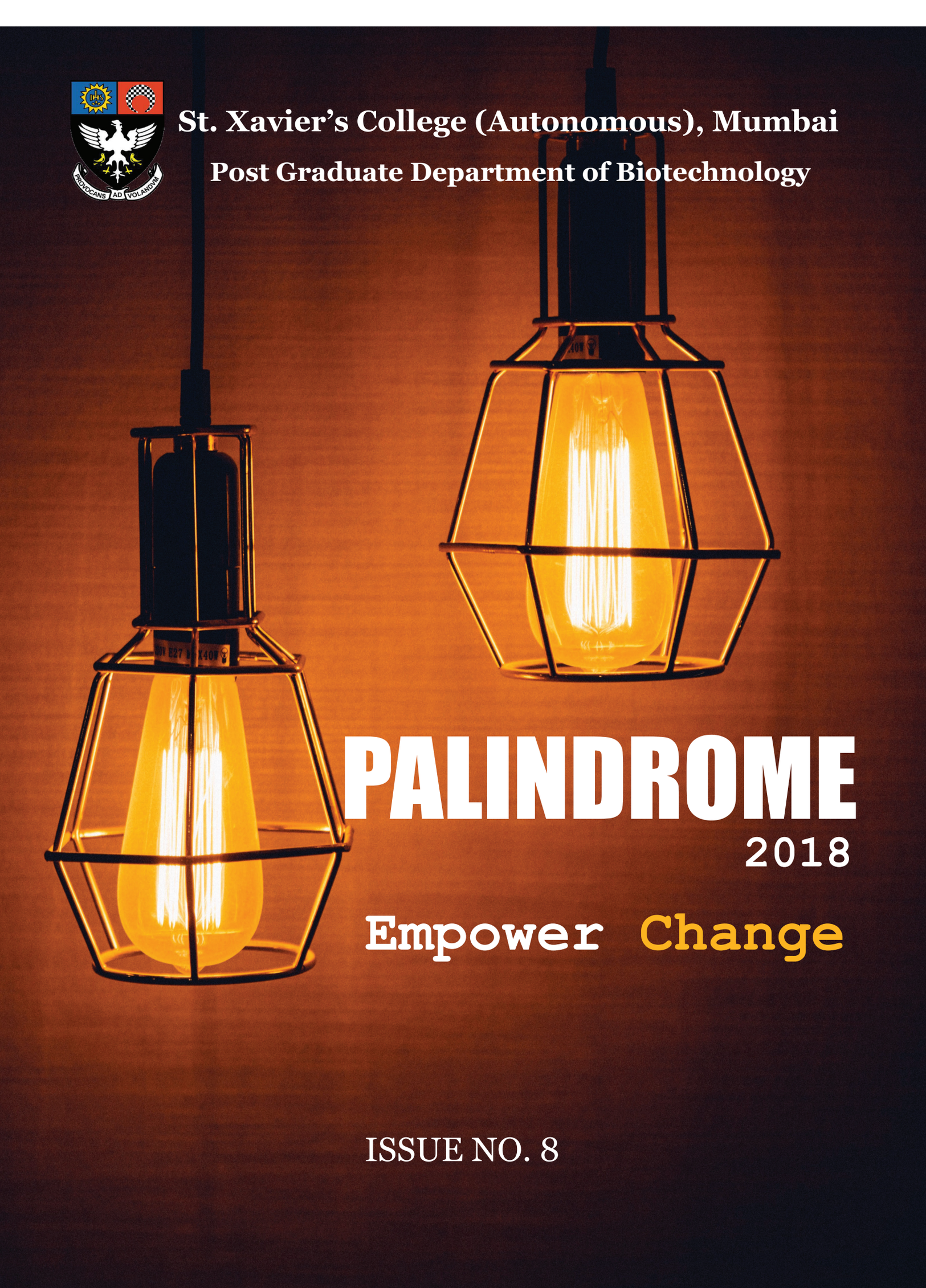

St. Xavier's College (Autonomous), Mumbai

Post Graduate Department of Biotechnology

PALINDROME

2018

Empower Change

ISSUE NO. 8

Our Legacy

"Nurturing liberal education and critical thinking, since 1869"

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

This is truly in sync with the legacy of St. Xavier's College (Autonomous), Mumbai, which is at the cusp of its sesquicentennial anniversary. A throwback to the past glorious 150 years reveals the endeavors that it has so ardently strived to accomplish with the intent of creating an environment of liberal learning and critical thinking. Since the time of its inception, remarkable stories have been added to this journey starting from liberal education to its globalization, through to making education accessible to even those with disabilities. It has always relentlessly strived for excellence in education and advocated the virtue of its beneficence to society at large. In line with these are the various achievements and awards that the college has been conferred with, including the "STAR COLLEGE AWARD" by the Department of Biotechnology, Government of India.

All of these have indeed contributed into making St. Xavier's not just a college, but a way of life.

Here's to many more such years of learning and growing.

Palindrome

2017-2018

EMPOWER CHANGE

ISSUE NO. 8

Published By : Post Graduate Department of Biotechnology St. Xavier's College Autonomous - Mumbai

Cover image courtesy : Pixabay (https://pixabay.com/en/light-lamp-electricity-power-1603766/)

FROM THE TEACHER'S DESK

Dear Students,

We value a strong teacher-student relationship and aim to train you to become the future leaders in the field of Biotechnology. We facilitate your learning needs to stir your curiosity, instil critical thinking and creativity with an inquisitive research-oriented mind.

You are the reflective agents of true learning who in the future can bring about changes to our wonderful planet with sustainable design without waste and using sustainable alternatives making sustainability a lifestyle.

This magazine demonstrates the confidence you have acquired and developed while working towards your post-graduate degree which will forever assist you to communicate effectively on a global scenario.

We congratulate the students of M.Sc Part II batch of 2018-2019 who are instrumental in the making of our annual magazine Palindrome. We wish you all fruitful coming years of great discoveries, best of luck and abundant God's blessings.

Dr. Karuna Gokarn
Ms. Norine D'Souza
Dr. Shiney Peter
Dr. Ira Vashisht

"Change is the end result of all true learning"

Leo Buscaglia (author, speaker, and professor)

FROM THE EDITOR'S DESK

I am thrilled to present to you Issue No. 8 of the Palindrome magazine. This magazine is an annual publication by the Post Graduate Department of Biotechnology.

This year our theme revolves around empowering change in the society and focusses on the different aspects and areas in the field of Biotechnology that affects the industry, scientific community and the people in general. One of the most fascinating things about scientific research is its unpredictability. This unpredictability combined with the brilliant brains of masses is the face of innovation and also a key player in the struggle towards a sustainable future. At the end of the day, our entire effort is directed towards prolonging life. We owe this to our future generations and on a wider perspective, to our mother earth.

This magazine serves as a platform to encourage co-curricular activities and at the same time gives an outlet to students to express themselves creatively and share their views on relevant matters.

I am extremely grateful to our sponsors Lupin Pharmaceuticals Ltd., Indian Oil Corporation and Bassein Catholic Cooperative Bank without whom this publication would not have been possible. I extend my gratitude to Dr. B. A. Menezes and Dr. Rajendra Shinde along with the college management for always being supportive and encouraging. I would also like to thank our Head of the Department (Dr. Karuna Gokarn), the faculty (Dr. Shiney Peter, Ms. Norine D'souza and Dr. Ira Vashisht) as well as the non-teaching staff (Mr. Rajesh Mahadik and Mr. Prashant Manchekar) for their constant help and guidance.

Being a part of the editorial team has been one of the most enriching and unique experiences which has helped us to hone our skills and effectively work as a team. I thank the editorial team, authors and all contributors who stood as pillars and worked enthusiastically towards the publication of this magazine.

I hope that this effort is well received by our readers and helps them gain new insights.

- Clarice Bhattacharya
Editor-in-Chief

EDITORIAL TEAM

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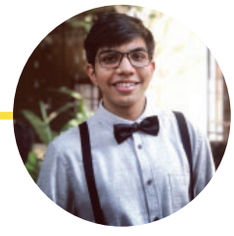
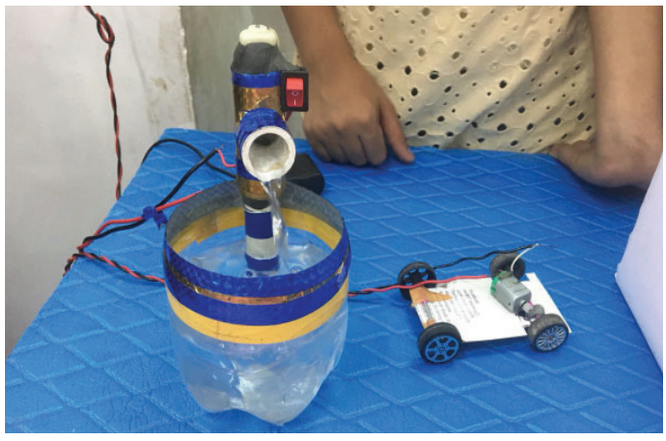
VEDANSHI DHARNIDHARKA

KUSH GUDKA



DIVYA GAUD

SOCIAL INITIATIVE REPORT



Palindrome 2017-18 aimed at achieving an educationally sound society by a minuscule contribution in spreading scientific consciousness among the community,. This feat was achieved by collaborating with Sparsha Charitable Trust.

The NGO majorly works towards involving under privileged students in various activities to make learning fun along with focussing on the overall welfare of every child. Every Saturday in the month of February was dedicated for this noble cause. The volunteers were dispersed in 5 centres across the city. With the cumulative efforts of the students, volunteers and the teachers, a science exhibition was successfully organised at the end of the month. The students with utmost diligence presented their working models, charts, prototypes, experiments; exhibiting not only their scientific knowledge but also their colours of creativity & imagination at its full swing. The exhibition gracefully served the main purpose of involving every child and making science enjoyable for them. It was indeed a mutually enriching experience. We feel fortunate to have had this opportunity to encourage the students to learn and express their creativity, and give back in a small way.

19th and 20th of January 2018

PALINDROME

The annual inter-collegiate festival organized by the Post Graduate Department of Biotechnology(PGDBT) aims at enhancing the potentials of the under graduate and post graduate bioscience students in industry relevant areas. It endeavors to bring all biological science students of various colleges across Mumbai under one roof and provide them with a platform to showcase their scholastic and non-scholastic potentials

LEGACY

Following the legacy of St. Xavier's College (Autonomous), this year too the students of PGDBT associated themselves with *Sparsha Charitable Organization* to spend time and teach scientific concepts to underprivileged children..

...Through a looking glass

The theme aims at learning, appreciating and adapting to the shifting paradigms of biology. We are also trying to touch various other aspects of the changing society.

Free Press Journal, Mumbai Edition, 05 Mar 2018. Titled '*Underprivileged kids enrolled at Sparsha create science models*'.

5 enriching activities for igniting young minds and widening their horizons

Fundamental of Entrepreneurship

Forensics

Cerebrocrakers

Beyond the bench- Bioinformatics for beginners

Cascade

Core Team

Chairperson: Ashika Singh

Vice-Chairperson: Ruqayya Manasawala

Treasurer: Clarice Bhattacharya

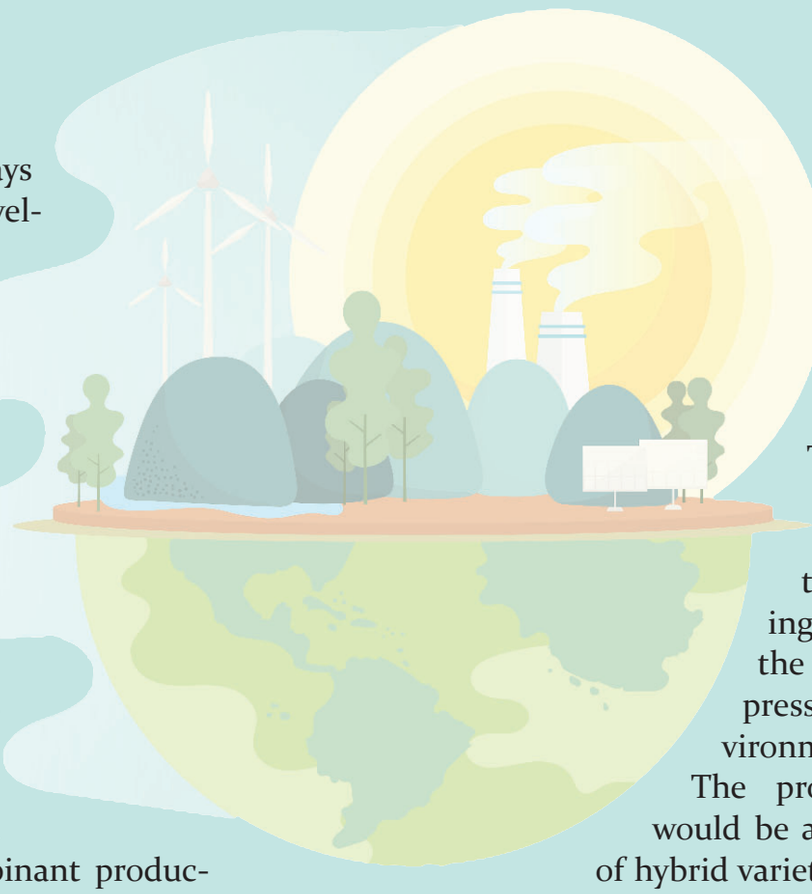
Special Thanks to:

Dr. Karuna Gokarn, Ms. Norine Dsouza, Dr. Shiney Peter, Dr. Ira Vashisht, Mr. Rajesh and Mr. Prashant

Palindrome
2017-18

IN THIS ISSUE

IS BIOTECHNOLOGY THE SOLUTION TO THE GLARING ENVIRONMENTAL REALITY?



Technology has always been at the cusp of development and dramatic improvements in every sphere of our lives since time immemorial. Right from industrial revolution to modern biotechnology, the world has adopted the newer technologies with open arms to harness the most out of available resources. From vaccines, recombinant production of insulin, point of care devices, which have revolutionized healthcare to the development of new cultivars in agriculture to keep up with the increasing demands. It is safe to say that most of us use the products and services of this technology on a day to day basis. In the process of this forwardness, however, the environment has always suffered the consequences of being second to economic growth.

So can this research intensive industry of biotechnology be of any help in combatting the global environmental challenges that we face today? With the recent positive wave in the country to reduce the plastic pollution in the environment, biotechnology is helping lead the way by not only using microbes to degrade the plastic waste (Bioremediation) but also coming up with ecofriendly biodegradable plastics.

The agriculture sector is hassled to meet the ever increasing food demand of the population thus, pressurizing the environmental reserves. The probable solution would be adopting the use of hybrid varieties which would give increased productivity and resistance to adverse environmental condition. However, a lot of skepticism exists over the use of this technology and its impact on the natural system which needs to be evaluated. There are several studies which show that the general benefits of biotechnological processes far outweigh the risks involved with its usage. However, caution needs to be executed to make sure the risks are minimized to the least degree possible to make the most of this rapidly evolving technology. Apart from this, the inconsistencies in the regulatory framework surrounding this technology needs to be sorted to help it reach its full potential.

-Shiza Sarguroh
MSc II

WOMEN IN SCIENCE

To be accepted as a scientist who happens to be a woman is still an uphill task in areas considered a man's world. However, women have not only flourished in the field of science and scientific leadership, but have also have become an inspiration for many others to make their mark as scientists.

Aruna Dhathathreyan
Professor and scientist at CSIR-Central Leather Research Institute, Chennai, India. Her fields of work and research include biophysics, biophysical chemistry, and surface sciences.

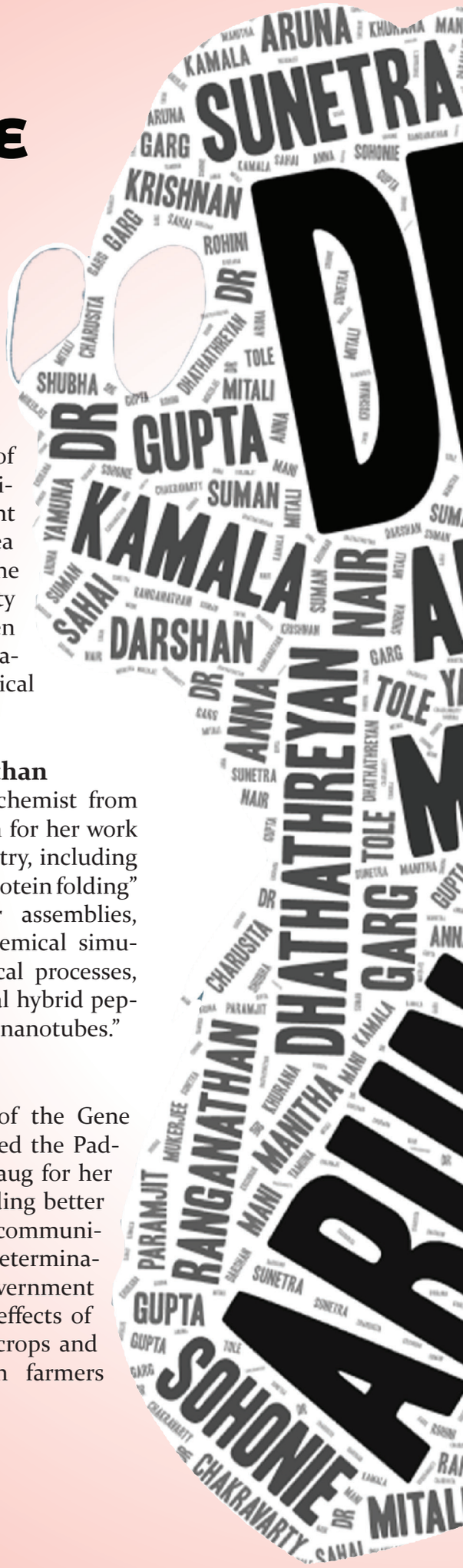
Anna Mani
The only woman scientist to work with C.V. Raman, is well known for her work in atmospheric physics and instrumentation, study of radiation, ozone and atmospheric electricity. Joining the India Meteorological Department in 1948 she rose to become the Deputy Director General of Observatories in Delhi.

Dr. Kamala Sohonie
The first Indian woman to get a Ph.D in a scientific discipline and owns a number of golden titles. She applied to the IISc for a research fellowship and met with rejection merely because she was a woman! But that did not deter her from pursuing her passion and proved her calibre by discovering the enzyme 'Cytochrome c'.

Sunetra Gupta
A novelist and winner of the Royal society of Rosalind Franklin award for her scientific achievements. She is a professor at Oxford University of theoretical epidemiology at department of Zoology. Her area of interest includes the evolution of diversity in infectious pathogen especially those for malaria using mathematical model.

Darshan Ranganathan
She was an organic chemist from India who was known for her work in bio-organic chemistry, including "pioneering work in protein folding" and "supramolecular assemblies, molecular design, chemical simulation of key biological processes, synthesis of functional hybrid peptides and synthesis of nanotubes."

Dr. Suman Sahai
She is the Founder of the Gene Campaign, has received the Padma Shri and the Borlaug for her efforts towards providing better livelihoods in rural communities. Her undying determination made the Government pay attention to the effects of genetically-modified crops and the problems Indian farmers face.



Paramjit Khurana
Researcher at the Department Of Plant Molecular Biology in Delhi University. She has developed 'All Weather Seeds,' which help farmers that depend on weather conditions. The developed hybrid strains of mulberry, wheat and rice are resistant to drought, heat and have a higher UV radiation capacity.

Charusita Chakravarty
Chemistry professor at IIT Delhi, Associate Member of the Centre for Computational Material Science, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore. Her work on the effects of change in molecular base of DNA proteins has won her the Shanti Swarup Bhatnagar Prize.

Dr. Manitha Nair
Awardee of the Innovative Young Biotechnology Award 2012. Her research focuses on development and clinical translation of biomimetic nanomaterials towards musculo-skeletal regeneration. She also studies the signalling cues which occur in lineage-specific differentiation of stem cells. She was awarded the Kerala State Young Scientist Award in 2016 for her outstanding contributions in Science and Technology.

Shubha Tole
Professor at TIFR and recipient of Shanti Swarup Bhatnagar prize in 2010. She seeks to study how genetic mechanisms control our brain, to understand defects like autism and epilepsy. She discovered a master regulator gene which controls the development of the brain's cortex hippocampus and amygdala.

Yamuna Krishnan
Awardee of the Shanti Swarup Bhatnagar prize in 2013. She works in the field of bionanotechnology, wherein she synthesizes filamentous DNA which is administered in cells to provide information on conditions inside such as acidity and other factors. This technique has the potential to mimic the behaviour of viruses and help in increasing drug delivery efficiency.

Mitali Mukerjee
Senior Principal Scientist-Genomics and Molecular Medicine and developer of Ayurgenomics. Her broad research area is the understanding of human genome structure and its variations for applications in development of biomarkers for predicting the susceptibility to diseases and in understanding of human phenotypes.

-Bushra Khan and Neha Kumari
MSc I

HUMAN HAND IN SUFFERING

Biotechnology, over a period of time, has proved to be a unique amalgamation of biology and technology in addressing varied issues ranging from agriculture to human health. However, as acceleration is always backed by deceleration, biotechnology too is not exempted from it. An involvement of numerous human minds attracts a conflict of interest which is quite inevitable in its being. Keeping that in mind, we as individuals meant to have a sound scientific attitude need to address a few cardinal discrepancies in the progress of this field.

One of the earliest innovations of Biotechnology is genetically modified crops (GM crops). With the increase in population, urbanisation and reduction in the culturable land space, GM crops serve as a good candidate for sustainable agriculture. Despite of being scientifically proven, many nations hover the question of it being unethical & toxic to human beings. Concomitantly, The anti GMO groups suggest that it does not support marginal farmers but are only profitable to multinational companies with overpriced crops and are therefore promoted worldwide. However, the world today is facing a scarcity in food and it is practically impossible to serve this ever increasing population by conventional methods. It is therefore the need of the hour to adopt newer technologies with an open mind and try focusing on curbing the ill effects and improving the beneficial effects of the same.

Talking about ethical objections, the use of embryonic stems cells can't be overlooked. Stem cells have been proven to be an effective potential to cure traumatic injuries, transplantation and eradicating problems such as infertility. Various religious groups believe that its use is unethical as it is a potential human being. Nations like Europe forbid the idea of using embryonic stem cells for research but allow abortion, contraception etc. which is quite ironic. Senator Hatch hits the nail when he says "I believe that human life begins

in the womb, not a petri dish or refrigerator. To me, the morality of the situation dictates that these embryos, which are routinely discarded, be used to improve and save lives. The tragedy would be in not using these embryos to save lives when the alternative is that they would be discarded." To tackle such issues research institutes should follow the regulations by the US National Academies of Sciences and the International Society for Stem Cell Research.

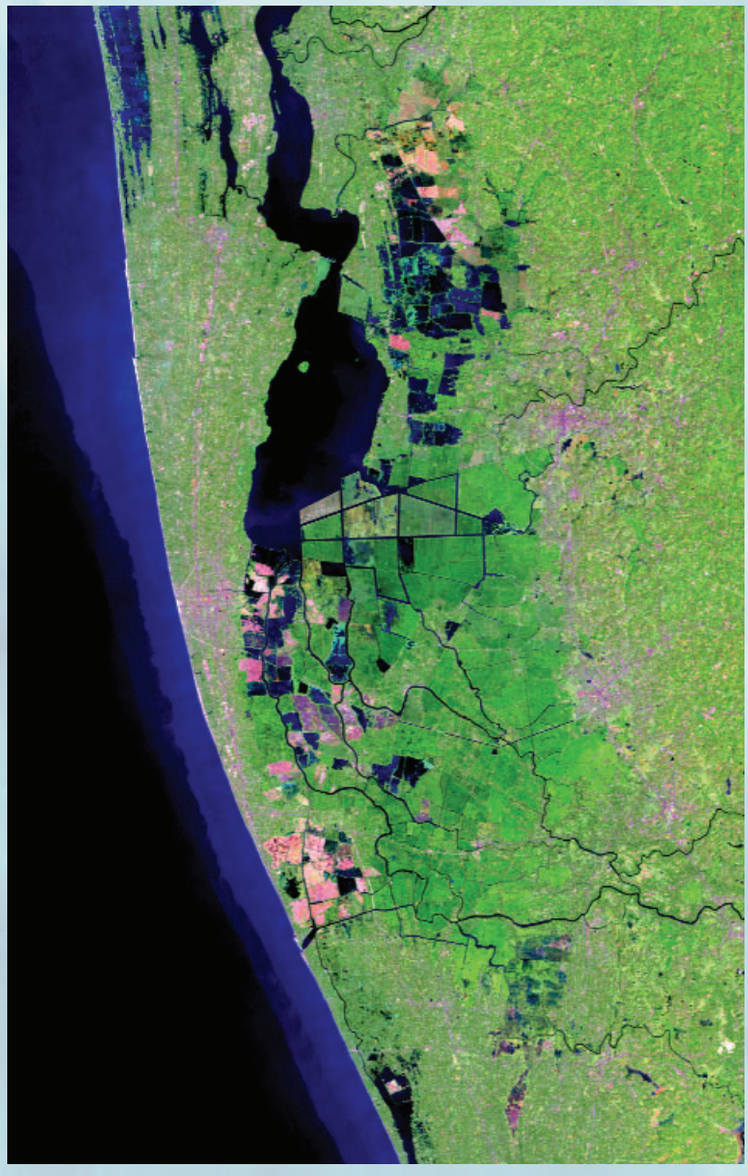
Continuing on the use of embryos, biotechnology's gift to infertile couples was the inception of In Vitro Fertilization (IVF) which comes under the broader umbrella of Assisted Reproductive technology (ART). Although the technique has been an overwhelming achievement, its misuse can't be repudiated. Few of these include unregistered IVF clinics, female foeticide, illegal sex determination, exploitation of individuals in the name of monetary helps & commercialization of the entire objective. Stringent regulations and rigorous monitoring can be useful in curbing those grave issues.

However, the process would be cumbersome as it requires a coordinated connection between the regulators, doctors, policy makers and the end receivers.

In a nutshell, it is important to be aware about the current scenarios and to have a broader perspective when it comes to accepting newer technologies along with weighing all the ifs and buts that it comes with. Changing perspective is difficult but not impossible, and with appropriate information it can be achieved in the long run.

-Tejas Suryawanshi and Stinita D'souza
MSc II

DAM REVENGE



BEFORE

Image Courtesy: NASA Earth Observatory

The word 'Nature' lets one imagine, a beautiful picture of sparkling white sand surrounded by emerald green water, or a calm green forest with a glint of sunlight, or snow-kissed mountains with encircling clouds. Nature is indeed synonymous with exotic, beautiful and serene but what happens when nature gets furious? It takes on dangerous, life-threatening avatars - tsunamis, cyclones, floods, earthquakes, storms, etc. and these are what we refer to as Natural Disasters. Natural disasters claim thousands of lives all over the globe every year causing great economic and human losses.

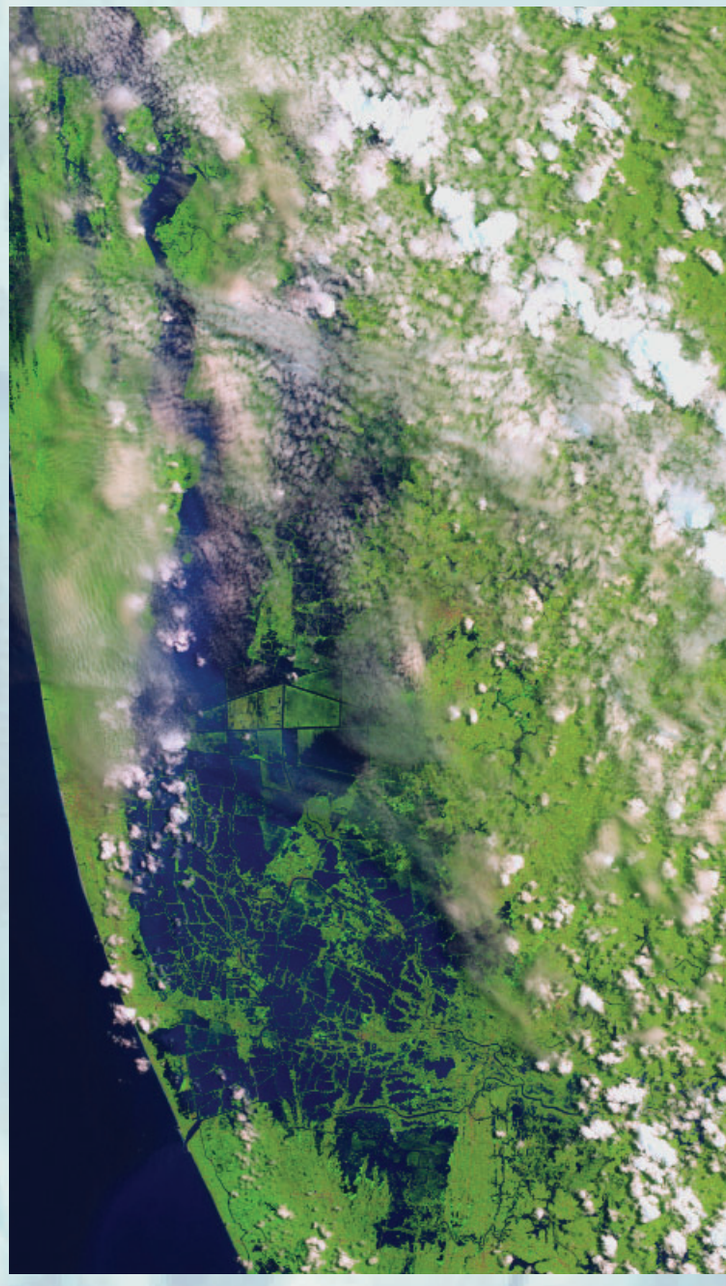
The main question here is 'Is nature to be blamed solely? Aren't we humans majorly responsible? As ridiculous as it may sound, we truly are responsible for natural disasters as it is mainly our actions that compel nature to take on its furious forms.

Let's take the example of the recent Kerala Floods that traumatized the entire nation. It may seem that release of water from dams brought on this great flood. But could that be the only reason? Illegal poaching, cutting down trees for forest produce, deforestation and other human activities have equally contributed to this doom. 'Every action has an equal and opposite reaction', Newton's third law of motion is quite relevant. The

environment does find its way of getting back at us for our misdeeds.

Floods, tsunamis, cyclones are very destructive, but the aftermath of such disasters are more destructive and grueling. In case of Kerala floods, mass death of earthworms have further added to the woes of farmers in the entire state. Environmentalists are boggled by this phenomenon which they explain is quite rare. Since the top soil was washed away by floods, the new layer of exposed soil is unable to absorb water efficiently, increasing the soil temperature. Earthworms in the soil crust cannot cope up with such high temperatures and wriggle out of the soil, break themselves up and die in the open. This further causes cracking of soil ultimately leading to dry, parched patches of land that can no longer be brought under cultivation. There is also the lurking fear of an impending epidemic that may plague the state.

What is nature really trying to teach us? The key is to not mess with nature and to improve on policies set up to conserve mother nature. We do require stringency in the implementation of existing environment conservation policies. Science plays an important role in assessing environmental damage and setting up better policies for environment protection. Hence, environmentalists and scientists together prove to be a valuable asset for any country.



AFTER

-Ruqayya Manasawala
MSc II

ELECTRICITY AND MICROBES

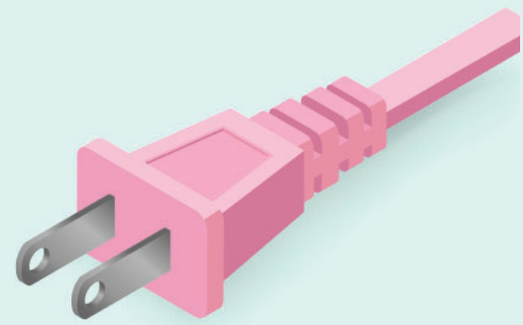
Population explosion has increased the demand for natural energy resulting in exploitation of natural reserves & subsequent exhaustion. To save the resources for future generations, it is the need of the hour to devise alternatives to harness the power of nature; fermentation is one of the many alternatives.

Historically, fermentation has been utilized to enhance flavour, texture & shelf life of eatables & beverages. Nowadays, fermentation is used for production of various value added products, biogas, biofuels, etc. Electro-fermentation has garnered a lot of attention that merges traditional industrial fermentation with the science of electrochemistry for the production of fuels, hydrogen and electricity with the help of indigenous microbiota. EF-based strategies have witnessed various advancements in order to increase the compactness and efficiency of the setup to make it cost effective and sustainable.

Various industries and research institutes have demonstrated the large-scale operation of microbial electrochemical technologies for on-site conversion of urine into ammonia and hydrogen, and for cost-effective wastewater treatment. This technology also has potential applications in the area of energy efficient desalination of water and bioremediation. The main advantage of this technique is that we need not work under stringent sterility, a task most microbiologists dread simply because of the fact that the sample usually comes from wastewater, sludge, or sediment. EF is also an alternate option to produce and extract useful chemicals from pure substrates as well as treat bio-waste taking into consideration parameters such as pH & osmolality.

Extensive research is required to bring EF from the lab scale to the market. The potential of EF is very wide, and its versatility in integrating bio-based production of food, biofuels, industrial green chemistry through renewable current production chains (solar, wind etc.), will attract the interest of the industrial world and will be a new frontier of the upcoming bio- based economy.

-Mayuri Goriwale and Subhasini Singh
MSc II



SHOOTING BLANKS?

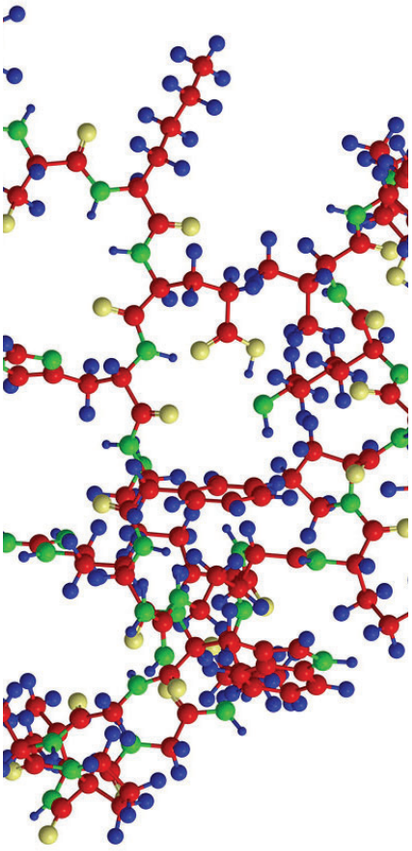
'Silent killer on the loose' is a trivial statement heard during the monsoon. The killer leaves behind a few signs and symptoms such as high grade fever, chills at night and severe headache, joint pain, fatigue, nausea cramps, vomiting. Well you guessed it right, it is the MOSQUITO. They are the carriers of the humanity's deadliest diseases causing millions of deaths across the globe. Stagnant water serve as breeding grounds for mosquitoes, so eradication and population-control efforts involve removal or treatment of such water sources. Many hypotheses state that global warming is likely to increase their number and range. With conventional methods of controlling mosquitoes losing their effectiveness over a period of time, a technique known as Sterile Insect Technique seems to be quite promising. In this technique mosquitoes are modified by infecting them with an organism named Wolbachia that hijacks the reproductive machinery of the mosquitoes thus rendering them sterile.

Female mosquitoes generally mate only once in their lifetime, thus a successful mating with a sterile male prevents the development of an offspring. Due to the mass release of sterile males into the wild, the non-sterile males are outnumbered by a huge margin. Another important step is segregation between male and female mosquitos. If females were to be released in the wild then instead of reducing the female population, the released population would add on to the existing population. Thus to reduce this, a method such as 'Genetic Sexing' has been developed which helps eliminate the female population in the early stages of development.

An important reason as to why males were chosen to be made sterile is because females copulate only once but males copulate number of times. This helps in spreading the sterility trait to a wider range. SIT engineered male mosquitoes were released in Brazil using drones. The experiment was found to be effective but the widespread was found to be quite less. This technique is quite naïve and has a lot of scope for development. Advanced research would definitely lead to its maximum utility and a mosquito free world wouldn't be a distant dream.

- Kush Gudka and Prashant Suvasia
MSc I

NEWS & VIEWS

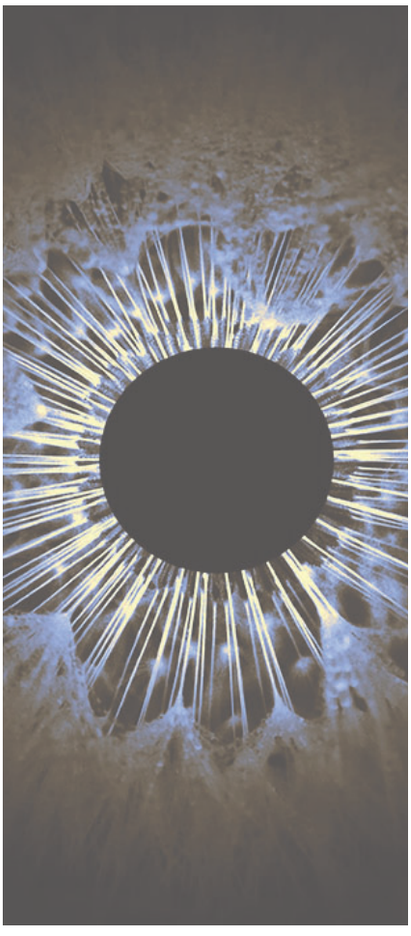


The NGS equivalent of Protein sequencing is here

A new method of protein sequencing has been developed by researchers at the University of Texas at Austin. This method is a lot more sensitive and effective at identifying protein molecules as opposed to the currently employed Mass spectrometry. It can now be possible to sequence millions of individual protein molecules in a single sample simultaneously. This technology could help better understand the role of proteins in normal functioning or diseased conditions.

Nobel Prize in Physiology and Medicine 2018

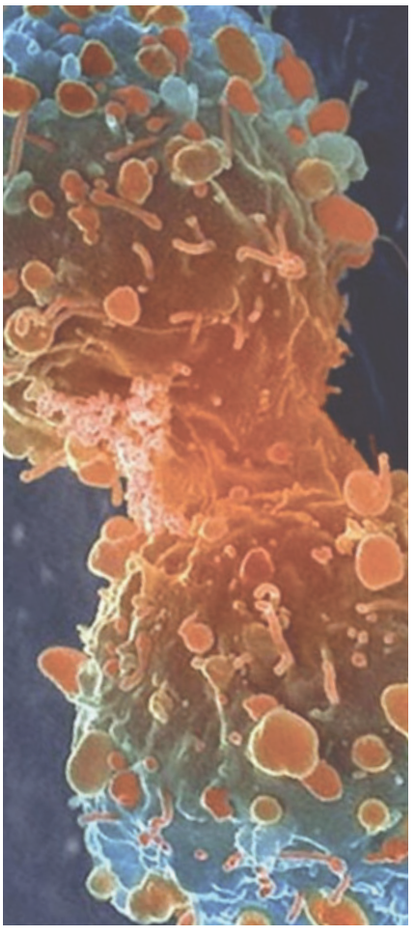
The Nobel Prize in Physiology and Medicine 2018 was jointly awarded to James P. Allison and Tasuku Honjo for their discovery of inhibition of negative immune regulation in cancer treatment. While James P. Allison studied the T cell protein CTLA-4 which functions as a brake on T cells, Tasuku Honjo discovered the PD-1 protein expressed on the surface of T cells with a similar function as that of CTLA-4. Novel therapeutic strategies such as this Immune checkpoint inhibition therapy have helped broaden our ammunition in the fight against cancer.



Reticular Adhesions: The new entrant in the class of cell-matrix adhesions

Newly discovered structures by a team of research scientists at the Karolinska Institute, Sweden, the 'reticular adhesions' are protein complexes that aid cells in attaching to their surrounding i.e the extracellular matrix. They have unique molecular composition which is distinct from the already known focal adhesions. The study also implies their role in the attachment of daughter cells at the right place after cell division.

NEWS & VIEWS



Enzymes to help unleash the body's power to fight back the big C

A study has identified an enzyme PEG-KYNase which helps degrade the molecule Kynurenine that acts as a roadblock to immune surveillance leading to the growth of cancer cells and metastasis. The next step to this therapeutic approach is to initiate clinical trials to test the safety and efficacy of the enzyme.

Expanding the Biotechnology horizon in India

To make the most of the numerous offerings of the Biotechnology industry, an increased amount of funding is pouring in to facilitate better R&D opportunities, set up manufacturing plants as well as knowledge and think tanks. With this regards, the Telangana govt. has proposed to set up India's first Biopharma hub to be spread across 40,000 square feet in the Genome Valley, Hyderabad.

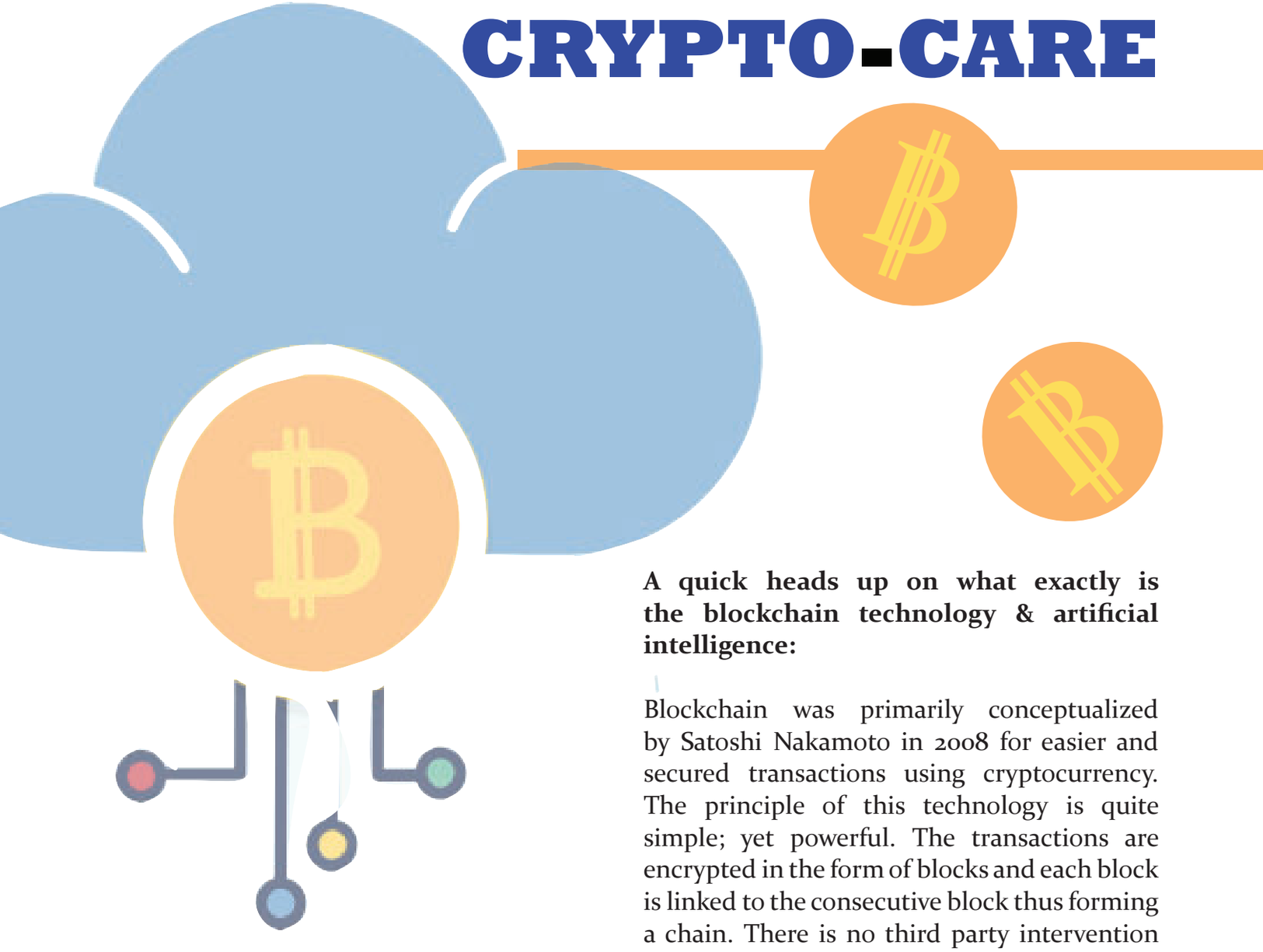
How *B.fragilis* turned the tables to colonize the gut

The human gut commensal, *Bacteroides fragilis* modulates its surface architecture to facilitate binding of IgA in mice which helps in the mucosal colonization. The study indicates that apart from pathogen clearance, IgA response is also utilized for microbiome establishment.

- Shiza Sarguroh
MSc II

Soutce: Nature.com and ncbi.nlm.nih.gov

CRYPTO-CARE



With the advent of technology in practical use for facilitating various objectives, its use in improving the healthcare standards is not far behind. The paradigm is shifting towards a more sustainable approach for better healthcare facilities. The blockchain technology has efficiently paved its way through to prove itself as our first step towards sustainability. Concomitantly, Artificial Intelligence quite intelligently seems to follow the lead.

A quick heads up on what exactly is the blockchain technology & artificial intelligence:

Blockchain was primarily conceptualized by Satoshi Nakamoto in 2008 for easier and secured transactions using cryptocurrency. The principle of this technology is quite simple; yet powerful. The transactions are encrypted in the form of blocks and each block is linked to the consecutive block thus forming a chain. There is no third party intervention that can add, delete or modify those blocks thus protecting it from any breach. The cost incurred for circumventing those blockchains is much higher than value of what's being protected which secures the entire system.
Meanwhile, Artificial Intelligence is generically defined as "the development of computers to engage in human-like thought processes such as learning, reasoning and self-correction". AI encompasses a wide range of applications in varied fields including healthcare such as robotics (especially associated with assistance in surgical operations), diagnostics, statistical analysis of medical data, etc. The two major branches are virtual & physical.

How does blockchain technology & artificial intelligence fit into the entire plot of healthcare?

The healthcare industry is swarming with heaps of data on patient medical records, clinical trials data & outcomes of various research endeavours. The data tends to be redundant and is subject to tampering most of the time. The use of blockchain technology majorly focuses on creating a secure database for efficient storage of data that can be shared, exchanged and used amongst the concerned stakeholders. It can be used to manage medical records; the system is completely decentralized hence there are no chances of changing the data. Blockchain aims at breaking the barrier of data opacity when it comes to medical research. The researcher can have direct access to the patient's data (only by consent) and device novel strategies for effective treatment. This also increases the amount of data that can be amassed for a single objective. The industry incurs huge losses due to counterfeit drugs. Blockchain can be used to track the supply chain and help in avoiding such situations.

Talking about AI, one of its most fascinating aspect is the "jeopardy! software" (mainly used by the Watson hardware, developed by the IBM), that has appeared to be a boon in health care. It is a probabilistic software that aims at troubleshooting complexities with respect to diagnostics and treatment purposes. This helps in eliminating the irrelevant tests that are being conducted, thus proving to be cost effective. One of the notable features of this software is interrogative analysis of the patient's symptoms to provide diagnostic and treatment related suggestions.

One of the recent applications of AI is in the prognosis of Type 2 diabetes by screening for SNPs. The unconventional use of artificial neural networks highlights the brain and heart related abnormalities instead of focussing on the conventional diagnostic applications by using imaging techniques such as single-photon emission computed tomography (SPECT) and positron emission tomography (PET).

Made for each other!

Artificial intelligence and blockchain technology work synergistically. Blockchain technology enables storing personal data in a processed form whereas AI helps in operating the data, while it is still in the encrypted state in a secured manner. Using AI algorithms, the data stored in blockchain can be used for investigation, like in the audit process. The advances in AI are acting as the guiding light for constructing better blockchains with improved qualities such as self-adaptation, self-learning etc. Both of these cutting edge technologies are essential catalysts for developments in providing improved guidance and giving spectacular benefits in medical as well as non-medical fields.

- Shalini Roy Chowdhury and Rutuja Chalke
MSc II

THE PHYSICS OF BIOLOGY

From the juvenile stages of our introduction to the field of science, we are primed to identify it as a consortium of distinct disciplines like chemistry, biology and physics. How interesting would it have been if the lines separating these disciplines as isolated entities were blurred? The boundaries between physics and biology became less obvious with the discovery of the DNA double helix by Crick and Watson along with Franklin and Wilkins. Erwin Schrödinger's 1944 book, "What Is Life?" inspired Crick and Watson about genes and genetic coding. This marked the first merger of physics and biology. Despite physicists uniting to solve biology related issues, there were few void spaces that divorced the two fields as individual disciplines.

In the last decade, path breaking experiments challenged cell biology, wherein cellular mechanics were solely identified by genetic composition of the cell. Experiments established the importance of mechanical forces or physical forces in the environment, the way cells sense and respond to signals. This led to the emergence of a new field of science that formed an interface between biology and physics - MECHANOBIOLOGY.

A mechanical force has been found to regulate cellular processes from cell proliferation to differentiation, embryogenesis to formation of bone structure, maintaining homeostasis to generating inflammatory responses. The pursuit to understand the dynamic relationship of cell mechanics with biology was the driving force for mechanobiology to grow dramatically.

During morphogenesis, the initial intrinsic primary forces are responsible for cell migration and rearrangement, however, extrinsic forces play key role during maturation of cells to form skeletal and smooth muscles. Bone Mechanobiology involves remodeling of osteoblasts and osteoclasts with the help of mechanosensors (proteins complexes) that can adapt to external environment and bring about communication between the cells. Neuromechanobiology, an unexplored field involves understanding the effect of electric, chemical and mechanical environment on the nervous system. Effectual understanding of these external forces can give better insights into neurotherapeutics for most of the debilitating disorders.

Scientific opinion progressed in one field can propagate to be significant in another.
We don't quite know yet what the physics of biology will entail.
But we for sure won't understand life without it.

Although the way cells respond to mechanical signals is still not clear, these signals can be converted into medical value with some technological innovations. Any changes in the transduction system can lead to development of diseases like heart failure, asthma, osteoporosis, atherosclerosis, lower back pain, deformities and even cancer. Recent progress in medical application of these forces has investigated the influence of mechanical forces in therapeutics.

Mechanobiology has been involved in healing serious wounds by forming a layer above the wound. Due to the contraction of cells around the adhesion molecules there is complete closure of scars around the wound. While generating scaffolds for tissue regeneration, mechanical stresses should be taken into consideration. During tissue fabrication, these stresses provide the spatial arrangement and organize the cells. They control the cellular phenotype that is growth, differentiation, apoptosis, necrosis, formation of different cell lineages during tissue repair and regulate patterning of cells. Extracellular matrix mainly controls the signal transduction mechanism and thus, mechanical forces involved after incorporation of artificial ECMs must be regulated for tissue and organ reformation.

Cancer, which has become a leading cause of death can be cured with the approach of Mechanobiology. Mutations in the genetic makeup play significant role in development of tumor. However, the physical environment surrounding the tumor can result in its metastatic progression. Manipulation of these external environments involved in progression of signaling cascades can offer new insights for treatment of cancer.

With several laboratories developing tools like three-dimensional microfluidics and magnetic nanoparticles to analyze the forces acting between cells, between proteins and cell membrane, Mechanobiology is primed to emerge in the future, and expand our understanding of cellular mechanics.

-Akhila M. Nair
MSc II

BRIDGING THE GAP

The gap in understanding science will lead to misconstruing it.
-T. V. Venkateswaran

The world is progressing towards exploring different scientific advances making it increasingly evident that the present and the future depend heavily on it. However, the societal acceptance and reception of such technologies is questionable. One of the major factors is the lack of communication of researchers and scientists with the general public as well as within the community itself. Often times the researchers also get lured by publication bias and end up publishing articles in predatory journals thereby encouraging pseudo-scientific views. in India, biotechnology being one of the innovative sectors has a significant role to play in enhancing global profiles which ultimately contributes to economic growth of the country. There are a large number of institutions providing huge scope to facilitate research and development (R&D) in the field of biotechnology. The relationship between academics, R&D, market structure, market dynamics, innovation, and scientific communication determines how scientific knowledge will be absorbed and diffused in the economy. It's high time we make science accessible to the public who also happen to fund a lot of it, and inspire critical thinking and scientific temperament. Sometimes, the channels through which such information is made available to the public may not interpret it correctly or might take it out of context. Dialogue between the scientific community and the society will help spread the right information as well as validate the existing information available to the public. Apart from this, it will help in developing informed public policies and also enlighten them of the uncertainties involved in scientific pursuit.

There is nobody more nuanced than a researcher herself to disseminate the complex information with ease and precision. So it's important that the scientific community takes it up as a responsibility and not an obligation.

-Lizelle Fernandes, Conceetha Sequeira and Haifa Parkar
MSc II

An initiative by the batch of 2016-18 to propagate and make science accessible in daily life

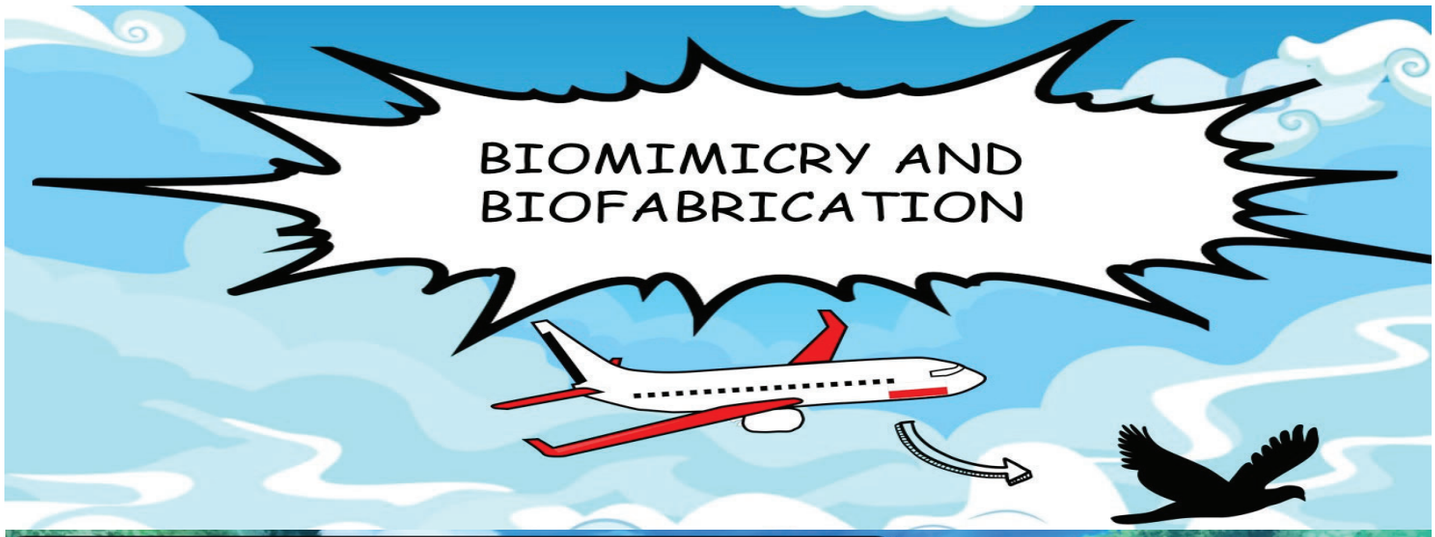
FRESHLY BREWED SCIENCE

Science is simple, so much so that it can easily be discussed over a cup of coffee and that exactly is where we began. A simple assignment was pushed forward with a vision in mind to become the unconventional platform accessible for science.

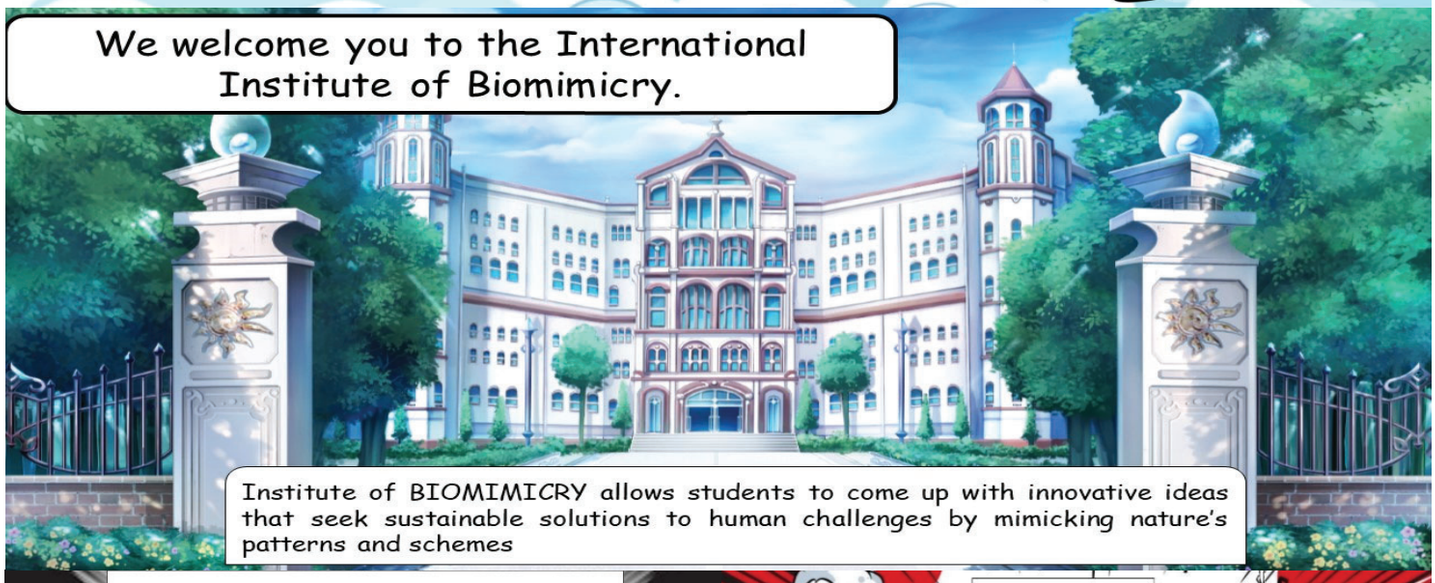
We at The science café believe science is for all. As an organization, it is an initiative for all the inquisitive minds out there and deliver science to them in simplest and unique possible way. We run on sheer eagerness to unravel the mysteries around us. We thus plan to share science by conducting a series of talks and events by experts in the fields at social places like cafes in an informal way with the public.

The very first edition was commenced by Dr. Santhosh Gaikwad, the only practicing taxidermist of India. The second edition of our café covered the topic 'You are what your microbes eat'. The session was conducted by Mr. Shreyas Kumbhare, one of the pioneers in gut microbiology. We don't stop just as it, a lot more of intriguing ways to indulge in science is about to be delivered. Curiosity has been man's long-lived nature, we only aim at creating a space for all curious minds from all age group come participate and feed their curiosity. This oddity is our sole driving force with which we are willing to contribute to science and society.

BIOMIMICRY AND BIOFABRICATION



We welcome you to the International Institute of Biomimicry.



Institute of BIOMIMICRY allows students to come up with innovative ideas that seek sustainable solutions to human challenges by mimicking nature's patterns and schemes

There seems to be a commotion in the otherwise tranquil Institute?

I'm obviously better!

You are both wrong. I am the best!

My powers are clearly better!

Lets take a look at the superpowers of these superheroes...

SPIDERMAN

My superpower to produce silk is beyond compare!

Mimics Spider silk

I can produce silk with high tensile strength, that can be used as scaffolds for tissue engineering.

MOSQUITO MAN

My ability to use needles with great aptitude for delicate maneuvers makes it the best superpower

I have needles which can be used as painless drug delivery mechanism

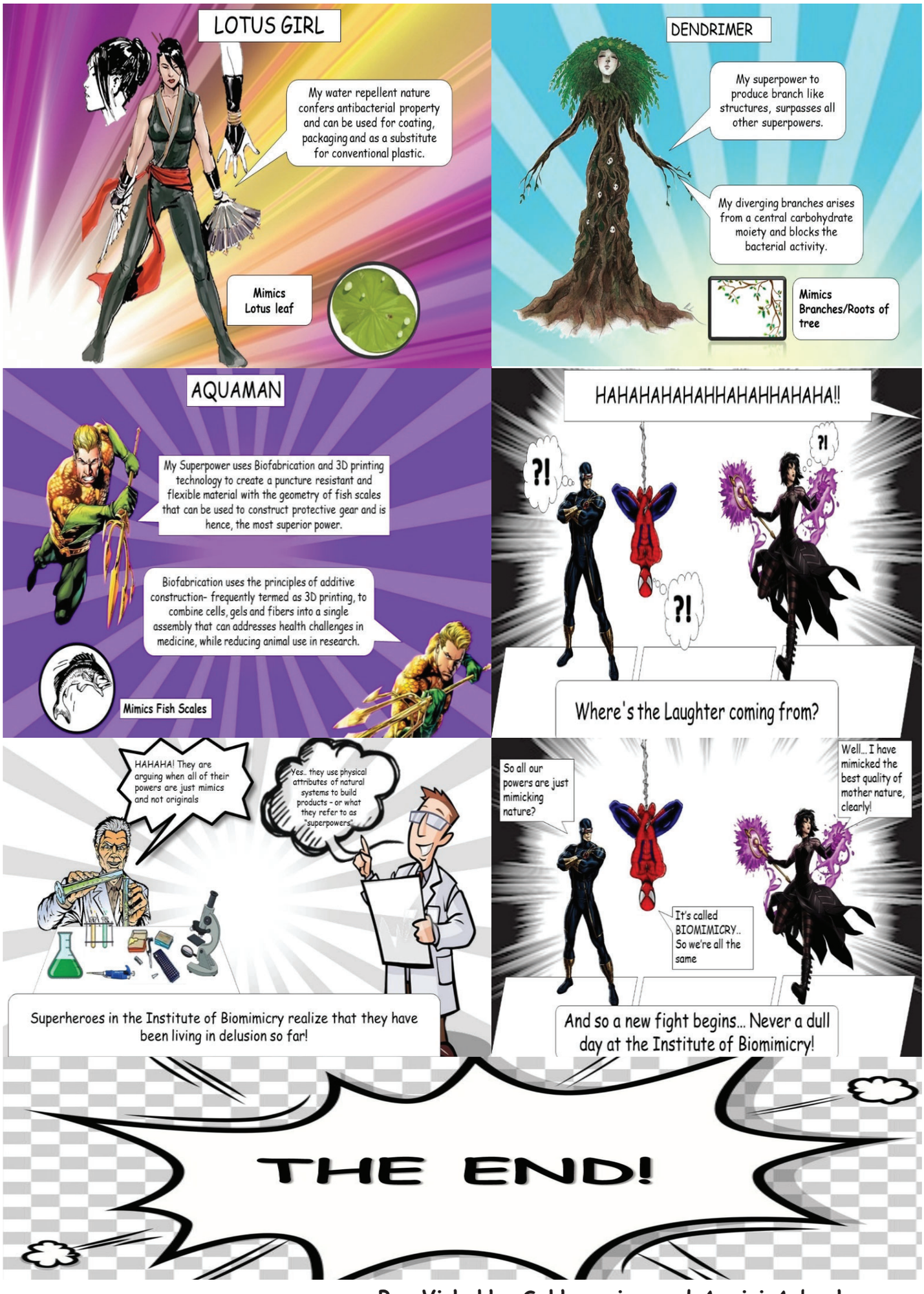
Mimics Mosquito proboscis

Mr. COOL

My superpower causes a drop in the indoor environment by 5-6°C and hence, is obviously the better superpower.

I am composed of "hydroceramic" a composite material, to absorb any moisture from the environment. And when water evaporates, it cools the surface as a means of passive cooling for buildings.

Mimics Human skin (sweating)



By: Vishakha Sakhareriya and Aswini Anbazhagan

Offbeat

01 Placenta encapsulation

Women across the globe are spellbound by the benefits of placentophagy (placenta-eating). Even though the concept is nebulous and still in its infancy, it has been followed by renowned celebrities such as Kim Kardashian, January Jones and Alicia Silverstone. The custom of placenta consumption has been majorly prevalent amongst the Chinese, Vietnamese, Hungarians and Italians. Its perceived benefits are reducing post-natal bleeding, increasing breast milk production and reducing postpartum depression by increasing the energy levels and balancing hormones. Placentophagy is said to be a potent concoction that provides the necessary nutrients along with elevation of iron levels which aid in restoring the mother's body after childbirth.

So how does one encapsulate the placenta?
The placenta is required to be collected within 48 hours of childbirth to avoid contamination. After collection, it is washed to get rid of the clots and blood. Later, it is steamed; followed by dehydration. Some encapsulators steam the placenta with herbs to make it more palatable. After dehydration, the placenta is ground into a fine powder which can be encapsulated. One can expect to receive around 150-200 capsules which can be consumed directly, added to smoothies or sprinkled on salads. The estimated cost of placenta encapsulation is around $200-$400.
Although the efficacy of consuming placenta hasn't been scientifically proven, its benefits lay an extensive path for it to become an effective health supplement for postpartum women in the near future.

- Sarah Barretto
MSc II

02 Water Bears of the invertebrate world

Tardigrades are nature's beautiful creation, having the ability to sustain all kinds of harsh environmental conditions prevalent in nature. They belong to the phylum Tardigrada which was discovered 230 years ago consisting of 700 different species. They are eight-legged, mini creatures which are found to reside on moss, lichens, and algae near aquatic environment.

Many species are transparent and they are tiny about a quarter to half a millimetre long. At one point, they were in the race to be the model organism to study development. They are commonly known as water bears and have gained popularity since the last couple of years due to their special features; such as cryptobiosis and tolerance to radiation. Interestingly, tardigrades lower their metabolism to a level enough to keep them viable and not carry out major metabolic processes during unfavourable and harsh conditions. They produce proteins named Dsup i.e. damage separation protein that protects its DNA from damage on exposure to radiation thereby imparting radioresistance to the tardigrades. Other than this, they were found to be stable and maintain their reproduction ability when they were taken. The variations exhibited in population density and species with change in environmental conditions suggested that they could act as potential bioindicators.

- Rutuja Subhash
MScII

Smart microbes 03

Microbial ecosystem is characterized by the complex network of interactions existing amongst the microbial communities, with synthetic biology having the ability to combat any adverse perturbation caused. Microbiome engineering is a promising approach which involves altering microbial composition to improve phenotypic parameters of microbes to benefit the ecosystem and has several applicative aspects in agriculture and therapeutics.

One of its application is treatment for phenylketonuria. Deficiency of phenylalanine hydroxylase enzyme leads to the inability of metabolizing phenylalanine thus leading to phenylketonuria. When supplemented orally, the enzyme gets degraded by the gastric acids.

A recent study at its preclinical stage suggests that live bacteria such as engineered E.coli and lactic acid bacteria, *Lactobacillus reuteri* strain can be used to treat phenylketonuria in animals. Simplicity of the technique lies in delivering live bacteria that produce the enzyme, assuring continual production and persistence in the gut mucosa.

These engineered live organisms do not colonize the human gastrointestinal tract as well as can be biocontained to avoid their survival in the environment. Several studies confirm the feasibility of using live bacterial biotherapeutics with containment approaches in patients, thus, indicating a steady progress.

- Ashika Singh
MSc II

Internal Projects

Amrita Suresh, Sameeksha Bhaye, Jimcy Rajan, Aakansha Chand, Abhilash Babu, Froila D'costa, Michelle Das, Evelyn D'Souza

Production of Dextran using food waste and its utility in bacteriological media
Project Guide: Dr. Biswa Prasun Chatterji

Cytotoxicity profiling of *Musa* sp. (Banana inflorescence) and *Mangifera indica* (Mango kernel) extract: An in vitro study.
Project Guide: Dr. Shiney Peter

Nehal Dwivedi, Sanhita Ghuge, Mehvash Godiwala, Shweta Johari, Joice Mathew, Tanvi Kaku, Advait Kayal

Impact of media and chemical constituents on PHB production by *Bacillus subtilis* and *Cupriavidus necator*
Project Guide: Ms. Norine Dsouza

Prospecting in vitro models for assessing the cytotoxicity of food colours
Project Guide: Dr. Shiney Peter

Shruti Kharat, Komal Mishra, Priya Mishra, Nikita Bhosale, Minal Nenwani, Jinal Mehta, Vikram Saini

Production of dextran from beet pomace and its utility in growth of fungi and probiotics: An approach towards solid waste management
Project Guide: Dr. Biswa Prasun Chatterji

Cytotoxicity of plant extracts and their combinations with chemotherapeutic drugs on human cell lines
Project Guide: Dr. Shiney Peter

Arshad Shah, Hanzel Saldanha, Kris Silveira, Priyanka Subramani, Roma Sundar, Sushmita Varhadi, Partth Thakur

Media optimization and substrate suitability study for biofilm formation by cadmium tolerant microorganism
Project Guide: Ms. Norine Dsouza

Effect of polyphenols extracted from *Phaseolus vulgaris* on proliferation and iron uptake: An in vitro perspective
Project Guide: Dr. Shiney Peter

Role of PSMD9 in regulating the mRNA expression levels of migration and growth arrest related targets

Amrita Suresh (PI- Dr. Prasanna Venkatraman, ACTREC)

Differential gene expression helps us to predict the condition and fate of the cells. PSMD9 is a proteasomal chaperone that interacts with other subunits such as PSMC6 and PSMC3 and helps in the assembly of 26S proteasome. Our unpublished data suggests a role for PSMD9 in cellular migration and growth arrest. Over expression of PSMD9 in HEK-293 cells upregulates the mRNA expression levels of intracellular fibronectin, STAT3, C-MYC, CTNNB1, DAPK1. Comparisons were also made in the mRNA expression levels of these genes in cells grown on fibronectin matrix. When cells were grown in fibronectin the mRNA expression levels of PSMD9 increased 30-fold and a concomitant decrease in all above-mentioned targets were observed except for DAPK3. Overexpression of PSMD9 up to 30-fold showed a proportional decrease in fibronectin in a dose-dependent manner. We propose that human PSMD9 acts as a transcriptional factor and regulates the mRNA expression levels of these targets similar to rat PSMD9. Hence, better understanding of PSMD9's control in regulating these targets may help us to develop a novel target to design a therapy against cancer.

In silico characterization of fish antifreeze proteins

Hanzel Saldanha (PI- Dr. Aparna Chaudhari, CIFE)

Antifreeze proteins (AFPs) are biological antifreezes that have unique properties including thermal hysteresis (TH), ice recrystallization inhibition (IRI), and interaction with membranes and/or membrane proteins. These properties have been used in the preservation of biological samples below freezing points. 17 antifreeze proteins of fish were selected from NCBI and UNIPROT database based on their length. The amino acid composition of all 17 antifreeze proteins, their physical and chemical poperties were determined using Protparam tool. Cysteine residues were checked using Cys_rec tool. The secondary structure of all the proteins were predicted using sopma and gor tool respectively. PDB files were created by using swiss model and chimera tool respectively which were then used for the further mentioned tools. Also other tools like Coach server ,itasser , meta pocket 2.0, motif finder, prosite ,netoglc,p sort, coil server , predict protein, rampage and what if server were used and its description is mentioned in the further details of the proposal(in the objectives section). Hence, using all this tools we can study various physiological and structural Antifreeze proteins of fishes and also its applications in various computational (bioinformatics) studies.

Construction of a genetic linkage map of soybean (*Glycine max*) based on SSR markers

Jimcy Rajan (PI- Dr. Sudhir Kumar Gupta, Nuclear Agriculture and Biotechnology Division, BARC)

Differential gene expression helps us to predict the condition and fate of the cells. PSMD9 is a proteasomal chaperone that interacts with other subunits such as PSMC6 and PSMC3 and helps in the assembly of 26S proteasome. Our unpublished data suggests a role for PSMD9 in cellular migration and growth arrest. Over expression of PSMD9 in HEK-293 cells upregulates the mRNA expression levels of intracellular fibronectin, STAT3, C-MYC, CTNNB1, DAPK1. Comparisons were also made in the mRNA expression levels of these genes in cells grown on fibronectin matrix. When cells were grown in fibronectin the mRNA expression levels of PSMD9 increased 30-fold and a concomitant decrease in all above-mentioned targets were observed except for DAPK3. Overexpression of PSMD9 up to 30- fold showed a proportional decrease in fibronectin in a dose-dependent manner. We propose that human PSMD9 acts as a transcriptional factor and regulates the mRNA expression levels of these targets similar to rat PSMD9. Hence, better understanding of PSMD9's control in regulating these targets may help us to develop a novel target to design a therapy against cancer.

Characterization of change in bacterial cell size to maintain homeostasis

Aakanksha Mahendra Chand (PI- Prof. Supreet Saini, Indian Institute of Technology Bombay)

Bacteria are found in almost all ecological niches on Earth, and exist in different shapes and sizes. These morphological characteristics help bacteria to survive in an external environment and also contribute towards their growth and development, thus providing information about the effect of fluctuations on a complex genotype. It was stated that during reproduction process, due to increase in the cellular components, the amount of lipid also doubles which thereby leads to increase in cell membrane as the concentration of lipid bilayer increases. It has also been observed that cell size of a bacterium is a function of the growth rate in the given environment. Growth rate is dependent on various factors such as nutrient accessibility, light intensity, temperature, pH etc. Bacterial systems are exposed to varying external environment and such conditions causes stress within the bacteria which leads to change in the morphology of cell. In this project, we aim to understand the molecular underpinnings of the physiological change by the bacteria under their controlled environments thereby maintaining homeostasis and the application of such structural variation is also explored.

Self-assembly Driven Pattern Formation By Adherent Cells In Response To Mechanical Heterogeneity

Nehal Dwivedi (PI- Dr. Abhijit Majumder, Indian Institute of Technology Bombay)

Cell patterning is a preliminary step in tissue morphogenesis. In the current research, we have asked the question about the role of mechanical heterogeneity on cell patterning. To study in vivo cell patterning, the lab has designed a novel substrate by introducing a glass bead within a homogeneous polyacrylamide (PAA) gel. The effect of substrate's geometrical parameters on the zone of radial alignment was found to be dependent on the size of the embedded bead and thickness of the gel above the bead surface. Further, neuroblastoma cells, human mesenchymal stem cells, NIH-3T3 fibroblast cells and HeLa cells were cultured on the glass bead embedded substrate, to check if the alignment is cell state-specific or not. Next, we fabricated a model substrate which can resemble the in vivo mechanical microenvironment of tumour cells, by introducing PAA bead of stiffness similar to tumour cells within the PAA gel. Using similar technique, substrates can be tailor-made by varying their geometrical parameters to control in vitro cell patterning, to create better tumour models, lab on chip devices, etc and has potential application in the field of tissue engineering.

Mapping Soil Microflora for Plant Growth Promoting Activity and correlating with Soil Health

Sanhita R. Ghuge (PI- Dr. Rajendra Marathe, Mahyco)

Soil microbes represent the unseen biological activity in soil that play critical role in plant nutritional recycling and also comprise a large portion of the genetic diversity on Earth. The present investigation was carried out with the objectives to estimate and screen microbial flora in rhizospheric soil and root samples. The nutritional status in terms of N and P content in soil samples was found to be in the range of 9.8 mg -122 mg/kg available N, and 0 mg -125 mg/kg of available P. A total of 250 microbes were isolated and each one was screened for different plant growth promotional traits. On the basis of different lab bioassays and pot culture studies in net house, two potential isolates (Iso-90 and Iso-247) selected, were identified using 16s rRNA sequencing as *Klebsiella oxytoca* and *Enterobacter cloaca*. Both these cultures showed significantly better plant growth promotional activities such as seedling vigour root and shoot growth in maize. Pathogenicity of the strains needs to be studied, before using them as bio-inoculants.

Cloning, expression and purification of Capping protein - ⁄ regulator involved in Actin Polymerization Dynamics in *Plasmodium berghei*

Mehvash Godiwala (PI- Dr. Avinash Kale, CBS)

Apicomplexan parasites are a group of intracellular, obligate, eukaryotes responsible for a wide range of diseases promptly malaria within humans and animals. Capping protein (CP) is an essential component of the glideosome complex responsible for gliding motility, prevents formation of elongated filaments and helps in branching to create stable structures. CP is a heterodimer composed of α and β subunits which bind to the actin filament and helps to control cell shape and movement. The aim of this study is to induce the CP heterodimers by cloning and expressing the gene with the pET vector system. Subsequent to protein induction, the heterodimers would be purified and their molecular interaction would be studied with respect to actin. Using molecular biology approaches, gene sequences for the subunits were cloned using *E. coli* BL21(DE3), followed by extraction and amplification. The amplicons for α-subunit were digested using BamHI and SalI then ligated within pET-23b vector system. The results obtained with help of this study form the preliminary resource needed for further protein expression and purification, which can be used for understanding regulation of actin by capping proteins and identifying novel drug targets.

Development of Point of Care Device for Detection of Presence of Cephalosporinase Enzymes in Bacteria

Sameeksha Bhaye (PI- Prof. Rinti Banerjee, Indian Institute of Technology Bombay)

Antibiotic usage all over world has increased due to improper prescription, which has led to amplify the incidences of antimicrobial resistance (AMR). Prescription of any antibiotic requires antibiotic susceptibility testing and time taken to analyze results take approximately 20-24 hrs. Point of Care Test (POCT) which works on biosensing technology has got recognition due to its advantages like easy handling and rapid detection (5mins- 1hr). Cephalosporin is naturally synthesized β-lactam antibiotics and its inappropriate utility has led to gain resistance up to 4th generation. Drug resistant micro-organisms like MRSA and VRE had undergone mutation and synthesize certain proteins like Penicillin Binding Proteins (PBP) which inactivates and hydrolyses cephalosporins into its acids. Detection of these hydrolytic activity is implemented by iodometric method. In this study, development of a Point of Care Test based on iodometric test on paper based flow – through device has been attempted. The presence of cephalosporinase enzyme in bacteria that are resistant to such antibiotics can be easily detected with this device. This aids in rapidly deciding course of treatment.

Investigating Structural Aspects of Histone Proteins H2A and H2B in the Formation of the Specialized Nucleosome

Advait Shailendra Kayal (PI- Prof. Dr. Ashutosh Kumar, Indian Institute of Technology Bombay)

Histones play a major role in the formation of chromatin by the compaction of DNA and in the epigenetic regulation of transcription. The regions of the DNA that are bound to the histones becomes inaccessible to the transcription machinery. For the regions to become accessible, the histone proteins undergo certain post translational modifications (PTM) such as acetylation, phosphorylation, methylation etc. It has been observed that different types of PTMs may occur on the same histones, and seem to have an effect on each other. These are termed as Cross Talks between the PTMs. One PTM may promote or repress the addition or removal of another PTM. In this study, the main aim is to obtain high yields of histone proteins and to carry out NMR studies of the proteins. Further, we aim to form a dimer of H2A and H2B protein and carry out its structural analysis. This project also aims to devise a methodology by which the mechanism and the dynamics by which the cross talks occur between the different PTMs on the histone tails can be understood.

Identification of genetic mutations in steroid 5- reductase type 2 and androgen receptor genes in patients with disorders of sex development

Shruti Vilas Kharat (PI- Dr. Dhanjit Kumar Das, NIRRH)

Children across are born with abnormally developed chromosomal, gonadal or anatomical sex known as disorders of sex development. In this study, we have focused on two genes viz. SRD5A2 (Steroid 5-α reductase type 2) and AR (Androgen Receptor). An individual with SRD5A2 or AR gene mutation is genetically male with normal XY chromosomes but is born with ambiguous genitalia. The objective of this study is to screen individuals with SRD5A2 and AR mutation and determine the pathogenicity of mutations in causation of DSDs that ultimately results in hormonal imbalance. In this study, 38 unrelated patients were successfully analyzed for mutations in the Exon 1-5 region of SRD5A2 gene and Exon 2-5 region of AR gene. In 15 patients, SRD5A2 gene mutation was found in Exon 1. In case of AR gene, Exon 1 & 6-8 couldn't be analysed due to standardisation issues with PCR. However, 2 patients were detected with AR gene mutation in exon 4 and exon 5 respectively. Nonetheless, it is important to perform large cohorts' analysis to study genotype-phenotype correlations necessary for genetic diagnosis of these syndromes.

Expression and Purification of Sge1 from *Fusarium oxysporum* f.sp. cubense for understanding its role in pathogenicity in Banana

Komal Mishra (PI- Prof Jacinta D'Souza, CBS)

Fusarium wilt has emerged as the most potent global threat to banana cultivation. The causative agent of the disease, *Fusarium oxysporum* f. sp. cubense (Foc) has evolved over the years affecting various cultivars of banana. Currently, Foc Race1 and Foc TR4 (Tropical Race 4) are the strains affecting the banana cultivation in India and other countries. The pathogenicity has been majorly attributed to transcription factors such as Sge1 that play a major role in colonization and in-planta growth of Foc. In this study, Sge1 was cloned in different bacterial expression vectors and overexpressed in *E. coli* host systems. The expression of Sge1 (39 kDa) was not observed in pET28a+ vector system but when cloned in pET32a+ vector, overexpression was observed in *E. coli* BL21 (DE3) and Rosetta 2 (DE3) pLys strains. The weight of the induced protein differed from the actual molecular weight of the SGE1 protein. Bugbuster treatment (protein extraction reagent) revealed the presence of the induced protein in the supernatant of the cell lysate. This signifies that the induced protein is soluble and can be purified.

Determine phosphorylation status of AKT and STAT3 in cells overexpressing the PSMD9 proteasomal chaperone

Sushmita Sunil Varhadi (PI- Dr. Prasanna Venkatraman, ACTREC)

The network analysis of protein-protein interaction enables us to understand the interaction between different cellular components. Cellular migration is one such event wherein aberrant signalling can trigger metastasis. The study focuses on understanding the role of AKT in signalling between Integrin-Beta1 and STAT3 pathway in cells over-expressing PSMD9 proteasomal chaperone. To achieve this, we used the HEK293 cells over-expressing PSMD9 grown on fibronectin as a mammalian model for metastasis. We show that over-expression of the PSMD9 proteasomal chaperone resulted in suppression of AKT phosphorylation levels and a corresponding increase in PSMD9 protein levels in cells grown on fibronectin matrix. The result suggests that suppression of AKT phosphorylation has a key role, presumably in cell cycle arrest and PSMD9-mediated cellular migration. Current efforts focus on elucidating the role of hypoxia and serum starvation and how it modulates the AKT phosphorylation levels, mimicking migration conditions. This study lays the foundation for establishing the critical link between AKT and STAT3 as part of the fibronectin/integrin axis in PSMD9 mediated cellular migration. The link would answer, if it could make the STAT3-integrin beta-1 axis vulnerable to possible drug intervention.

Evaluating role of ERBB2 as a potential therapeutic target in cervical cancer

Roma Sunder (PI- Dr. Amit Dutt, ACTREC)

Cervical cancer affects women worldwide. Molecular somatic alterations usually cause mutation or amplification of a gene, altering the cell signalling pathway which results in uncontrolled cellular proliferation. Blocking these genes by using suitable inhibitor can aid in reducing carcinogenesis. ERBB2 an epidermal growth factor receptor targeting breast cancer patients has shown good clinical efficacy. In this research study, the role of ERBB2 as a potential candidate for molecular targeted therapy in cervical cancer was evaluated. For functionally validating the role of ERBB2, C33A and SiHa cell lines were used. These cells were transfected by shRNA to knockdown ERBB2 and after puromycin selection five different shRNA knockdown clones from each cell line were chosen for further experiments. Certain characteristics such as cell proliferation, cell migration and anchorage independent growth were examined in these knockdown clones with respect to parent cells. This study concludes that knockdown of ERBB2 doesn't affect the overall cell survival, cell migration and cell transformation in cervical cancer and may not be a potential target in cervical cancer cell lines.

Towards understanding the role of a Type II metacaspase (CrMC2) in the cell death of *Chlamydomonas reinhardtii*: An evolutionary link to Programmed Cell Death in higher organisms

Priya C. Mishra (PI- Prof. Jacinta S. D'Souza, CBS)

Programmed Cell Death (PCD), initiated by chemical and physical stress in various organisms, involves various signalling molecules and proteins. In-silico studies suggest the presence of CrMC1 and CrMC2 metacaspases in *Chlamydomonas reinhardtii*. The CrMC2 gene was cloned in pET45b and pET32a, and expressed in *E. coli* BL21 (DE3), Rosetta 2(DE3) pLysS and Rosetta gami 2(DE3) pLysS, with the two vectors. The protein was found as separate subunits, p20 and p10, in *E. coli* Rosetta 2(DE3) with pET32a, checked using anti-6XHis. Only the small subunit (p10) was purified by Ni-NTA affinity chromatography. Optimum induction of full-length CrMC2 protein in *E. coli* remains to be done to identify the substrates and link between caspase and metacaspase after purification. In another study, constitutively expressing CrMC2 clones (CEC) of *Chlamydomonas reinhardtii* were used to check the effect of such ectopic expression in the presence and absence of stress. Compared to the wild-type CC4533, the CEC did not show a significant increase in death. DNA laddering was observed in oxidative stress. Nevertheless, the growth of CEC was slow compared to the wild-type.

Identification, characterization and functional evaluation of vaginal *Lactobacillus* spp.

Nikita Baban Bhosale (PI- Dr. Clara Aranha, NIRRH)

Human as holobioants share a mutualistic association with the microbial community. The vaginal niche is predominated by *Lactobacilli* spp. and plays a vital role in maintaining the reproductive health by various biochemical and biophysical methods. Antimicrobial drugs are quite effective to combat these urogenital infections but acquire resistance rapidly. In the present study, 7 vaginal *Lactobacilli* strains were identified using gram staining and molecular biology techniques. It was observed that 6 of the 7 strains showed optimum growth in MRS media and 1 showed optimum growth in BHI. Lactic acid production was observed. The growth inhibition against various RTI causing pathogens like *E.coli, S.aureus, P.aeruginosa, C.albicans, N.gonorrhea, G.vaginalis* was studied and it was observed that the supernatants from these Lactobacilli had the potential to inhibit these pathogens. It therefore suggests that there is a presence of biochemically active bactericidal component in the supernatant. This assay was carried out using pH neutralized and pH non-neutralized supernatants and results show that the inhibition by neutralized pH supernatants was higher than the non-neutralized due to bacteriocin like molecules which requires further purification.

Extra-Cellular Cell-Free Chromatin Modulates PD-1

Shweta Johari (PI- Professor (Dr.) Indraneel Mittra, ACTREC)

The suppressive nature of immune cells in tumor-microenvironment plays a crucial role in tumor progression but what triggers the regulation of anti-tumor immune response is still unclear. To investigate whether the cell-free chromatin from cancer cells also orchestrate the immune escape surveillance, we carried out Immunofluorescence staining (IF) on primary human CD4+/CD8+ T lymphocytes exposed to cancer cfCh (10 ng). Furthermore, RNA was harvested from primary human T-lymphocytes exposed to cfCh (10 ng), HcfCh (40ng) and DNA isolated from cancer patients (40 ng) to quantify PD-1 gene expression. The increase in PD-1 gene expression was directly correlated with the increase in concentration of cancer cfCh thereby indicating a kinetic relation between cfCh uptake and PD-1 gene expression. The aforementioned modulation of PD-1 gene in primary T-lymphocytes exposed to cancer cfCh is completely abrogated by utilizing the chromatin neutralization agents thereby indicating the possible role of cfCh in dictating the expression of PD-1 gene. Therefore, we propose that by targeting the cell-free chromatin released from the cancer cells, the immune homeostasis balance from tolerized state to the attacking state can be achieved without the expense of autoimmune associated events.

Deciphering the Bacterial community associated with Indian Lotus (*N. nucifera*) cultivated in Dal Lake, Kashmir

Kris Silveira (PI- Dr Yogesh Shouche, NCMR/NCCS Pune)

Lotus is an aquatic, rhizomatous perennial herb commonly found growing in marshes and bogs, the plant is an economically viable and also possesses significant cultural and religious value. A complex community of bacterial, fungal and macroscopic organisms directly or indirectly affect the plant's functioning. In the present study, the endophytic bacterial diversity of Lotus plant (*N.nucifera*) was studied along with the variation in diversity across the plants parts. 117 bacterial cultures were isolated, identified and dereplicated primarily using MALDI-TOF-MS which were confirmed by 16S rRNA gene sequencing. Isolates from 16 different genera and 4 phyla largely dominated by Firmicutes were present with less common taxa between each plant part. The study also revealed that the community was differentially affected by the microenvironment they existed in and with the physiological characteristics of the plant that created a unique niche conducive for the growth of specific bacteria. Understanding the diversity and localisation of bacteria widens our comprehension of the Lotus plant and its multiple facets, along the way aiding in production of therapeutic secondary metabolites, increasing crop yield and nutrient availability of soil.

HA-GQD hybrid NIR responsive Polymeric Nanocarriers for Photothermal Therapy

Jinal Mehta (PI- Dr. Rohit Srivastava, Indian Institute of Technology Bombay)

Photothermal Therapy is a technique which destroys the cancer cells adroitly. It makes use of Photothermal Nanotherapeutics, irradiated with Near Infra-Red (NIR) light to generate heat, killing the diseased cells. An effort has been made to develop a nanocarrier system comprising of a polymer and a thermoresponsive metal nanomaterial for image guided photothermal cancer therapy. Glycol chitosan functionalized Poly (lactic-co-glycolic acid) (PLGA) particles were synthesized by solvent emulsion method. Gold nanoparticles formes a shell over chitosan functionalized solid spheres by ex-situ hybridization. Hyaluronic acid (HA) forms a layer over these nanoshells via adsorption, and graphene quantum dots (GQDs) are embedded in it. The purpose of these nanoparticles (NPs) having inherent fluorescence is the NIRF imaging directed photothermal ablation of cancer cells. The synthesized NPs of size 250-300nm, were subjected to various characterization studies. They were analyzed for surface charge, uniformity, elemental concentration, absorption maxima, and crystallinity. They showed excellent biocompatibility and fluorescence in the NIR region in-vitro. To sum up, HA-GQD Au-PLGA, display synergistic properties and can be considered as a multifunctional theranostic agent.

Synthesis and characterization of silk nanoparticles for delivery of bioactive molecules

Minal C. Nenwani (PI- Prof. T. Govindaraju, JNCASR)

Tremendous advances in material sciences have led to the development of biocompatible, biodegradable and tunable biomaterials for application in the field of medicine. Fibroin nanoparticles exhibit pH dependent drug release and have encapsulation property. Sericin on the other hand is hydrophilic and has large number of reactive amino acid side chain. In this study, fibroin and sericin proteins were simultaneously regenerated from Bombyx mori cocoon and characterized. Further, cytocompatible nanoparticles ranging from 100-150nm were fabricated using the desolvation method. The size and surface charge were measured using dynamic light scattering and cytotoxicity was measured against mouse fibroblast cell line. The morphology of fibroin nanoparticles was also determined using Transmission Electron Microscopy. The nanoparticles were further conjugated with fluorescent dyes and characterized. This was backed up with cellular uptake studies wherein fibroin nanoparticles exhibited a time dependent entry in fibroblast cells. The proposed nanoparticles can be optimized for cell imaging studies. They can also be used as potential drug delivery vehicles and functionalized for site specific drug delivery. Furthermore, these nanoparticles can be modified for theranostic applications in disease management.

Cysteine specific fluorescence probe to monitor protein unfolding

Abhilash Babu (PI- Dr. Ruchi Anand, Indian Institute of Technology Bombay)

Fluorescence spectroscopy and protein labelling are sensitive method to understand the dynamics, conformational changes and stability of proteins. Protein labelling is commonly carried by addition of an extrinsic fluorophore like fluorophore L. It is specific, sensitive and fluorescent only in the presence of free cysteine residues in proteins. Thus, can be used for studying structural changes which occur during the complex unfolding of a protein. tRNA Adenosine Deaminase (TadA), an RNA editing enzyme comprised of 161 amino acids has been used as a model system to study unfolding. TadA consist of five cysteine residues at position 83, 86, 63, 109 and 137. Theses residues do not take part in disulphide bond formation. As TadA unfolds itself, fluorophore L will conjugate with the cysteine residues and show an increase in fluorescence intensity as the unfolding increases. In order to understand the unfolding pattern these cysteine residues were mutated to alanine and serine residues. The objective of this study was to use principles and methodologies of molecular biology, protein purification, fluorescence spectroscopy and CD spectroscopy to study protein unfolding.

Genetic monitoring of zebrafish across different generations using microsatellites

Froila Joyce D'costa (PI- Dr, Mujahidkhan Pathan , ICAR- CIFE Mumbai)

The Zebrafish, *Danio rerio,* is an indigenous fish inhabiting widely in north east India but very scare information is available with respect to the genetic diversity/population structure of this species. Molecular markers represent an abundant source of genetic markers which are highly polymorphic and dispersed evenly throughout eukaryotic genomes, co-dominant in nature, highly polymorphic, easily typed, and Mendelian inherited. In the present work three di repeat microsatellite loci viz., DZ9871I, DZ7125NC, DZ1412NC were selected for genetic characterisation of zebrafish stocks collected from wild viz., Cuttack, Mangalore, Tripura, West Bengal and Assam. The mean effective number of alleles, observed heterozygosity, expected heterozygosity, unbiased expected heterozygosity and fixation index were 13, 0.72, 0.92, 0.95 and 0.20 respectively. All the loci tested deviated significantly from Hardy Weinberg equilibrium. About 50 markers were used to screen the parents (male and female) and 30 loci genotyped were heterozygous for both the parents and 20 loci were homozygous for single/ both parents. The mean heterozygosity was high for the samples genotyped and only few loci got fixed in the F1 generation. Thus, these markers can be used to monitor further filial generations of zebrafish.

Development of point of care device for the detection of presence of bacteria in infections

Michelle Jerry Dias (PI- Prof. Rinti Banerjee, Indian Institute of Technology Bombay)

Bacterial infections (Urinary tract infections/Upper respiratory tract infections/Sepsis) are still a leading cause of mortality across the globe. Though conventional techniques of diagnosis are available, that are time consuming and have few limitations. Point of care devices (POCDs) rescue this situation by providing specific data rapidly, without requirement of spatial laboratories with expensive instruments and expert technicians. In this study development of a point of care device is being targeted that will detect presence of bacteria from in samples of infected individuals. Two strategies were designed one being modified cell staining device and other device using biopolymeric, dye entrapped, organic nanoparticles synthesized by ionic conjugation. Efficacies of both the devices were studied for the detection of bacteria with the lowest detectable concentration of 1x105 cfu/ml. The results indicated that strategy involving the nanomaterial was found to be working the best across the test bacterial strains and the visible readout obtained in few minutes upon addition of sample. This will revolutionize the current diagnostic scheme and surely lead to proper and regulated treatment of patients.

Investigating the role of microridge dynamics in the ability to sustain tension in zebrafish epidermis

Evelyn D'souza (PI- Dr. Mahendra Sonawane, TIFR Mumbai)

The epidermis being the outermost layer of metazoans experiences a variety of physical stresses, and has developed mechanisms that allow its integrity to be maintained under such mechanical stresses. It is known that aPKC (atypical Protein Kinase C), a part of the apical aPKC/Par3/Par6 complex, phosphorylates Lgl (Lethal Giant Larva) to restrict it to the basolateral domain. This study aims at identifying a relationship between the elongated aPKC microridges and their possible role in sustaining external stress in the zebrafish epidermis. The epidermis in these embryos was subjected to an external mechanical stretch by injecting a drop of biologically inert mineral oil into the hindbrain ventricle. Observations suggest that the aPKC morphants are subjected to an increased mechanical stretch, due to which the cross sectional area of the epidermal cells increase and the longer microridges in the morphants, by breaking down, can act as membrane reservoirs to satisfy the sudden demand for membrane. It was also observed that the longer microridges in the aPKC morphants are relatively less sensitive to Latraculin A treatments, a drug that prevents actin polymerization, as compared to wildtype embryos.

Carbon nano-onion impregnated polymer nanoparticles as Near Infrared fluorescent probe for bioimaging

Tanvi Sushil Kaku (PI- Prof. Rohit Srivastava, Indian Institute of Technology Bombay)

Bioimaging is indispensable for studies relating to inter and intra cellular and molecular interactions and Near infrared (NIR) imaging is a new generation line of bioimaging probes. We aimed at developing carbon-based NIR-fluorescent, photostable imaging probes with excellent biocompatibility for live cell imaging. Carbon nano-onions (CNOs) were synthesized from hexane extract of *Mangifera indica* leaves with green synthesis approach. The CNOs were further functionalized with PEG and PLGA rendering stability. Functionalization of CNOs was confirmed using the X-ray photoelectron spectroscopy and FTIR. Furthermore, the morphological analysis showed that the CNOs impregnated in PEG and PLGA showed a size range of 100 – 150 nm and 35-105 nm respectively. Optical characterization showed that these particles show strong photoluminescence in NIR region. The CNOs-PLGA nanoparticles showed excellent biocompatibility at a concentration of 0.1 mg/mL when added to L-929. Flow cytometry experiments revealed a high cellular uptake of CNOs-PLGA nanoparticles. Confocal Laser Scanning Microscopy further confirmed cellular uptake, in different cell lines. In sum, we developed an NIR-fluorescent bioimaging probe based on carbon with an environment-friendly approach that can be used to enhance bioimaging by reducing autofluorescence by cell components.

Viscoelasticity of cellular micro-environment influences spreading dynamics, morphology and proliferation of human mesenchymal stem cells

Priyanka Subramani (Dr. Abhijeet Majumdar, IIT Bombay)

Existing literature focuses primarily on the effect of substrate elasticity on different cell behaviours. The effect of viscous component (Loss Modulus) and anisotropy of a substrate on hMSC's behaviour is relatively unexplored. Elucidating the influence of a substrate's loss modulus on hMSC morphology, actin expression, and proliferation is mainly carried out along with cell-cell interactions. It was found that cells on viscous gels had significantly higher cell spread area as compared to elastic gels while the circularity followed the opposite trend. The mean actin intensity decreased with increasing loss modulus. A study of the initial cell attachment dynamics found that, up to the first 90 minutes post seeding, cells on viscous substrate showed a trend of cell spreading similar to that followed by cells on a stiff substrate. At thickness' below the critical depth, cells were expected to show increased area as compared to thickness above critical depth. However, the expected trend was not obtained. Overall, this study shows that the viscoelastic nature of a material indeed influences cell behaviour and cell-cell interaction may further augment this response. Understanding the response of cells to substrate viscoelasticity and anisotropy could help us in designing efficient biomimetic scaffolds for tissue engineering.

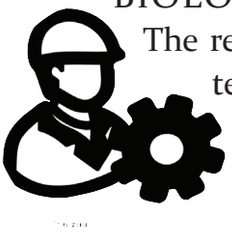
Biophysical characterization of *Chlamydomonas reinhardtii* GRX2 and its interaction studies

Vikram Saini (Prof. Jacinta S. D'Souza, CBS)

The *Chlamydomonas reinhardtii* genome database shows six annotated Glutaredoxins (GRXs) of which GRX2 is a dithiol Glutaredoxin (12 kDa). Monothiol GRXs function along with the conserved protein family- the BolA like proteins. Genomic analysis predicted a robust co-occurrence between the monothiol GRX and Bol A protein genes. Mass spectrum of purified GRX2 predicted the molecular weight of the protein to be 12.7 kDa. Qualitative analysis of far-UV CD spectra and FTIR spectrum of GRX2 confirmed the α-helical nature of the recombinant GRX2 protein. BeStSel webserver was used for further quantification of the recombinant GRX2 secondary structure revealing amount of α-helix to be up to 30% , ~12% of β-sheets, 14% of β-turns and 44% of unordered structures. ITC analysis showed, strong binding between CrGRX2 (oxidised) and GSH (reduced) with a binding affinity, K ass = 3.9 x 10 5 M -1. Overlay Assays of BolA with purified CrGrx2, showed no interaction proving only monothiol GRXs interacts with BolA. Overlay assay of *Chlamydomonas reinhardtii* wild type CC-124 under oxidative and osmotic stress conditions with purified GRX2, showed four distinct bands of interaction suggesting the expression of partners of CrGRX2 during these conditions.

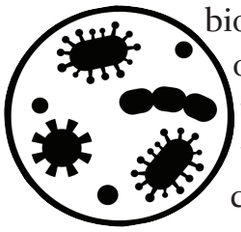
CAREERS IN BIOTECHNOLOGY

Biotechnology, being one of the progressive fields, is an amalgamation of various branches of science. It is expanding its horizons with every rising sun. It implies the use of biological processes in the industrial domain for the creation of a new product or to modify a pre-existing product. It involves utilization of the living systems for development in healthcare, food, agriculture industry, etc. It offers a plethora of career choices ranging from sales and marketing to research and development, manufacturing to quality control and assurance.

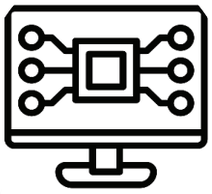


BIOLOGICAL TECHNICIAN: The responsibilities of a biological technician is to assist scientists and biologists in experiments that deal mainly with live organisms, setting up and maintaining equipment, a collection of information and samples, tracing and correcting faults in a mechanical or electronic system etc.
Education required – Bachelor's degree in the field of biology. Training is provided on the job.

DNA ANALYST: They are forensic science technician responsible for cataloguing and analyzing DNA evidence. They work in the laboratory testing DNA samples.
Education required – A bachelor's degree in forensic sciences, molecular biology genetics, or related field. Other requirements include knowledge of laboratory procedures and equipment; strong verbal and written communication skills.



MICROBIOLOGIST: Duties of a microbiologist include examination of microorganisms, studying their growth, their interaction with humans, infections caused by them, treatment and prevention of disease, etc.
Education required – Bachelor's degree in the related field.



BIOINFORMATICIAN: They help the scientists to process, manage, and analyze the genomic and molecular data by the application of computers. They are employed in several fields like the pharmaceutical industries, healthcare sectors, etc.
Education requirement – A specialist background in biology related field.

FOOD SCIENTIST AND TECHNOLOGIST: They are experts in nutrition. They utilize their understanding in formulating new products and methods of food processing and preservation through genetic modification and additives.
Education required – Bachelor's degree in food science

BECOME AN ENTREPRENEUR: Biotech startup is a thriving employment in India. Believe it or not, heavy capital investments are made by entrepreneurs globally thus, envisaging a regenerated better future. So, be your own boss!
Education requirement – Bachelor's degree in Biotechnology

SOIL AND PLANT SCIENTIST: This is a field of applied biotechnology. They apply their advanced knowledge of environmental science to maximize land use and increase food production.

Education required – Master's degree with coursework specific to the field that includes soil chemistry, biochemistry, entomology and plant physiology.

TAKE UP JOBS IN INTELLECTUAL PROPERTY RIGHT AND PATENTING: One can become a patent analyst whose job is to read the patent application and understand the invention. Other positions like a patent agent, patent drafter, IP proofreader, or a legal researcher are also available.

Education requirement –Bachelor's degree is needed for the patent analyst position. Requires strong communication and good English.

WRITING AND EDITING JOBS: One can be a scientific editor. This is for the ones who have a good grip on technical and scientific information and would enjoy amending articles and stories to improve their credibility.

Education requirement – Master's degree in Biotechnology and good English vocabulary

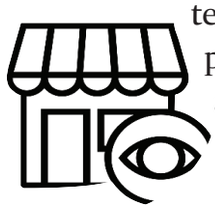
PASS ON THE KNOWLEDGE: You can choose teaching as your profession in your favourite organization. One can go for it if they have a passion for mentoring students.

Education requirement – Master's degree in Biotechnology and required to clear the NET-LS exam.

GET A JOB IN RESEARCH AND DEVELOPMENT: This is one of the interesting jobs and the best options if you are passionate about research. The work may be laboratory based or industrial research and development.

Education requirement – Master's degree in Biotechnology.

QA-QC ANALYST: They have a wide variety of industries to work in. They inspect and test the equipment as well as products before, during, or after the production process to ensure that the standards have been met. Their work includes analyzing and recording quality data.



Education requirement – Vary greatly from a degree to specialized training depending upon the industry. On-the-job training may be required.Research Associate, Senior Research Scientist, Biotechnology Sales, Forensic Analyst etc.

The important aspects required to build a career in this field are education, communication, and the passion to learn and work upon it. If you enjoy science, like investigation and solving problems, and cherish learning every day, a career in biotechnology is for you.

-Divya Gaud and Nihira Deolikar
M.Sc. I

A NEXT LEVEL DETECTIVE

Want to procure your desired end product? Want to check the health of a plant or animal? Want to know about the quality of food that you are eating? Ever wondered how incredible it would be to detect any upcoming fatal disease?

Biosensors are biological tools with characteristics such as specificity, reproducibility, stability, biocompatibility, selectivity, accuracy that utilizes the interaction between the analyte and the biological entity to produce a biological response which is measured using detectors.

Biosensors have found their wide applicability in the healthcare sector. Fluorescence resonance energy transfer-based biosensors help in diagnosis of chronic myeloid leukemia by determining the efficacy of imatinib treatment. Aptamers, affibodies, peptide arrays, and molecularly imprinted polymers are used as sensing material considering the above application. Nucleic acid or antibody based biosensors such as piezoelectric, electrochemical, and optical biosensors are used for the detection of Mycobacterial infection.

Recent advances in the field of sports were observed by developing affinity-based biosensors in sport medicine and doping control analysis. Wearable biosensors that determine the electrolytes and metabolites in sweat, saliva or tears have been developed. As an application, microbial fuel cells are being used for water treatment and also as potent power sources in case of environment based sensors. In case of food security and quality checks, hypoxanthine biosensors were developed to determine the fish and meat quality.

Additionally, a biomimetic textile-based biosensor was developed which works on the principle of direct insertion of the biosensor into the plant tissue. The advantages of using this technique was easy assessment of the crop quality along with no physiological damage post insertion of the biosensor into the plant.

The rapid development in the field of biosensors in the recent years is mainly credited to developments in fabrication of nanoparticles; use of novel bio-recognition molecules; and novel nanostructured devices. Considering its wide applicability, biosensors have become a boon to the society and show promising progress in production with help of biotechnology.

-Berness Falcao and Pragnesh Parmar
MSc II

SCIENCE BEHIND SUPERHEROES

Superhero: Captain America
Superpower: Agility, strength, speed, endurance and reaction time superior to any Olympic athlete who ever competed.
Superpower acquired through: Super soldier serum
Science behind the superhero:
Scientists have identified a number of genes like the ones involved in improving the oxygen carrying capacity of blood or increasing muscle mass which can be hyperactivated to give this desirable response.

Superhero: Deadpool
Superpower: Quick wound healing, Regeneration of lost limbs, Agility, Anti-aging, Physical strength and quirky one liners!
Super power acquired through: Cancer treatment gone wrong
Science behind the superhero:
The quick healing power can be attributed to a super active immune system and an efficient inflammatory response, while the natural ability to reverse aging could be due to telomerase activity. The regeneration power comes from fast wound healing and increased cellular proliferation and differentiation of undifferentiated stem cells.

Superhero: Spiderman
Superpower: Proportionate Strength and agility of a spider. A 'Spider Sense' that warns him of a nearby danger
Superpower acquired through: Bitten by a radioactive spider as a teenager
Science behind the superhero:
Mutation of DNA and integration of radioactive spiders DNA into him giving him spider like abilities.

Superhero: Hulk
Superpower: Physical strength, brilliant warrior, uncontrollable power, genius scientist
Superpower acquired through: Exposure to gamma rays
Science behind the superhero:
Gamma radiation breaks down the double stranded DNA, leading to epigenetic switches during DNA repair and reassembly. Red blood cells and hemoglobin breaks up, and one of its metabolite biliverdin turns blood green in color leading to transformation into big, green hulk.

Superhero: The Flash
Superpower: Superhuman speed & ability to pass through objects by modulating the speed.
Superpower acquired through: Spillage of a rack of chemical struck by a lightning bolt.
Science behind the superhero:
A large number of mitochondria & continuous supply of enzymes required in glycolysis provides the energy for running.

IN CONVERSATION WITH
DR. KARUNA GOKARN

DR. KARUNA GOKARN
Head of Department,
PG Dept. of Biotechnology,
St. Xavier's College,
Mumbai

1. How is nature critical to a 21st-century urban ethic?

We are living in the Anthropocene period where climate and the environment have a significant human impact. Access to land, parks, sanctuaries and to natural waters, is all related to health, safety, and recreation. We need to treat our planet with reverence and not just as a set of resources. Reclaiming a place for nature and implementation of green infrastructure for a wholesome future is critical to 21st-century urban ethic.

2. Sustainability issues have been discussed at length in the past but what are the issues in translating theory to practice?

Increasing population constrains our resources and drains the economy. Industrialisation brings economic growth but is also responsible for deforestation, greenhouse gas emissions, and global warming causing climatic changes. We are facing extensive water pollution and solid waste (especially non-biodegradable) disposal crisis. These and many more do have adverse environmental, social and health impact. Handling these issues is a real challenge to mankind.

3. What do you think about the concept of "environmental space"? Should every person in the world have the same share of environmental space?

We need to utilize any resource (renewable or non-renewable) that our Earth's ecosystems provide, carefully and sensibly without depriving the present and future generation. This is the concept of environmental space. Yes, everyone in the world has the right to an equal share of environmental space and this will be true only when the resources are consumed sustainably without violating global equity.

4. The market is becoming increasingly competitive. In such times what can students do to make sure they stand out / are a cut above the rest?

Competition always contributes to quality, it's not always about winning. Students should whole-heartedly put their 100% in whatever they do. When you succeed, you realize that there is hardly any competition. To elaborate, show sincere interest in any task taken, be inspirational and inspire others. Pay attention to details and take responsibility, be confident, disciplined, and patient. Believe in yourself, voice your ideas and be unique.

Believe in yourself, voice your ideas and be unique, so, take the lead with excellence.

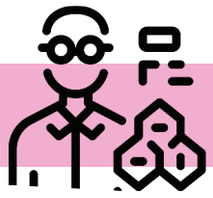
The value of academia is assessed in terms of service to society, we have to reach out.

5. How do you think we can bridge the gap in communication between academia and society?

The value of academia is assessed in terms of service to society, that we have to reach out to. Yes, we can definitely bridge the gap in communication between academia and society by engaging in a dialogue-discourse with society. For example, explaining research and innovations in a lucid way not only educates the public but also rationalizes that educational funds and resources are being spent judiciously. This would then satisfy the taxpayer's interests.

6. What changes would you like to bring about in the department to facilitate the process of learning?

My vision is to make our department a department of excellence with state-of-art facilities, one of the strongest not only in our college but nationally and internationally. The action plan is to communicate, collaborate and network with industry and academia globally for research and development. Using diverse and effective teaching-learning pedagogies and working as a team in true spirit for the benefit of each and every student approaching us.



WHAT MOTIVATES A BIOTECHNOLOGIST?

Is it the excitement of seeing the transformed colonies the next day? Visualizing that one DNA band on agarose gel that will design my biomarker? Evaluation of therapeutic efficacy of the anti-cancerous drug molecule that I designed or to see the colour of the solution change on successful standardization of the new assay? What drives a biotechnologist? It's the rush you get when you see a positive result. It makes your sleepless nights, slogging days and endless discussions worthwhile and you feel motivated enough to start the whole cycle all over again...

The biotechnology as we know it today seems to revolve around recombinant DNA; however, the classical biotechnology began long before we understood the enigma of genes. The current form which has attracted tremendous attention and popularity seems to have emerged around the end of the nineteenth century. Now, why do we see a spotlight on biotechnology in magazines, news articles, journals, and all sorts of print and electronic media? It is because biotechnology has been projected as a true friend and in fact, a saviour of mankind. Karl Ereky, an agriculture engineer from Hungary coined this term in 1919 which could be the solution to two major crises known to man - Food and Energy. The prediction stands absolutely true if we see the scenario today, we are standing on the cusp of the major predicament encircling the exact same parameters and many more. Boom of research in biofuels, drug discovery and genetically modified organisms is a convincing testament to this.

Now one might ask, "What has biotechnology achieved?" Are we there yet or where can we place ourselves in the journey ahead? We cannot say exactly where we are, but one thing we can say for sure, we surely have reached a stage where biotechnology has managed to venture from the confines of a laboratory to the real life. We have recently seen the rise of CRISPR which has taken the concept of genetic modifications to an astounding level. So much so, that even the developers of the technology seem to be unable to fathom its possibilities. Now, we can grow human body parts in a laboratory; we have stretched the life expectancy tremendously with presentation of gene therapy and drug discovery; we have observed a tremendous advancement in food crop quality and yield and the environment problems too have received a fair share of boons of biotechnology.

What made all this possible? It's the beauty of biotechnology indeed, which has amalgamated the best of all biological sciences. Here, you can see a biotechnologist sitting with a physicist for design of an analytical instrument, along with a chemist working on the assay and a microbiologist/botanist/zoologist for extraction of the enzyme responsible for the assay and a physician for observing the symptoms and recommendation of the test.
The commercial potential of biotechnology is

gigantic as it takes every aspect of human life under its umbrella. To share the major burden of achieving the bio-economy target, what has appeared at the forefront is entrepreneurship which holds substantial promise. The most promising aspect of biotechnology is that it has managed to secure a position in the eligibility criteria for almost all the jobs associated with biological sciences. You can choose from countless options like research and development, biomedicine, instrumentation, diagnostics, education, law and several others. The best part is, each one of them holds immense opportunities and an adventurous future. Very few fields can offer such versatility in terms of job prospects.

A level of anxiety and insecurity is often observed in fresh graduates regarding job prospects in biotechnology. But what is lacking is not jobs, it is the awareness of opportunities and sensitivity to the demand in the industry. This is the major cue as biotechnology is the science of tomorrow, it changes its technologies like smartphones update their software as per demand. You need to be aware of what is the upcoming demand and try to place yourself in that path today itself. See for an example, everybody thought that experimentation and analysis of nucleic acids and proteins would be the entire scope of biotechnology but one day scientists realized that we have collected so much data that we need another technology to extract maximum potential of this data collection. Here comes bioinformatics! With advent of bioinformatics, came the greed for more data which led to NGS which in turn made elucidation of whole genome or transcriptome sequence of an organism a routine job. Genomics, Proteomics and Metabolomics, which were projected as the technology of the future is what we live in today and it is here to stay. Sounds challenging!! It is. But does it not make it even more interesting? So, buckle up, brace for more and keep working towards your passion as there is so much that lies unexplored under that rock.

However, the roadblocks are challenging with major issues like acceptance of GMO's and several ethical concerns surrounding research in Biotechnology. Every biotechnology professional needs to be responsible about his experimentation objectives and side-lines because the impact can be huge! Always try to be a problem solver because it is what Biotechnology was developed for...
Steve Jobs once said that, "I think that the biggest innovations of the 21st century will be at the intersection of biology and technology. A new era is beginning". If you have an idea to begin, skill to work and the tact to sell; then there is nothing that can stop you from achieving success.
So, dear biotechnologist, "Are you motivated yet?" I very well think you are....

- Dr. Ira Vashisht, Asst. Professor

THE DEPARTMENT

FACULTY

FROM (L-R)

Ms. Norine D'souza, Dr. Ira Vashisht, Dr. Karuna Gokarn(H.O.D), Dr. Shiney Peter

NON TEACHING STAFF

- Mr. Rajesh Mahadik
- Mr. Prashant Manchekar

CLASS OF 2017 - 19

CREATIVE FOR A CAUSE

मानवाची विज्ञानवारी

चिकित्सा आणि जिज्ञासेशी मानवाची मैत्री झाली
आणि विज्ञानाच्या अद्भुत जगाची जादू त्याला भावली !!

गरजेच्या अश्वावर होऊन स्वार शोधयात्रा त्याने आरंभली
सृष्टीच्या पोटात दडलेली गुपित या प्रवासात अनुभवली !!

कधी शोधले उत्क्रांतीचे मूळ तर कधी मनी नुसतीच प्रश्नावली
नेहमीच उत्तर नाही गवसले तरी कुतूहलाची साथ ना सोडली !!

इंद्रधनूच्या रांगांपरी विज्ञानाच्या विविध अंगांची त्यास भुरळ पडली
जीव, रसायन अन भौतिकतेची सुंदर सांगड त्याने अलगद घातली !!

निसर्गाच्या अन बुध्दीच्या साथीने कधी त्याने नवनिर्मिती केली तर
कधी विज्ञानाच्या अंतरंगात हरवून जाता त्यास अनेक कारणे उमगली !!

मानवाच्या जीवनातली विचारांची हिरवळ जरी विज्ञानामुळे दाटली तरी
निसर्गाची हिरवळ विज्ञानाच्या साथीने जपण्याची आता खरी वेळ आली !!

- ऋतुजा सुभाष
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