 billion people on the planet, will be generated in a single year as a result of this. According to predictions, this amount will increase to 107 trillion megabytes by 2025.

The good news is that DNA might hold the answer to our data needs. One gramme of DNA, which is equivalent to 215 million gigabytes, can hold up to 215 petabytes of data, making it one of the most advantageous forms of data storage. One kilogramme of the substance has the potential to hold all of the world's data, and DNA is capable of storing everything from text to images and movies. It can last millions of years and won't deteriorate over time like CDs and cassette recordings.

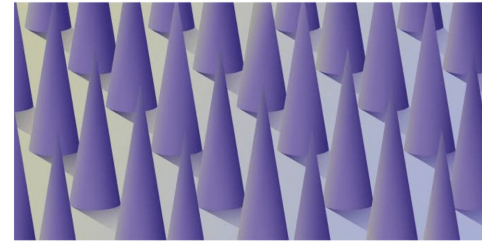
If we don't find better data storage technologies, we could be moving towards a massive bottleneck in our storage capabilities which could start growth for businesses and innovations in alternative to our current storage devices is DNA based data storage. DNA has a lot of advantages when it comes to data storage, for example, its ultra compact and easy to replicate a single gramme of DNA can store up to 215 petabytes which is 200.15 million gigabytes the entire world's data could be stored in just one kilogramme of the stuff and you can store everything from text to images and videos in DNA. It can last hundreds of thousands of years and won't degrade overtime like cassette tapes and CDs.



Next the stored DNA is read by a DNA sequencer finally the decoding software translate the sequences back into bits that can be understood by computer. Using the device, researchers encoded the word hello into DNA and converted it back to readable data. The device first converts the digital files into binary code consisting of ones and zeros orbits the system then uses a specialised software that encodes the bids into DNA sequences using strands of the dna's four letter alphabet ATCG Angie the device then synthesises the DNA and stores it as a liquid. Next the stored DNA is read by a DNA sequencer finally the decoding software translate the sequences back into bits that can be understood by computer.



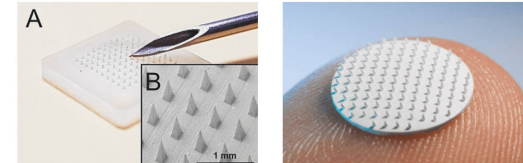
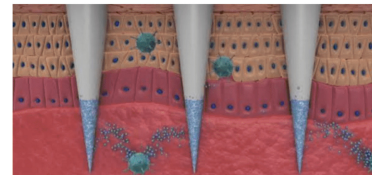
Although these are available, there is no need for us to switch our pen drive with this because first of all DNA hard-drives are expensive and still not in its best stage for usage. This hard drive is a high end solution for big companies for data storage such as Google and Microsoft, something that is advance and revolutionary.



MICRONEEDLES

Microneedles or Microneedle patches are micron-scaled medical devices used to administer vaccines, drugs, and other therapeutic agents. The microneedle method is an updated approach to deliver compounds through the skin, with advantages such as minimally invasive, painless, convenience, and improved patient compliance. It is divided into four major types: solid, hollow, dissolving, and coated. It punctures the stratum conium layer of skin to create a pathway for drug molecules to diffuse through the skin more quickly.

These are half a millimeter in height and made from a hydrogel forming material which is remarkably similar material to soft contact lenses so that it can be hard in the dry states. It can penetrate the skin and it rapidly then takes influence from the viable skin and swells the former more jelly like material and through this jelly medicines are delivered and biomarkers are picked up. No pain and no bleeding is experienced while using microneedles.



Microneedles have been developed to deliver drugs and vaccines, with interest from patients, healthcare providers, and companies. Microneedles are poised to make expanded impact on clinical medicine over the coming years.

DID YOU KNOW?

In ancient times, treatment of advanced tumors that were on or near the surface of skin was done using cautery, an instrument used to destroy abnormal tissue by burning, scarring and searing.



ASTROBIOLOGY

LIFE BEYOND EARTH

WHO ARE ASTROBIOLOGISTS?

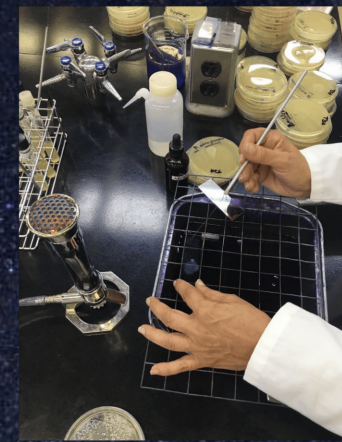
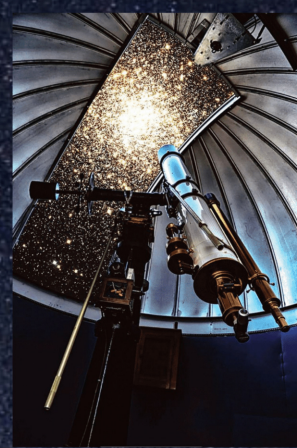
An astrobiologist is a person who studies the possibility of life beyond Earth. Astrobiologists try to understand how life originates and how life can survive in many different types of environments. They look for places where simplest form of life may exist and study different planets and moons to see if conditions there might support life. They also study the extreme life right here on earth.

WHAT IS ASTROBIOLOGY?

Astrobiology is the study of life in the universe. The search for life beyond the Earth requires an understanding of life, and the nature of the environments that support it, as well as planetary, and stellar interactions and processes. Astrobiology includes the knowledge and techniques from many fields, including astronomy, biology, chemistry, atmospheric science, and aeronautical engineering etc.

HOW DO THEY WORK?

Astrobiologists spend lot of time in laboratories on our home planet, testing lifecycle of bacteria that can survive in harsh conditions to learn about their capacity to survive. They explore the possibility of life on other planets. Their work also involve study of moons of different planets to identify environment that can support life.



HOW TO BECOME AN ASTROBIOLOGIST?

Firstly, earn a bachelor's degree in Scientific course. Most common majors for aspiring astrobiologists is astronomy, but you can also choose a closely related subject like biology, chemistry or physics.

After completing bachelor's, pursue a master's degree in astrobiology. There are also options to earn master's degrees in areas like life in extreme environments and cosmology.

Now to earn a professional experience, the most common way is to complete research project. Because of this, many candidates start engaging in independent research. There are also opportunities to take part in research projects with organizations like NASA, which you can find online.

While completing research, it can also be beneficial to expand your professional network. This can help you introduce to new industry techniques that other professionals use and can open you to more work possibilities.

With some research experience and a network, you can start applying for job as an Astrobiologist. You can typically find jobs for at government agencies, research centers and other organizations that focus on scientific exploration.

CHEMISTRY IN DAILY LIFE



Ice cream- Behind this seemingly simple summer treat, there is some complicated chemistry at play. Ice creams are an example of an emulsion. In ice cream, tiny droplets of fat are dispersed through the water. The fat comes from the cream and during ice cream production they are broken down into tiny droplets. Milk proteins, which are also added during the production process, coat the fat droplets and prevent them from interacting with one another. This stops them from becoming large droplets again because the proteins stuck to the surface of the fat droplet repel one another.



Many vegetables and fruits are strongly colored because they contain a special kind of chemical compound named carotenoids. These compounds have an area called chromophore, which absorbs and gives off particular wavelengths of light, generating the color that we then perceive.



T-shirts worn by football player are made of polyester. Polyester are group of polymer which are very large molecules built up from smaller molecules. Polyester is durable, lightweight and only absorbs 0.4% of its weight of water. Most sweat is carried along the fibres, rather than absorbed, and can evaporate.



In our daily lives, lotions, fragrances, talcum powder, and a variety of other cosmetic goods we use are developed in laboratories using chemicals for our health and skin. As a result, chemistry is important in maintaining the pH of our skin, keeping it healthy, and removing any marks.

FOOD SCIENCE

Food Adulteration and Detection

The food we eat is absorbed by our body which is further released in the form of energy. This helps sustain our life and carry out day-to-day activities. However, if there is any compromise in the quality, it can directly affect our productivity and even lead to health problems. Thus, the food we consume must be free from any mixing of elements. But, unfortunately, some people carry out such activities to earn more profits, the process for which is commonly called food adulteration. Adulteration is the process of mixing harmful elements into the food with a similar texture and appearance but not the same composition. There is a very detailed literature on various aspects of food adulteration including its detection.

Food adulteration is a huge concern in all parts of the globe. The principal aim behind food adulteration is to alter the quality of food products for economic advantage. Such actions usually take place by substitution with less valued food and increasing the weight or volume by mixture of undeclared ingredients. Adulterated food is often sold cheaper than unadulterated food, making it more attractive to consumers. Adulterated food is a severe public health hazard in India, and thousands of people fall ill every year, and many die after consuming adulterated food. There are different ways of performing food adulteration, some of which include adding water to increase its weight, using cheaper ingredients and even adding dirt or other contaminants. The most common adulterants used in food are chemicals such as formalin, potassium bromate, lead, and mercury. These chemicals can cause serious health problems such as cancer, kidney damage, and neurological disorders. Any food product that is a public health threat is classified as the effect of adulteration though there may be many different types of causes or motivations.



As the methods of adulterating foods have become more sophisticated, very efficient and reliable techniques for the detection of fake manipulations are required. There are several analytical methods that have been used for food authentication, which includes-

Chromatography, allows food companies to identify components of food. By using this technique they can test nutritional quality of food.

Enzymatic methods, method used for the measurement of compounds such as sugars, acids, alcohols and other metabolites in foods and beverages.

Proteomics method, process to identify protein as well as interaction of protein with other components of food.

DNA based technique, PCR is an in vitro method that allows the identification of an animal species existing in food samples by detecting a specific sequence of a target DNA.

Although sophisticated lab techniques are accurate and precise, yet they are costly and time consuming. It is essential to develop reliable "quick screening tests" which a common person can perform at the level of household.



Some methods that can be undertaken at home are as follows:

To check if milk is adulterated with detergent or not, pour it into a bottle and shake it well. If it forms a foam, it means the milk contains adulterants. If not, it's free from such substances.

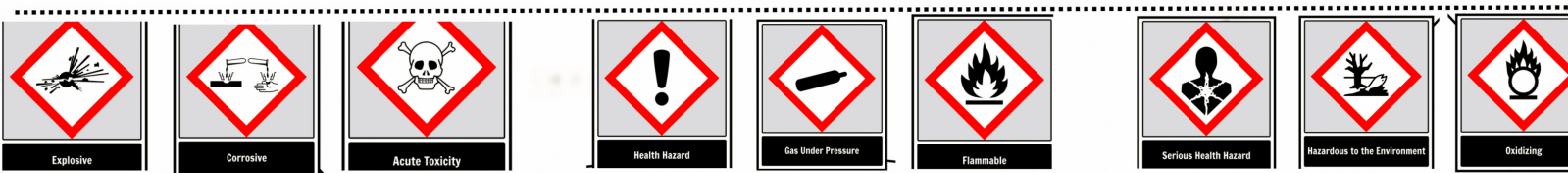
To find adulterated products like chalk powder in jaggery or sugar, take it in a container and mix it with water. If you see some residue precipitating at the bottom, it contains contaminants.

For detection of other oils in coconut oil, take coconut oil in transparent glass. Place this glass in refrigerator for 30min. After refrigeration, coconut oil solidifies and if it is adulterated then other oils remain as a separate layer.

To check if cumin seed are adulterated with grass seeds coloured with charcoal dust, rub small amount of cumin seeds on palm. If palm turns black, adulteration is indicated.

Therefore there are several ways for the detection of adulterated food at household level.

To conclude, food adulteration is a common practice among people in India that can harm our health. So, it is better that you know about the process and the food items that are a product of such malpractices.



- Personal protective equipment such as lab coats, footwear, gloves, safety goggles and glasses, face shields, hard hats and respirators. Should be used in order to protect ourselves when working with chemical hazards.
- Do not eat, drink, smoke, handle contact lenses, apply cosmetics, or store food for human consumption in the laboratory.
- Decontaminate all work surfaces before and after your experiments, and immediately after any spill or splash of potentially infectious material with an appropriate disinfectant. Take care to minimize the creation of aerosols and/or splashes.
- Glass breakage is a common cause of injuries in laboratories. Clean glass which is in good condition should be used. Always use glassware of the proper size and allow at least 20% free space.
- A researcher must refer MSDS before handling any chemical. The Material Safety Data Sheet (MSDS) describes properties, reactivities, potential chemical hazards, and safe handling procedures for commercially available chemicals.

LAB SAFETY RULES

Entrepreneurship in Life Science

Becoming an entrepreneur is no longer an uncommon activity. Entrepreneur means a risk taker, developer and creator of new enterprises. Nowadays, entrepreneurship in the field of life science is of great talk. An entrepreneur should have potentially new ideas because investors usually tend to invest in ideas and innovation which generate adequate returns of their investments. Along with this, one should know people management skills and should be able to bond with his or her employees.



For this he/she should be really interested in people who have done entrepreneurship before. He/she should be willing to learn, listen and build a team around them and shift their thinking from about themselves to about their team. Sometimes an entrepreneurial mindset is beneficial for scientists who are not interested in starting their own company. This helps them to identify opportunities and how to use them.

He / she should be able to inspire and motivate their employees. Previously, students of life science were advised to either go into academia or go to big pharma because the biotech area had just started and there were very few organizations and success stories were also less. This made it a little risky field. But now we have lots of success stories. Entrepreneurship in life science or Bio-entrepreneurship means entrepreneurial activity in the biology or biotechnology sphere. A lot of times research and exploration of new innovation is much better in these smaller organizations. A scientist can also start his /her company.



But also Bio-entrepreneurship is not that simple as compared to entrepreneurship in IT and other non biology based sectors. They require very good laboratory infrastructure and instrumentation facilities. In India, Bio-entrepreneurship has become easy and convenient with the help of BIRAC (Biotechnology Industrial Research Assistance Council) which is a non profit organization. It supports healthcare and biotech startups through different strategic schemes. Some top life science startups in India are Actofit, Unifize, Zelthy, Biocon Ltd., Jubilant Life Science etc..



BIOCHEMISTRY IN FASHION INDUSTRY



Enzymes are proteins that help speed up chemical reactions in our bodies. Enzymes are now a crucial component of the cloth manufacturing. Being a biochemistry student myself, I was unaware that enzymes were utilized in clothing.

When all is said and done, enzymes are the wonder product. Amalyses, Pectinases, Proteases and Peroxidases are some other types/ classes of enzymes which are immensely used in fashion and textile industry.

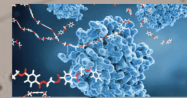


We all know that the study of biological processes at the cellular and molecular level is known as biochemistry. Hence, biochemistry aids in understanding the chemical underpinnings of the process through biological molecules that take place within and between living cells. The understanding of tissues and organs, as well as the structure of organisms and their activities, are all related to this. Biochemistry is therefore being applied in research in regards to botany, medicine, and gene enhancement. The fashion sector is currently using biochemistry as well. But the question here is, how biochemistry plays an immense role fashion industry?

Enzymes are frequently used to launder and bleach fabrics, give jeans a denim appearance, and deter wool from shrinking. Since these operate in moderate circumstances and can be biodegraded, enzymes conserve valuable energy. These are used to bleach fabrics, remove starch, break down extra hydrogen peroxide, and break down lignin.



Fashion industry waste is well known to have a terrible impact on the environment. The apparel business is infamous for the amount of resources it wastes and the millions of garments that wind up in landfills every day, in addition to producing almost 10% of the world's carbon emissions, because of this enzymatic treatments are becoming more and more popular in the fashion industry because they use less energy and are more ecologically friendly than alternative methods.



The fashion and textile sector already greatly benefits from the use of biochemistry and biotechnology which leads to the biological revolution in the fashion industry. With the use of biofabrication, several players all over the world are already radically changing the fashion sector. Biofabrication is the production of complex biologic products from raw materials such as living cells, matrices, biomaterials, and molecules.

The most recent industrial advancements involve the use of cellulases for denim finishing and lactases for bleaching and decolorizing cloth effluents. Additionally, using enzymes speeds up processes, saves energy and water, improves product quality, and has the ability to integrate processes. Because they are biocatalysts and very specialized, enzymes are used cautiously, requiring less packing material and reducing the impact of transit.

Enzymes have been altered and biotechnology has progressed based on various applications in textile manufacturing. In order to implement green technology and meet the demands of the fourth industrial revolution, enzymes are used in every step of the production process for textile chemical processing.



THE UNIVERSE SEEMS NEITHER
BENIGN NOR HOSTILE, MERELY
INDIFFERENT

~CARL SAGAN

AI IN LIFE SCIENCES



In computer science and computers, the term artificial intelligence has played a very prominent role. The term has become more popular due to recent advances in Artificial Intelligence and Machine Learning. Along with Computer science, in many scientific fields, AI is being increasingly considered and integrated, especially in the context of Big Data. Given their complexity and highly interdisciplinary nature, the life sciences provide ample opportunities for AI to impact R&D efforts in a variety of ways. The theme of our magazine for Edition 2 is – “The Role of Artificial Intelligence in the Field of Life Sciences”. Well, Life Science is a broad field. You’ll get to know how AI is influencing Biotechnology and Bioinformatics mainly in this article.

AI or Artificial Intelligence has a transformative impact on biotechnology. There are many areas where biotech companies can leverage AI to enrich their processes, drive innovation and explore new business models. The pace for innovation is accelerating in the biotechnology industry. Biotechnology companies are now realizing the value that AI can bring to their entire business, in the form of –Accelerated R&D, Analysis of humongous databases, Effective decision-making, and Cost-effectiveness. Biotechnology can be categorized into a few types like agricultural biotechnology, medical biotechnology, animal biotechnology, industrial biotechnology, and bioinformatics. Let us see how Artificial Intelligence is impacting these branches of biotechnology.

Agricultural biotechnology develops genetically modified plants to increase crop yields or introduce new characteristics to the existing plants. It involves conventional plant breeding, tissue culture, micropropagation, molecular breeding, and genetic engineering of plants. Artificial Intelligence (AI) is being increasingly used in a wide number of areas, including agriculture and allied sectors. Use of AI in agriculture and plant science research will facilitate identification of most suitable lines for breeding programmes, identification of candidate genes, and ecological sustainability. Biotechnology firms are now leveraging Artificial Intelligence and Machine Learning techniques to develop and program autonomous robots that handle important agricultural tasks like harvesting crops at a much faster pace than humans. Computer Vision and Deep Learning algorithms are leveraged to process and analyse the data captured by drones. This helps in monitoring crop and soil health. Machine Learning algorithms help in tracking and predicting various environmental changes like the weather changes that impact the crop yield.

The most important sub-field of Biotechnology is Medical Biotechnology. Medical biotechnology uses living cells for the betterment of human health by producing drugs and antibiotics. It also involves the study of DNA and genetically manipulates the cells to increase the production of important and beneficial characteristics. Artificial Intelligence and Machine Learning are extensively used in drug discovery. Machine Learning helps in discovering small molecules that could give therapeutic benefits dependent on known target structures. Machine Learning is widely used in diagnosing diseases as it uses the true result to improve the diagnostic tests i.e., the more diagnostic tests that are run, the more accurate results can be achieved. AI is also helping in reducing the radiation therapy planning process resulting in saving time and improving patient care. Apart from the above-mentioned applications, these technologies are widely used in gene editing, radiology, personalized medicine, medication management, etc. When saving minutes can mean saving lives, AI and machine learning can be transformative not only for healthcare but for every single patient.

Animal biotechnology is a branch of biotechnology in which molecular biology techniques are used to genetically engineer (i.e. modify the genome of) animals in order to improve their suitability for agriculture, industrial, or pharmaceutical applications. This branch applies molecular biology techniques to genetically engineer/modify the animals to improve their sustainability for pharmaceutical, industrial, or agricultural purposes. The breeding of animals is one area where Artificial Intelligence and machine learning models provide valuable insights. Selective breeding is a very common practice where animals with the most desirable characteristics are bred with each other so that their offspring will also result in the same traits. This practice is implemented on the molecular level too where genetic characteristics among the animals are selected and such animals are bred. Machine learning is being used to interpret large genomic data sets and annotate a wide variety of genomic sequence elements.

Industrial biotechnology is all about biopolymers substitutes, the invention in various areas like vehicle parts, fuels, fibers, new chemicals, and the production process. Internet of Things (IoT), Machine Learning, and Artificial Intelligence analyse the machines, predict outages, optimize equipment, etc to provide efficient production and better product quality. Computer-aided designs and Artificial Intelligence are coming up with the desired molecule design. Robotics and Machine Learning cultivate the strains and test to what extent the desired molecule was reached.

Bioinformatics is an emerging branch of biological science that emerged from the combination of both biology and information technology. It is the application of computer technology to the understanding and effective use of biological and biomedical data. Bioinformatics helps the acquisition, storage, processing, distribution, analysis, and interpretation of biochemical and biological information with help of mathematical, computer

science, and biology tools to understand the biological significance of a variety of data. This information is organized in large data pools. This information needs to be harnessed to gain tremendous insights. Artificial Intelligence and Machine Learning are leveraged in DNA sequencing from the huge data crunch involved, classification of protein along with protein’s catalytic role and biological function, analysis of gene expressions, genome annotation where a certain level of automation is required to identify the locations of genes, computer-aided drug design, etc. In this way artificial intelligence is widely used in Bioinformatics.

Artificial intelligence (AI) is used in biochemistry for a variety of purposes, including the prediction of protein secondary structures, drug delivery, and enzyme creation. The value of AI in enhancing a variety of human endeavours cannot be overstated, hence efforts should be made to promote its use in biochemistry, the biomedical sciences, and other fields. There are various new emerging fields in Life Sciences like System Biology, Computational Biology and Synthetic Biology in which AI is going to be used at tremendous level.

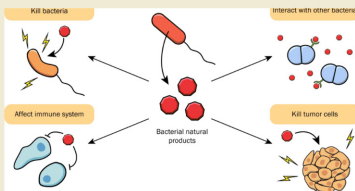
Thus, AI has infinite possibilities in the field of Life Sciences specially in Biotechnology.

Hope this article will help you in your future endeavours in Life Sciences.!



MED TALK

Certain organisms like plants, fungi and bacteria are able to make molecules known as secondary metabolites or natural products. These molecules have an effect on other organisms in various ways. They are used to kill harmful infections bacteria or even used as therapeutics. One most important use of natural products is antibiotics. Many scientific community focuses on bacterial natural products which also have other therapeutic uses.



Common antibiotics such as streptomycin, vancomycin, and erythromycin, were all natural products found from bacteria. Let's talk about one such bacterial natural product, Bleomycin. Bleomycin is a natural product found from *Streptomyces verticillus*. It is chemotherapy agent with antibiotic antitumour activity used in treatment of range of cancers including, neck and head cancer, squamous cell cancer, lymphoma, testicular and ovarian cancer.



The main mode of action of Bleomycin is to inhibit synthesis of DNA. At high concentration of drug, cellular RNA and Protein synthesis are also suppressed. Bleomycin is an antibiotic that belongs to subfamily of glycopeptide antibiotic. These are antibiotic isolated from bacteria containing glycosylated cyclic structure. Bleomycin is also used as medication for control of fluid level around lungs caused by tumors that have spread to the lungs.



DID YOU KNOW?

The human stomach can dissolve razor blades. The pH level of human stomach is typically 1.0 to 2.0 which makes it incredibly strong acid. So it was found that thickened back of the single edged blade dissolved after 2 hours of immersion in stomach.



CURIOS SEARCH



Unnatural Selection
2019 · Documentary · 1 season
IMDB: 7.9



Biohackers
2020 · Drama · 2 seasons
IMDB: 6.8



Modern Marvels
1992 · History · 21 seasons
IMDB: 8.1



Extra Life: A Short History of Living Longer
2021 · 1 season
IMDB: 7.3



The Gene: An Intimate History
2020 · 1 season
IMDB: 8.1

MONTHLY SCIENCE

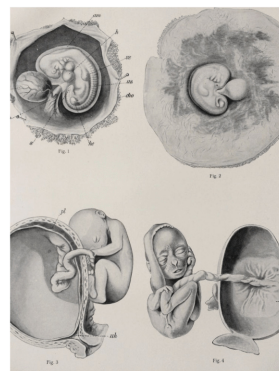
AI In Drug Discovery

We all know that AI has the benefit of a world full of techniques, data and various processing power. But now, it has been found in drug development that, both machine learning systems and chemists can work together to solve complicated drug discovery problems. These are not here to replace medicinal chemists, but to empower and help them. Medicinal chemists depend on their knowledge and experience to design a biological analysis suitable for high throughput screens, which undergo subsequent trial and errors to refine compound sets. But AI enables analysis of far more information than a human can do on their own. Also it is impossible for a chemist to remember each and every data they have personally generated for a single program but machine learning can do this relatively easily by benefiting us with the decades of work in the field of medicinal chemistry in the public domain. Best example of human AI partnership is Logica, it draws AI technology from Valo Health and chemical research capabilities of Charles River Laboratories.



This is beneficial for both worlds as it enhances early discovery and gives a fundamental rethink to how entire drug discovery is conducted. In this way by integrating AI and human originality we can enter a new phase of discovery with calculable estimate of risk. This is just a beginning but AI, with data generation will change the way we perform drug design problems.

Creation of embryo-like structures from monkey embryonic stem cells



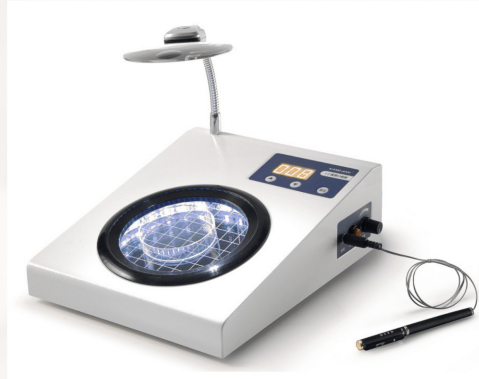
A team of investigators from China reported for the first time the creation of embryo-like structures from monkey embryonic stem cells. They started with macaque embryonic stem cells which they exposed to number of growth factors in cell culture. For the first time, embryo like structure was formed using non human primate cells. This embryo like structure when studied under microscope, found to have similar morphology to natural blastocysts. It is also called as blastoids. Single-cell RNA sequencing revealed that the different types of cells found within the structures had similar gene expression patterns to cells found in natural blastocysts. These blastoids were then transferred into the uteruses of 8 female monkeys, out of which, in only 3 the structure implanted.

This implantation resulted in the changes similar to that seen in normal pregnancy like release of progesterone, formation of early gestation sac, amniotic fluid etc. However, faetues didn't form and the structure disappeared after about a week. Researchers highlight that there are still many differences in these embryo like structures and natural blastocysts. These structures do not have full development potential. Investigators plan to focus on further developing the system of culturing embryo-like structures from monkey cells in future.

LABORATORY CORNER

Haemocytometer

is a counting-chamber device originally designed and usually used for counting blood cells. This device was invented by Louis-Charles Malassez. A haemocytometer consists of a thick glass microscope slide with a grid of perpendicular lines etched in the middle. The grid has specified dimensions so that the area covered by the lines is known, which makes it possible to count the number of cells in a specific volume of solution.



Have you ever wondered how bacterial colonies are calculated? The advanced science has the solution of your curiosity..

Colony Counters are used to calculate numerous bacterial colonies. A colony counter is an equipment used to count colonies of microorganisms growing on agar plates. There are numerous types of colony counters available for counting bacteria and yeast colonies rapidly and precisely. Some of these colony counters are manually operated, while others are automatically operated.

Vortex Mixer or vortexer, is a simple device used commonly in laboratories to mix small vials of liquid. It was invented in the late 1950s by Jack Albert Kraft and his brother A, Harold D. Kraft. It consists of an electric motor with the drive shaft oriented vertically and attached to a cupped rubber piece mounted slightly off-centre. Vortex shakers produce a circular orbit motion to facilitate mixing the contents of lab containers placed on the mixers platform.



DNA Sequencer is a scientific instrument used to automate the DNA sequencing process. Given a sample of DNA, a DNA sequencer is used to determine the order of the four bases: G (guanine), C (cytosine), A (adenine) and T (thymine). The first automated DNA sequencer, invented by Lloyd M. Smith, was introduced by Applied Biosystems in 1987. The third-generation DNA sequencers measure the addition of nucleotides to a single DNA molecule in real time. Thus, DNA sequencers play a vital role in the biotechnology industry. The ability to know the four-letter sequence of any gene or DNA segment is essential to conducting research and analyzing the genetics.

To know more about DNA Sequencing techniques, visit :-

<https://youtu.be/rA8MUR4pqNE>



PAUL BERG

American scientist Paul Berg (1926–2023) spent more than fifty years making important contributions to biochemistry and molecular biology. He resolved key problems in metabolic chemistry and discovered the mechanisms by which DNA and RNA direct the synthesis of proteins in living systems. He and his coworkers at Stanford University created the first recombinant DNA in 1972. (rDNA). For his research on rDNA and protein synthesis, he was awarded the 1980 Nobel Prize in Chemistry, sharing with Walter Gilbert and Frederick Sanger.

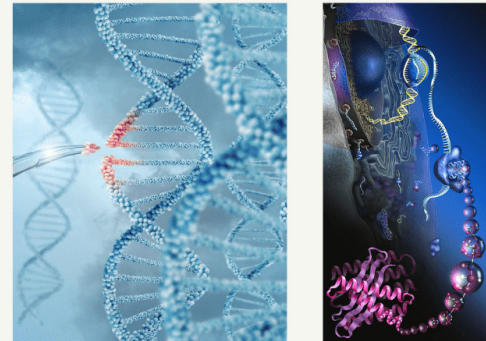
At Stanford University, Paul Berg and Charles Yanofsky conducted research using phage-mediated transduction, a crucial technique that has been extensively used and developed for our current understanding of the molecular biology of microbes. Phage-mediated transduction is the transfer of genes from one strain into another using a virus as the carrier of that new genetic information.

He took a year off and went to work at the Salk Institute with Renato Dulbecco to work on the tumour viruses, but at the same time he decided to switch his research from bacteria to mammalian cells. This was primarily done to see if the ideas that had predominated about gene function in microbes were also applicable to mammalian cells. Because tumour viruses are known to have relatively short genomes and to turn normal cells into cancer cells, he picked them.

During his time there, it was reported that when SV40 or polyoma infects mammalian cells, virus are produced, but amongst the progeny there are variants which contain only cellular DNA and not viral DNA which was very similar to the bacterial transduction system P1, which infects E coli and comes out as P1 particles but containing E coli segments of DNA intrigued him to think trying to develop a transduction system form a mammalian cells to facilitate the genetic modifications of cells much as they had done with microbes.

The prospect of finding a gene present in the human genome's 3 billion base pairs and finding it in a virus particle that contained 5 kilobases seemed pretty slim to him, but he liked the idea that they could actually introduce new genes into mammalian cells and that they could do that without a virus particle. However, it quickly became clear that a single virus particle could not contain very much DNA, in fact, the limit is about 5 kilobases. They ingested the SV40 DNA, which was known to join up with foreign DNA and integrate into the DNA of infected cells. So his first idea was: Could they get two different DNAs join them together covalently, and then use them as a way as a transducing agent?

They possessed a plasmid Lambda DV gal, a little DNA molecule of around 10 KB that had three bacterial genes that encode the gal operon, which prevents the bacterium from metabolising galactose, together with the Lambda genes and suitable genes for replicating in E. coli. They needed to find a technique to attach DNA molecules together, so they used what was previously known as cohesive ends in the bacteriophage Lambda. The goal was to take the two DNAs and link them together. The bacteriophage has these cohesive ends, which means that they can be attached to other molecules that have the same sort of ends or they may be joined to the two ends to make a circle.



To achieve their goal, they created synthetic ends for the two molecules they wished to combine. To do this, they polymerized A or T onto the ends of one and A or T on the other, creating two molecules with A ends and T ends that would combine when combined. Although it wasn't known at the time, they were able to create the first instance of recombinant DNA. The first recombinant DNA molecule included SV40 and Lambda DV gal in equal amounts. It was intended to be able to multiply these molecules in E coli, introduce mutations into the SV40 sequence, translate them into mammalian cells, and determine if the foreign genes could be expressed. So, it was the first notion and the initial realisation of that notion, which finally resulted in the technological progress of the entire community, with the exception that it became much simpler to link DNA molecules collectively via cohesive ends produced by restriction enzymes.



His work on recombinant DNA is one of the foundations of biotechnology and many related techniques. At the age of 96, Paul Berg, a pioneering scientist, passed away on February 15. Dr. Berg will always be regarded as one of the greatest scientists because of the significant influence his work had on genetic engineering, biochemistry, biotechnology, chemistry, and other fields.

THE DYNAMIC DUO

In 1895, W.L. Bragg, who was five years old at the time, fell off his bicycle and fractured his forearm. At the time, X-rays were still being tested.

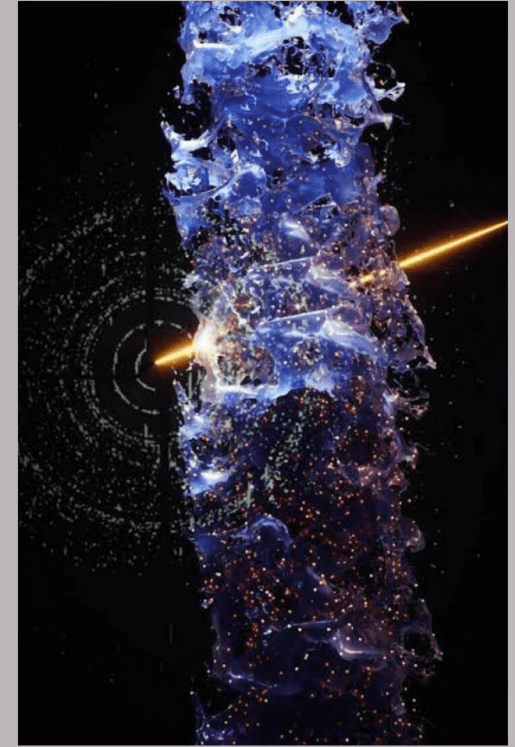
W.H. Bragg, a maths and physics specialist, had been conducting his own X-ray experiments. Bragg used his equipment to scan his son's broken leg to create the first X-ray images ever obtained in Australia. Both the scientists being British, Australia played a significant role in the part of their research.

In 1895, W.L. Bragg, who was five years old at the time, fell off his bicycle and fractured his forearm. At the time, X-rays were still being tested. W.H. Bragg, a maths and physics specialist, had been conducting his own X-ray experiments. Bragg used his equipment to scan his son's broken leg to create the first X-ray images ever obtained in Australia. Both the scientists being British, Australia played a significant role in the part of their research.

The Braggs developed their own X-ray discovery, which, like so few other genuinely outstanding ideas, had occurred to them while they were on summer vacation. W.L. Bragg, a Trinity College physics student, spent the summer at home. In the summer of 1912, W.H. Bragg and his son discussed a new book by Max von Laue, a German scientist who believed that X-rays could be diffracted through crystals. The young man returned to school eager to carry out his own research. W.H. Bragg was constructing a home-based X-ray analyzer to examine X-ray wavelengths. When his son came to visit during his son's school vacations, they combined their study efforts. Despite what the W.H. Bragg eventually came to refer to as "the difficulties of these theories," which set back more than just scientific research.

Together, they established the most appropriate and important new area of study: the use of x-rays for analyzing crystal structure. The use of x-rays as a tool to methodically find how crystals are made is exclusively due to the Braggs. They created a method for analyzing the three-dimensional structure of crystals atom by atom. W.L. Bragg worked on the maths while W.H. Bragg built the x-ray detector. Today, laboratories around the world still conduct the type of study that they founded.

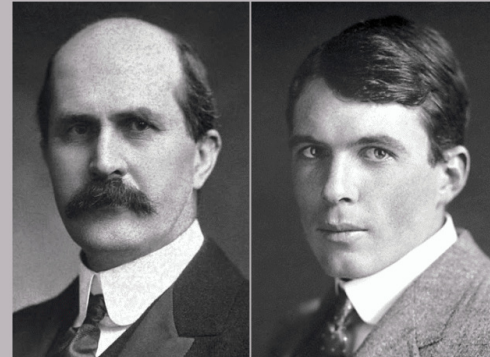
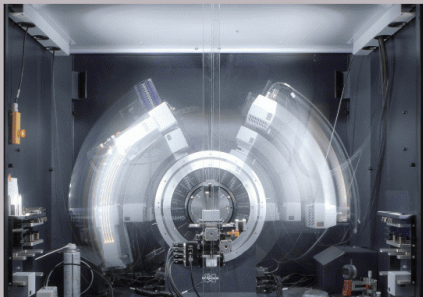
They published various scientific papers on crystal structure after their joint publication of 1915: *The Crystalline State* (1934), *Electricity* (1936), and *Atomic Structure of Minerals* (1937). Their research interests later included the application of X-ray analysis to the structure of protein molecules, determining for the first time the structure of the highly complex molecules of living matter.



At the age of 25, W.L. Bragg is the youngest scientist to receive Nobel Prize in Physics and at the time, he was the youngest-ever Noble laureate in any discipline. He was awarded the Hughes Medal of the Royal Society in 1931; the Royal Medal of the same Society in 1946, and the Roebing Medal of the Mineral Society of America in 1948. Their discovery is a huge blessing to our field as crystallography is majorly used from chemist to mineralogists. Their contribution is immense and will always be remembered as dynamic technique.

The first and only father-son team to receive the Nobel Prize in Physics for their excellent achievement is William Henry Bragg the father and William Lawrence Bragg the son. They received their prize in 1915 for using x-rays to analyze the crystal structure. W.H. Bragg, who was raised in a farmer family, chose a career in science and achieved great success as a physicist, chemist, and statistician.

Prior to completing his schooling at King William's College in the Isle of Man, W.H. Bragg attended Market Harborough Grammar School. In 1881, he was selected as a junior student at Trinity College, where he studied mathematics under the guidance of eminent scholar Dr. E. J. Routh. He served as the Third Wrangler in Part I of the Mathematical Tripos in June 1884, and the first class in Part II the following January. He studied physics at the Cavendish Laboratory for a part of 1885, and at the year's close, he was selected to serve as Professor of Mathematics and Physics at the University of Adelaide in South Australia. Later, he served as University College London's Quain Professor of Physics.



William Henry Bragg

William Lawrence Bragg

STAR OF THE DEPARTMENT



Miss Yamini Meshram

Dr Ambedkar College, Nagpur, India.
Masters in Biotechnology

CSIR – Centre for Cellular & Molecular Biology (CCMB)
Project-Based Trainee / Dissertee | Oct 2017 - Nov 2018

Saibiosystems Pvt. Ltd.
Scientific Editor and Bioinformatics Trainee
Dec 2018 – May 2019

ICAR – Central Citrus Research Institute (CCRI)
Research Fellow | Aug 2019 – Jun 2020

The University of Manchester, Manchester United Kingdom
PhD in Cancer Sciences (Pursuing, expected completion in 2024).

Miss Yamini Meshram, a former student of Dr. Ambedkar College, Nagpur who is currently pursuing her PhD from University of Manchester, gives us an insight about her PhD program, her journey from India to UK and many more in form of interview. Take a look:

How was your journey from M.Sc. at Dr. Ambedkar College to PhD at University of Manchester?

It was like a Rollercoaster ride. When I was doing masters I never really thought of doing PhD. For doing dissertation, NEERI was the best option in Nagpur. Then I got motivated by Dr. Hirapure Sir who told me about centralized institution. He told me that I had to mail people, tell them about my education and the subject of interest. But, then I thought, why NEERI, why not best in India? That's how I applied for dissertation and went to CCMB, Hyderabad. While doing my project there, I got interested in cancer field and thought to continue it for my PhD as it had good scope and name. For doing PhD in India, NET is required, funding issues and many more. Doing PhD from abroad is good and also quite popular, I got motivated and decided to apply for foreign institutions and universities. And luckily, I got selected in University of Manchester which is a whole lot of new experience.

What was your application procedure for PhD in University of Manchester?

For PhD, there are certain Advertise positions which are funded, so we can apply there directly but they take a long course of time as there are many rounds of interview and other procedures. The other way is to directly email the scientist of whom you have read papers and other publications, so you can write that in your mail and your topic of interest and how you can work under them. Then they will let you know if they have any positions or not or any chance for you to work under them in future in certain amount of time and if they have any funding or not. If they have funding, then they can just hire you and if not, you can search for funding by applying for it and inform them so they can hire you. So these are the ways to apply.

How to apply for masters in University of Manchester?

There are different programs and different intakes like January intake and September intake, so you can apply in these intakes by filling forms for respective universities, write SOPs, recommendation letters, etc. Your GPA also plays a very important role in selection procedure.

What was your reason to do PhD from a foreign University? And did you apply for other universities as well?

I first thought of going to USA because of Ivy league, but there in Harvard, they had a 5 year course and their own taught program for 1 year and rotate labs for 2nd year which is in all the 3 year course like a master's degree, but I already did my master's and did not wanted to invest my time there. Here in Europe, the same PhD can be done in 3-4 years so I decided to do my PhD from UK and here, there is no compulsion for taught courses and you can start your PhD degree right away for research. Here, there are some procedures and exams for continuation for the next year but way better than that of USA. University of Manchester is one of the top universities in UK and comes in top 10, so applied here and luckily got it.

Tell us about your PhD work in brief.

My PhD course is on Cancer Biology in which I am studying about cellular responses towards the irradiated matrix. It is basically a matrix which I irradiate which is particularly on breast cancer. Radiotherapy is one of the treatments which are used in breast cancer, so there is an extracellular matrix covering in our cells which help us in signaling, sometimes due to radiations and dosage other cells also get affected. We want to minimize the dosage so that only targeted area can be focused and just to cure that tumor.

Where do you see yourself in 5 years? Tell us about your future goals.

My PhD itself will take 2-2.5 years for completion and then I will probably do my postdoc at the same time I would think for applying in industries, they have a strict dateline but they pay well. So after my PhD I would apply for both whichever opportunity I will find best at that point of time, I'll take it.

What is the scope for life sciences in UK?

It is a big country which means more universities, more industries, more opportunities.

Did you face any difficulties at University of Manchester?

(Difficulties like understanding different concepts, major difference in Laboratories and handling of instruments as compared to India)

It was not that difficult for me because after my dissertation I continued in CCMB, Hyderabad for 6 months for experience and for gaining practical knowledge about lab equipments and machinery and also did some other projects which helped me a lot. That is I guess the reason why I did not face much difficulty or difference here. And also people are helpful here. If you need help, ask for it in the early stage, even if it's something small, they provide adequate help.

How practical knowledge is important in our field?

If you want to go in research related field or academia, you got to have practical knowledge and experience. Even if you apply for a job in this field, they will look into your skills and not theory based knowledge.

How was your experience at Dr. Ambedkar College?

Experience in Dr. Ambedkar College was lovely. The staff is very helpful, very cooperative and everybody helped me from Dr. Hirapure Sir to Dr. Mrs. Mehere mam. They always motivate and support you. So, in all, it was a wonderful experience.

Your message to juniors.

Have a work life balance. It is not just about studying, fun in life is also essential. And always imagine yourself where you want to be, if you idealize it and work for that imagination, you will yourself find ways to achieve it and other thing will automatically happen. There no need to take much pressure about it.

NEXT GEN BIO-FERTILIZERS

Mentor : Dr. Pradip Hirapure Sir

**Students : Diksha Dayma
Anisha Rahate**



These days there is an imbalance in the ecological system causing various climatic changes which causes variations in temperature and weather patterns. This climatic change directly affects the crop yield and its quality. Due to this, now farmers are in a dilemma on how to improve crop production and quality amongst all these abiotic stress conditions. Our students Anisha Rahate and Diksha Dayma under the guidance of assistant professor Dr. Pradip Hirapure sir are trying to come to grips with this issue. They are trying to find a bacterial consortia to make an Abiotic stress tolerant biofertilizer. The need for this advanced biofertilizer is because conventional fertilizers do not work in abiotic stress conditions.

Abiotic stress conditions are defined as the negative impact of non-living factors on living organisms in a specific environment. They are performing different tests by



subjecting the microbes to various factors like salinity, drought, temperature, pH, metal and so on. These tests will help them formulate a bacterial consortia which is stress tolerant. These consortia will be then used for plant and pot experiments to test the plant growth promoting activity of these microbes. On talking with the students, they expressed their future objective on this project. They said, "We are trying to prepare a better bacterial consortia which will work in diverse stress conditions. We are also assuming that the bacterial samples collected may have novel microbes which we will further give for DNA sequencing. We hope that our project will be a success and can be a great help to the agriculture sector.

**ONGOING PROJECT
IN OUR DEPARTMENT..**

ARTICLES

WRITTEN BY THE STUDENTS OF
DEPARTMENT OF BIOCHEMISTRY AND
BIOTECHNOLOGY

BARIATRIC SURGERY - CHANGING LIVES

PRASHANSHA KORI

(2nd Year)

In course of evolving and proceeding life, advancement in medical science is one of the best accomplishment for the whole world. Everyone might know about the success humans have achieved after introducing surgeries and saving millions of lives. Surgery is as old as humanity for anyone who has ever stanchd a wound has acted as a surgeon. Everyone might have heard about tons of weight loosing techniques like customised food, controlled diet, exercise, yoga and even some medicinal pills . But , what if we have a surgery for that too, with least complications.

Out of these, life changing and remarkable surgeries, one is known as 'Bariatric surgery'.Gastric bypass and other weight- loss surgeries- known collectively as bariatric surgery- involve making changes to your digestive system to help you lose weight. First metabolic surgery is attributed to Kremen in 1954 : The jejuno- ileal bypass . Who doesn't want to have a perfect body and weight. Everyone in this world go through hundreds of medications and different routines just to have a perfectly shaped body and appearance. This surgery may sound ordinary but I think it's one of the most extraordinary thing. I mean, just think about it, how amazing it would be it weight loss become easier. It has two mechanism of actions

1. Restrictive surgery and 2. Mal absorptive surgery.

Bariatric surgery is generally of five types, out of which, the most common and acceptable one is Roux- en-Y gastric bypass. It works in two different ways : Restriction: The surgeon separates the upper portion of the stomach from the lower portion. The upper portion (or the "pouch") is then connected to a limb of the small intestine, called the "Rouxlimb." The new stomach pouch restricts the amount of food you can eat, making you feel full after eating only a small amount of food.

Mal-Absorption: Once the smaller pouch is created, the surgeon reroutes your digestive system to bypass the larger part of your stomach and part of your small intestine. The result of the bypass is you absorb fewer calories and nutrients from the food you eat (mal-absorption). Other types include Mini- gastric bypass, Laproscopic sleeve gastrectomy, Gastric banding, Intra gastric balloon placement. All other types work little differently but the outcome remains same.

The success of this surgery is one of the greatest triumph in medical science. It is one of the best method to reduce weight. It is mostly done in the people who fails to loose weight even after proper medications , diet, exercise or any other method . Like every surgery has its pros and cons, this one too does. The procedure reduces your ability to absorb nutrients and calories; you will need to take vitamin supplements for the rest of your life. You will need to follow the low-sugar and low-starch diet guidelines following surgery, since you may experience discomfort, including vomiting and diarrhea. This procedure is not reversible. Complications include the possibility of leaks, bleeding, blood clots, infection, and blockages. Out of all the bariatric surgeries performed till now, one is the most well known and miraculous one. Eman Ahmed, who was once the heaviest woman (around 500 kg) in the world, died at the age of 36 due to comorbid conditions in Abu Dhabi's Burjeel hospital. She came to Mumbai's Saifee hospital for a weight-loss surgery from Alexandria in Egypt. Ahmed was moved to Mumbai in a special plane for the bariatric surgery. During her nearly-three-month stay in the hospital she lost around 330 kg. The doctors had to put her on a liquid diet before conducting the weight-loss surgery. FromMumbai's Saifee hospital she was shifted to Abu Dhabi's Burjeel hospital for further treatment.

This is one of the greatest success India achieved in medical science. It's overwhelming that India and World is moving forward and finding different ways and treatments for one's wellness, comfort and health but we as humans need to know that our health is priory our own responsibility. We should have good diet and stay healthy.

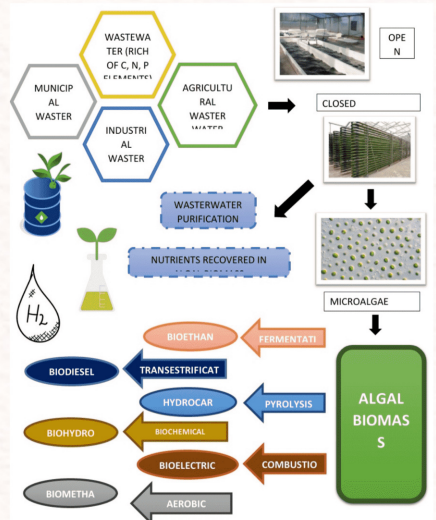
ALGAE BIOTECHNOLOGY

An initiative toward sustainable development

ANISHA RAHATE
(1st Year)

The rapid growth of the world's population has exacerbated environmental challenges. Several types of environmental pollution contribute to ecological imbalances and global warming. Many toxic substances, including heavy metals, nuclear waste, chemical fertilizers, pesticides, and pharmaceutical by-products, contribute to pollution. Efforts must be made to manage wastewater properly and develop cost-effective biofuels and bioproducts to mitigate these issues. Due to their abundance and ease of implementation, algae are of significant interest as potential feedstocks for a variety of applications. Bioremediation involves processes like bioaccumulation and biosorption and utilizes microalgae to reduce wastewater pollution. The reutilization of biomass and the reduction of greenhouse gas emissions have also generated considerable interest in microalgae. Algae can also be used to develop high-quality bioproducts and produce biofuels. The concept of using green algae for biofuel production has attracted enormous attention due to rising oil prices due to global warming.

Additionally, microalgae pigments have been shown to provide health benefits, including the prevention of neurological disorders, cancer, heart disease, and eye disorders. They can also be utilized as bio-fertilizers and food additives. Given the importance of algae, global production of algal biomass has increased significantly over the past 50 years but its utilization is not up to the mark. Currently, algae cannot be commercialized efficiently due to economic and technological barriers that make production costly. The development of a low-cost microalgae biorefinery that manages wastewater treatment and produces biofuels and bioproducts is under intensive research.



CANCER IMMUNOEDITING

DIKSHA DAYMA
(1st Year)

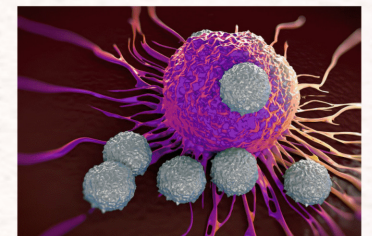
Tumor formation can occur, both due to genetic or environmental factors. When tumors are formed in a particular part of body they travel to other regions too, resulting in more tumor formation. But these cells are constantly under surveillance of the cells of immune system. The concept that the immune system can identify and control tumor cells is called as Cancer Immunosurveillance. Furthermore, the immune system can also promote tumor progression through suppressing anti-tumor immunity and immunoselection of poorly immunogenetic variants. In general, the dual-host protective and tumor promoting actions of immunity are referred to as Cancer Immunoediting. Therefore, the tumor microenvironment is like scene of battle between two opposing immune responses; one side of system is attacking the tumor cells while the other promotes it. In, 1909 the immunologist, Paul Ehrlich postulated that immune system can identify and destroy early tumors in absence of therapeutics.

Immunoediting evolves through 3 states also called as 3Es:

1. Elimination
2. Equilibrium
3. Escape

In elimination the innate and adaptive immunity work together. They detect and destroy the tumor cells before they become clinically evident. However sometimes cell variants may escape this and might not get destroyed. So, these cells enter the equilibrium phase in which immune system controls net tumor cell growth. This is the longest of the three phases and may occur over period of years. Now this functional dormancy of tumor cells may get interrupted which results in leading of tumor cells in escape phase. In this phase the edited tumor grows progressively and in an uncontrollable manner which leads to its clinical detection.

Now to help strengthen the immune system attacks scientists are developing immunotherapies. Immunotherapy uses a person's own immune system to fight cancer. Researches are still going on developing immunotherapies which help strengthen the immune system or by inhibiting suppressive immune environment.



NEUTROPHILS

A major component of Immune system

DEVIKA KAVISHWAR

(2nd Year)

Elie metchnikoff discovered neutrophils in 1882. These are the most abundant leukocytes in our body. They are also called as Polymorphonuclear neutrophils (PNMs). Neutrophils shows a remarkable role in killing the pathogen or microbe that is harming the body. Neutrophils play various roles in different diseases, including infectious diseases, metabolic diseases, autoimmune diseases and aging-associated diseases. They provide the first line defense of innate immune system.

In many types of infections, neutrophils are released more than the usual number. Neutrophils can identify microbes by pattern recognition receptors (PRRs) that bind to the microbial structure. These PRRs are expressed on the plasma membrane or some cell they are inside the cell either in lysosomes or in cytosol. They navigate to the infection site. These migration is derieved by pathogen driven molecules such as N-formulated peptides that are by product of bacterial protein synthesis. With some resident immune cells, neutrophils are also recruited from the blood these process is known as extravasation. Then these neutrophils perform three steps to destroy the pathogen. These 3 process are phagocytosis, killing and digesting. In phagocytosis process the pathogen is completely engulfed by the neutophils. Lysosomes then fuse into the bacteria delivering the agents that kill and degrade the microbes. These cells also clear the damaged cells or cell debris from the body.

Recently a new mechanism is described that the release of neutrophils extracellular traps (NETs) which are made up of DNA, histones, elastase, myeloperoxidase and others which perform a process named netosis too. This process involves suicidal, vital and mitochondrial netosis.

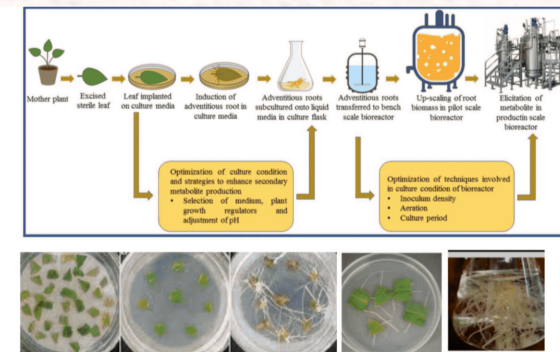
Neutrophils also plays an important role in Cancer which is a serious disorder causes due to the abnormal cell growth. Neutrophils can promote or inhibit cancer metastatic progression. Many evidenced indicates that neutophils can promote cancer development and tumor progression. These neutrophils develop pro and anti phenotypes in the case of cancer. In pro tumor function the neutophils promotes tumor growth and metastasis, while in anti tumor function neutophils prevent tumor progression and metastasis. In some animals elimination of neutrophils can reduce metastasis where in other animals elimination of neutrophils leads to metastasis formation but it can increase the risk of many pathogenic infections.

Thus, Neutrophils plays a very important role in our Immune System.

GENETICALLY MODIFIED HAIRY ROOTS CULTURE FOR SECONDARY METABOLITES PRODUCTION

ROHINI PATLE AND BHAGYASHRI PATLE

Hairy roots (HRs) are differentiated cultures of transformed roots generated by the infection of wounded higher plants with *Agrobacterium rhizogenes*. This pathogen causes the HR disease leading to the neoplastic growth of roots that are characterized by high growth rate in hormone free media and genetic stability. HRs produce the same phytochemicals pattern of the corresponding wild type organ. High stability and productivity features allow the exploitation of HRs as valuable biotechnological tool for the production of plant secondary metabolites. In addition, several elicitation methods can be used to further enhance their accumulation in both small and large scale production. However, in the latter case, cultivation in bioreactors should be still optimized. HRs can be also utilised as biological farm for the production of recombinant proteins, hence holding additional potential for industrial use. HR technology has been strongly improved by increased knowledge of molecular mechanisms underlying their development. So we Rohini Patle and Bhagyashri Patle currently working under the guidance of Prof. Pradip Hirapure on Induction and optimization of hairy root culture of *Convolvulus prostratus* and *Tinospora cordifolia* using two strain of *Agrobacterium rhizogenes* MTCC 532 and MTCC 2364. For Induction and optimization of hairy root culture we firstly we revived bacterial culture and performed explant transformation using needle pricking method and co-incubation of culture explant method. Further we will perform screening of transgenic hairy roots using Rol-B gene with PCR.



Hola Amigos..!

This article is specially for my GEN Z fellows. We all are living in an advanced and highly competitive era. For students like us, today's rapidly evolving world demands more than just good scores. Our Expectations are increasing with our age. So, it becomes very crucial to understand what world needs and what we can serve to the world..!

This 21st Century demands a generation acquiring valuable skills. Before we jump to main topic...Let us look at our surrounding happenings...

While scrolling the infinite ladder of Instagram and YouTube, you must have came across various videos or reels saying – “Learn a Skill Now”, “Importance of having a skill or hobby” “Top ten skill to learn online” etc., Many famous social media personalities like Sandeep Maheshwari, Ankur Warikoo are making tons of videos on importance of Skill Development. Have you ever wondered the Marks-based Educational System of India is suddenly trying to become a Skill-based Educational system through New Educational Policy. Why is it so? This is because, “Skill Development is a need of an hour”.

Skill Development is very important because it allows us to improve attributes and qualities vital to effective performance in any area of our life. Skill means the ability to do a particular work with perfection. New skills gives new chances and thus eventually help in enhancing the quality of life. It is scientifically proven that, the structure of our Brain changes as we learn a new skill. This is because our brain starts strengthening itself over time as we learn a new skill. By knowing the importance of skill development in this era, Our Honourable Prime Minister has launched National Skills Development Mission of India in year 2015. Prime Minister Modi's words on Skill Development are, “The more we give importance to skill development, the more competent will be our youth”.

Being a student, the most common yet essential skills we need to learn are - Communication, Time Management, Decision making, Leadership, Adaptability etc., By developing these skills one can become more confident and individualistic in life.

Importance of developing a SKILL

Now lets us understand a second and most important aspect of this topic. Every person pursues some hobbies or has individual interests. Generally, we do not pursue our hobbies after childhood. But, if we pursue our hobby, develop it into a valuable skill there is nothing better than this..! And this is what “Follow Your Passion” means. For example, In childhood, you used to love making clay pots. So, to covert this hobby into a skill..you can join any Pottery Classes and learn this skill professionally.

We all are running in a race called life. The energy we need to run in this race is nothing but Money. As this world is being advanced, it became necessary to have a second source of income for better quality of life. We can't truly rely on the academics and jobs. So, if you develop a skill, you'll start making money from what you loved and you'll enjoy this process.

Friends, Life is a beautiful journey and living this life peacefully and happily is what we need at the end. If you started enjoying your work, stress and anxiety levels will automatically go down and you'll be able to truly LIVE this life. So, here is another benefit of learning a new skill and pursuing your hobby. Now, you must be wondering how we can develop a skill. The answer is- by reading, Joining some certificate courses, joining some professional organisations and by asking help from a mentor.. one can easily develop any skill.

I hope through this article, you all have understood the Importance of Developing a Skill. So, from this moment, try to develop any valuable skill you have or create one..

Adios..!

"The future belongs to those who learn more skills and combine them in creative ways"

WORTH YOUR READ !!

“ It isn't the challenge that defines you.
It's what you do with it

Life in 21st Century is not at all easy. Though life expectancy and quality of life has been increased due to advanced development in Technology and Medical Sciences, there are many serious issues human civilization is dealing with..! The most serious issue humans are facing is – “Collapsing Mental Health”. This situation is more commonly seen amongst students like us who are still in schools and colleges. Nowadays, having panic attacks, anxiety, uncontrollable stress have been a daily part of our lives. The life of a student in this highly competitive world is full of stress, anxiety and an uncontrollable load of expectations from parents, teachers, friends etc., Though there are various issues nowadays students are dealing, but “To Quit” or “To Give Up” is not an option at all.

So, along with our studies, it has become crucial to learn balancing our mental health. The most impressive practice for dealing with Stress and anxiety issues is Meditation. Meditation is a mind-body practice in which our attention is focused on being mindful of the present, your breath and our mind to promote awareness, cultivate wellbeing and reduce stress and anxiety. Sarah Meyer Tapia, a meditation coach, associate director of Health & Human Performance and head of Wellness Education at Stanford University says, “ Meditation is to be present and know what we are doing, while we are doing it, any activity can be meditative if we're fully present”. meditation helps relieve our subjective levels of anxiety and depression, and improve attention, concentration, and overall psychological well-being. Many Scientific studies has concluded that, meditation helps in managing stress and depression. A review study last year at Johns Hopkins University looked at the relationship between mindfulness meditation and its ability to reduce symptoms of depression, anxiety, and pain. Researcher Madhav Goyal says, ' Meditation isn't

a magic bullet for depression, as no treatment is, but it's one of the tools that may help manage symptoms'. So, to deal with these modern issues like depression, addiction..one can make Meditation their friend and rebuild their life..!

After meditation, students can go for exercise and Yoga to maintain their physical body as well as mental health. Due to over addiction of social media, our generation and upcoming generations have almost forgot what Outdoor Games are..! Scientists have found that, Aerobic exercises, including jogging, swimming, cycling, walking, gardening, and dancing, have been proved to reduce anxiety and depression.



There is a very different practice which anyone can perform and it impressively helps in balancing mental health and that is – 'Self-Affirmations'. I believe that, this Universe is all about Energy Transfer. As it is said, “As you sow, so shall you reap”. So, it is our responsibility to feed our mind with positive thoughts. Self-Affirmation like, 'I can do this' helps a lot in boosting our self confidence. Being the most advanced and most open-minded generation, it is our responsibility to normalize taking a therapy or counselling. In India, many people don't go for the



therapies because of social pressure. But, these therapies can make someone's life better than ever before. Awareness about 'Mental Health' is very important in today's era. So, let us stand for each other and fight strong against the battle of depression, self-doubt and low self-esteem. Remember one thing, at last, all that really matters is YOU..!

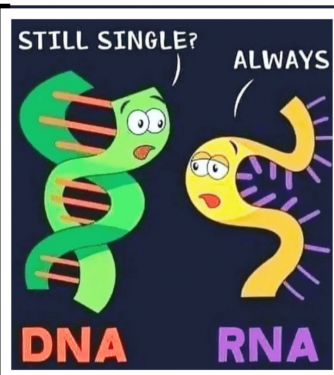
So, make your mind strong like a covalent bond with the help of Spirituality and Psychology.

Hope this article will become a bright ray of light in your life..!

See you soon..

- Kanchan Deoghare

BIOMICS



Me removing the scab from my wound

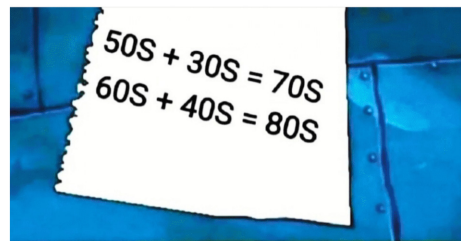
My platelets which formed the coagulation to stop the blood



Bacteria when they're growing in nature



Bacteria when you're trying to grow them for an experiment



Med students

Others

Our sincere efforts have made us to accomplish the task of completing this magazine. However, it would not have been possible without the kind support and help of many.

We would like to express our sincere gratitude to our respected Principal Dr. (Mrs.) B.A. Mehere Ma'am and college for providing us with facilities required for our magazine.

We would like to thank Head of Biochemistry and Biotechnology Department Dr. Utpal Dongre Sir for their valuable message and guidance.

We would like to thank Dr. Deovrat Begde Sir, Dr. Pradip Hirapure Sir and Ms. Rita Lakkakul Ma'am for their valuable suggestions and support.

We express our gratitude towards SPRUCE Clinical Research and Medical Coding Institute, Nagpur for sponsoring this Magazine. We would like to thank Ms. Yamini Meshram for giving us her valuable time and guidance. Also, all the students who have contributed in this magazine, we appreciate you and thank you.

Team Catalyst

Kanchan Deoghare
Content Developer &
Writer

Janvi Wane
Writer

Nandini Purohit
Writer

Clinical research and Medical coding
ISO 9001:2015 Certified

Authorized Education Partner of AAPC in India

**Make a Global Career in Clinical Research & Medical Coding
Get PG and Advance Diploma**

- Clinical Research
- Medical Writing
- Pharmacovigilance
- Clinical Data Management (CDM)
- Regulatory Affairs
- With English and Business communication.
- Medical Coding
- CPC (Certified Professional Coder)

Get International Certification in all above courses.

Spruce offers:

- Training by Doctors and CPC certified Experts.
- Online/offline and daily/ weekend batches.
- 100% CPC passing record.
- 100% Placement Assistance, till job.

**PAN India placement support from 2nd day of joining
and achieved 100+ placements in 2022.**

 **3rd Floor Navprabhat Chambers, Ramdaspath,
Nagpur, MS,440010**

 **www.sprucestudies.in.**  **9595025757/8999499930**



thecatalyst.dacn



thecatalyst.dacn@gmail.com



THE CATALYST

Magazine by Department of Biochemistry
and Biotechnology, DACN, Nagpur.