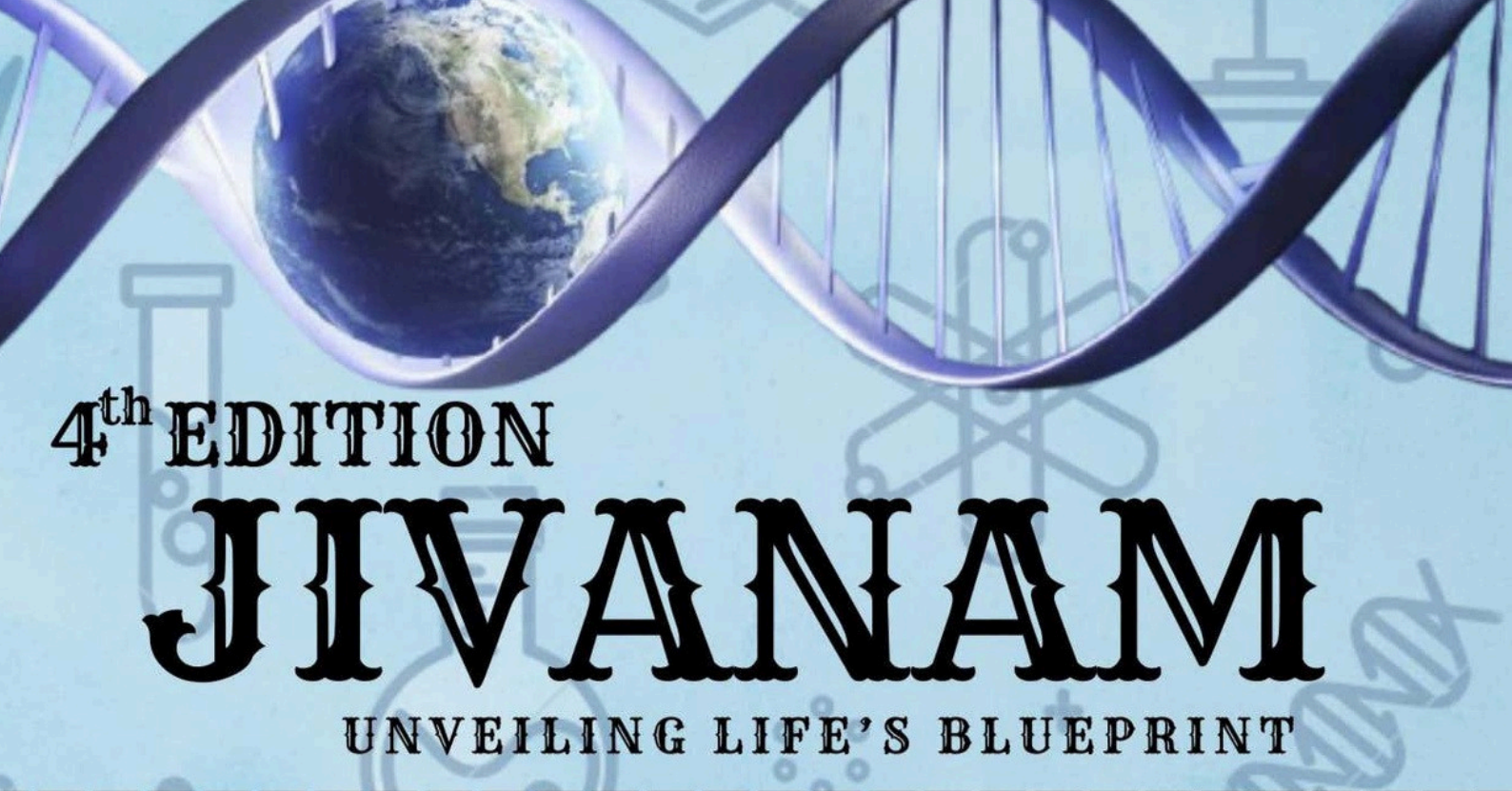




4th EDITION

JIVANAM

UNVEILING LIFE'S BLUEPRINT



**BIOTECHNOLOGY:
A CATALYST FOR FUTURE
BIO-INDUSTRIES**



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**" Our world is built on
biology and once we
begin to understand it,
then it becomes a
technology."**

- Ryan Bethencourt

From Principal's Desk

Dear Students,

It is with great enthusiasm that we welcome you to another edition of ***Jivanam***, magazine of the Biochemistry Department. The curiosity, innovation, and passion for science is evident in this publication, making it a true reflection of our academic spirit and a continuous effort to strive for excellence.

All the students are invited to share their knowledge, creative ideas, and research insights, transforming this magazine into a space where intellect meets imagination. Let “***Jivanam***” be the voice of our scientific journey—whether through discoveries, experiences, or thought-provoking perspectives.

Your contributions not only inspire but also strengthen our vibrant and enthusiastic scientific community. Looking forward to witnessing your brilliance in these pages!

Wishing you success and creativity always.

All the Best.

Dr J. J. VORA
Principal
M. G. Science Institute

From Faculty Desk



Welcome to the fourth Edition of the Magazine '**Jivanam**' from Biochemistry Department of - M. G. Science Institute, Ahmedabad.

It gives us immense pleasure to announce the launch of our department's magazine '**Jivanam**'. The theme of the magazine is "Biotechnology: A Catalyst for Future Bioindustries".

We congratulate the students for the choice of the theme as it is very relevant. The future of the Bioindustry is undoubtedly exciting, filled with a potential for groundbreaking innovations that can change the world & biotechnology is going to play a pivotal role in this industry.

This magazine is a most powerful platform for the students where they can focus their talents as well as their creativity which may be benefited to all. It plays a very important role where hidden talents of the students are exhibited & honed. The magazine is the product of sheer hard work and dedication of the editorial team & the students who have contributed the various articles. We acknowledge & salute the students for their commitment & enthusiasm for continuing the good work

started by their seniors 4 years back. We hope that this endeavor will help them in future careers.

Biochemistry department since the last thirty-three years strives to provide quality education and a comprehensive overall development of students. This magazine is an attempt to prepare the students for the exciting times of new development and research going on in different fields of biological science.

We hope that the articles in the magazine are interesting enough to create curiosity & will be able to motivate the students to engage in learning and understanding their role in the future times to come.

Once again congratulations and we wish the students success in all their future ventures.

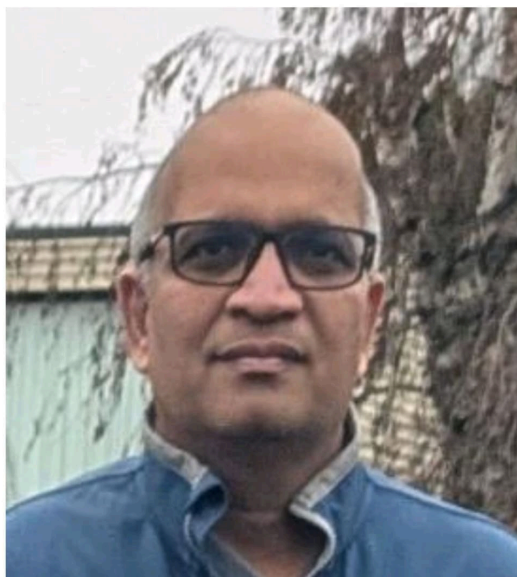
DR. H. V. PANDYA

PROF. S. V. JHA

DR. V. R. NADAGOUDA

PROF. ABHISHEK CHUDASAMA

WARMEST WISHES



Dear JIVANAM Team,

Congratulations on the 4th edition of JIVANAM! I extend my warmest wishes to all of you for your enthusiasm, dedication and passion in showcasing the wonders of biotechnology in this edition. May the discoveries and innovations featured within these pages ignite curiosity and a passion for knowledge. I hope every article, experiment and insight shared in this issue inspires future innovations.

Let your curiosity and inspiration be your driving force.

Best,

Amit Thakar

Year of graduation - 1998

Research Professor

Washington State University

Journey of Jivanam

Author:- Ritikaba Vaghela

Alumni(Biochemistry)) Batch: 2020-2023

The idea of starting Jivanam Magazine was born out of a shared vision among my peers and me during our second year at M.G. Science. It so happened that our HOD, Dr.H.V. Pandya came into the class and discussed what we should do for the Science Day celebration. There were many suggestions, such as holding an awareness event, decorating the department, and more. However, what struck me was the idea of compiling thoughts and knowledge from all the students in our department. What could be better than a science magazine for the Biochemistry department? The college had many talented individuals—writers, artists, and thinkers—and it could become a platform to showcase this talent. Soon, this casual conversation began molding into a student science magazine.

The next big question was: what would we call it? We wanted a name that resonated with life, vibrancy, and the essence of growth, which are at the core of the college experience and, of course, closely tied to our field of biosciences. After brainstorming many names, we settled on Jivanam, a Sanskrit word that means “life.” It encapsulated the very purpose of the magazine: to celebrate the life, thoughts, and stories of our college community.

Establishing the magazine was no easy task. From convincing students to be a part of it, to rallying a team of enthusiastic contributors, to finalizing content—it was a series of efforts and collaborations. We planned to collect submissions, edit drafts, and design the layout. Jivanam wasn't just a magazine; it became a learning experience for everyone involved. It taught us teamwork, perseverance, and how to transform a vision into reality.

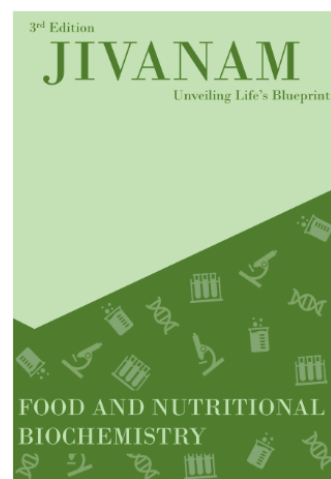
When we finally released the first edition of Jivanam, the overwhelming response from students and faculty was worth every effort. It became more than a publication; it became a space for expression and a symbol of our collective creativity. Starting Jivanam was not just about the magazine itself, but about creating something meaningful that would inspire others long after we graduated.



1st Edition



2nd Edition



3rd Edition

The Biotech Revolution – A New Era of Scientific Discovery



The topic "Biotechnology: Catalyst for Next-Generation Bio-Industries can inspire students in several ways such as Students are encouraged to think about how innovations in biotech will impact different Sectors of industries. Students can see biotechnology as a pathway to entrepreneurship, as they can be the creators of new biotech products and start-ups that address unmet needs in various industries, encouraging them to think creatively and take initiative.

This topic can also resonate with readers by addressing emerging trends, potential breakthroughs, and the future of bio-based industries, sparking interest in the profound changes biotechnology brings to economies, societies, and even daily life.

By positioning it as a catalyst, you're emphasizing how biotechnology is not just a part of these industries but actively transforming them, making them more efficient, sustainable, and capable of solving global challenges.

Help to guide the development of the biotechnology industry in a responsible and sustainable way.

Facilitate collaboration: Connect researchers, entrepreneurs, and investors. Developing. new treatments for diseases, personalized medicine, gene therapy, and regenerative medicine.

Improving crop yields, developing drought-resistant and disease-resistant crops, and producing sustainable biofuels.

There is growing public interest in biotechnology and its potential to improve human health, the environment, and the economy.

By focusing on "Biotechnology Catalyst for Next Generation Bio-industries," a magazine can educate the public and Raise awareness about the potential of biotechnology and its applications. It highlights a rapidly evolving and impactful field. It is driving significant innovations across various industries.

The introduction of the magazine titled Biotechnology is the Catalyst for the Future. Bio Industries explores the profound. impact biotechnology is having on shaping the future of various industries. In an era marked by rapid technological advancements, biotechnology stands at the forefront, revolutionizing multiple sectors such as healthcare, agriculture, energy, and environmental sustainability. The theme of this magazine highlights biotechnology as a powerful tool driving innovation, fostering sustainability, and unlocking new possibilities for the global economy.

As the world continues to face global challenges like food security, environmental degradation, and health crises, biotechnology offers promising solutions This magazine. delves into how biotechnology is catalyzing. the future of bio industries, driving a new era of scientific discovery, economic growth, and environmental stewardship. With groundbreaking research and technological advancements, biotechnology is poised to shape the future of industries worldwide.

Moreover, biotechnology is instrumental in the transition to a green economy. It plays 0 crucial role in developing renewable energy sources, such as biofuels and bioplastics, reducing the dependence on fossil fuels and mitigating the impact of climate change The use of biotechnological innovations in waste management and pollution control also showcases its potential in fostering a cleaner, more sustainable planet.

The global biotechnology market is expected to grow to \$3.88 trillion by 2030, and some of its goals include:

- Fighting disease and hunger. Biotechnology
- Reducing ecological footprint:
- Saving energy: Biotechnology can help save energy
- Developing personalized medicine:
- Making agriculture more efficient:

Some other factors that are driving the growth of the biotechnology market include:

- Government initiatives that support the biotechnology industry.
- Investments in the biotechnology industry
- The development of new and advanced: technologies
- The growing demand for synthetic biology applications
- The increasing funding for biotechnology startups
- The Asia Pacific region is expected to have the fastest growth rate in the biotechnology market from 2024 to 2033.

Mullis Legacy: How One Man's Discovery Changed The Face of Biotechnology

Early Life and Education

Mullis grew up in rural North Carolina, where his interest about the natural world was evident from an early age. Working both hard and smart to make sure that he stands out tall among his peers. He pursued his undergraduate studies in chemistry at the Georgia Institute of Technology, graduating in 1966. He later earned a Ph.D. in biochemistry from the University of California, Berkeley, in 1972. Personal Life and Philosophy Mullis's was known for his unconventional personality and outspoken views. He was an advocate for creative thinking in science and often challenged established norms. Beyond his scientific pursuits, he was a writer, penning an autobiography titled 'Dancing Naked in the Mind Field,' which offers insights into his life and philosophy. His academic journey was marked by a blend of creativity and unconventional thinking, which would later define his career to ensure that he stands out among his peers.

Born: 28 December 1944, Lenoir, North Carolina, United States

Died: 7 August 2019 (age 74 years), Newport Beach, California, United States

Education: College of Chemistry, University of California, Berkeley (1972), Georgia institute of technology, Dreher high school

Awards: Japan Prize (1993), Nobel Prize in Chemistry (1993), William Allan Award (1990), John Scott legacy medal and premium (1991)

Parents: Cecil Banks Mullis, Bernice Barker Mullis

Spouse: Nancy Cosgrove Mullis

Children: Louise Olsen, Christopher, Jeremy

Mullis was a Nobel Prize winning American biochemist who invented the polymerase chain reaction (PCR) technique. PCR is used in forensics, Genetics, and medicine.

Introduction to PCR

The Invention of PCR in 1983, while working at Cetus Corporation, Mullis developed the polymerase chain reaction (PCR), a method that enables the amplification of specific DNA sequences. Mullis's innovation was inspired by his knowledge and understanding of DNA replication. This invention Revolutionised the field of molecular biology, making it possible to analyse genetic material with unprecedented precision and speed. PCR became a landmark technology in diverse areas, including medical diagnostics, forensic science, and evolutionary

biology. By balancing the natural process of DNA synthesis, he devised a method to amplify small amounts of DNA exponentially.

Contribution towards Biotechnology

Kary Mullis's invention of the polymerase chain reaction (PCR) revolutionized biotechnology by enabling the rapid and specific amplification of DNA sequences. Here's how PCR has impacted biotechnology in Diagnostic Medicine, Genetic Testing, Prenatal Diagnosis, Forensics, DNA Fingerprinting, Gene Cloning, Gene Expression Analysis: PCR-based techniques like RT-PCR quantify gene expression levels in cells and tissues, Recombinant DNA Technology and Genetic Engineering. The impact of PCR is immeasurable; it has been vital in the development of diagnostic tests for diseases such as HIV and COVID-19, as well.

Conclusion

Kary Mullis passed away on August 7, 2019, but his legacy still remains with us due to his immense contribution-in the field of biotechnology and biochemistry through the transformative power of PCR. His discovery continues to cement science enabling breakthroughs in medicine, genetics, and beyond. Mullis's life and work remind us of the boundless potential of human creativity and the profound impact of scientific innovation. And that everything can be achieved with a motive and determination.

Biotech Beauty: Bridging Biotechnology and Skincare Innovation

Author- Sneha Patel

Department of Biochemistry Semester VI Student

“Biotech Beauty” introduces a new age in beauty research by bridging the gap between Biotechnology and the skincare and cosmetic business. This novel technique makes use of biotechnology developments to create products that go beyond typical cosmetic formulation, providing personalized, science-backed skincare solutions.

The use of biotechnology ideas and techniques in the production of skincare, cosmetic and personal care products are referred to as a biotech beauty. It entails utilizing biotechnology developments such as genetic engineering, molecular biology and biochemistry to generate unique and effective beauty solutions. Bioactive chemicals, customization, personalization, sustainable practices, innovative formulation, clinical validation and efficacy, regenerative medicine and anti-aging, ethical issues and digital and tech integration are some of the features of biotech beauty. Biotech beauty combines scientific innovation with skincare.

DNA Analysis and Personalized skin care

DNA analysis and personalized skin care are emerging trends in the beauty industry that aim to provide customized skin care solutions based on an individual genetic information. DNA analysis involves sequencing an individual's genetic material to identify specific genetic variation or single nucleotide polymorphism that may impact various aspects of skin, health and aging. By analyzing this genetic markers, brands can gain insights into an individual's genetic predisposition, such as collagen breakdown, antioxidant protection, inflammation response and sun sensibility.

Based on the result of DNA analysis, personalized skincare formulations and recommendations can be tailored to address the specific genetic needs of an

individual's skin. This can include customized products with ingredients that target specific concern or recommendation for lifestyle and skincare routine that optimize skin health.



(Courtesy: Potential Cosmetic Active Ingredients
Derived from Marine by Product)

Nature inspired active ingredients

Humans have long been inspired by the diversity and complexity of the natural world but haven't always had the tools to truly explore it's potential benefits. While some companies take the approach of leveraging biotechnology to more sustainably or efficiently reproduce.

One example of such a biotech company that is inspired by the tree of life is Arcaea. Currently known for tackling body odor with their first

biotech-produced active ingredient ScentARC, the company is also currently exploring marine life for sun protection benefits. They have been examining species of marine life especially fishes that naturally produced unique molecules to protect themselves from harmful UV radiation.



(Courtesy: Biotech beauty A new Era in Skincare and Cosmetic Science)

Measurable impact of biotech vs. natural ingredients

With sustainability at the top of industry's list of concerns, biotech is the route to solve some of the industry's most pressing issues, with measurable impact.

In the 1960s the Hyaluronic acid was historically sourced from animals and human connective tissues- a common source being rooster comb. This required farming, slaughter, and extraction which significantly uses more land and resources. In terms of effectiveness, this natural method would mean variable quality and molecular structure which could affect performance in formation. Over time, the use of animal derived Hyaluronic acid has decreased due to potential allergic reactions, ethical concerns.

The Biotech version, produced using Biofermentation, a process using lactic acid bacteria, is typically created in a controlled environment . Biotech derived Hyaluronic acid often has a more consistent molecular size, allowing for better hydration and absorption in skincare formulations.

The Role of Lab-Grown Ingredients In Beauty:

Purity and consistency: Lab-grown ingredients are consistently pure and of high quality. Synthetic ingredients can be precisely controlled ensuring uniformity in skincare formulations, unlike natural ingredients whose composition may vary due to environmental changes.

Novelty and Innovation: The use of Lab-grown ingredients in skincare products enables innovation. Scientists are able to design and produce novel compounds or molecules with particular qualities intended to address a range of skincare issues, including dehydration, pigmentation, aging, and more.

Cost-effectiveness: In certain cases, sourcing and extracting rare or pricey natural ingredients can be more expensive than producing ingredients in a lab-controlled setting. This cost-cutting can make high quality skincare more affordable to a broader audience.

Conclusion:

The global cosmetics market is growing due to increased consumer interest and frequent use of products. Biotechnological processes in the industry now enable the large-scale production of active ingredients, reducing costs and ensuring they are free of contaminants.

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Metabolic Engineering: Manipulation of Biochemical Pathways for Industrial Use

Author- Kanika Pareek

Department of Biochemistry Semester VI Student

Abstract

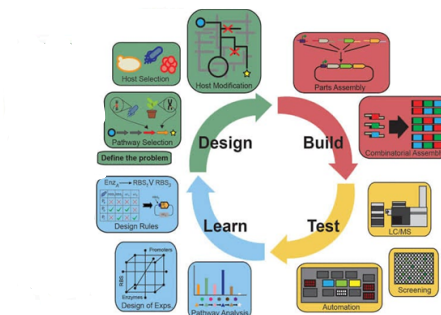
Metabolic engineering is one of the emerging fields which includes principles from both biochemistry, molecular biology, genetic engineering, and systems biology to redesign and further optimize microbial and plant metabolic networks. The goal here is to manipulate biochemical pathways such that desirable chemicals and industrially relevant compounds, such as biofuels, are produced in greater amounts. The overall objective is to optimize bioprocesses in terms of efficiency and sustainability, with a focus on the efficient use of renewable resources and green chemistry. Here, principles of metabolic engineering, applications, and strategies for changing metabolic pathways for industrial purposes, are provided.

Theory of Metabolic Engineering

Metabolic engineering is a field developed from what has been learned about metabolic pathways, a description of biochemical reactions operating in a cell. These pathways control the flux of metabolites—the small molecules that cells produce or consume in their quest to maintain life. The goal in metabolic engineering is the redesign of these pathways, optimizing flux of metabolites toward desired products and minimizing unwanted byproducts or waste. This is often achieved through the input of genetic modifications, such as the introduction of foreign genes, knockout of specific enzymes, or the overexpression of proteins important for the reaction, coupled with the modulation of environmental and culture conditions.

The process often starts with the detailed mapping of the host organism's metabolic network. Other tools of systems biology, like genomic sequencing, transcriptomics, proteomics, and fluxomics, are used to determine the general metabolic status of an organism. With this information, key enzymes or regulatory factors in the pathway can be targeted

for modification. CRISPR-Cas9, RNA interference (RNAi), and gene knock-in/knock-out strategies have greatly changed the way metabolic engineers can influence gene expression and redesign the metabolic network inside the cell.



Credit: Analytics for metabolic engineering)

Methods for Metabolic Pathway Engineering

Pathway Insertion

There are many diverse approaches in metabolic engineering, and one prevalent method involves the insertion of heterologous pathways, which means pathways not native to the host organism. For example, by introducing genes encoding enzymes from another organism, it is possible to create novel metabolites, such as biofuels, pharmaceuticals, or specialty chemicals. This approach is widely applied for the industrial production of bio-based fuels, such as ethanol or butanol, or high-value chemicals such as terpenoids, which are most commonly derived from plants.

Feedback Regulation and Flux Control:

Metabolic networks are very strictly regulated through feedback mechanisms, usually to prevent the overaccumulation of intermediates or end products. One of the biggest challenges in metabolic engineering is precisely how to overcome such feedback inhibition or limitation. Engineering the regulatory elements controlling gene expression, enzyme activity, or metabolic flux is critical. For example, the removal of

feedback inhibition, increased efficiency of enzyme catalysis, or artificial feedback loops for the enhanced yield of a target product is an example. Such a process may also include different modifications related to transcription factors, riboswitches, or even checkpoints in metabolic pathways.

Synthetic Biology and Modular Pathways

Synthetic biology refers to the area on the overlapping ground, including the design and construction of new biological parts or even entire pathways from scratch. Modular pathways can be designed by constructing biosynthetic building blocks into standard functional modules. This enables complex biochemical pathways, which are more robust and easier to control in their efficiency. Synthetic biology enables metabolic engineers to create completely new pathways that would not occur in nature, usually with non-natural substrates or producing new-to-nature products.

Applications of Metabolic Engineering

Metabolic engineering has far-reaching applications in various fields, making significant contributions to biotechnology and industrial sustainability. Some of the most prominent applications include:

Biofuel Production

Metabolic engineering plays a key role in biofuel production, focusing on the generation of ethanol, butanol, and biodiesel from renewable resources. Microorganisms, particularly bacteria and yeast, are genetically engineered to efficiently convert plant sugars into biofuels. This often involves modifications to central carbon metabolism, such as optimizing glycolysis, fermentation pathways, and ethanol tolerance. One of the notable successes in this field is the development of a more productive *Escherichia coli* strain for bioethanol production.

Pharmaceutical and Nutraceutical Manufacturing

Metabolic engineering enables the production of high-value pharmaceuticals and nutraceuticals by manipulating biosynthetic pathways in microorganisms or plant cells. A notable example is the revolution in the production of artemisinin, an anti-

malarial drug, which was made possible by the genetic engineering of *Saccharomyces cerevisiae* to produce the compound from simple sugars. Engineered microbes are also used to produce vitamins, amino acids, and bioactive peptides, which have applications in food, health, and medicine.

Bioplastics and Biochemical Production

Metabolic engineering has also contributed to the bioproduction of bioplastics, such as polylactic acid (PLA), derived from renewable resources like corn starch or sugarcane. Similarly, the bio-based production of biochemicals, including succinic acid, lactic acid, and 1,3-propanediol, through engineered microbial strains, is an emerging sector in the chemical industry. These innovations aim to reduce reliance on petroleum-based chemicals and promote more sustainable bioprocesses.

Environmental Applications

Metabolic engineering also advances environmental sustainability. Microorganisms can be engineered to degrade toxic compounds, helping with bioremediation efforts. The re-engineering of metabolic pathways to break down toxins enables the use of bioaugmentation systems in waste treatment or carbon capture and detoxification, promoting more sustainable environmental practices.

Conclusion

Metabolic engineering is a crucial component of modern biotechnology, enabling the production of biofuels, chemicals, pharmaceuticals, and bioplastics. Its potential lies in improving the precision of metabolic pathway modulation, leading to more sustainable alternatives to current manufacturing processes. Continued progress in systems biology, synthetic biology, and gene-editing technologies will likely unlock new frontiers in metabolic engineering, driving further innovation in biotechnology and industrial sustainability.

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BIOTECHNOLOGY IN MARINE RESOURCES: UNLOCKING THE POTENTIAL OF THE BLUE ECONOMY

Author: Sheetal Pradhan

Department of Biochemistry Semester VI Student (General Secretary 2024-25)

The “Blue Economy” is a sustainable economic development strategy that leverages marine and ocean resources, covering over 70% of Earth’s surface. These resources offer solutions for global challenges like food security and environmental sustainability. Biotechnology is playing a crucial role in unlocking these resources, offering innovative solutions in industries like aquaculture, pharmaceuticals, biofuels, and environmental management. This article explores how marine biotechnology is shaping the future of the Blue Economy.

The Role of Biotechnology in Marine Resources:

Marine biotechnology is a crucial tool in harnessing the diverse biological potential of marine organisms, such as algae, fish, and marine plants, to create products and services that benefit industries. The global blue economy is expected to reach over \$3 trillion by 2030, with marine biotechnology playing a significant role in achieving Sustainable Development Goals like poverty alleviation and clean energy. The market size for marine biotechnology is expected to grow at a CAGR of 7.2% from 2024 to 2034, reaching around USD 13.59 billion.

New Research and Innovations in Marine Biotechnology:

The field of marine biotechnology is rapidly evolving with continuous breakthroughs and new research further expanding its potential.

1. Marine Microbial Metagenomics

The study of genetic material recovered directly from environmental samples. By examining these microbes, researchers are discovering new

enzymes, bioactive compounds, and metabolic pathways. This research could lead to novel products and processes for biotechnology, such as enzymes used in bioremediation or antibiotics capable of fighting drug resistant bacteria.

2. Marine Biotechnology for Carbon Sequestration

A study recently demonstrated that genetically modifying algae (eg. *Chlamydomonas reinhardtii*, *Dunaliella salina*, *Synechocystis* sp. PCC 6803) could significantly enhance their ability to capture and store CO₂. This could contribute to large scale carbon capture projects, reducing the overall concentration of greenhouse gases in the atmosphere.

3. Marine Bioprospecting for Novel Compounds

Researchers are now able to identify and catalog bioactive compounds from marine life more efficiently. Recent studies have discovered novel peptides and proteins (eg. Aplidine, Didemnin, Jaspamide etc.) derived from deep sea organisms that possess antimicrobial, anti-inflammatory, and anticancer properties. These compounds are currently undergoing preclinical trials, showing immense promise in the development of next generation therapeutic agents.

4. Antioxidant Agents

In recent studies, researchers have found that marine algae, specifically red and brown algae, contain compounds with strong antioxidant properties. These antioxidants have potential applications in reducing the risk of chronic diseases such as heart and neurodegenerative conditions, opening up new avenues for therapeutic interventions.

5. Biopharmaceuticals

One notable research development is the use of marine derived enzymes in vaccine production. The stability of these enzymes at varying temperatures could lead to more effective and accessible vaccines, particularly for developing nations.

Ex. Human papillomavirus (HPV) has been developed using shark derived compound called squalamine

Vaccine against influenza has been developed using a jellyfish derived compound called green fluorescent protein (GFP).

Ex. The anticancer compound “Ecteinascidin 743” from marine tunicate has shown promising results in clinical trials.



(Credit: Dr. Vijay Sakhuja, Blue Economy: Awareness, Education and Financing)

How Marine Biotechnology can help future Bio- industries?

1. Biofuels and Renewable Energy

Marine microorganisms such as algae and cyanobacteria, are being studied for their ability to produce biofuels like biodiesel and bioethanol. These biofuels can play a significant role in reducing dependence on fossil fuels and mitigating climate change.

Ex. “Algal biofuels” are being researched as a sustainable alternative to petroleum-based fuels.

2. Sustainable Agriculture

Seaweed extracts can be used to enhance plant growth, improve soil health, and increase resistance to pests and diseases. The application of marine organisms can reduce the reliance on chemical pesticides and fertilizers, leading to more sustainable farming practices.

3. Bioremediation and Environmental Protection

Marine bacteria and algae can be used in bioremediation processes to address oil spills, plastic pollution, and other harmful waste materials. This contributes to the protection of marine ecosystems and other environmental settings. Ex. Marine bacteria, such as “*Alcanivorax borkumensis*” are employed to break down oil spills in marine environments.

4. Marine Based Bioplastics

Marine biotechnology can play a role in the development of biodegradable and sustainable alternatives. Marine organisms like algae and molluscs produce materials that can be used to create bioplastics, offering a more eco friendly solution to plastic pollution.

Ex. “Alginate” derived from brown seaweed is already used in the food and medical industries and it has potential for bioplastic development.

5. Marine derived Biocatalysts

Marine microorganisms are a source of unique extremozymes that can be applied in various industries, including food processing, textiles, and biofuel production. They can be used to reduce energy consumption and chemical usage.

Ex. Marine enzymes such as lipases and proteases are used in the detergents and leathering for efficient processing.

6. Aquaculture

Marine biotechnology can improve aquaculture practices by enhancing the health and growth of marine species through the use of marine based feeds, probiotics, and vaccines. It can also aid in reducing the dependency on wild fish stocks, which are under increasing pressure from overfishing.

Ex. The development of vaccines for fish diseases can improve the health of aquaculture species and reduce the need for antibiotics.

Conservation of Marine Biodiversity:

With marine ecosystems under severe threat from human activities, biotechnology provides tools for conservation-

- 1) **DNA Barcoding and Metagenomics**
- 2) **Cryopreservation**
- 3) **Restoration Efforts**

Conclusion:

Marine biotechnology is a crucial tool for the Blue Economy, enhancing food security, healthcare, environmental sustainability, and renewable energy. As research and innovation progress, it will become a vital pillar of the global economy, fostering a more sustainable and resilient world for future generations. As countries and industries recognize its importance, marine biotechnology will serve as a foundation for sustainable ocean resource use for future generations.

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CRISPR-Cas9 Gene Editing: A Breakthrough in Biotechnology

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Department Of Biochemistry Semester IV Student

Introduction

The CRISPR-Cas9 system has emerged as one of the most promising biotechnological tools of the 21st century, revolutionizing genetic engineering and biochemistry. This innovative technology allows scientists to edit DNA with unprecedented precision, enabling new approaches in medicine, agriculture, and industrial biotechnology. Its discovery and refinement have led to remarkable advances in the understanding and treatment of genetic diseases.

The Science Behind CRISPR-Cas9

CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) and the Cas9 protein work together as a molecular system for targeted DNA modification. Originally discovered in bacteria as a defense mechanism against viruses, scientists have harnessed CRISPR-Cas9 as a tool to cut and modify specific DNA sequences. In essence, CRISPR functions as a guide, leading the Cas9 enzyme to the desired location in the genome, where it creates a double-strand break. The cell's natural repair mechanisms then allow for the deletion, addition, or alteration of genes at that site, opening up vast possibilities for genetic editing.

Applications in Biochemistry

In biochemistry, CRISPR-Cas9 is making a profound impact on the study of gene function, protein synthesis, and metabolic pathways. Researchers are using this tool to create precise gene knockouts, study the effects of gene regulation, and develop novel therapeutic strategies. For instance, CRISPR is being explored to treat genetic disorders like sickle cell anemia and cystic fibrosis by directly correcting mutations at the DNA level.

Recent Advancements

The field of CRISPR research is continuously evolving. Recently, scientists have developed advanced forms of CRISPR, such as base editing and prime editing, which allow for even more precise modifications without creating double-strand breaks. These innovations reduce the risk of off-target effects and make gene editing safer and more efficient. Another exciting development is the potential use of CRISPR to combat antibiotic resistance, a growing threat to public health.

Ethical Considerations

While CRISPR-Cas9 presents incredible opportunities, it also raises significant ethical questions, particularly in human gene editing. The possibility of editing human embryos or creating genetically modified organisms (GMOs) has sparked debate within the scientific community and the public. Regulatory frameworks and ethical guidelines are being made to ensure the responsible use of this powerful technology.

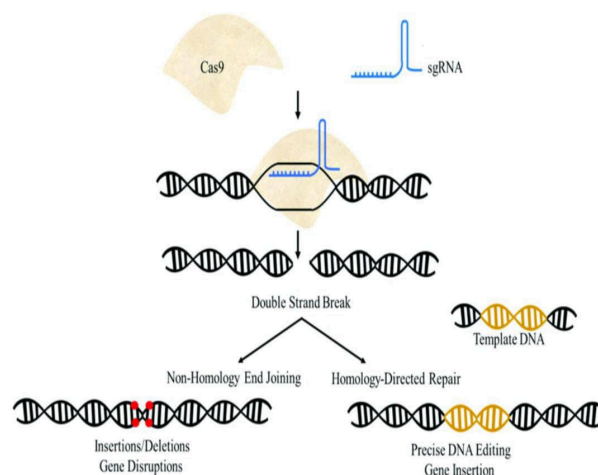


Fig: -CRISPR-Cas9 Mechanism

(Reference-Aftab Ahmad)

Conclusion

CRISPR-Cas9 is undoubtedly one of the most transformative tools in biotechnology and biochemistry. Its ability to modify genes with precision has the potential to revolutionize medicine, agriculture, and industrial applications. As research continues, CRISPR will likely play a pivotal role in shaping the future of genetic engineering and personalized medicine.

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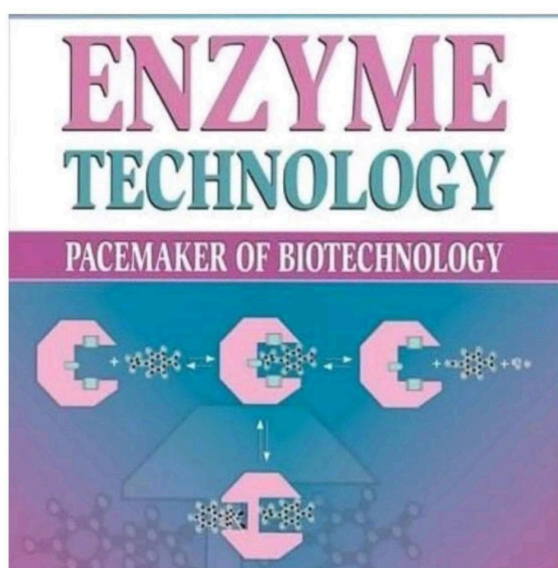
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Enzyme Technology- Backbone of Modern Bio-industries

Author: Pearl Patel

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Enzyme technology has become a cornerstone of the modern biotechnology and industrial sectors. Enzymes are biological catalysts that accelerate chemical reactions, making them ideal for use in a wide range of industrial applications, from food and beverages to pharmaceuticals and biofuels.



(Courtesy: Book by Nooralbettu Krishna Prasad)

Enzyme Engineering:

Advances in genetic engineering, protein optimization, and enzyme immobilization techniques are enabling the design of more efficient and robust enzymes, which are critical for scaling up industrial applications.

Energy Efficiency:

Enzymes operate under mild conditions (e.g., moderate temperatures, neutral pH), which leads to lower energy consumption compared to traditional chemical processes.

The continuous evolution of enzyme technology has opened up new possibilities in various bio-industrial sectors. From enzymes used in biocatalysis for pharmaceutical manufacturing to enzymes in waste management and

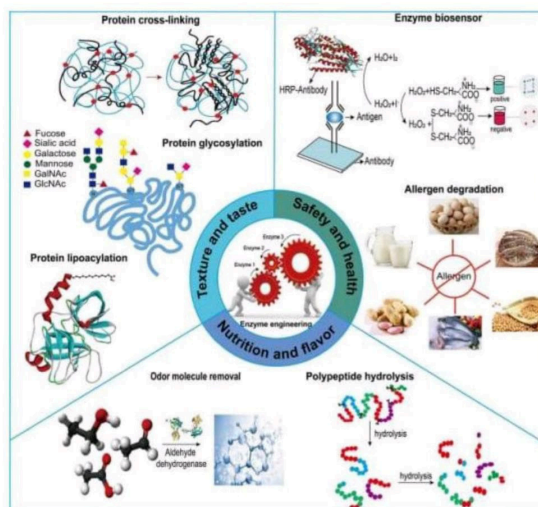
bioremediation, the innovations in enzyme technology are transforming the bio-industries

Biocatalysis in Pharmaceuticals:

Enzymes are increasingly used in pharmaceutical manufacturing for the synthesis of active pharmaceutical ingredients (APIs), offering a more precise and environmentally friendly approach.

Synthetic Biology and Enzyme Engineering:

The integration of synthetic biology with enzyme technology is enabling the creation of novel enzymes with enhanced properties, further driving the growth of bio-industries.



(Courtesy: Current progress and prospect of enzyme technologies in future foods)

Lignocellulose-Degrading Enzymes

Overview:

Enzymes capable of breaking down lignocellulose into fermentable sugars are being optimized for better efficiency in biofuel production. Recent innovations focus on enzyme cocktails that can degrade both cellulose and hemicellulose, which are abundant in plant biomass.

Applications:

Biofuels, biorefining, and renewable energy sources.

Thermophilic Enzymes for Industrial Processes**Overview:**

Enzymes derived from extremophiles (organisms living in extreme environments) are being developed for high-temperature industrial processes. These thermophilic enzymes can function under conditions that would denature typical enzymes, making them valuable in industries like food processing, textile, and paper production.

Applications:

Biofuels, paper and textile industries, food processing (e.g., enzyme-based tenderizing and fermentation).

Protease-Based Meat Alternatives**Overview:**

Proteases and other enzymes are being used in the production of plant-based meat alternatives, mimicking the texture and flavor of animal meat. These enzymes help to break down plant proteins into more meat-like textures, enhancing the quality of plant-based products.

Applications:

Food industry, specifically in plant-based meat production.

Enzymatic Protein Folding and Refolding**Overview:**

Recent innovations in enzyme technology also focus on improving protein folding processes for biopharmaceutical applications. Enzymes capable of assisting in the folding and refolding of therapeutic proteins, which is critical for the development of effective biopharmaceuticals, have been optimized.

Applications:

Drug manufacturing, especially for therapeutic proteins and monoclonal antibodies. These recent innovations in enzyme technology offer exciting potential for bio-industries, contributing to sustainability, efficiency, and the development of

new products and services. As enzyme engineering continues to evolve, it will likely play an even more pivotal role in shaping a sustainable, bio-based economy.

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Plant-Based Vaccines and Biopharming: Revolutionizing Medicine and Agriculture

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Plant-based vaccines and biopharming are two exciting fields within biotechnology that are opening new doors in medicine and agriculture. These innovative approaches leverage plants' natural abilities to produce pharmaceutical products, offering a more sustainable, cost-effective, and scalable alternative to traditional drug production methods. In recent years, there have been significant breakthroughs in both areas, with promising discoveries and innovations that could revolutionize how we manufacture vaccines, therapeutics, and other important biological products.

What is Biopharming?

Biopharming, or "pharming," refers to the use of genetically modified plants to produce pharmaceuticals, including vaccines, antibodies, and other therapeutic proteins. This biotechnology approach transforms plants into "biofactories" that can grow and harvest valuable pharmaceuticals in a more sustainable and cost-effective manner than traditional methods like bacterial or mammalian cell culture systems. Biopharming offers numerous advantages, such as lower production costs, easier scalability, and the ability to produce complex molecules that are often difficult or expensive to synthesize through traditional methods. One of the most well-known examples of biopharming is the production of insulin in genetically modified tobacco plants, which has been a major focus of research.

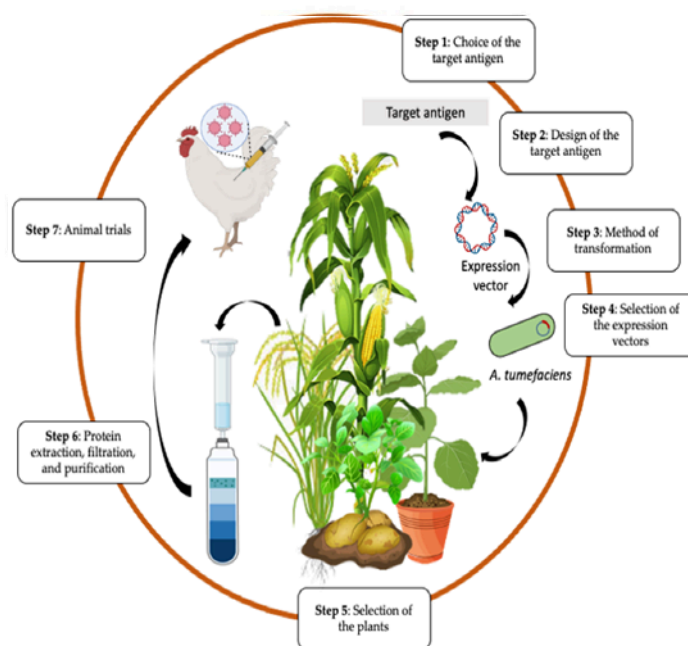
The Rise of Plant-Based Vaccines

One of the most promising applications of biopharming is the development of plant-based vaccines, which use genetically engineered plants to produce viral proteins that can trigger an immune response when consumed or injected into the body. Unlike conventional vaccines, which require complex fermentation or cell culture processes to produce antigens, plant-based vaccines can be grown in large quantities in a relatively short period.

Recent Breakthroughs in Plant-Based Vaccines

Zika Virus Vaccine in Tobacco Plants in 2023,

researchers at UC Davis and Kentucky Bioprocessing achieved a breakthrough in plant-based vaccine development by creating a vaccine for the Zika virus using genetically engineered tobacco plants. The vaccine works by inserting genes from the Zika virus into the tobacco plant's DNA, allowing the plant to produce virus-like particles (VLPs). These particles mimic the virus and trigger an immune response when consumed, without causing infection. This vaccine not only demonstrates the potential of plants in vaccine production but also highlights the advantages of using plants over traditional methods. Tobacco plants, when genetically modified, can be grown quickly and produce large quantities of the vaccine at a fraction of the cost of traditional cell-based vaccine production.



(Credit: Ika Nurziah)

COVID-19 Plant-Based Vaccine In 2020, Medicago, a biopharmaceutical company, developed a plant-based COVID-19 vaccine known as CoVLP. The vaccine was produced using genetically modified tobacco plants that were engineered to produce the spike protein of the SARS-CoV-2 virus. The plant material was

then harvested and purified to create virus-like particles (VLPs), which, when injected, triggered a strong immune response in clinical trials. In 2021, Medicago's plant-based COVID-19 vaccine became the first of its kind to receive approval for emergency use in Canada.

CoVLP's development has sparked renewed interest in plant-based vaccines, especially due to its cost-effectiveness, faster production timeline, and ability to be scaled up quickly in response to emerging infectious diseases. The success of CoVLP suggests that plant-based vaccines could play a pivotal role in future pandemic preparedness.

Edible Vaccines: A New Frontier

Edible vaccine, which are produced directly in food crops, are another promising innovation in biopharming. By inserting vaccine genes into crops such as bananas, potatoes, or rice, scientists are creating foods that can act as oral vaccines. These crops are consumed directly, delivering the vaccine to the body in a safe and convenient form. In 2024, researchers at University of California, Davis demonstrated progress in developing edible vaccines against Zika and Norovirus using genetically engineered plants. The plants were modified to produce antigens from these viruses, which were then tested in animal models. The results were promising, suggesting that oral vaccines produced in crops could eventually be used to combat diseases in areas with limited access to traditional vaccination programs.

The Advantages of Plant-Based Vaccines and Biopharming:

1. **Cost-Effective Production:** Traditional vaccine production methods often involve costly cell cultures, fermentation tanks, and complicated purification processes. In contrast, plant-based vaccines can be produced at a fraction of the cost, using plants that grow quickly and require minimal infrastructure.
2. **Scalability and Speed:** Plant-based vaccines can be scaled up rapidly and produced in large quantities to meet urgent health demands. The ability to grow and harvest plants on a large scale makes them ideal for responding to pandemics or emerging infectious diseases.
3. **Sustainability:** Plant-based vaccine production is more environmentally friendly compared to traditional methods. It reduces the need for energy-intensive facilities, chemicals, and animal testing, offering a more sustainable approach to vaccine manufacturing.

4. **Accessibility:** In many parts of the world, access to traditional vaccines is limited due to supply chain issues or infrastructure challenges. Edible vaccines, produced in commonly grown crops, can be a game-changer, providing a more accessible and easy-to-distribute form of immunization.

The Future of Plant-Based Vaccines and Biopharming:

The future of plant-based vaccines and biopharming looks incredibly promising, with continued research focusing on improving the efficiency and safety of plant-derived vaccines. Experts believe that in the next decade, plant-based vaccines could become a standard method for fighting a wide range of infectious diseases. As research progresses, these innovations could also extend to other areas of medicine, such as cancer therapies, autoimmune diseases, and even gene therapies.

Additionally, the global push for sustainable and cost-effective healthcare solutions will likely continue to drive investment into biopharming. As the world faces new health crises and increasing healthcare costs, plant-based vaccines and biopharming could provide critical solutions to global health challenges.

Conclusion:

Plant-based vaccines and biopharming are at the cutting edge of biotechnology, offering transformative solutions for medicine and agriculture. With advances in genetic engineering, scientists are turning plants into powerful tools for producing life-saving vaccines, therapeutics, and other essential biological products. The recent success of COVID-19 plant-based vaccines, edible vaccines, and biopharming technologies marks just the beginning of a revolution in healthcare, with the potential to reduce costs, increase accessibility, and improve sustainability in medicine.

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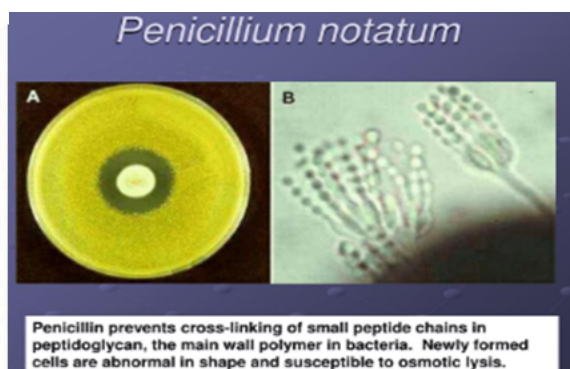
Microbial and Environmental Biotechnology: A Tool for Transforming the World Around Us

Author: Mahi Vaidya

Department of Biochemistry Semester II Student

In an age where sustainability is no longer optional, the field of microbial and environmental biotechnology has emerged as a powerful tool to address global challenges. By harnessing the natural capabilities of microorganisms and developing innovative biotechnological solutions, researchers are creating pathways to cleaner energy, improved waste management, and healthier ecosystems.

Kary Mullis (1944–2019): Invented the Polymerase Chain Reaction (PCR), a technique widely used for amplifying microbial DNA, revolutionizing microbiology and biotechnology. Alexander Fleming (1881–1955) Pioneered the use of microbes in medicine. Discovered penicillin, the first antibiotic derived from *Penicillium* Mold.

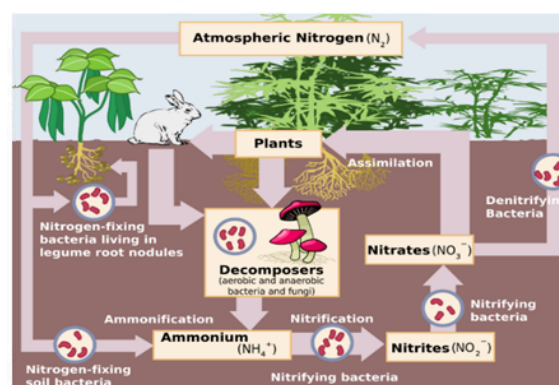


(Courtesy: Penicillin the story of an antibiotic)

The Power of Microorganisms:

Microorganisms play a monumental role in maintaining life on Earth. From breaking down organic matter in soil to fixing atmospheric nitrogen for plant growth, microbes are nature's most efficient workers. Scientists have found ways to harness their metabolic activities for a

variety of applications, turning them into allies in environmental preservation.

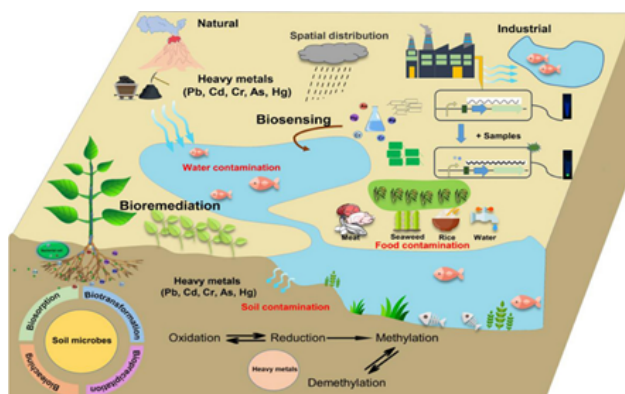


Nitrogen Fixation

Innovations in Waste Management:

One of the most impactful applications of microbial biotechnology is in waste management. Biodegradable plastics, for instance, are produced using microbial fermentation processes. Similarly, microbes are employed in bioremediation projects to clean up oil spills (Ananda Mohan Chakrabarty (1938–2020) Developed genetically engineered *Pseudomonas* bacteria capable of breaking down oil spills), degrade toxic chemicals, and neutralize heavy metals in contaminated environments. This not only reduces pollution but also restores ecosystems to their natural state.

Tackling Climate Change by capturing and storing carbon dioxide. Projects are underway to enhance microbial carbon sequestration processes in soil, which not only reduce greenhouse gases but also improve soil fertility. Additionally, methane eating microbes are being studied to reduce emissions from agricultural and industrial sources.



BIOREMEDIATION (Credit: Jian Chen)

Advancing Sustainable Agriculture through the development of biofertilizers and biopesticides. These products utilize beneficial microbes to enhance crop growth and protect against pests, reducing the reliance on synthetic chemicals and minimizing environmental impact.

A Sustainable Future:

As the global population grows and environmental concerns intensify, microbial and environmental biotechnology holds the promise of a sustainable future. By integrating these technologies into industrial, agricultural, and environmental practices, we can reduce our ecological footprint and promote a healthier planet.

The field continues to expand, driven by scientific innovation and interdisciplinary collaboration. With every discovery, we edge closer to a world where the balance between human progress and environmental stewardship is not only achievable but sustainable.

Microbial Biodegradation of Plastic Waste:

1. Enzymatic Degradation: break down plastic polymers into smaller molecules.
2. Bioplastic Production: from renewable resources, reducing dependence on fossil fuels.
3. Bioremediation of Plastic Waste: Using microbial consortia to break down plastic waste in landfills and oceans.

Microbial Production of Biofuels and Bioenergy:

1. Bioethanol: Fermentation of plant sugars by yeasts to produce ethanol fuel.
2. Biodiesel: Transesterification of vegetable oils or animal fats into biodiesel fuel.

3. Biogas: Anaerobic digestion of organic waste to produce methane gas as a renewable energy

Conclusion:

Microbial and environmental biotechnology exemplifies the harmony between science and nature. Its applications are vast, from powering our cities to cleaning our rivers, proving that the smallest organisms can have the biggest impact on our future.

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The Next Generation of Protein Engineering

Author – Sanvi Chauhan

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Protein engineering is a fascinating and rapidly advancing field of biotechnology that holds enormous potential for medicine, agriculture, and environmental sustainability. By manipulating proteins, scientists can design new proteins with specific functions or modify existing ones to improve their performance.

With the advent of new technologies, protein engineering is entering a new era, often referred to as the "next generation." This article explores the innovations driving this next generation of protein engineering in a simple and easy-to-understand manner.

○ What is Protein Engineering?

Proteins are the building blocks of life. They play critical roles in nearly every biological process in our bodies, from digesting food to fighting infections.

Scientists can engineer proteins by altering their amino acid sequences, the unique building blocks that make up proteins.

This process can improve the protein's function or even create entirely new proteins with specific tasks, such as curing diseases, improving crops, or cleaning up environmental pollution.

Traditionally, protein engineering involved trial and error. Scientists would modify a protein and test it to see if it has the desired effect.

However, recent advances in technology are changing the way proteins are designed and created, making the process faster, more accurate, and more effective.

Advances in Technology Driving the Next Generation of Protein Engineering

Artificial Intelligence (AI) & Machine Learning (ML) One of the biggest breakthroughs in protein engineering is the use of artificial intelligence (AI) and machine learning (ML). These

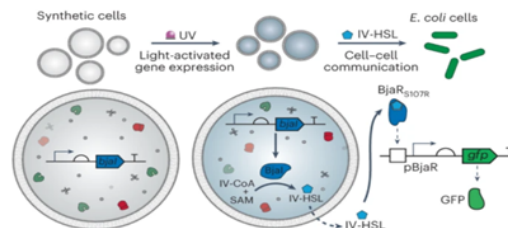
technologies can analyze vast amounts of data and predict how proteins will behave based on their amino acid sequences. By feeding AI models with information about known protein structures, scientists can quickly generate new protein designs with a high chance of success.

For example, companies like Deep Mind have developed AI models that can predict the 3D structure of proteins. This prediction is incredibly important because the function of a protein depends on its shape. If we understand how a protein folds and fits together, we can better design it for specific tasks.

Synthetic Biology:-

Synthetic biology is a multidisciplinary field that combines biology, engineering, and computer science to design new biological systems. In protein engineering, synthetic biology enables scientists to construct entirely new proteins or even entire networks of proteins that don't exist in nature. By using standardized building blocks and modular designs, scientists can create proteins with custom-made functions, such as those needed for drug delivery or environmental cleanup.

Synthetic biology is pushing the boundaries of what is possible in protein engineering, enabling the creation of novel proteins with a wide range of applications.



(Courtesy: Engineering cellular communication between light-activated synthetic cells and bacteria)

Directed Evolution:-

Directed evolution is another technique that is helping to drive the next generation of protein engineering. This method mimics the process of natural evolution by generating a large number of protein variants, selecting the ones with the desired properties, and then "evolving" them further. In the lab, this involves introducing mutations into a protein's DNA and then testing the resulting protein for its function. One major advantage of directed evolution is that it allows scientists to improve existing proteins rather than creating them from scratch.

For example, directed evolution has been used to create enzymes that work more efficiently at higher temperatures or in harsh industrial conditions.

This approach has been particularly useful in developing proteins for use in biotechnology, pharmaceuticals, and environmental applications.

Applications of Next-Generation Protein Engineering:-

The advances in protein engineering are already having a profound impact across several industries. Here are some key areas where the next generation of protein engineering is making a difference:

Medicine:

In medicine, engineered proteins are being used to develop targeted therapies for a variety of diseases. For instance, protein-based drugs like monoclonal antibodies are already used to treat cancer, autoimmune diseases, and infectious diseases. With advancements in protein engineering, scientists are now able to create more specific and effective treatments, potentially with fewer side effects. Additionally, protein engineering is enabling the development of gene therapies that can correct genetic disorders at the molecular level. By designing proteins that can replace faulty ones, scientists hope to treat diseases such as cystic fibrosis or muscular dystrophy.

Agriculture:

In agriculture, protein engineering is helping to create crops that are more resilient to diseases, pests, and environmental stress.

For example, researchers are developing proteins that can protect crops from harmful insects or enable them to thrive in drought-prone areas.

Additionally, protein engineering is being used to create more nutritious foods, such as rice with higher levels of essential vitamins and minerals.

Environmental Sustainability:

Protein engineering also has applications in environmental sustainability. For example, engineered proteins can be used to break down pollutants in the environment, such as oil spills or plastic waste. Proteins that can degrade toxic chemicals or help clean up waste are a growing area of research, offering potential solutions to some of the planet's most pressing environmental challenges.

Conclusion:-

The next generation of protein engineering is set to transform the way we approach biological problems. Thanks to advancements in artificial intelligence, gene editing, synthetic biology, and directed evolution, scientists are able to design and create.

Proteins with unprecedented precision and efficiency. As these technologies continue to evolve, the possibilities for protein engineering are virtually limitless, opening up exciting opportunities for solving some of the world's most pressing challenges.

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Exploring the Cosmos with Living Space Suits: “The Nanotech Revolution”

Author – Kaveri Goswami

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Abstract:

Bacterial cell-based space suits, enhanced by nanotechnology, are a groundbreaking innovation in space exploration. Researchers at the University of California, Berkeley developed protective spacesuits for bacteria in 2018, combining microbial systems with semiconductors. Despite challenges like material selection, durability, self-healing capabilities, and manufacturing complexity, the integration of synthetic biology and nanotechnology offers promising opportunities for human space exploration, including self-repairing capabilities and sustainable resource generation.

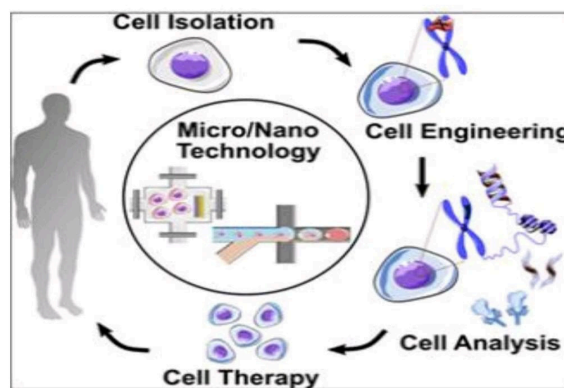
Introduction:

As humanity ventures further into space exploration, the need for advanced protective gear becomes more critical. Traditional space suits, while effective, come with limitations such as bulkiness, limited durability, and susceptibility to extreme space conditions. The intersection of nanotechnology and space exploration has opened up new possibilities for advancing astronaut safety and efficiency. In recent years, researchers have been exploring innovative approaches to revolutionize space wear, one of the most intriguing innovations to emerge from this collaboration is the development of bacterial cell-based space suits enhanced with nanotechnology.

What do you mean by term Nanotechnology?

Nanotechnology is the science, engineering, and application of materials and devices at the nanoscale—typically within the range of 1 to 100 nm—where unique physical, chemical, and biological properties emerge. By manipulating matter at the atomic and molecular levels, nanotech enables the creation of innovative solutions across various fields including medicine, electronics, energy, and materials science. By harnessing any one of the potential or

the power of genetically engineered synthetic biology and nanomaterials, bacterial cell-based space suits could redefine the way we explore the cosmos, making long-duration missions to Mars and beyond more feasible. This article delves into the science behind this groundbreaking technology, exploring its potential applications, challenges, and the future it promises for space exploration.



(Credit: Prithvijit mukherjee)

Description:

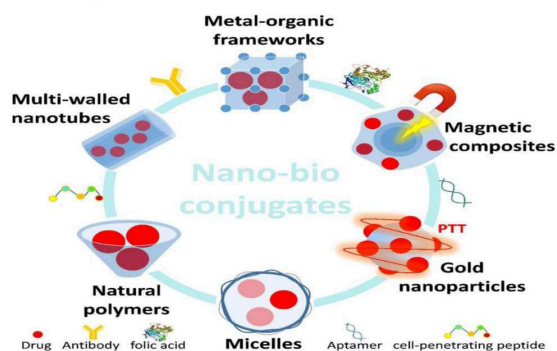
This futuristic concept leverages the remarkable adaptability of bacteria, engineered to thrive in harsh environments, combined with the precision of nanotechnology to create a self-sustaining, self-repairing, and highly efficient protective layer for astronauts. These bioengineered suits aim to provide superior resistance against radiation, extreme temperatures, and micro-meteoroid impacts while offering enhanced flexibility and comfort.

History of Nanotechnology:

Nanotechnology, a groundbreaking field of science and engineering, was first conceptualized in 1959 by physicist Richard Feynman, who introduced the idea of manipulating individual

atoms and molecules in his famous lecture "There's Plenty of Room at the Bottom."

However, the term "nanotechnology" was officially coined in 1974 by Norio Taniguchi, a Japanese scientist. It wasn't until the 1980s, with the development of advanced tools like the scanning tunneling microscope (STM), that practical advancements in nanotechnology began to take shape where unique properties such as increased strength, lightweight composition, and enhanced electrical or thermal conductivity emerge.



(Credit: Weinjie Zhan)

Application:

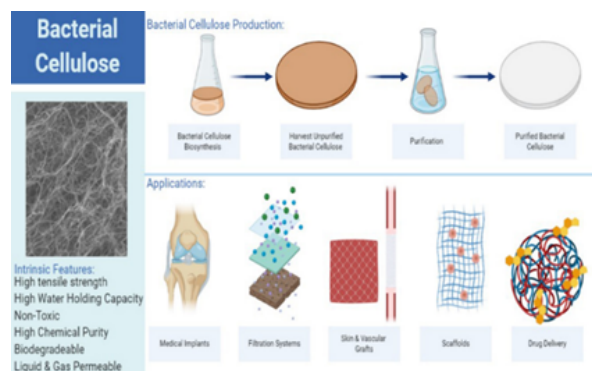
This technology finds applications in a wide range of fields including medicine, where nanoparticles are used for targeted drug delivery; electronics, with the development of smaller and more efficient processors; energy, through improved solar cells and batteries; and materials science, enhancing the strength and durability of everyday products.

Benefits:

The benefits of nanotechnology are vast, offering improved efficiency, durability, and performance across various applications. It has the potential to revolutionize healthcare, electronics & industrial production by enabling miniaturization, precision, and functionality at an unprecedented level.

Examples:

For example, in the medical field, gold nanoparticles are used in cancer treatment to deliver drugs precisely to tumour sites, minimizing damage to healthy tissues. Similarly, nano-enhanced coatings on clothing and surfaces provide antibacterial and self-cleaning properties, improving hygiene and maintenance.



(Credit: Sam Swingler)

Challenges:

Despite its numerous advantages, nanotechnology also presents challenges and ethical considerations, such as potential health and environmental risks associated with nanomaterials, regulatory concerns, and the need for responsible development. Scientists and policymakers are actively working to ensure safe and sustainable progress in the field.

Developing bacterial cell-based space suits using nanotechnology faces challenges such as material selection, manufacturing process, durability, self-healing, and cost. Researchers are exploring the use of *Escherichia coli* infused with synthetic hydrogels for cyborg cells. Overcoming these challenges will require interdisciplinary collaboration and significant advancements in both biotechnology and materials science.

Conclusion:

As nanotechnology continues to evolve, its influence across industries is expected to grow, opening up new possibilities in fields such as space exploration, biotechnology, and artificial intelligence, driving innovation, and shaping the future of technology in ways once thought impossible.

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Nano delivery of Nucleic Acids: A New Perspective to Gene Therapy

Author – Mudra Patel

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Introduction:

What are Nanoparticles?

Nanoparticles are tiny particles, typically between 1 to 100 nanometers in size. Due to their small size, they have unique properties like increased reactivity and strength. Made from materials like metals, polymers, and carbon, they are used in various fields, including medicine for drug delivery, for delivering genes into the cells in gene therapy, electronics for advanced devices, and environmental protection for cleaning pollutants. Their small size and large surface area give them special capabilities not found in larger particles.

What is gene therapy?

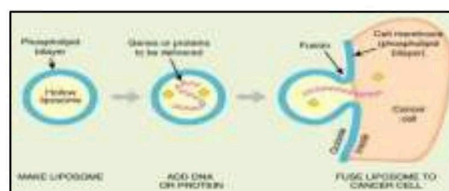
Gene therapy is a medical treatment that involves altering or replacing genes inside a person's cells to treat or prevent disease. It aims to correct faulty genes responsible for diseases or introduce new genes to help fight illness. This can be done by delivering healthy copies of genes into a patient's cells, repairing defective genes, or using genes to produce proteins that can help treat a condition. Gene therapy holds potential for treating genetic disorders, cancers, and some viral infections.

1. Types of Nanoparticles Used in Gene Therapy

Nanoparticles for gene therapy can be broadly classified into two categories: **viral** and **non-viral** delivery systems. While viral vectors (e.g., adenoviruses, lentiviruses) have been used extensively, non-viral nanoparticles are becoming increasingly popular due to their lower immunogenicity and ease of production.

a. Lipid-Based Nanoparticles

Liposomes: These are lipid bilayer vesicles that can encapsulate nucleic acids and facilitate their fusion with cell membranes, allowing the release of genetic material into the cytoplasm. Liposomes can be modified with targeting ligands to enhance specificity for certain cell types.



(Courtesy: Encyclopedia of Fish Physiology (Second Edition), 2024)

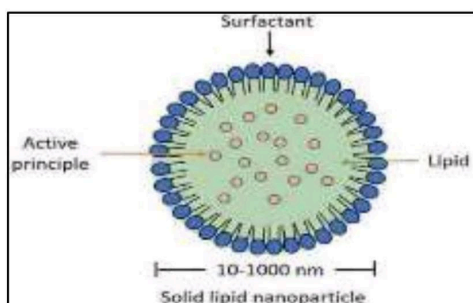
Solid Lipid Nanoparticles (SLNs): These nanoparticles are composed of lipids that remain solid at body temperature. They are known for their stability and are a good candidate for gene delivery.

b. Inorganic Nanoparticles

Gold Nanoparticles: Gold nano-particles can be functionalized to attach to DNA or RNA, facilitating their uptake by cells. They are also used for gene silencing application.

2. Dendrimers

Dendrimers are highly branched, tree-like polymers that can be precisely engineered to encapsulate genetic material. They have a high surface area for functionalization and can offer controlled release and improved delivery efficiency.



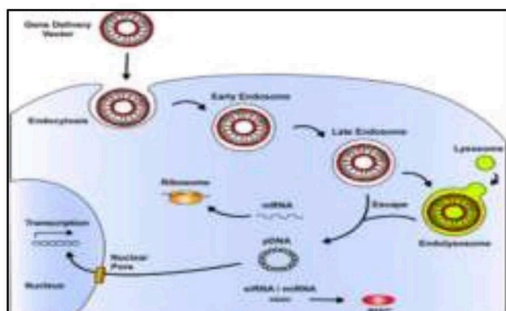
(Courtesy: Solid Lipid Nanoparticles)

1. Mechanisms of Gene Delivery by Nanoparticles

Nanoparticles facilitate the delivery of genetic material through several mechanisms:

a. Endocytosis

Most nanoparticles are taken up by cells through endocytosis, a process in which the cell membrane engulfs the nanoparticles to form vesicles. Once inside the cell, the nanoparticle can release its genetic cargo into the cytoplasm.



(Reference: Charles.H.Jones)

b. Membrane Fusion

Some nanoparticles, particularly lipid-based ones, can directly fuse with the cell membrane, releasing their contents into the cell without requiring endocytosis.

2. Advantages of Nanoparticles in Gene Therapy

Enhanced Stability: Nanoparticles can protect genetic material from degradation by nucleases, ensuring that the therapeutic genes reach their target cells intact.

Targeted Delivery: Nanoparticles can be engineered with surface modifications (e.g., antibodies, peptides, or small molecules) that recognize specific cell receptors, allowing for targeted delivery to particular tissues or cells.

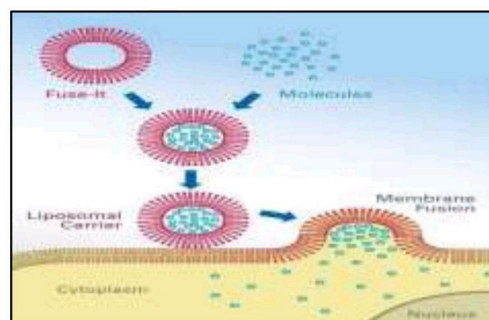
Controlled Release: Nanoparticles can provide sustained or controlled release of genetic material, potentially reducing the frequency of dosing and improving therapeutic outcomes.

Scalability: Nanoparticle based delivery systems can be produced on a large scale with relatively simple methods, making them more feasible for clinical applications.

Challenges and Limitations

Despite their promising potential, there are several challenges associated with the use of nanoparticles in gene therapy:

Toxicity: Some nanoparticles, particularly cationic ones (like PEI), can cause toxicity due to their ability to disrupt cellular membranes or induce immune responses.



(Courtesy: Membrane fusion technology is alternative to gene transfection)

Inefficient Delivery: Although nanoparticles can improve delivery efficiency compared to naked DNA or RNA, achieving high levels of transfection (introducing foreign DNA/RNA into a cell) remains a challenge for many formulations.

Endosomal Entrapment: The endosomal escape remains a major hurdle for nanoparticles in gene delivery. Many nanoparticles are trapped in endosomes, which may lead to degradation of the genetic material before it reaches the nucleus.

3. Current Applications in Gene Therapy

Nanoparticles have been applied to a wide range of gene therapy strategies, including:

Cancer Therapy: Nanoparticles can deliver genes that enhance the immune response against cancer, correct genetic defects in tumor-

suppressor genes, or deliver siRNA to silence oncogenes.

Cystic Fibrosis: Nanoparticles have been investigated for the delivery of the CFTR gene to patients with cystic fibrosis, a disease caused by mutations in the CFTR gene.

Gene Editing: Nanoparticles are being explored as carriers for CRISPR-Cas9 gene-editing systems, which can be used to correct genetic mutations at the DNA level

4. Future Prospects

The future of nanoparticles in gene therapy holds promise in several areas:

Personalized Medicine: With the ability to target specific cells and tissues, nanoparticles could enable more personalized gene therapy approaches, optimizing the treatment for individual patients.

Gene Editing and RNA Therapy: As technologies like CRISPR and RNA interference evolve, nanoparticles will play a crucial role in delivering gene-editing tools and RNA-based therapeutics efficiently.

Conclusion

Nanoparticles offer a versatile and promising platform for gene therapy, with significant advancements in design, targeting, and delivery efficiency. While there are still challenges to overcome, particularly in terms of toxicity, efficiency, and regulatory approval, the use of nanoparticles in gene therapy represents an

exciting frontier in the treatment of genetic disorders, cancers, and other diseases.

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Nano-Biosensors

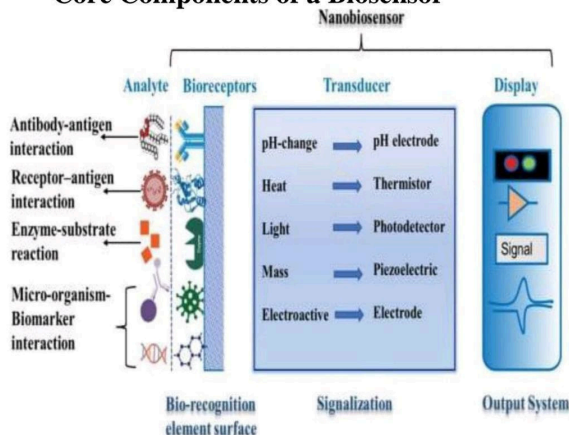
Author-Stavya Pathak, Meet Vala
Alumni Of Biochemistry and Physics Batch:2021-2024

Nano-Biosensors are a class of biosensors that integrate nanostructures to detect gases, chemicals, biological agents, electric fields, light, heat, and other stimuli with exceptional precision. A **nano-sensor** refers to a system in which at least one structural component operates at the nanoscale, enabling enhanced sensitivity and functionality.

The integration of nanomaterials into biosensors significantly enhances their performance and efficiency. Various nanostructures, such as **nanoparticles**, **nanotubes**, **nanowires**, **nanopores**, and **nanocomposites**, are utilized to improve the sensor's capabilities. In these systems, the biological element (e.g., DNA strands, antibodies, enzymes, or whole cells) serves as the key component for specific analyte detection. Nanostructures bridge the gap between the bioreceptor and the transducer, optimizing signal transduction at the nanoscale.

Working Mechanism of Nano-Biosensors

Core Components of a Biosensor



1. Bioreceptor: A biological component (e.g., DNA, enzymes, or antibodies) that interacts specifically with the analyte.

2. Transducer: Converts the bioreceptor-analyte interaction into a measurable signal.

3. Reading System: Captures and quantifies the physical changes resulting from the interaction.

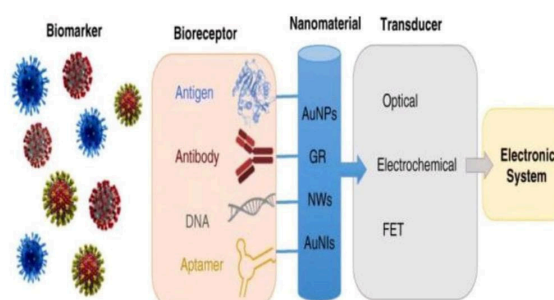
Electrochemical Biosensors: Electrochemical biosensors are a widely used subset of biosensors. Their detectors leverage biological elements to combine the analytical precision of electrochemical techniques with the specificity of bioreceptors.

1. Mechanism:

- bioreceptor is immobilized on an electrode.
- Interaction between the analyte and the bioreceptor produces an electrical signal (Amperometric, potentiometric, or other responses).
- The intensity of this signal correlates directly with the analyte concentration.

2. Role of Nanomaterials:

- Nanomaterials enhance the sensor's performance by increasing the surface area of the bio-receiver, improving signal sensitivity and response times.
- Their unique physicochemical properties (e.g., high surface activity and excellent conductivity) make them ideal for filling the nanoscale gap between the bioreceptor and the transducer.



Types of Transducers in Nano-Biosensors

- **Electrochemical Transducers:** Measure changes in current, potential, or resistance due to analyte interaction.
- **Optical Transducers:** Detect changes in light intensity, frequency, or polarization.
- **Mechanical Transducers:** Monitor variations in bending, mass, or resonant frequency.
- The final signal is processed and quantified by the reading system, which provides an accurate measurement of the analyte concentration.

Advantages of Nano-Biosensors: The incorporation of nanomaterials into biosensors offers numerous advantages, including

1. **High Surface Area:** Nanoparticles strongly adsorb biomolecules, enhancing bioreceptor activity and sensitivity.

2. **Catalytic Properties:** Nanoparticles exhibit strong catalytic effects due to their high surface activity.
3. **Improved Electron Transfer:** Excellent conductivity of nanomaterials facilitates efficient electron transfer between electrodes.
4. **Stability of Biomolecules:** Nanoparticles help biomolecules retain biological activity, ensuring compound stability.
5. **Multi-Analyte Detection:** Nano-Biosensors enable simultaneous analysis of multiple analytes.

Applications of Nano-Biosensors

Nano-Biosensors have diverse applications across several domains:

1. **Biomedical and Diagnostic Applications:**
 - Disease detection (e.g., glucose monitoring, cancer biomarker detection).
 - Point-of-care diagnostic devices.
 - **Example: Nanomaterial-Enhanced Glucometers**
 - Conventional glucometers measure blood glucose levels using electrochemical detection. When enhanced with **gold nanoparticles (AuNPs)** or **carbon nanotubes (CNTs)**, the performance of these devices improves significantly.
 - **Gold Nanoparticles:** Serve as an effective matrix for immobilizing glucose oxidase, increasing electron transfer rates and enhancing signal sensitivity.
 - **Carbon Nanotubes:** Provide superior conductivity and larger surface areas, facilitating high-precision glucose detection even at low concentrations.
- Modified glucometers using nanomaterials are faster, more accurate, and more reliable, addressing limitations of traditional designs.
2. **Environmental Biosensing:**
 - Monitoring pollutants, toxins, and pathogens in air, water, and soil.
3. **Wearable and Implantable Devices:**
 - Health monitoring systems for real-time data collection.
 - Implantable sensors for chronic disease management.
4. **Drug Development and Screening:**
 - High-throughput screening of pharmaceutical compounds.
 - Monitoring drug interactions at the molecular level.
5. **Food Industry Quality Control:**
 - Detection of pathogens and contaminants in food products.
 - Monitoring freshness and nutritional quality.

Conclusion

Nano-Biosensors represent a significant advancement in detection and diagnostic technologies. By harnessing the unique properties of nanostructures, these systems achieve unparalleled sensitivity, stability, and versatility.

Their potential applications in healthcare, environmental monitoring, and various industries continue to expand, paving the way for innovative solutions to complex challenges.

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CRACKING WATER CRISIS THROUGH ADVANCED BIOREMEDIATION TECHNIQUE – MBBR

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Assistant Professor Department of Biotechnology

Introduction

Bioremediation is a revolutionary, eco-friendly process that utilizes the efficiency of microorganisms for removal of pollutants from natural resources. The phenomenon is a vital process for restoration of pollutant contaminated air, water and soil sites through sustainable methods. Biotechnology is an extensive field that applies unique properties of organisms or systems with technological insight to solve the key problems of era related to environment.^[2]

Bioremediation is classified into two main categories: *in situ* and *ex situ* bioremediation. *In situ* bioremediation involves the treatment of contaminants at the site of pollution, without

moving the contaminated material. *Ex situ* bioremediation is the removal of contaminated material out of the site; the polluted stuff is transported to the defined remediation for the bio-treatments. The methods utilize power of microorganisms like bacteria, fungi, or algae, which naturally break down hazardous pollutants into less harmful components.^[1]

Major benefits of bioremediation include its cost-effectiveness, minimal eco-friendly, and sustainability. Microorganisms used in bioremediation can be indigenous or engineered to enhance their potentials to degrade or chelate specific pollutants such as plastic, dyes, heavy metals, pesticides, hydrocarbons, and organic solvents. Biotechnology helps to enhance bioremediation process and speed by genetically modifying microorganisms to increase their efficiency in breaking down pollutants. Techniques like enzyme expression modifications, genetic

engineering, metagenomics, and synthetic biology enable scientists to develop more effective bioremediation agents. These modified organisms are customized robustly to survive in extreme environmental conditions, such as extreme pH levels, temperature fluctuations, or high concentrations of pollutants.

The Moving Bed Biofilm Reactor (MBBR)

There are several techniques used for solid waste, liquid waste and sludge handling through bioremediation process such as bardenfo technique, fluidized bed reactor, anaerobic composter, trickling filter and many more. One of the revolutionary biotechnological solutions for wastewater treatment and pollutant removal from the environment is the Moving Bed Biofilm Reactor (MBBR) system which is a point of discussion in this article. This system has the benefits of traditional activated sludge processes with biofilm technology, offering significant advantages in both performance and cost-effectiveness.

The MBBR functions by using polymeric carriers or "biofilm carriers," which are suspended and continuously moved in the reactor hence called moving bed biofilm reactor. These carriers provide a larger and noncorrosive surface area where microorganisms can grow and form a biofilm. The biofilm consists of bacteria and other microorganisms that degrade organic pollutants in the water. As wastewater flows through the reactor, the microorganisms in the biofilm consume the contaminants, breaking them down into harmless substances like water, carbon dioxide, and nutrients.

The moving bed aspect refers to the fact that the biofilm containing carriers are preferably in motion typically driven by aeration or mechanical agitation. This movement helps the microorganisms to continuously access to the pollutants and remains in active state.^{[1][3]}

Significance of MBBR Technology

1. Provision of High Surface Area for biofilm: MBBR tiny systems provide a large surface area for colonization. The biofilm carriers boost the system's ability to treat wastewater.
2. Condensed and Efficient: MBBRs are more compact and space saver than traditional treatment systems hence are useful in areas with limited land availability.
3. Treatment Efficiency: The submerged movement of biofilm carriers enhances towards optimal conditions for microbial activity, improving faster degradation of contaminants. MBBRs are highly effective at removing organic matter, nitrogen, and even phosphorus from wastewater.
4. Hardiness to Toxic Shock Loads: MBBRs can handle fluctuations in pollutant concentrations, such as sudden spikes in organic matter or toxic chemicals, better than conventional systems. The diversity and compactness of biofilm makes MBBRs more resilient to changes in waste water quality.^[2]

Challenges and Future Directions

- Higher Cost and Implementation
- Limited Range of Pollutants can be treated
- Environmental Consideration regarding Genetically modified organisms and plastic

The future of MBBR based bioremediation lies in improving the capabilities of microorganisms for enhancing biofilm technology, and improvising advanced monitoring and control systems. As the field of biotechnology continues to develop, more specialized and efficient systems will play a crucial role in addressing some of the most pressing environmental challenges, like pollution ^{[1][2]}

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"Shaping the Future of Bio-Industries: A Career in Biotechnology"

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Alumni (Biochemistry), Batch: 2005-2008

Current Position: Freelancer Scientific Writer

Biotechnology is an interdisciplinary field that integrates the principles of biology, chemistry, physics, and engineering to harness the potential of living organisms—whether whole or in part—for the development of a wide range of products (Gavrilescu and Chisti, 2005). This understanding has been shaped not only by theoretical knowledge gained through academic studies but also by practical, hands-on experience in the field. Biotechnology plays a pivotal role across various industries, including food, agriculture, biofuels, medicine, therapeutics, nutraceuticals, and environmental sectors (Gavrilescu and Chisti, 2005; Soetaert and Vandamme, 2006).

Biotechnology plays a crucial role in shaping modern bio-industries, and through this article, I would like to share my personal career journey and industrial experiences, illustrating how biotechnology has become a driving force in the evolution of these industries.

My fascination with human physiology began as early as Class 3. At that time, I envisioned a future in medicine, aspiring to make a difference in human health. However, during Class 11, I was introduced to genetics and molecular biology, which piqued my interest in biotechnology. Although it wasn't the traditional medical path, I

realized it was a field that allowed me to explore similar interests with a more research-driven approach.

My first practical experience in biotechnology came during my first year of BSc. While many of my peers focused on botany and zoology, my friends and I were immersed in molecular biology experiments—attempting plasmid extractions, loading agarose gels without spilling, and finally checking the quality of our plasmid DNA. Those early days of hands-on learning remain some of the most memorable moments of my academic journey.

Although I was drawn to biotechnology, I chose to pursue a MSc. in Biochemistry to satisfy my passion for human physiology. I am proud of this decision, as it allowed me to blend my interest in biology with a deeper understanding of biochemical processes. My dissertation focused on diabetes, animal experiments, and enzymology, but I also gained valuable experience in molecular biology techniques, including genomic DNA and RNA extraction, PCR, and RT-PCR.

During my PhD, I further honed my skills in molecular cloning and a variety of molecular

biology techniques, such as gel retardation assays, DNA damage assays, qRT-PCR, microarrays, animal cell culture, and microbiology. A significant portion of my PhD work involved learning molecular cloning and Western blotting from the ground up. These rigorous training years paid off when I transitioned into industry, where I applied my academic knowledge to real-world challenges.

My industrial career began at Yashraj Biotechnology Ltd. (YBL) in Navi Mumbai, where I was able to directly apply my expertise in molecular biology and cloning techniques to advance recombinant antigen production projects. This role also introduced me to various protein expression and purification techniques, expanding my skill set in biotechnology.

Next, I briefly worked with the Biotechnology Industry Research Assistance Council (BIRAC) in New Delhi, where my role was less about hands-on lab work and more focused on evaluating grant applications and project proposals. This experience deepened my understanding of the broader biotechnology landscape, covering areas such as vaccines, biosimilars, environmental technologies, and medical devices.

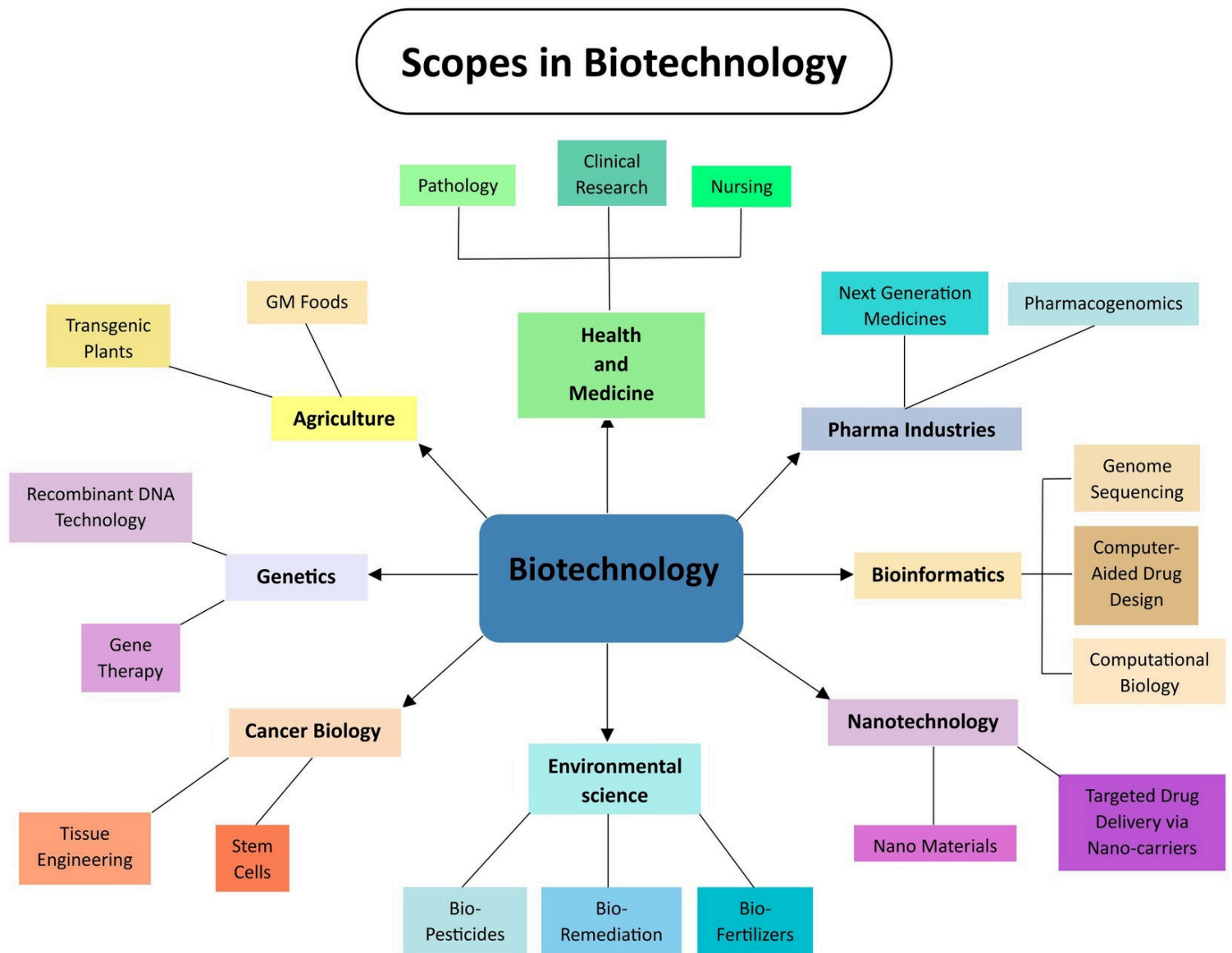
My most recent role was with the Cell and Gene Therapy group at INTA's Pharmaceuticals in Ahmedabad. This rapidly growing field focuses on personalized medicine for rare genetic diseases and cancers, and I was able to apply my years of knowledge to design new projects and troubleshoot challenges. One of the key areas I worked in at INTA's was large-scale plasmid

production, a critical component of gene therapy. I also had the opportunity to share my expertise with colleagues who were less familiar with plasmids. In addition to gaining expertise in gene therapy, I worked extensively with adeno-associated viruses, lentiviruses, and various cell lines, as well as learning analytical techniques.

In addition to my experience in human therapeutics, a brief training stint at IFFCO in Kadi allowed me to gain valuable insights into plant tissue culture, broadening my biotechnology knowledge. More recently, my work as a freelance scientific writer has kept me engaged in a variety of life sciences and environmental science topics, with biotechnology consistently being a key component of my assignments.

As a final thought, I often remind my mentees that understanding biology and biotechnology requires a strong foundation in the basic principles of physics and chemistry. These interdisciplinary foundations are essential for truly grasping the complexities of the life sciences.

Scope and Job Profile of Biotechnology in India



Job Profile for Biotechnology/Biochemistry

• Clinical technician	• Bio-medical Engineer
• Chemical operators at chemical plants	• Environmental health and safety officer
• Microbiologist	• Biostatistician
• Bio-medical equipment technician	• Consultant at Pharma and Biotech-based industry
• DNA Analyst	• Forensic Science Technician
• Business development manager in Biotechnology-based Industry	• Process Engineer and product manager (New products)
• Pharmaceutical Manufacturer	• Animal Research Associate
• Research Scientist	• Plant Breeder

Challenges and Ethical issues in Biotechnology

Biotechnology is used to integrate natural science and organisms, cells, parts thereof, and molecular analogous for products which are useful to humans. Like making curd, wine, bread and all microbe-mediated processes could also be thought as a form of biotechnology. In today's sense it refers to such a product which are genetically modified. For example, test tube baby, synthesizing a gene and using it. Developing DNA vaccine or correcting defective genes, all are the part of biotechnology. In biotechnology, some ethical standards are required to evaluate the morality of all human activities that might help or harm living organisms. Biotechnology has too many challenges and some ethical issues.

Major challenges faced by biotechnology are given below:

Funding and financial challenges - An Industry requires investment in research and development. But in this industry, there is no full chances that any research will be 100% success, so there are many chances of financial losses. So, many investors are not ready for investment in this industry due to high risk and long – term project.

Technical challenges - Biotech field heavily depends on advance technologies like genetic engineering, CRISPR, synthetic biology etc., developing these technologies needs some accuracy and safety. For example, using the tool CRISP for editing genomes requires exceptional precision. Because it can have some unexpected consequences. For high scale production like lab-grown meat or biofuels, are difficult due to technological limitations.

Complexity in biological systems - living organisms are too complex so, before doing any invention by using living organisms, its complicated to understand the system and structure of that organism.

Public acceptance- Due to unknown fear and lack of education public do not ready to accept biotech. Invention like IVF. Etc.

Regulatory challenges - One of the most significant challenges in the biotech industry is navigating the complex landscape of regulations and approval processes. As biotech innovations often push the boundaries of existing regulatory frameworks, companies must adapt to even changing rules and requirements.

Ethical issues of biotechnology:

There are many issues related to culture, legal, environmental, and religious aspects that represent action against moral principles and so many in biotech. Some major issues are:

Genetic modification and engineering: Changing in the genetic code of organisms including humans, raise ethical questions about playing nature's' role.

Cloning: Cloning, especially human cloning is about the creation of individuals and the high chances to misuse cloning method which raise the many questions related to identity and anatomy.

Animal Welfare - Biotechnology involves the use of animals for research, agricultural advancements and drugs development, raise ethical questions like pain of that animal which used in research and in transgenic animals that are invented for human benefits challenges traditional views on the intrinsic value of animals.

Environmental impact - GMO's genetically modified crops may crossbreed with wild plants, which disturb ecosystem. Ethical question also raises on sustainability because large scale biotech. Applications can harm natural resources or generate waste which affecting long – term sustainability.

Biopiracy and intellectual property - Biotech inventions lead to patents and intellectual property disputes. Question raise on biopiracy means the commercial exploitation of biological resources, from indigenous communities, without their proper permission.

List of Leading Biotech Companies in India

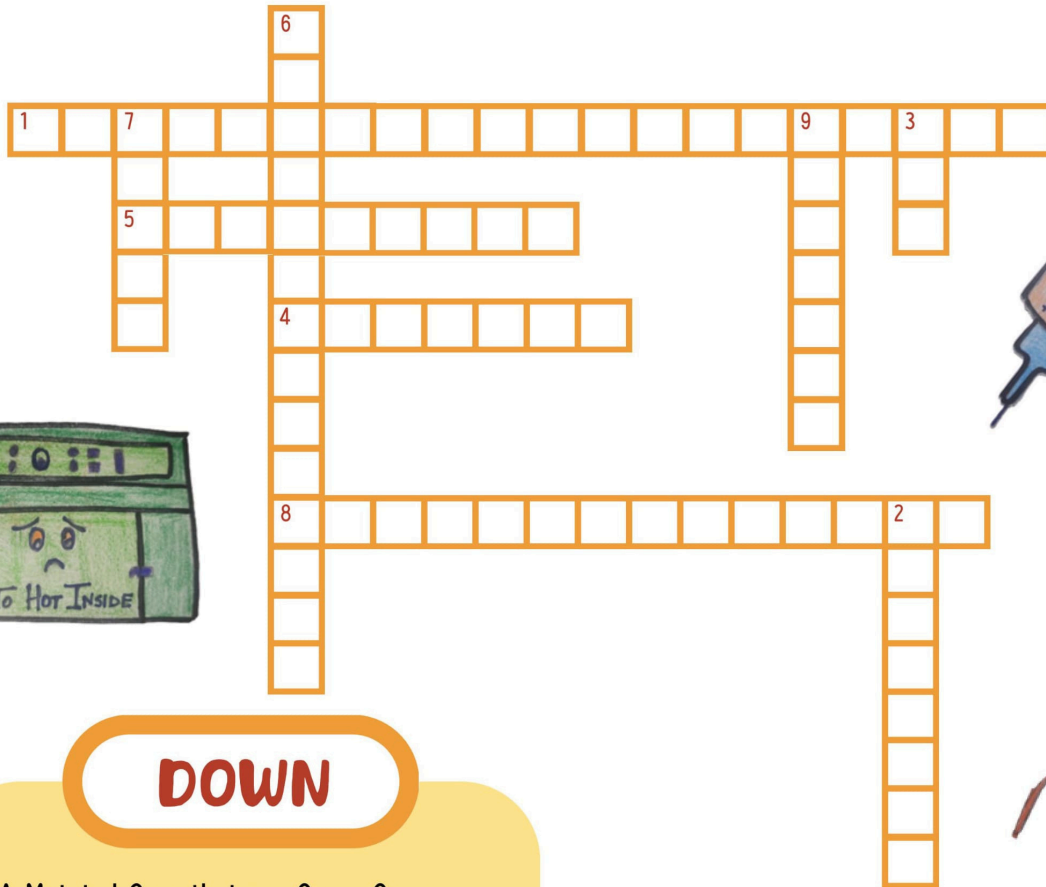
No.	Companies	Main Domain	Locations		
1	 Serum Institute of India	➤ Immunobiology ➤ Vaccines	Maharashtra Bihar Uttar Pradesh		
2	 Biocon Limited	➤ Biologics ➤ Biosimilars ➤ Biopharmaceutical	Maharashtra Andra Pradesh Telangana Tamil Nadu Delhi Gujarat	Karnataka Madhya Pradesh Rajasthan Odisha West Bengal	
3	 Dr. Reddy's Laboratories	➤ Biosimilars ➤ Active Pharmaceutical Ingredients (APIs)	Telangana Maharashtra Andhra Pradesh Uttar Pradesh Madhya Pradesh Tamil Nadu Karnataka Chhattisgarh Jharkhand Himachal	Gujrat Punjab Haryana Kerela Odisha West Bengal Delhi Assam Uttarakhand Bihar	Chandigarh Jammu and Kashmir Rajasthan
4	 Cipla Limited	➤ Biosimilars ➤ Bioinformatics	Maharashtra Uttar Pradesh Karnataka Gujrat Haryana Andhra Pradesh Rajasthan Bihar Punjab Madhya Pradesh Himachal Pradesh	Tamil Nadu Assam Telangana Goa West Bengal Kerela Sikkim Chandigarh Jharkhand Uttarakhand Delhi	Jammu Kashmir Chhattisgarh Odisha
5	 Sun Pharmaceutical Industries	➤ Biopharmaceutical ➤ Generic pharmaceutical	Uttarakhand Maharashtra Uttar Pradesh Gujarat Madhya Pradesh Tamil Nadu Andhra Pradesh Kerala Himachal Pradesh Delhi	Punjab Haryana Jammu & Kashmir Odisha West Bengal Sikkim Rajasthan Karnataka Assam	Bihar Dadra & Nagar Haveli Telangana Chhattisgarh Goa Chandigarh Jharkhand Uttarakhand

6	 LUPIN Lupin Limited	➤ Biosimilars ➤ Generic Pharmaceutical ➤ Innovative Therapies	Maharashtra Uttar Pradesh Gujrat Madhya Pradesh Karnataka Tamil Nadu Rajasthan Goa Delhi Telangana	West Bengal Assam Andhra Pradesh Sikkim Jammu Kashmir Chhattisgarh Chandigarh Odisha	Jharkhand Uttarakhand Haryana Bihar
7	 BHARAT BIOTECH Bharat Biotech	➤ Biotherapeutics ➤ Vaccines	Maharashtra Uttar Pradesh Gujrat West Bengal Karnataka Telangana		
8	 Zydus Cadila	➤ Vaccines ➤ Biosimilars ➤ Generic Pharmaceutical	Gujarat Diu & Daman Telangana Sikkim Maharashtra		
9	 Panacea Biotec <i>Innovation in support of life</i> Panacea Biotec	➤ Generic Pharmaceuticals ➤ Anti-retroviral Drugs ➤ Vaccines ➤ Antibodies	Maharashtra Tamil Nadu Punjab Bihar Delhi Gujrat Telangana Himachal Karnataka West Bengal Karnataka	Madhya Pradesh Andhra Pradesh Chandigarh Rajasthan Himachal	
10	 Intas Pharmaceuticals	➤ Biosimilars ➤ Bio-Pharmaceuticals ➤ Monoclonal Antibodies	Uttarakhand Haryana Chhattisgarh Jammu & Kashmir Punjab Chandigarh Andhra Pradesh Madhya Pradesh Telangana Assam Karnataka	Delhi Bihar Odisha Rajasthan West Bengal Tamil Nadu Sikkim Uttar Pradesh Maharashtra Gujarat	

CURIO-CORTEX

CROSSWORD PUZZLE

Read the clues below and fill in the grid.



DOWN

2. A Mutated Gene that can Cause Cancer.
3. The primary energy carrier in cells, consisting of adenine, ribose and three phosphates.
6. A covalent bond between two sulphur atoms, commonly found in protein structure to stabilize their shape.
7. A microscopic infectious agent that requires a host cell to replicate.
9. A small circular DNA used in Genetic Engineering.

ACROSS

1. Enzyme that synthesizes DNA from an RNA template, often associated with retroviruses.
4. Protein molecule around which DNA is wrapped in eukaryotic cells to form nucleosomes.
5. Enzyme that joins RNA molecules by forming a phosphodiester bond between them and also used as enzyme in splicing process.
8. The use of living organisms to clean up environmental pollution.



For Cross Word answers, please scan the QR code.



FUN-FACT

BANANA VACCINES

Scientists have developed bananas that can deliver vaccines. Imagine Eating a banana and getting vaccinated for Polio or the Flue- talk about peeling back the layers of science.

BEER FOR BIO-FUELS

Brewer's yeast the same organism used for making beer is now being genetically engineered to produce biofuels. So, your next road trip could literally be powered by beer.

ZOMBIE CELLS

Scientists have created "Zombie" cells that are stronger and more durable than living ones. This isn't from a horror movie- they are used in medical and industrial applications.

DEEP-SEA MEDICINE

Marine biotechnology explores the vast potential of ocean life for medicine, biofuels, and sustainable materials. Scientists have discovered marine bacteria that produce antibiotics and deep-sea organisms that inspire new cancer treatments

MYTH

MYTH

Biotechnology is only about food and crops

FACT

While biotech is Famous for GMOs, it also includes medical advances ,enviornmental clean up and even cosmetics

MYTH

Biotech medicine is full of side effects

FACT

Biotech medicines, like monoclonal antibodies and gene therapies, undergo extensive testing to ensure they are effective and safe, often with fewer side effects then trad

MYTH

Biotechnology eliminates the need for farmers

FACT

Biotechnology Support farmers by creating harder crop and tools, but it doesnt replace them. farming still requires skill and labour.

MYTH

Biotechnology is unnatural

FACT

Humans have been modifying organisms for countries through selective breeding. modern biotechnology is simply a more precise way of acheiving similar results often in less time.



***BATCH
2022-25***



***BATCH
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***BATCH
2024-28***



34th ESTABLISHMENT DAY CELEBRATION OF BIOCHEMISTRY DEPARTMENT



TEACHER'S DAY CELEBRATION



TALK of KEYUR TRIVEDI
ON
"JOURNEY FROM GUJARAT TO
GENEVA"



**VISIT SBRI(Sandip and Bhavini Research Institute)
- Neuberg Supratech.**

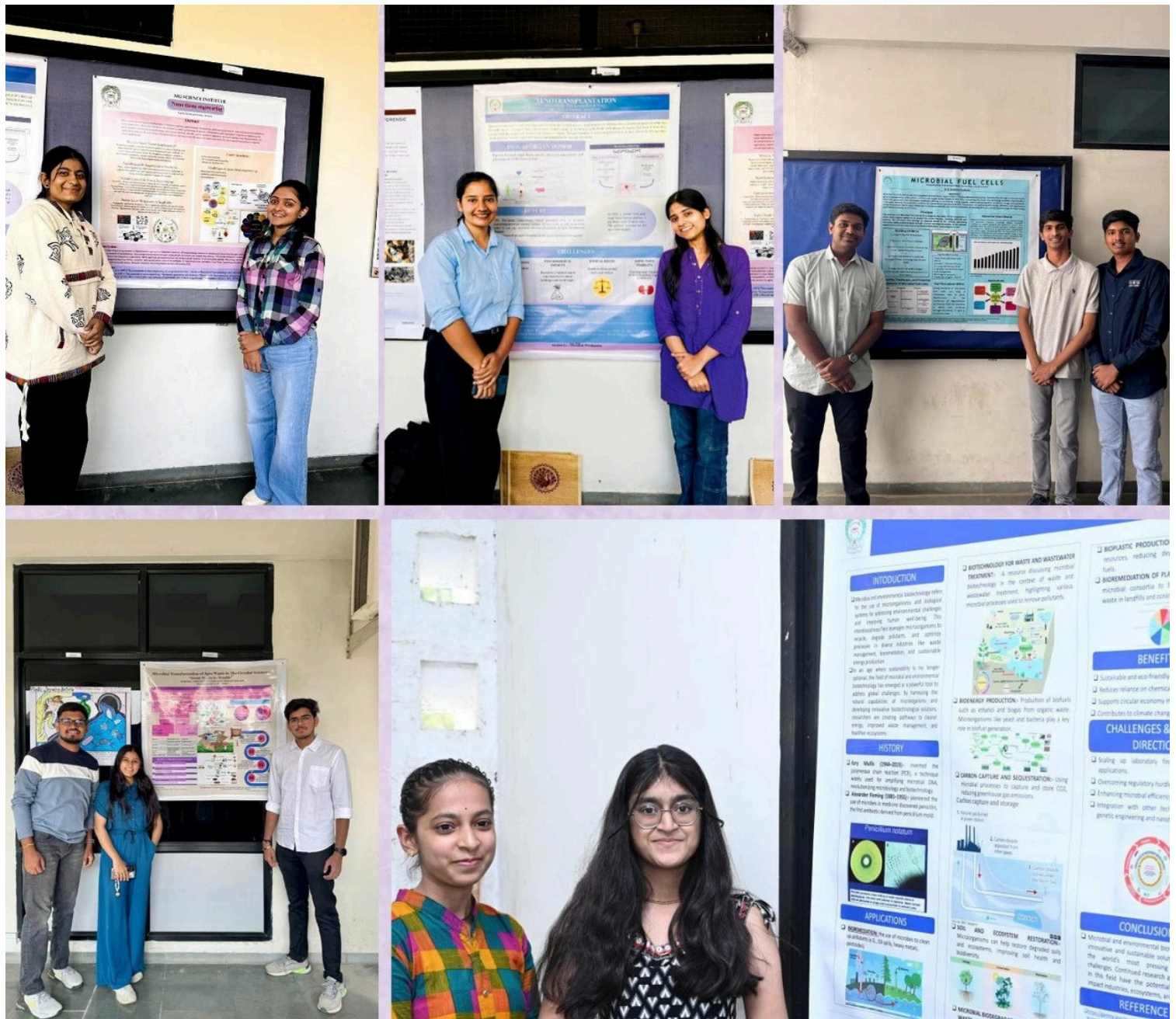


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**VISIT INDRASHIL UNIVERSITY
FOR
GENE CLONING WORKSHOP**





PARTICIPATED in SCIENCE MANTHAN at CHARUSAT UNIVERSITY



NAVRATRI CELEBRATION

STUDENTS PARTICIPATED in THE CULTURAL FEST “ANVAYA” and WON THE PRIZES .







Note of Thanks

Dear Esteemed Faculty and Students of the Biochemistry Department,

The entire team of JIVANAM, writing to express their heartfelt gratitude to all those who have contributed to the creation of the fourth edition of Jivanam, the Biochemistry Department's distinguished magazine. This publication not only showcases the collective intellectual vigor of our department but also serves as a rich testament to the exceptional commitment and passion that each contributor has invested in its development.

The magazine, Jivanam, transcends the boundaries of a typical academic publication. It encapsulates the vibrant pulse of biochemistry, transforming complex concepts into engaging narratives that stimulate both thought and discussion. The research, articles, and creative expressions within these pages reflect the diverse talents and perspectives that are nurtured within our department, embodying the academic rigor and curiosity that define us.

We would like to extend our deepest gratitude to each of the faculty members of our department for you to generously dedicating your valuable time and expertise to the creation of the fourth edition of Jivanam. Your unwavering commitment to academic excellence and your willingness to contribute to this endeavor have been pivotal in making this publication a success.

The time and effort you have invested—whether through mentoring students, reviewing articles, or offering your guidance—have greatly enriched the content of this magazine. It is your expertise, insight, and passion for biochemistry that have elevated the quality of the work presented in Jivanam. Your support has not only contributed to the intellectual depth of the magazine but has also fostered a sense of collaboration and inspiration among all involved.

We are deeply appreciative of how you continue to nurture the academic growth of students, offering your time and knowledge despite your many other responsibilities. It is this dedication to both teaching and research that makes our department so exceptional and ensures that Jivanam remains a valuable resource for all who read it.

A special heartfelt thanks to the youngest professor of the Biochemistry department Prof. Abhishek Chudasma for his constant contribution to the team and constant guidance. Your fresh perspective, boundless enthusiasm, and dedication have played an essential role in bringing this publication to life. Despite your relatively short time in the department, you have already made an indelible mark, not only in the classroom but also in the academic and creative projects we undertake. Your involvement in this magazine has been particularly noteworthy. Your willingness to offer your time, share your knowledge, and encourage the innovative ideas of your peers and students has made Jivanam a richer and more engaging publication. The energy and passion you bring to your work are truly inspiring.

We would also like to extend a special thank you to the editorial team and all those involved in the design and production of Jivanam. Your dedication to excellence in both content and presentation is evident, and your tireless work has ensured that this edition is as polished and impactful as it is

**With sincere appreciation,
The Editorial Board.
Jivanam 4.0**

Honouring Our Editorial Roots

As we release JIVANAM 4.0, we acknowledge the remarkable work of our past editorial board members. Your legacy continues to inspire us, and we strive to build upon the foundations you've laid. Thank you for your vision, leadership and for your invaluable contributions to JIVANAM. Your contributions have shaped JIVANAM into the magazine it is today. Thank you for paving the way for us. We appreciate your efforts and are grateful for the opportunity to build upon your success.

Now we would like to acknowledge the following editorial team members who contributed to our previous edition:

1st EDITION: 1) Ritikaba Vaghela (Batch:2020-2023)

2) Avani Parmar (Batch:2020-2023)

3) Aditi Baluni (Batch:2020-2023)

2nd EDITION: 1) Ritikaba Vaghela (Batch:2020-2023)

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8) Sneha Patel (Batch:2022-2025)

9) Vihaan Jani (Batch:2023-2027)

10) Pearl Patel (Batch:2023-2027)

With sincere appreciation,

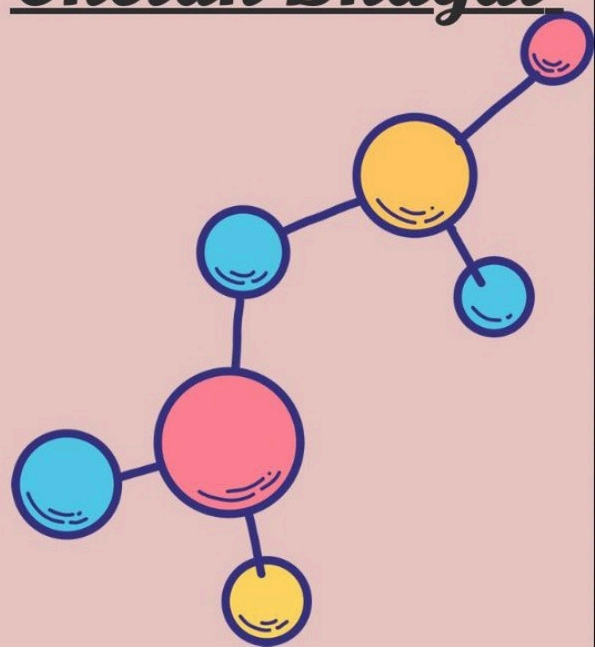
The Editorial Board,

JIVANAM 4.0.



***“Don’t chase success.
Instead, chase your
passions, follow your
curiosity, and success will
become a natural byproduct
of your persistence and
effort.”***

Chetan Bhagat





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