



St. Xavier's College, Autonomous - Mumbai

Calendrappe

2017

Changing perspectives

Feature

- Interview with the Principal
- A Decade's journey : PGDBT
- Unfolding the Vaccine Epidemic

ISSUE NO. 7

Our Legacy



St Xavier's College, Mumbai was established in 1869 by the Society of Jesus, an organisation started by St. Ignatius Loyala. The UGC has conferred the college with coveted award of "College of Excellence" in 2014. In 2015, the college has been conferred "STAR COLLEGE AWARD" by the Government of India, Department of Biotechnology (DBT), New Delhi. St Xavier's College looks upon itself as an academic community where scholars, both students and teachers, have the freedom and responsibility to communicate, evaluate and enlarge human kinds store of knowledge. The college stands for academic excellence and endeavours to create an environment which generates a love for learning, a habit of critical thinking and the ability for

accurate expression. Its strives after character formation based on thae love of God and the servcie of humanity, with a view of training citizens who will be marked for all round development and a sincere commitment to God and country.

St Xavier's college, thus, strives to contribute to the necessary of the transformation of the prevailing social conditions.

The Post Graduate Department of Biotechnology at St Xavier's college aims at preparing academically sound students with the regard for non-scholastic affairs. The autonomous system aims at inculcating in the students the skills of current advancements in the field of biotechnology.



Changing Perspectives

Issue No. 7

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“ A little progress a day adds up to big results ”

From the Editor's Desk

It is my privilege to be writing to you from the editor's desk and to be able to present to you the 7th edition of Palindrome Magazine. This magazine is an annual publication by the Post-Graduate Department of Biotechnology. It serves as a platform to highlight the co-curricular and extra-curricular activities undertaken by students and also gives them an outlet to express themselves creatively and share their take on relevant matters.

The theme of the magazine this year is 'Changing Perspectives'. In keeping with the theme, we have chosen some popular but at times misrepresented or misunderstood topics and tried to put it across in a way that will enhance the reader's knowledge. Topics like big data analytics have been included so as to introduce the reader to newer, unconventional areas and job opportunities available in the same. An effort has also been made to inform the reader about the importance of ethical practices in science. While it is definitely a big ask to change someone's perspective, it is our intention to give readers a fresh perspective on pertinent topics and leave them with the curiosity to know more and look for answers themselves. This edition of the magazine also celebrates our department completing a decade since its establishment and the highlights section depicts its journey through the years.

I am extremely grateful to our sponsors Lupin Pharmaceuticals Ltd. and Organica Biotech without whom it would not have been possible to publish this magazine. I would also like to extend my gratitude to our principal, Dr. Agnelo Menezes along with the college management for being supportive and encouraging of all our endeavors. I would like to thank the faculty of the department (Dr. Shiney Peter, Mrs. Norine Dsouza and Mrs. Ira Vashisht) as well as the non-teaching staff (Mr. Rajesh Mahadik and Mr. Prashant Manchekar) for their continual help and guidance. Lastly, my most heartfelt thanks goes out the editorial team, authors, contributors and my fellow batch-mates for receiving the concept of this magazine enthusiastically and working diligently towards its publication.

Working on the editorial team has been a unique learning experience and an excellent growth opportunity. It enabled us to hone our communication skills, writing and editing skills and strengthened our ability to work as a team. I strongly urge the coming batches to carry forward the legacy of this magazine and gain from it as much as they can.

It is my sincere hope that this effort is well received by our readers and that they gain new insights after reading it.

***- Priyanka Subramani
Editor-in-Chief***



From the Faculty's Desk

Science is a way of thinking, a way of skeptically interrogating the universe with a fine understanding of human fallibility, much more than it is a body of knowledge.

-Carl Sagan, noted American astrobiologist and science communicator

St. Xavier's College is a 147 year old premier educational institute which strives for an intellectual endeavour that focuses on critical and creative thinking in students. With numerous comparative advantages in terms of research development (R&D) facilities, knowledge, skills and cost effectiveness, the biotechnology industry in India has immense potential to emerge as a global key player. In the recent past, there has been a considerable investment and input in manpower development, in biotechnology R &D and in the biotech industry. To cater to the increasing need for trained professionals, St. Xavier's College began the MSc- Biotechnology programme affiliated to the University of Mumbai from the academic year 2007-08. During this ten year journey, PGDBT has strived to train and ignite young minds so as to make them critical thinkers and humane professionals in every act that they will carry out in future. The various life skills (scientific approach, effective communication, creative thinking etc) along with intense conceptual learning acquired over a period of four semesters in the department has been instrumental in making each one of them assets to the world of Biotechnology.

This year's Palindrome magazine, in its 7th year of publication is an expression of a well coordinated effort right from deciding the theme, writing articles, compilation of research projects, editing and designing by the students of Semester IV, 2017-18. At its core, this periodical lays emphasis on scientific credence and ethical practices for acceptance of new technologies developed for the benefit of mankind through biotechnology.

Congratulations to the editorial team for their unwavering efforts to bring out this edition of Palindrome Magazine!

Wishing the entire batch of 2017-18 the very best in life

THE ZETOC

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Economics and Changing Trends
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Interview with Dr. Agnelo Menezes, Principal, St. Xavier's College (Autonomous), Mumbai



Q) St. Xavier's College is very well known and prestigious institute. What according to you is the unique selling point of students who pass out from St. Xavier's?

A) I think what happens to our students when they go through training at St. Xavier's, is that they gain in confidence, they gain in criticality and they gain a conscience. So the '3 C's' is what I'm looking at- confidence, criticality and conscience. That is what makes our students stand out in public. And I'm saying this from my personal experience as a student of St. Xavier's.

Q) Along with being the Principal of our college, you are also a professor of economics. What attracted you to the profession of teaching and what does teaching mean to you?

A) For me teaching is about sharing and learning. What attracted me to this is that by default I was called to teach after my graduation and I know no other occupation. The college called me back to teach and that's why I'm here today.

Q) To what extent do you think the biotech industry is contributing to the Indian economy in

today's scenario and do you think it is going to change in the coming years?

A) I am not too sure if the biotech industry is fully optimised in India. I think we are still dependent upon a lot of inputs, for producing final outputs. The biotech sector still has a long way to go in our country. Concurrently, the government has to be putting in more money into biotech higher education and not simply allow it to run in the way it is right now, which is in the form of a self-financing course. If the government starts stepping in, it will become more affordable and will attract more individuals to take on this kind of a professional qualification.

Q) We see a trend wherein students tend to go abroad to pursue their higher education and then continue to build careers there. In this regard, what do you think our government can do to retain talent within the country?

A) I think what the government has to be offering is scholarships- like JRFs- for researchers, and not keep withdrawing these kinds of scholarships, which has been the trend in the last few years. The government has been withdrawing scholarships and subsidies for any kind of research that's taking place at a higher level. Additionally, I think we could stand to gain from incentivizing research by putting a commission based system in place. That would mean work which leads to a commercially viable product would earn the student/researcher an added remuneration over and above their base salary.

The government has to be putting in more money into biotech higher education

I would say carry forward the '3 Qs', as we like to put it to our students over here.

Question, quest and quiz. If you inculcate this, I think you will be someone of significant value

Q) There are several integrated courses that are coming up these days like biostatistics and biophysics. Do you think that integrating biology and economics would add value to both fields as well as to the individual learning them?

A) I can't see that- 'bio-eco', if you were to form that kind of a word- working as a full-fledged discipline, because by default they belong to different genres- one is natural science and one is social science. But what I can see scope for, is students of biotechnology learning economics. It would come in very handy, and I am saying this from my experience in business schools. When you learn economics you gain a certain sharpness about business, about how to commercialize a particular venture. So while I can't see a bio-eco discipline, what I can definitely envisage is economics becoming an important part of a biotech students overall learning. I think it has to be put into the syllabus.

Q) As the principal of this college, what is your opinion about the Department of Biotechnology?

A) I think we've got to push it a little more. What I am happy about is that there are a very large number of students who are coming to Xavier's for this course, we don't have any seats going empty. But there is not much output in the public domain and I think that's where we've got to go. For example in the form of research and internships, I don't know how much of contribution has actually been taking place in a novel way- it may not be in a significant way but if an employer comes back and tells us that this student gave us a new idea, a new streak of thought, then I

think we would be accomplishing our mission at Xavier's. What I'm seeing is that you'll are good scholars but the conversion into the commercialised sphere is rather wanting.

What I can definitely envisage is economics becoming an important part of a biotech students overall learning

Q) Lastly, as a teacher what would be one piece of advice you would give students who are leaving St. Xavier's and taking their first steps in the real world?

A) I would say carry forward the '3 Qs', as we like to put it to our students over here. Question, quest and quiz. If you inculcate this, I think you will be someone of significant value. You might not necessarily become someone with a position in the society, but you will become someone of significant value to the community.

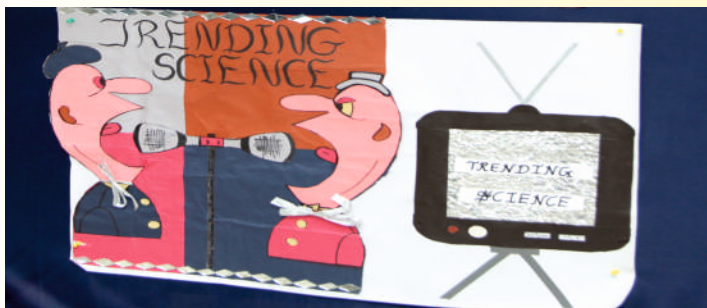


PALINDROME

Palindrome is the annual inter-collegiate festival organized by the students of the Post-Graduate Department of Biotechnology at St. Xavier's College under the guidance of the department faculty. The event was held on 16th December, 2016 with the goal of enriching the minds of students academically and also to leave them with a strong message on social responsibility. This year, the motto of the fest was 'Holding Hands to Help' and in keeping with this motto, the Department of Biotechnology associated with Sparsha Charitable Trust, an NGO located in Mumbai, to contribute towards the cause of child education.

The day of the event saw participants really push themselves both intellectually and creatively, ensuring such fierce competition that the judges were at times left in a fix about which team performed the best. With three events and two workshops, Palindrome 2016-17 witnessed a footfall of 200 participants from 13 different colleges across Mumbai. Events included a quiz event called 'The Brainiac', a skit and role-play event called 'Trending Science' and a creative arts event called 'Candid Comics'. The forensics workshop was conducted by Ms. Riva Pocha





REPORT

and Ms. Alethea Vaz and the bioinformatics workshop was conducted by Mrs. Norine D'souza.

Based on the feedback received, it was apparent that participants had enjoyed their day at the fest. The team behind Palindrome worked diligently for over a month to make sure that the events planned were thought-provoking and lived up to the standards set by previous editions of the festival.

Palindrome 2016-17 would not have been possible without the kind support and sponsorship from Lupin Pharmaceuticals Ltd and Organica Biotech. This fest would not have become a reality without the support of the Principal of St. Xavier's College, Dr. Agnelo Menezes, the guidance of our HOD, Dr. Shiney Peter and the department faculty Mrs. Norine D'Souza and Dr. Biswa Prasun Chatterji. The non-teaching staff, Mr. Rajesh Mahadik and Mr. Prashant Manchekar were a great source of help and guidance while planning the logistics of the event. A sincere vote of thanks goes out to Mr. Clyde for his helping hand in setting up the XIMR prior to the event.

The entire team has for sure reflected upon the importance of team-work and this was a great learning experience. Without doubt, Palindrome indeed made us feel like a family!



Social Initiative Report

“Education is the premise of progress, in every society, in every family.”

- Kofi Annan



The motto of Palindrome 2016-17 was 'Holding Hands to Help' where the team behind Palindrome decided to contribute to the society by engaging and teaching the students from local government schools. We joined hands with Sparsha Charitable Trust, a non-profit organisation which aims to provide critical healthcare, education and cater to the well-being of under privileged children, for the social initiative.

Under the guidance of Ms Sarika Desai, co-founder of Sparsha Charitable Trust and our teachers, the team spent their Saturdays in the month of January teaching kids the importance of health and hygiene, and the basics of science everyday life and banking. The team was divided into three groups and we covered three centres every Saturday, teaching about 20 students each. We tried to make the sessions as interactive as possible by using creative tools and quick demonstrations. Each session always had some fun element in the form of games or dance. On the last day, students from all three centres were combined and gift sets of stationary kits and biscuits were distributed to all students.

This initiative was an overwhelming experience. Though it was a small step, to be able to give the gift of education made us feel that in some way, we were holding their hands to guide and help them.





Internal Projects

Percival D'Gama, Jay Doshi, Niral D' Silva, Minoshka Jones, Yash Kamble, Namrata Kanojia, Cindy Khiangte

Study of potential applications of pectin extracted from fruit waste

Project Guide: Mrs. Norine Dsouza

Comparative cytotoxicity analysis of Pectin and Heat modified Pectin on LN 18 and

HEK 293

Project Guide: Dr. Shiney Peter

Amogh Mhatre, Akeeth Pinto, Prachiti Prabhu, Ankita Rane, Dipali Shah, Alison Vaz, Jyoti Vishwakarma

Comparative study of biosynthesis of PHB from *Bacillus* strains using commercial and natural carbon sources and bio-waste

Project Guide: Mrs. Norine Dsouza

***Invitro* cytotoxic effects of Aloe vera on LN 18 and HEK 293 cell lines**

Project Guide: Dr. Shiney Peter

Joel John, Urvazi Kotwal, Jueeli Lad, Aiman Lakdawala, Ketki Magar, Kimaya Meher, Mayuresh Mestry

Xanthan gum production from food wastes and its recovery using salt solutions and sea water

Project Guide: Dr. Biswa Prasun Chatterji

Evaluation of toxicity of *Momordica charantia* (Bitter gourd) extract on mammalian cell lines

Project Guide: Dr. Shiney Peter

Ketaki Bachal, Snehal Bamane, Riddhi Bhavsar, Sherlyn Caldeira, Chinna Susan Philip, Akshay L. D'mello, Junita Desouza

Bioconversion of food waste to xanthan gum and its potential application in agarose gel electrophoresis

Project Guide: Dr. Biswa Prasun Chatterji

Cytotoxicity study of *Trigonella foenum-graecum* seed extract on LN18 and HEK 293

celllines

Project Guide: Dr. Shiney Peter

INDIAN WOMEN IN SCIENCE

In the various branches of science and technology, we need only glance to see several pioneering women scientists who have immensely contributed to the field, having a deep-rooted impact and who even today provide a powerful source of inspiration.



Asima Chatterjee

Field : Organic Chemistry and Phytomedicine

First lady scientist to be elected as the General President of the Indian Science Congress Association.



Dr. Aditi Pant

Field : Oceanography

Became the first Indian woman to have been to Antarctica on a research expedition in 1983.



Dr. Indira Hinduja

Field : Medical Science

Successfully conducted Gamete intra fallopian transfer technique giving India its first GIFT baby in 1988.



Tessy Thomas

Field : Engineering

One of the country's leading experts in ballistic missiles and is the project director for the Agni-IV missile at the DRDO. She is the first woman to lead a missile team in India, and is also known as "Agniputri".

Field: Biotechnology

Pioneering entrepreneur who is the MD of India's largest biotechnology firm Biocon. Has donated immensely for development of cancer research and treatment. Independent director at Infosys.



**Kiran
Mazumdar-Shaw**

Field: Astronomy and Physics

Professor at Yale University. Natarajan has demonstrated that there is an upper limit of how massive black holes can get, as they begin to stunt their own growth eventually. Natarajan is on the advisory board of NOVA ScienceNow.



**Priyamvada
Natarajan**

Field: Botany and Cytogenetics

Credited to have created a high yielding variety of sugarcane that would thrive in Indian conditions amongst her most outstanding work. Director General of the Botanical Survey of India, 1952.



**Dr. Janaki
Ammal**

Field: Biotechnology

President and executive director at Indian Institute of Advanced Research. Sustained effort to promote growth of biotechnology in India and also encouraging the progress of women in science.



**Dr. Manju
Sharma**



Indian Institute of
Technology Bombay

Research Internship 2016 - 17

Alison Vaz (PI: Dr. Pramod P. Wangikar, Biosystems Engineering Laboratory)

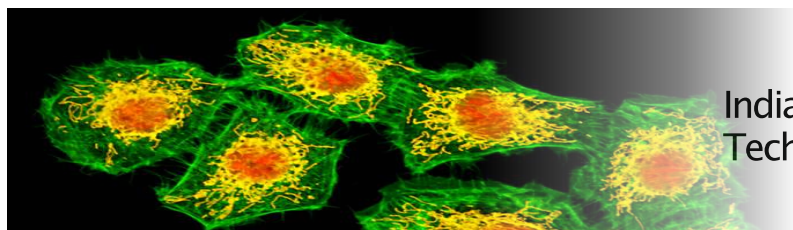
Comparative analysis of *Synechococcus elongatus* PCC 7942 and its alkane mutant strain

A number of problems have arisen due to the extensive utilization of fossil fuels most of which affect the ecosystem. Therefore it is important to develop sustainable sources for the synthesis of biofuels with the use of biological sources. Cyanobacteria are considered to be promising host organisms for production of the same. This research aimed to study and compare the growth characteristics, growth rate and doubling time of *Synechococcus elongatus* PCC 7942 and its alkane mutant strain. The experimental conditions need to be optimized to create a baseline for the execution of Metabolic Flux Analysis. The biochemical content of *S. elongatus* PCC 7942 and its mutant strain can be determined to understand the rates of production of the biological macromolecules. To optimize the protocol for extraction of the intermediate metabolites two protocols were executed, one using 80:20 methanol:water mixture and the other using 100% methanol. With the help of these metabolic flux values the underlying pathways could be analyzed to utilize these cyanobacteria as cell factories.

Kimaya Meher (PI: Dr. Pramod P. Wangikar, Biosystems Engineering Laboratory)

Standardization of Miniaturized platform for Screening Promoter Library in *Synechococcus elongatus* PCC 7942

Synechococcus elongatus PCC 7942, a cyanobacterium, was used as a model system for studying circadian rhythm. 'Promoter engineering' is an approach of synthetic biology used for engineering promoters, which are further screened and characterized. Due to drawbacks of traditional screening, this study was designed to establish a suitable platform for screening and characterization of the engineered *rbcL* promoter. 6 well, 24 well and 96 well microtitre plates were used to study growth characteristics of *S. elongatus* PCC 7942. The 24 well plate platform was ascertained to be suitable for high throughput screening. Under 0.03% and 1% CO₂ conditions, mutant I showed lower expression of the reporter gene while mutant II showed high eYFP expression. Mutant I did not show repression under 1% CO₂ condition whereas mutant II showed the repression of eYFP expression under 1% CO₂. Thus the 24 well plate can be used for further expression or repression of any heterologous genes.



Research Internship 2016 - 17

Junita D'souza (PI: Dr. Abhijit Majumder, Department of Chemical Engineering)

Substrate stiffness as a modulator of cells depth sensing ability

Adherent cells are seen to probe and respond to mechanical parameters of the matrix. One such parameter is matrix stiffness, which the cells probe by pulling and pushing on the substrate through actin myosin contractility, the other is the depth of the substrate. Literature has shown that cells on soft thin gels can sense the rigid surface underlying the substrate. The current study investigated how deep stem cells such as hMSC and C2C12 (a muscle stem cell) can sense a substrate. The results indicated that both cell types could sense above 100-micron depth. The results highlight that stiffer the substrate, more is the traction force applied by the cells which is generated in response to the resistance that a substrate offers and is transmitted through the substrate via focal adhesion. hMSC are seen to sense the substrate more deeply. The study helps in understanding in vitro cellular behaviour in relation to the depth it can sense to apply it to in vivo systems. Thus aiding in rational designing and determining parameters for tissue construct and scaffolds.

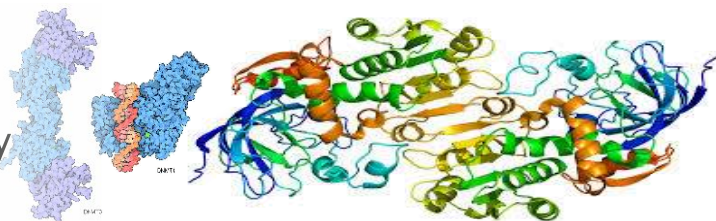
Ketaki Jitendra Bachal (PI: Dr. Abhijit Majumder, Department of Chemical Engineering)

A study to explore the effect of ⁶⁰Co-irradiation treatment on mechano-sensing ability of glioblastoma cells

Glioblastomamultiforme (GBM) is a malignant astrocytoma. The invasive nature of GBM is accounted for by several factors such as cancer stem cells, blood brain barrier, hypoxic regions in GBM. But the most important cause of GBM relapse in patients is due to the resistant cells that sustain aggressive treatment regimes. ⁶⁰Co- γ irradiation does affect mechano-sensing of GBM cells and gives rise to a set of cells insensitive and more active on soft substrate. It can be concluded from the studies that aggressiveness of the relapsed GBM cells might be due to their shift in substrate sensitivity and the elongated cell population obtained on 0.5kPa. This study can help us to segregate the relapsed GBM cells from tumors and analyze the proteins expressed by them ,which would help design a highly specific treatment for GBM.



Indian Institute of
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Research Internship 2016 - 17

Ankita Rane (PI: Dr. Ruchi Anand, Department of Chemical engineering)

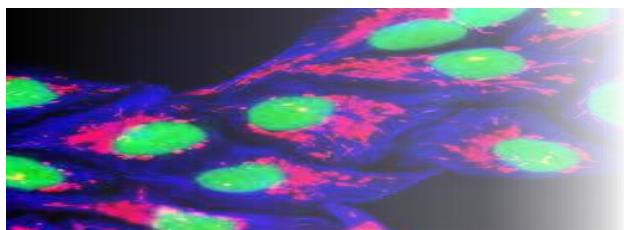
Structural and Biochemical Characterization of Methyl transferase Involved in Antibiotic Resistance

Antibiotics have strengthened modern medicine. However with such solicitations of antibiotics there is an upsurge of a serious problem associated with it known as resistance. The multidrug resistant pathogens are emerging at an alarming pace globally. Antibiotic resistance is a primordial phenomenon, however it has been perceived lately in several organisms which is definitely a matter of concern. To acquire resistance, pathogens employ several strategies and one such classic mechanism is modification of drug target site via methylation reaction. Two such families of protein namely Erm and KsgA involved in methylation are chosen in this study to understand resistance mechanism. Understanding the structural and molecular aspects KsgA and comparative analysis of both KsgA and Erm will be beneficial in understanding the details regarding the molecular mechanism adopted by these superbugs to confer resistance.

Yash Kamble (PI: Dr. Pramod P. Wangikar, Department of Chemical Engineering)

Characterization of Alcohol dehydrogenases from different organisms

There is an acute demand for the identification and characterization of novel and indigenous alcohol dehydrogenase (ADH) enzymes to improve the efficiency of known reactions and to mediate biotransformation of new substrates to produce drug intermediates. In this study, three novel genes viz. ADH1, ADH2 and ADH3 from three different organisms were characterized with respect to best substrate, optimal pH and optimal temperature conditions. These genes were transformed and over expressed in *E. coli* BL21(DE3). In terms of yield, ADH1 had the lowest level of expression with 50% of the enzyme being secreted into inclusion bodies. ADH2 and ADH3 were expressed to a greater degree, with only 10% and 20% respectively being produced as insoluble fractions. Beta-ketoesters were found to be the best substrate for all enzymes, while the optimal pH and temperature for ADH1, ADH2 and ADH3 activity were 7.0 & 45°C, 5.0 & 40°C and 6.0 & 40°C respectively.



Research Internship 2016 - 17

Joel John (PI: Dr. Rohit Srivastava, Department of Biosciences & Bioengineering)

Synthesis and Characterization of IR dye conjugated Polycaprolactone nanoparticles as a potential agent for Photothermal Therapy

Photothermal Therapy is a modern-age therapy that involves the use of Near Infrared Radiations (NIR) for the treatment of various medical conditions, especially cancer. The focus of the current study was to develop a nanotherapeutic system involving Polycaprolactone (PCL) conjugated with a copolymer. The polymer and co-polymer will encapsulate the IR dye. The polycaprolactone acts as the polymer which in conjugation with the copolymer forms the nanosphere. The composite nanoparticles are a novelty in photothermal therapy as the particles ensure thermal ablation and optical imaging by using a single formulation. The formulation of the nanoparticles was carried out using the emulsion method. The formulated nanoparticles (NPs) were found to be in a size range acceptable for in vivo studies. The DLS data confirmed the size that was obtained by microscopic analysis. The surface charge of the NPs rendered them more stable at room temperature. PDI index of formulation was well within the acceptable range. The FTIR graph showed similar results as that obtained in literature. This work demonstrated the photothermal activity of the composite nanoparticles

Prachiti Prabhu (PI: Dr. Ashutosh Kumar, Department of Bioscience and Bioengineering)

Optimizing expression and purification of histone proteins

Histones play an important role in DNA compaction and epigenetic regulation of transcription. Specialized histones like Cse4 and CENP-A are found to replace H3 in the nucleosome in the centromeric region. Though crystal and specialized nucleosomes structures are available, the solution structures are not available. Solution structures can provide the dynamics of binding of the histone proteins to one another which would allow us to understand the mechanisms of assembly and disassembly of the nucleosome and to understand changes in chromatin structure upon binding of histone to DNA. The focus of this project was to standardize the growth, induction and purification parameters of H2A, H2B and Cse4 C-terminus, to produce high quality and quantity of proteins, so as to form dimers and subsequently the nucleosome-core (containing H2A, H2B, H3 and H4) as well as specialized nucleosome (containing H2A, H2B, Cse4/Cse4 C-terminus and H4) -to analyze the structure by NMR. Proteins were expressed in different E. coli strains, purified and structurally characterized by recording their circular dichroism spectra and fluorescence emission spectra. The H2A-H2B binding parameters were then computationally characterized to check the feasibility of the H2A-H2B dimer formation.



Indian Institute of
Technology Bombay

Tata Institute of
Fundamental Research



Research Internship 2016 - 17

Snehal Bamane (PI: Dr. Prashant Phale, Department of Biosciences & Bioengineering)

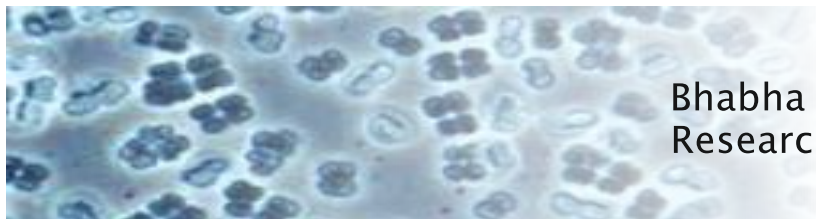
Effect of aromatic compounds like phthalate isomers and carbaryl pesticides on seed germination

The industrial revolution has led to the use of aromatic compounds in fungicides, insecticides, plastics etc., causing detrimental effects to the environment. Carbaryl is one such aromatic compound used as an insecticide which has accumulated in the soil due to prolonged use. Phthalate isomers on the other hand are commonly used for manufacturing plastics due to their long durability and low volatility. They can enter the food chain by leaching into the soil and water bodies due to weak bonds in the polymer. This study attempted to investigate the effect of different concentrations of carbaryl and phthalate isomers on germination of *Vigna radiate* (mung bean), *Trigonella foenum-graecum* (fenugreek) and Brassicaceae (mustard seeds). The parameters considered were emergence of radicle, cotyledons and root hairs. Phthalate (10mg/ml) showed the highest toxicity for all three seeds affecting the seed germination as well as emergence of root hairs and cotyledons. The increasing concentrations of terephthalate (10mg/ml, 25mg/ml and 50mg/ml) showed a gradual decrease in the number of cotyledons for fenugreek seeds. Isophthalate and carbaryl did not show any explicit effect on seed germination.

Namrata Kanojia (PI: Dr. Shyamalava Mazumdar, Department of Chemical Sciences)

An approach to alkane hydroxylation: Development of engineered in-vitro green catalyst

Alkanes are saturated hydrocarbons and their derivatization into alcohol remains a task. Cytochrome P450 is one of the biocatalysts that can be used to bring about alkane hydroxylation. However, disadvantages of using these catalysts are limited substrate specificity, lower catalysis rate etc. To overcome these limitations CYP175A1, an orphan cytochrome P450 mono-oxygenase from *Thermus thermophilus*, can be engineered using a directed evolution approach. The crystal structure comparison between CYP175A1 and CYP153A7, an alkane hydroxylating P450 mono-oxygenase, was carried out and the analysis highlighted the important amino acid residues in the substrate binding pocket. These were further subjected to site saturation mutagenesis. A mutant library was generated and subjected to screening after co-expression of the mutant CYP175A1 and electron transfer partners' ferredoxin and ferredoxin NADP reductase containing plasmids into *E. coli* BL21 RP (DE3) cells. The mutants' libraries were co-expressed and analyzed. The characteristic peak for heme group was identified after LC-MS analysis. The expression level of CYP175A1 was less as compared to the electron transfer partners. Therefore the condition for expression of CYP175A1 in expression system needs to be optimized.



Research Internship 2016 - 17

**Mayuresh Anil Mestry (PI: Dr. Chandrakala Gholve, Thyroid Cancer section,
Radiation Medical Centre)**

**Use of magnetic particles in the radioassay for detection of anti-TPO auto antibodies
and study the coexistence of Hashimoto's thyroiditis and thyroid cancer**

The three major antigens involved in thyroid autoimmunity are thyroglobulin (Tg), thyroid stimulating hormone receptor (TSH-R) and thyroid peroxidase (TPO). Detection of Tg autoantibodies is a key element in diagnosis of Differentiated Thyroid Carcinoma (DTC). The coexistence of DTC with Hashimoto's Thyroiditis (HT, an autoimmune condition) is between 0.5-30%. The presence of thyroid autoimmunity with thyroid cancer may indicate a better prognosis for thyroid cancer. The study included patients with thyroid autoimmune disease (n=48) and thyroid cancer (n= 92). The serum samples were collected from patients visiting RMC OPD. Serum anti-TPO Ab and anti-Tg Ab levels were estimated by RIA kits in patients and normal group (n=55) using in-house developed radioassay and commercial Immunotech kit. In the present study, the diagnostic concordance between the in-house RIA assay and Immunotech kit were studied in controls (98.18%), thyroid cancer patients (95.6%) and thyroid autoimmune disorder patients (84.5%). 35.2% prevalence was found between Hashimoto's Thyroiditis and thyroid cancer indicating that Hashimoto's Thyroiditis does coexist with thyroid cancer.

**Ketki Kishor Magar (PI: Dr. Pramod Kumar Gupta, Tuberculosis Immunology,
Radiation Medicine Centre)**

**Immunomodulatory effects of polysaccharide rich extract of *Tinospora cordifolia*
on raw.246.7 cell line**

MTB clearance in macrophages is obtained by contribution of pro-inflammatory cytokine secretion, MAPK activation, nitric oxide (NO) formation and expression of surface molecules like MHC-II and co-stimulatory molecule CD-86. MDR-TB and XDR-TB are worst case scenarios in anti-tuberculosis therapeutics and require development and formulation of novel drugs. Polysaccharide rich extract (PRE) of *Tinospora cordifolia* is one such compound which has exhibited anti-mycobacterial activity of G14A (a more purified form of PRE) in murine macrophage cell line RAW 264.7. Western blot data demonstrated that PRE induced MAPK activation, which was represented by the activation of P38, ERK 1/2 and JNK 1/2. PRE caused secretion of pro-inflammatory cytokines as demonstrated by ELISA. No formation was noted on PRE treatment of RAW 264.7 cells. The flow cytometry analysis of FITC labelled anti-MHC-II and anti-CD86 stained RAW 246.7 cells after 48 hours showed that PRE treatment induced surface expression of MHC-II and CD-86 at doses of 1mg/ml and 2mg/ml respectively. PRE also lowered the intracellular survival rate of MTB to 50%.



Haffkine Institute

Institutional Biotech Hub
Pachhunga University College,
Mizoram University



Research Internship 2016 - 17

Amogh Mhatre (PI: Dr.Mrunal Ghag Sawant, Venous Animal Unit)

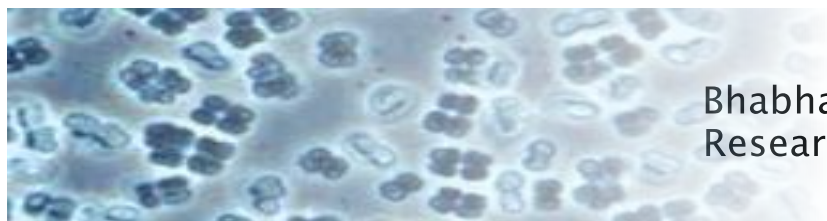
To determine the potency of vintage snake venoms

The demand for snake venom is enormous due to its potential benefits in research and therapeutics, therefore, venom from various snakes is milked and stored. However, not much attention is paid to the intactness of venom after storage. The aim of this study was to assess whether the vintage lyophilized venom samples remain potent for research. 9 Cobra venom (CV) samples (collected between 1935 & 2016) and Russell's viper venom (RV) samples (collected between 1972 & 2016) were assessed biochemically using Bradford's assay, SDS–PAGE, AGID, HPLC, and FTIR. No significant change was observed in protein concentration across all CV and RV samples, however RV & CV samples collected in 2015 & 2016 showed higher intensity bands in SDS-PAGE. AGID results suggested that antigenicity of all samples was still intact while HPLC results depicted more number of peaks of greater intensity for samples that were recently collected as opposed to vintage venom samples. The functional groups of venom components analyzed using FITR need to be characterized further.

Cindy Khiangte (PI: Dr. Vanramliana, Institutional Biotech Hub, PUC)

**Diversity of the mitochondrial cytochrome oxidase C subunit gene of the genus
Schistura (Teleostei: Nemacheilidae) from Mizoram, Northeast India**

Recent work suggests the mitochondrial gene, cytochrome c oxidase subunit 1 (COI), can aid the resolution of fish diversity. In the present study, eight *Schistura* species were collected. COI genes were isolated, amplified and sequenced. The gene sequences were analyzed for species diversity among the collected *Schistura* species. Phylogenetic and molecular evolutionary analyses indicated that out of 651 positions in the COI gene sequences analysed, 187 (28.7%) were variable with the third codon position being most variable site. The average base composition was A+T rich (51.2%). Average intraspecies and interspecies distance is 0.001 ± 0.001 and 0.136 ± 0.016 respectively. Distance exhibited by *S. aizawlensis* and *S. scyphovecteta* with respect to all other species clade indicated possible species divergence. Phylogentic tree analysis revealed that the developed database sequence of *S. aizawlensis*, *S. scyphovecteta*, *S. fasciata* and *S. khugae* clustered cohesively with two minor splits within a clade. Similarly, *S. paucireticulata* and database sequence of *S. beavani* clustered as a sister clade. This analysis revealed the suitability of COI in determining the genetic diversity of *Schistura* species in Mizoram.



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Jueeli G. Lad (PI: Dr. Roja Gopalakrishnan, Nuclear Agriculture and Biotechnology Division (NABTD))

Production of Secondary metabolites from tissue cultures of the medicinal plant *Adhatoda vasica*

Adhatoda vasica is traditionally known for its medicinal application. Vasicine, a quinazoline alkaloid, is the main secondary metabolite produced by *A. vasica*, which is mostly used for treatment of upper respiratory ailments. This project aims to increase Vasicine production through Micro-propagation of *A. vasica* using PTC. Axillary nodal stem and leaf explants were used for development of shoot and callus cultures, using the synthetic basal MS media supplemented with different combinations of phytohormones. MS media supplemented with BA (2mg/L) and half strength MS media, favoured shoot culture development whereas, BA (1mg/L) + 2, 4-D (2mg/L) and Kn (1mg/L) + 2, 4-D (2mg/L) supplements were ideal for callus culture. Chemical analysis using HPLC, showed highest vasicine content in shoot cultures grown in half strength MS media (2% dw) as compared to parent plant. These observations suggest a promising way of obtaining higher yield of Vasicine. Further optimization is required for augmenting Vasicine production.

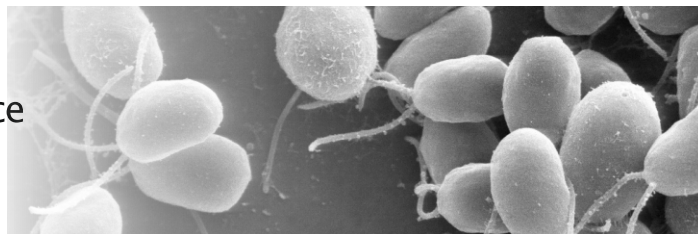
Jyoti Shambhunath Vishwakarma (PI: Dr. Narasimha Anaganti, Molecular Biology Division)

Dose dependent response of *Deinococcus radiodurans* promoters to various DNA damaging stresses

In response to environmental stress, living organisms change expression levels of various genes which are under stringent control. Their expression, under standard growth conditions, could be lethal to cells. *D. radiodurans*, an extremophile, alters its gene expression in response to DNA damage stresses. Promoter studies revealed that RDRM containing promoters are inducible under radiation stress. In the present study, 3 highly radiation inducible promoters were tested under various DNA damaging stress conditions. All three promoters showed dose dependent induction in their activity to gamma radiation and MMS stress. Results suggest the involvement of these genes in cellular repair. P_{gyrB} showed marginal induction whereas, P_{ddrB} and P_{1143} showed significant induction under UV stress. Six weeks of desiccation induced P_{ddrB} and P_{gyrB} , marginally repressed DR1143 gene promoter. These results suggested less involvement of DR1143 gene and key involvement of ddrB gene during cellular damage. The above results strongly suggests crucial role of ddrB for repair of all kinds of DNA damages.



Center for Excellence
in Basic Sciences



Research Internship 2016 - 17

Minoshka Jones (PI: Dr. Subhojit Sen, Sen Lab of Engineering)

Designing a restriction based analysis to detect DNA methylation in *Chlamydomonas reinhardtii*.

In humans, CpG hypermethylation at promoters leads to silencing of the tumor suppressor genes in cancer. To demonstrate the potential use of *Chlamydomonas reinhardtii* as a model system to study CpG correlated gene silencing in cancers, a phenotypic readout of the “Epigenetic Assay” was used. The transgene silencing was scored followed by a restriction based analysis to detect DNA methylation changes. Differential haplotype specific gene expression paradigm was observed. To study if CpG methylation can be correlated to gene expression, a restriction based analysis was devised employing the isoschizomer pair HpaII/MspI. HpaII restriction activity being sensitive to methyl-CpG, detects DNA methylation while MspI acts as a normalization control for restriction efficiency. PCR products of candidate genes from the *Chlamydomonas* nuclear genome were checked for HpaII/MspI cleavage sites in an in silico analysis indicating that cleavage by HpaI was inhibited due to presence of methylation in a transformant that had previously shown high level of silencing in the epigenetic assay, and also correlated to the level of silencing. The correlation once established, becomes the basis of a molecular screen assay for new epigenetically active compounds that might act as potential drugs against DNA methylation pathways for cancer treatment.

Percival Paul D'Gama (PI: Dr. Jacinta D'Souza, Department of Biology)

Probing the interaction of the amphipathic helix of an AKAP (ccdc108) with dimerization and docking domain-containing protein

Cilia are organelles that protrude from cells that harbour them. The hallmark of most motile cilia is the microtubular axoneme that typically consists of 9+2 organelle. Ciliary motility is regulated in part by phosphorylation and several molecules involved in signal transduction are localized to specific subcellular compartments. A common example is that of c-AMP dependent Protein Kinase-A (PKA) which is known to be targeted to various subcellular locales by A-kinase anchoring proteins (AKAPs). AKAPs serve as scaffolds for binding of different signal transduction molecules as they contain a motif called the Amphipathic Helix (AH) that binds to the Dimerization and Docking domain (D/D) present in regulatory subunits of PKA (RII). The flagella of *Chlamydomonas reinhardtii* harbour two AKAPs viz. AKAP97 and AKAP240. The AKAP240 (FAP65) protein sequence remains elusive; but partial sequence shows homology with CCDC108 (mouse sperm flagella). CCDC108 shares 49% homology with that of human CCDC108, and AKAPs from other organisms and its disruption leads to defective sperm motility. The interaction between CCDC108 and several typical and atypical D/D domain-containing proteins was studied. The results clearly indicate that FAP174, MycBP-1 and RIIa interact with CCDC108; further ascertaining that CCDC108 is an AKAP.



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Aiman Lakdawala, (PI: Dr. Deepak Modi, Molecular and Cellular Biology Laboratory) Development of Multiplex PCR Strategy for Detection of Yq Microdeletions in Diagnosis of Male Infertility

Male infertility is caused by microdeletions on the long arm of the Y chromosome and there is a wide heterogeneity in the data available on the prevalence of Yq microdeletions in India. This study aimed to identify the spectrum and current prevalence of Yq microdeletions and shortlist sequence tagged site (STS) markers that can be potentially used for screening infertile males via extensive meta-analysis. The study also aimed to optimize a multiplex PCR technique that would allow simultaneous detection of Yq microdeletions in the azoospermia factor (AZF) region. Prevalence of Yq microdeletions was found to be 6 %. The AZFc region was seen to be most commonly deleted (45.7 %) in infertile cases. Based on the meta-analysis, non-EAA markers were found to be frequently deleted in our population. 6 EAA and 8 non-EAA STS markers together were employed in developing three virtual multiplex PCR sets, of which, one set was optimized. Multiplex PCR optimized with the 14 STS markers is a rapid and beneficial strategy in identification of Yq microdeletions in our population.

Urvazi Cyrruss Kotwal (PI: Dr. Dipty Singh, Transmission Electron Microscopy Division) Molecular mechanism of action of Cypermethrin on perinatally exposed F1 male and female rats

Numerous studies have demonstrated that endocrine-disrupting compounds (EDCs) are a possible cause of female and male reproductive malfunctions. The current study aimed to decipher the action of Cypermethrin (CYP), a widely used insecticide and potential EDC, on perinatally exposed F1 rats, by examining the effect of CYP on genes involved in steroidogenesis and spermatogenesis. The adverse effect on gene expression was evaluated at PND22 (post-natal, day 22), PND45 (puberty) and PND75 (adult) stages. It was observed that animals exposed to CYP did bear alterations in the expression of steroid hormone receptors (AR, ER β), steroidogenesis genes (StAR, P450scc and P450c17) and genes involved in spermatogenesis (Cyclin B1 and Pcn α) as compared to the control group of animals. The present study underlined the endocrine disrupting potential of CYP, however the exact mode of action of this compound is yet to be deduced. The study may help identify the health risk associated with CYP exposure and the cellular/molecular/endocrine biomarkers for clinical diagnosis of CYP induced reproductive toxicity.



Research Internship 2016 - 17

Jay H. Doshi (PI: Dr. Avinash Kale, Department of Chemistry)

Characterization and comparative study of proteins of *Lactococcus* species isolated from *Aedes* and *Anopheles* larvae.

The emergence of mosquito borne diseases has reinstated the need for enhanced strategies to tackle this problem. Biological insecticides are proteins that either inhibit the growth of or form pores in the cell membrane of mosquito larvae, and hence can be categorically called larvicidal toxins. In silico analysis with sequences of Cry, Bin, MTX toxins against the organism *Lactococcus garvieae* showed the possibility of the incidence of Cry toxins in the organism on the basis of E-value obtained after pBLAST search results. The probable larvicidal toxins produced amid cluster of other proteins, by *Lactococcus* spp. were identified by employing LC-MS/MS. This data was processed with the software Morpheus to provide protein annotations by comparing experimental data with theoretical data (proteome of *Lactococcus* spp.) obtained from protein databases like UniProt. Based on the algorithms of Morpheus that annotate a protein with at least two unique peptides, the proteins were searched against various databases and research papers to identify their functions and possible role in larvicidal activity.

Niral Dsilva (PI: Dr. Avinash Kale, Department of Chemistry)

Differential proteomic analysis of *Bacillus* species isolated from *Culex* mid-gut larvae.

The application of unconventional strategies in mosquito control was highlighted in view of the fact that the incessant application of synthetic insecticides roots for the development of vector species resistance, biomagnification and adverse effects on environmental quality and non-target organisms including human health. Thus microbial insecticides can be considered as alternatives to chemical insecticides. Mosquitocidal *Bacillus thuringiensis* subsp. *israelensis* and *Bacillus sphaericus* are utilized as an alternative for synthetically manufactured chemical insecticides. Since the utilization of these locally accessible strains are constantly prudent in insect control programs, the research in more effective strains competent in overcoming the resistance should be sustained with prominence on the isolation of more toxic strains. The expected outcome of the project is the determination of the toxic protein coded by other *Bacillus* spp., and a reasonable approach in using the toxin as a mosquito larvicide.



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Research Internship 2016 - 17

Chinna Susan Philip (PI: Dr. Bhakti Pathak, Department of Structural Biology)

Understanding the proteolytic processing of the Trop2 protein by site directed mutagenesis approach

Trop2 protein has been known to have upregulated expression in cancerous cells as compared to normal cells. In cancerous cells, Trop2 undergoes proteolytic processing resulting in the shedding of the extracellular domain (ECD) and intracellular domain (ICD). The ICD translocates to the nucleus, where it plays a role in downstream signaling pathways that lead to tumour proliferation. Validation of the location of the cleavage site in human Trop2 protein was analyzed based on its location in mouse Trop2 at valine-194 via site-directed mutagenesis approach. It was found that Trop2 processing and post-translational modification, most likely glycosylation, was different in cell lines HEK-293 and OVCAR 4, as was the glycosylation pattern. The selected site appeared to have an impact on Trop2 processing in HEK-293 cells and not in OVCAR 4 cells. This hints that Trop2 processing and glycosylation may be tissue-specific. The comprehensive biochemical characterization of Trop2 is essential to identify diagnostic and therapeutic strategies that can abrogate its activation in cancer.

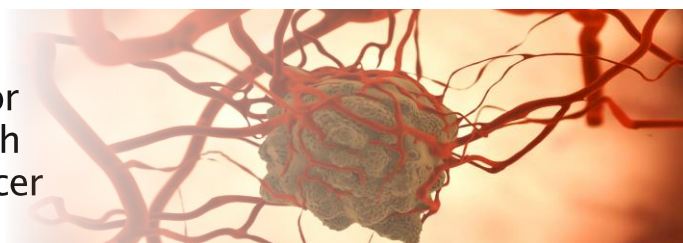
Riddhi Indravadan Bhavsar (PI: Dr. Dibyendu Bhattacharyya, Organelle Biology Lab)

To study functional interdependence between ER exit site and ER import site in *Pichia pastoris*.

The secretory pathway involves COPI and COPII mediated vesicular transport between the ER and Golgi. COPI and COPII are involved in retrograde and anterograde transport respectively. COPII vesicles originate from ERES, which is rich in COPII coat proteins. The incoming COPI vesicles are recognized by tethering proteins; dsl1, tip20 and dsl3 on the ER membrane, which are known as ERIS. This project aimed to determine whether there is any functional relationship between ERES and ERIS by using Auxin Inducible Degron (AID) as a tool. The aim was to tag ERES marker, Sec23 with AID tag and dsl3, representing ERIS with a fluorescent protein. In order to check functional dependence, Tip20 was tagged with AID and the other ERIS marker was fluorescently labeled. The addition of IAA stimulated SCF complex formation; that interacts with TIRI gene introduced in *Pichia pastoris* PPY12 and led to subsequent degradation of Sec23 and Tip20. Further imaging was carried out using confocal microscopy. A significant reduction in fluorescence intensity was seen in cells treated with IAA.



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Research Internship 2016 - 17

Dipali Ajay Shah (PI: Dr. Nikhil Patkar, Department of Hematopathology)

Standardization of an in vitro cell sensitivity prediction assay called BH3 profiling in Acute Myelogenous Leukemia (AML) samples

Apoptosis is crucial for development and maintaining complex cellular function. Mitochondrial pathway or the intrinsic pathway is important for determining response of cells to toxic insults, molecules and/or drugs. The intrinsic pathway is controlled by BCL2 family of proteins which regulates Mitochondrial Outer Membrane Potential (MOMP) which in turn is an important commitment of the cell to undergo apoptosis. BH3 profiling is a functional assay wherein BH3 peptides are used to elicit a response from mitochondria. This technique can be useful in determination of clinical response of patient to therapy. Critical problems in Acute Myelogenous Leukemia (AML) include chemo resistance, relapse and poor response to standard drug treatments. BH3 profiling enables the determination of dependence of cancer cells on anti apoptotic proteins, thus priming of cell which in turn helps predict the therapeutic responses for AML samples. This method was tested on 29 AML baseline samples to determine the effect of chemotherapeutic drugs Daunomycin (D), Cytarabine (C) and a combination of D+C. The priming of cells was correlated to different variables like gender, age, FAB categories, blasts percentage as well as cytogenetic risks to classify patients into different groups and thus determine the clinical response of patients to treatments.

Sherlyn A. Caldeira (PI: Dr. Pritha Ray, Imaging, Cell Signaling & Therapeutics)

Study of molecules responsible for adhesion and invasion in chemo- resistant ovarian cancer cells.

Molecules like the integrins and matrix metalloproteins (MMPs) play an important role in the regulation of ovarian cancer metastasis. Various studies report extracellular matrix degradation and remodeling occurring due to integrins and MMPs, leading to cancer progression. This project aims to study the role of integrins and MMPs in A2780 chemo sensitive and chemo resistant ovarian carcinoma cells. Since MMPs can act on a diverse group of ECM components including collagen, their activity in chemo sensitive and chemo resistant A2780 cells was also checked. The expression of integrin alpha 6 and beta 4 were found to be upregulated in A2780 late resistant cells as compared to sensitive A2780 and early resistant cells, suggesting that integrin receptors are activated. The activity of MMPs in early resistant A2780 cells was found to be higher in comparison to the sensitive and late resistant cells. Therefore, understanding the key determinants involved in metastasis and acquired chemo resistance is of paramount importance for improving prognosis.



Research Internship 2016 - 17

Akeeth Pinto (PI: Dr. Aparna Chaudhari, Fish Genetics and Biotechnology Division)

Studying genetic variation in zebrafish population using mitochondrial D-loop marker

The zebrafish (*Danio rerio*) is an eminent vertebrate model organism for genetic and developmental research due to its small size, early hatchling transparency, rapid generation time, tractable genetic assays and its resemblance to human genome. The degree of genetic variation has been reported to stimulate behavioural changes among many species of fishes and is important to understand the level of fitness and fertility among zebrafish populations. Mitochondrial D-loop marker was used for this study, since it is one of the finest molecular markers for intra population studies. The PCR products amplified were eluted from the gel and sent for sequencing. MEGA and DnaSP software were used to analyze the sequences. The results showed a high genetic variation in the D-loop sequence within the population. The results also displayed distribution of reported microsatellites to be majorly present within the coding region of the genome rather than the non-coding region, where they are normally distributed. Di-type microsatellite repeats were found abundantly and the most common Di-type repeat were TG repeats.

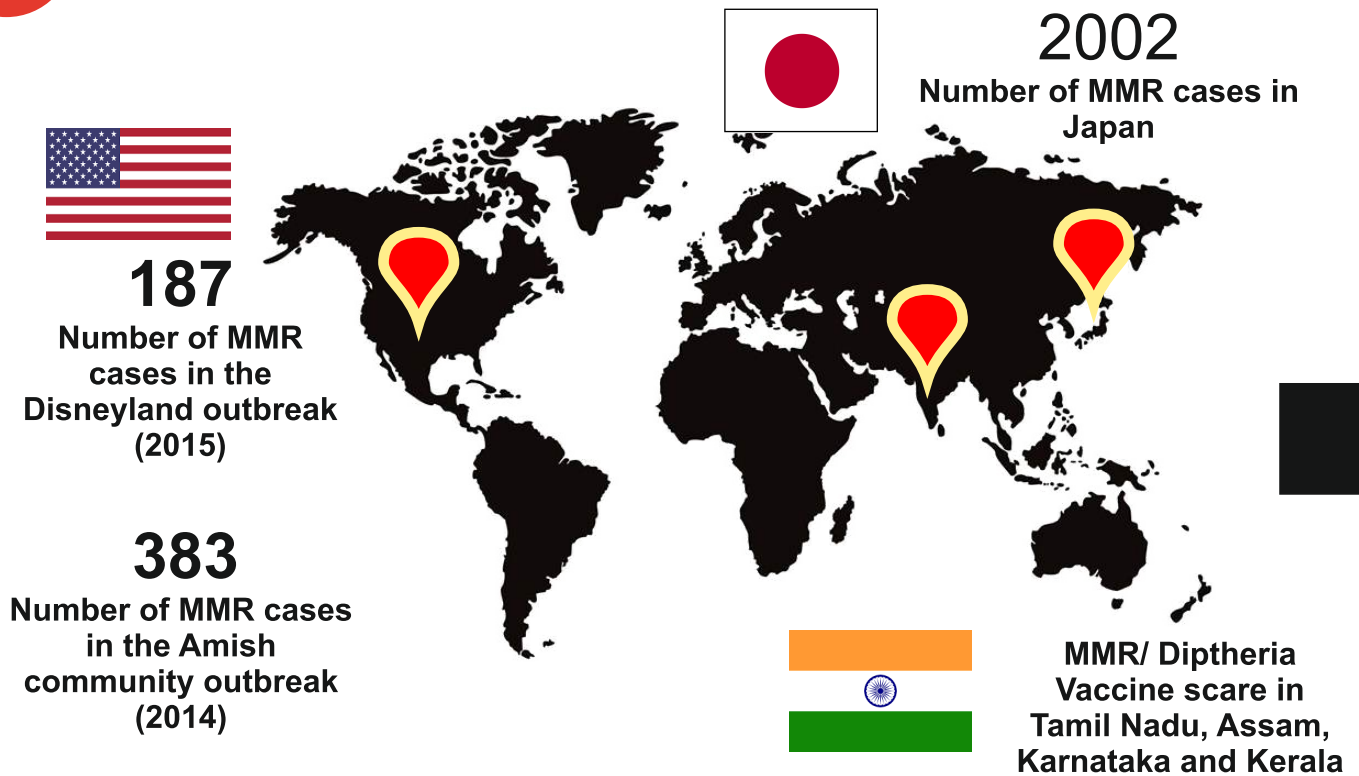
Akshay Leslie D'Mello (PI: Dr. Aparna Chaudhari, Fish Genetics and Biotechnology Division)

Genetic Diversity of *Danio rerio* species from West Bengal assessed using mitochondrial cytochrome b marker

Genetic diversity is an essential, powerful and unique tool for determining ecological status in aquatic ecosystems. In order to estimate the genetic diversity among *Danio rerio* species in West Bengal stocks by mitochondrial cytochrome-b marker, 26 samples were collected from CZebraG lab, a Genetic Resource Center at Andheri. The DNA was extracted and the quality and quantity of the extracted DNA was assessed by performing electrophoresis and nanodrop readings. PCR was carried out to amplify the target region. The cytochrome-b region in mitochondrial DNA of *Danio rerio* contained about 1140 base pairs. The phylogenetic relationship was calculated by using MEGA version 6 software. The divergence was estimated using Tajima's Neutrality test. The results from the study revealed that the population is undergoing low frequency variation with evolutionary divergence recorded to be 2.4331. Another part of the study was the *in silico* characterization of known microsatellite markers within *Danio rerio* species. The *in silico* characterization is also a useful identification of locus across species.

1 THE CRISIS

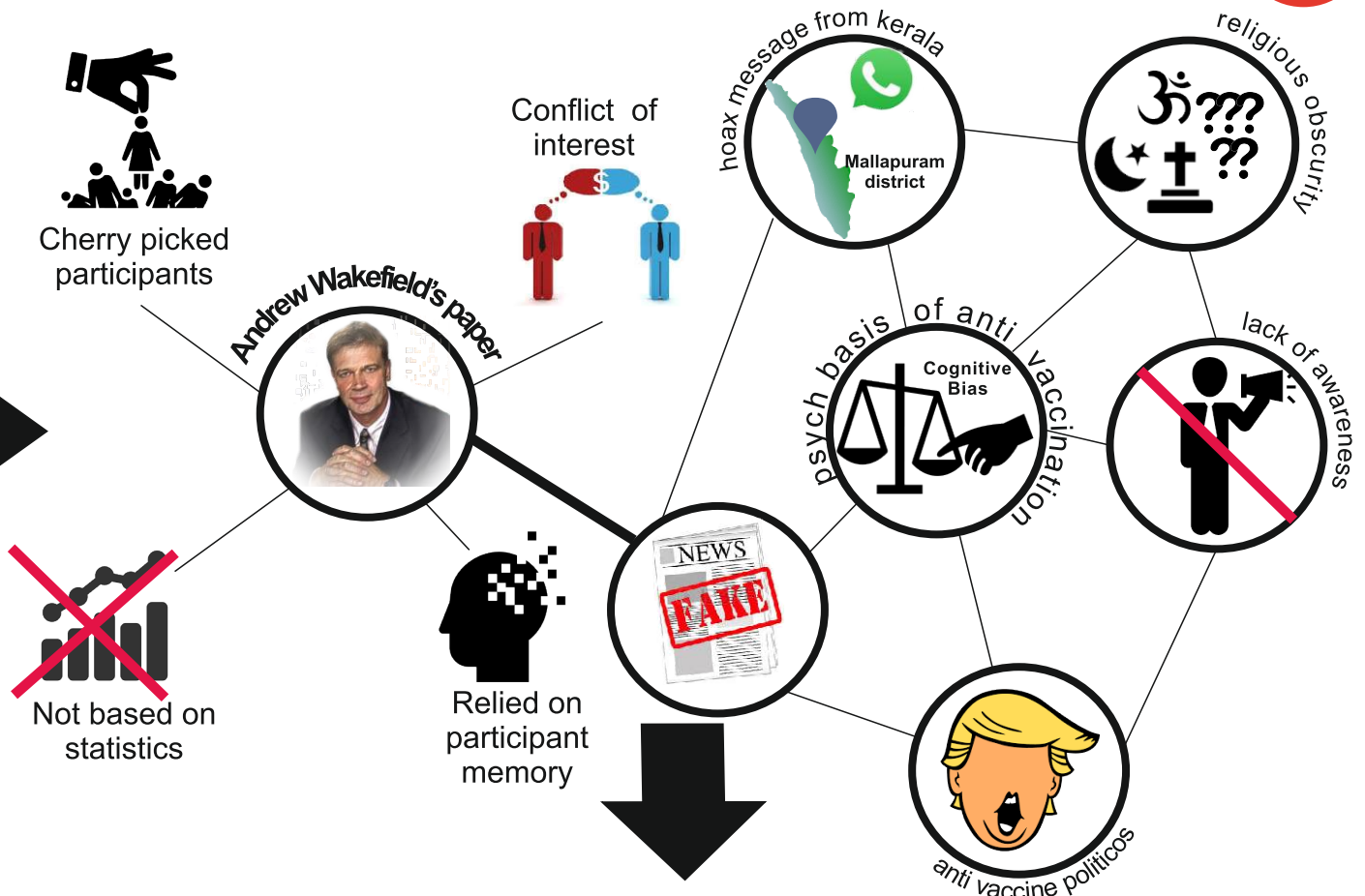
UNFOLDING THE



4 WHAT CAN WE DO ?

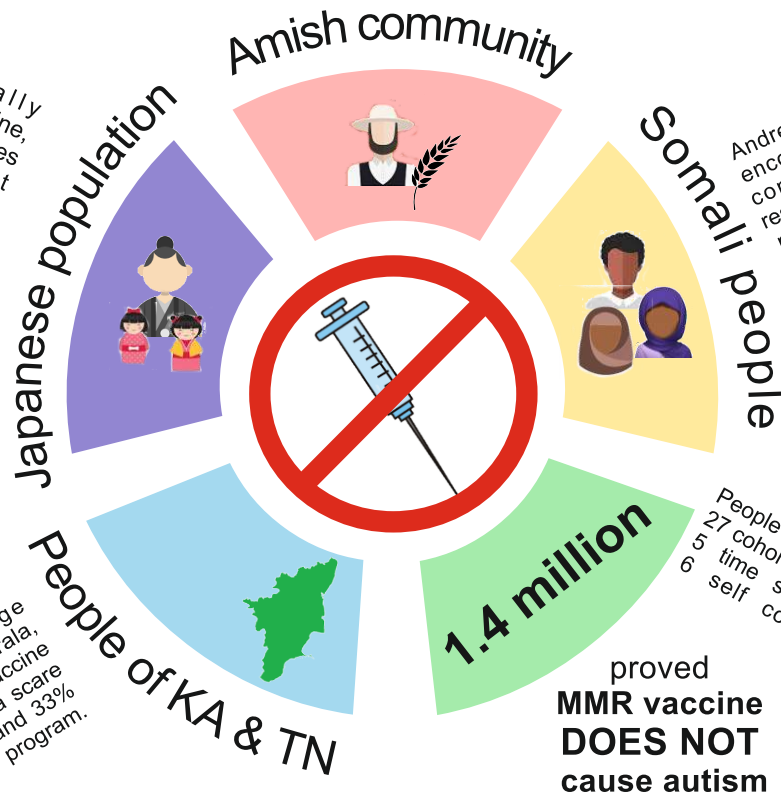
VACCINE EPIDEMIC

FUELLED BY? 2



Two Amish men, who returned from relief work from the Philippines, brought back measles and infected a poorly immunized Amish community in Ohio.

Japan has officially banned the MMR vaccine, as a large number of fatalities through government statistics were observed.



Andrew Jeremy Wakefield's encounter with the Somali community in Minnesota, resulted in declining vaccination rates and an eventual outbreak of measles.

A Hoax Whatsapp message from Mallapuram district Kerala, which accused the Diptheria vaccine to cause impotency caused a scare in TN and KA where 50% and 33% coverage of the vaccine program.

THE AFFECTED 3

The ABCs of Big Data Analytics: A biologist's Perspective



“Data is the new science. Big Data holds the answers.”
- Pat Gelsinger (CEO, Vmware)

In the present day scenario, the term “big data” is creating a lot of buzz, but what does it mean? In simple terms it is an enormous amount of data generated by advancement in every aspect of technology. Initially it concerned physicists and astronomers but has now paved its way into the biological domain. According to Harvard Medical School scientist, Dr. Isaac Kohane; every 12 minutes a new genome is sequenced which gives us a clear idea about the magnanimous amount of data generated. All the high-throughput techniques used in the Human Genome Project to the currently available Next Generation Sequencing have given rise to abundant data. In 2007, sequencing an entire genome would cost up to 10 million dollars, but as the cost of automated sequencers has reduced, sequencing a genome has become a low cost affair and consequently there is a sudden rise in data generation even from small laboratories. At

present, the European Bioinformatics Institute (EBI), UK, stores information about genes, proteins, small molecules etc. which amounts to 20,300 bytes of data. Looking at the massive data generated in biology, it is more appropriate to call it 'big data science'.

Several domains within the biological sector produce extensive amounts of data. The information about a patient's medical history and current health status, along with the clinical trial data and imaging information obtained from biomedical facilities, accounts for data generation. This data needs to be analyzed accurately to gain an understanding about prevailing diseases. The field of bioinformatics also generates a large amount of data from several biological fields; however a major portion of this data is redundant and needs to be curated. Pharmaceutical industries also require data analysis for drug discovery; before coming up with a novel drug, millions of compounds need to be screened. This involves analysis of already present information which is a herculean task in itself.

Big data can be characterized by three Vs: Volume, Variety and Velocity. Data obtained from the aforementioned areas are not only vast but also

heterogeneous in nature. This poses a major challenge for a biologist who is trying to analyze it. To make inferences from the database and facilitate decision making, we need efficient and smart systems in place. Artificial intelligence (AI) plays a crucial role in big data analytics as it possesses the potential to unravel the mysteries within such vast data. AI is the merger of hardware and software systems which counterfeit human intelligence. Softwares like Hadoop, MapReduce and Hive and databases like NoSQL are utilized by social media platforms and search engines to analyze the data generated. Nowadays, the various steps in the analysis of Next Generation Sequencing raw data like adaptor trimming, quality check of raw reads, annotation based de novo assembly, expression analysis and quantification, etc. can be performed by algorithms like MapReduce and APACHE-based Hadoop.

「Every 12 minutes a new genome is sequenced」

On a daily basis, we come across situations wherein there are constant advertisements of a product we have previously searched on web. Mega retailers constantly scrutinize our purchases to predict their shopping preferences. With each order placed, there is an expansion in the company's databank which allows them to understand the market better. Along the same lines, algorithms should be constructed for analysis of complex biological data to cater one's needs. But, in order to design such algorithms, an individual should be well equipped with both computational and biological knowledge. Some might think that data analysis is a far-fetched option for a biologist. On the contrary, the understanding about biology would help in better analysis of data generated in the biological domain. There is a constant demand for data scientists or biocurators in the health care facilities and pharmaceutical industries. They are professionals who deal with collection, analysis

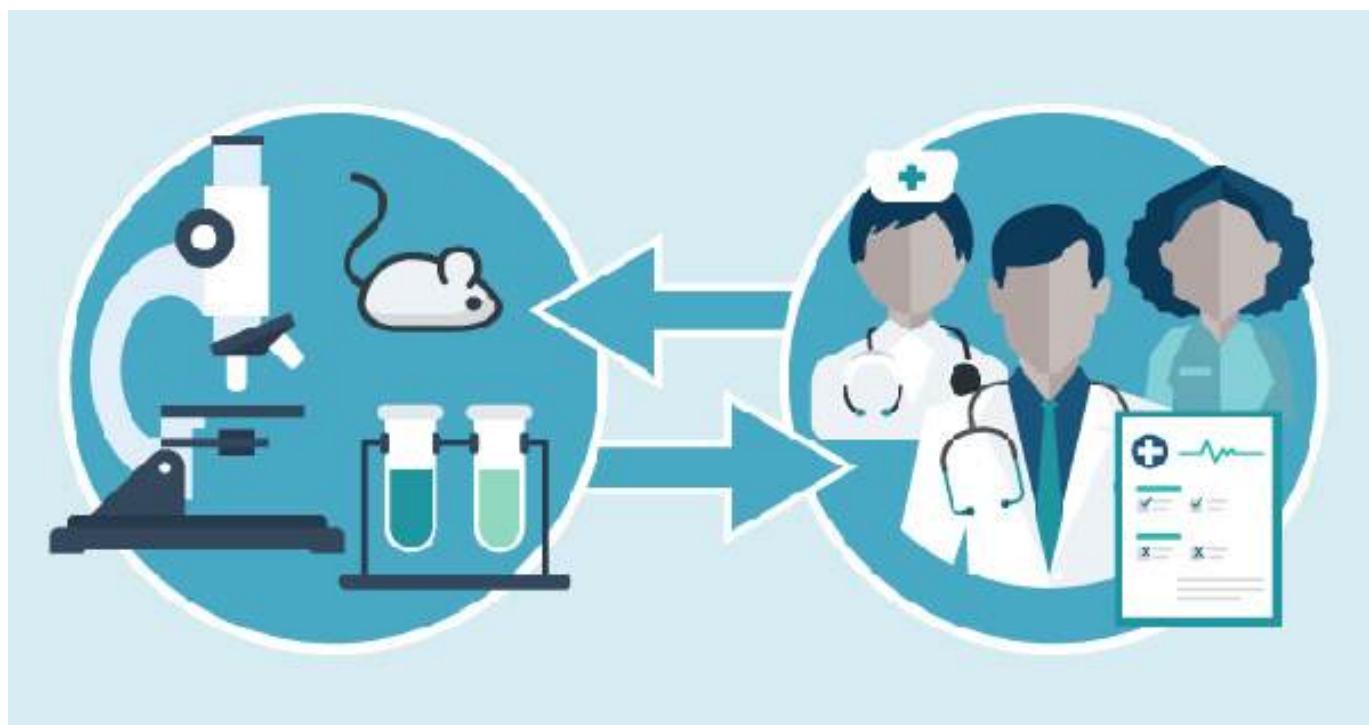
and interpretation of large datasets. It opens up a new job opportunity for students who have a background in biology and data analysis as they would better understand the complexity of biological data and interpret it in an effective way.

「Some might think that data analysis is a far-fetched option for a biologist. On the contrary, the understanding about biology would help in better analysis of data generated in the biological domain」

To be a data scientist, one must have a keen interest in biology with good writing and communication skills. An extensive knowledge of computational science and programming languages like R, Python, C/C++ or Java and ability to present large data in the form of statistical models is also beneficial. Now-a-days, the availability of massive open online courses or MOOCs makes it possible for even a biologist to learn about and certify themselves in data science and analysis sitting at home. Further, courses providing training in analysis and interpretation of real data sets in the context of healthcare and biology are also available. Educational institutes can play a crucial role in catering to students interested this field by conducting seminars and workshops for biological data analytics. This will keep students updated about the new job opportunities available to them in this field. Looking at the current scenario, our major focus should be on how to efficiently translate all the enormous data into information which will help us gain maximum insights into the field.

-Nehal Dwivedi and
Sushmita Varhadi
MSc-II

The Journey of a Drug from Bench to Bedside



“Every failure is a step to success. Every detection of what is false directs us towards what is true: every trial exhausts some tempting form of error. Not only so; but scarcely any attempt is entirely a failure; scarcely any theory, the result of steady thought, is altogether false; no tempting form of Error is without some latent charm derived from Truth.”

-W. Whewell, Author

Idea generation, planning and execution are some of the key factors which help academia benefit mankind. One such example where mankind has benefitted is in case of malaria. Considering the 4,29,000 deaths caused by malaria in 2015, it is encouraging that the study of malaria has been prioritised by National Institute of Allergy and Infectious Disease. Initially, a natural substance quinine, obtained from the Cinchona tree native to South America, was used

to treat malaria. However issues of short-supply soon surfaced. Such supply-side issues were overcome with the discovery of synthetic methylene blue, termed as 'magic bullets', which was found to kill the malarial parasite. Röhl worked on methylene blue chaperoned to a new compound where amino alkyl group replaced one methyl group; this new compound was named mecaprime. Johann Hans Andersag substituted the acridine ring with a quinolone ring of atabrine which was later known as chloroquine. This drug has now become the first-line therapy for malaria. Currently, there is a need for a technology that is cost efficient, gives quantitative and qualitative method of diagnosis and which does not require extensive expertise. In addition, it should be easily available in remote areas. One such product has been invented by Dr. Sai Siva Gorthi and team at IISc Bangalore. This product can be attached to a smartphone and a complete workflow of clinical microscopy is available in 30 minutes. In this manner, what was once considered a deadly disease with no known cure has become one which can be efficiently detected and cured.

Another notable success is in the field of adult stem cell based therapy in relation eye to injuries and defects. Accidental burns or limbal stem deficiency are known to cause partial or total blindness. In case of such ocular surface disorders, keratoplasty is the standard treatment. However, this intervention is risky and not always successful due to graft rejection. One solution to this problem is the use of limbal stem cell transplants. In one case, a 31 year old suffering from acid burn in his left eye underwent an unsuccessful keratoplasty. In another attempt to treat the condition, limbal progenitor cells, extracted from an amniotic membrane, were used to cultivate limbal epithelium in vitro. This was then successfully transplanted to the patient's eye. Similarly, fibrin-cultured limbal stem cells were used in an autologous transplantation to treat the affected cornea surface in patients totally deficient in limbal stem cells.

Despite the success stories we hear about various drugs and therapies, there are just as many that do not make it into the market. One such example is an embryonic stem cell based treatment that was proposed for diabetes mellitus- an autoimmune disorder associated with side effects including kidney failure, loss of eye sight and cardiac arrest. In spite of numerous efforts, the use of these stem cells as a therapeutic is still mired in ethical controversy and debate.

Failure of a trial or drug could also be attributed to misconceptions that humans have towards a certain technology

Another example is that of gene therapy which makes use of genetic material to modify defective cells. It holds promise as an innovative treatment for many diseases, one of them being cancer. Gene therapy could be useful in producing cancer vaccines, target viruses to cancer cells for apoptosis and administer genes into the cancer

cells to arrest their proliferation. The possibilities of potential treatments through gene therapy are plenty but there are serious safety concerns. A clinical trial was conducted for assessing a gene therapy that claimed to be a potential treatment for partial ornithine transcarbamylase (OTC) deficiency. After enrolment, a patient contracted acute respiratory distress syndrome (ARDS). Two days later, he died due to multiple organ failure caused by anoxia. The therapy failed due to the negligence of researchers in reporting adverse effects to the authority. The gene therapy resulted in the complete cleansing of the erythroid precursor cells and while there was no distribution of the vector adenovirus at the target organ, it was detected elsewhere.

Failure of a trial or drug may not be due to unsuccessful experiments or negligence of the scientists alone; it could also be attributed to misconceptions that humans have towards a certain technology. Recombinant technology took the world of therapeutics by storm in 1980s. The success rate and clinical phase transition were evaluated and it was found that 285 recombinant protein therapeutics that had undergone clinical trials during 1980-2003 by therapeutic companies had received FDA approval for rDNA therapeutics. To a biologist this technology has endless potential; however in reality, it is subject to stringent regulation and often comes under attack from skeptics who do not trust the science behind the technology.

For young scientists, failure should simply be the opportunity to begin again, this time more intelligently. As Winston Churchill rightly said, "Success consists of going from failure to failure without loss of enthusiasm".

-Roma Sunder and Shweta Johari
MSc-II

Messengers of Innovation

Have we come across someone in our friend circle or a relative who will instantly suggest a medicine or antibiotic for a common viral flu or even when you just sneeze? That's because it is our inherent nature to find solutions with the limited information they provide to us. If followed, the consequences are more detrimental than beneficial.

Similarly, despite the significant advancements in biotechnology in the field of diagnosis, newer therapies, vaccines, genomics etc, people tend to have had low levels of understanding of the intricacies. Innovations in biotechnology take years of precision and practice to make sure that it comes to see the light of the day. However, many people discard the innovation as being inconsequential or frugal. The people we are talking about here are not the 'common people' but even doctors, policymakers, fund allocators, drug procurers, formulary makers, drug regulators etc, who should be very well aware about what they do.

For example, let's consider a biotech company by the name X, who after decades of research has brought forth a biological molecule Y, which is used to treat a type of metastatic cancer and provides a median progression-free survival of additional 12 months which is statistically super-significant. Within a span of 2 years, another company Z, reverse engineers the molecule Y, launches a biosimilar of Y at 50% of the price. Though reluctantly, the market tries to accept the molecule and gradually the biosimilar Y gains importance. In all of this, the innovator is left out of the fence and is unable to reap the benefits of the risks taken. The whole idea of how a biotechnology company has decoded the problem of a gene mutation, zeroed down on the gene expression, understood what can bind to the protein of the over-expressed gene selectively, developed a targeted molecule, performed all the stability and efficacy tests, is somehow not receiving appreciation of the innovation. The only evaluation which is done is the cost and the additional median progression-free

survival, which in itself is not only grossly unfair to the innovating organization but is also risking thousands of lives, even if a better option was available.

Though this was just a sore example, it is the reality of the biotech industry. However, it is encouraging to see that some institutions –private and public- have started understanding the value of open communication of innovation, right to the end customers. For example, today there are many centers across India, where genome sequencing tests are carried out for cancer patients. However, only a few, including TATA memorial center in Mumbai, have genetic counselors who are employed to not only explain the concept of genomic sequencing to patients & their relatives, but also, how it can help them in the long run.

Some institutions have started understanding the value of open communication of innovation

In the entire value chain, from need identification to product development to patients having access to medicines, there are evident gaps in the system to which people of the biotechnology industry are not oblivious. In such a scenario the need of the hour, along with innovation, communication of essence of innovation is required. A great need today emerges for biotechnology graduates who understand the science behind the scientific innovation and for them to act as mediators to communicate the value to formularies, procurement agencies, government authorities and physicians. We have seen a flurry of counselors being set up by Patient Support Programs by biotechnology companies to address some of these issues. As much the problem seems to be tactical and a last mile issue, the roots stem from ensuring proper governance.

With more people understanding the variations, biotechnologies bloom as a major

Some of the companies, working to develop potential therapies for rare diseases, have been recruiting a team of MSLs (Medical Scientific Liaisons) who through scientific communication are trying to address the knowledge barrier. Certain companies and industries have set up workshops with these MSL's and with DCGI (Director General Controller of India in the recent years) groups to ensure that the decision makers have a complete image, about the molecule and not just



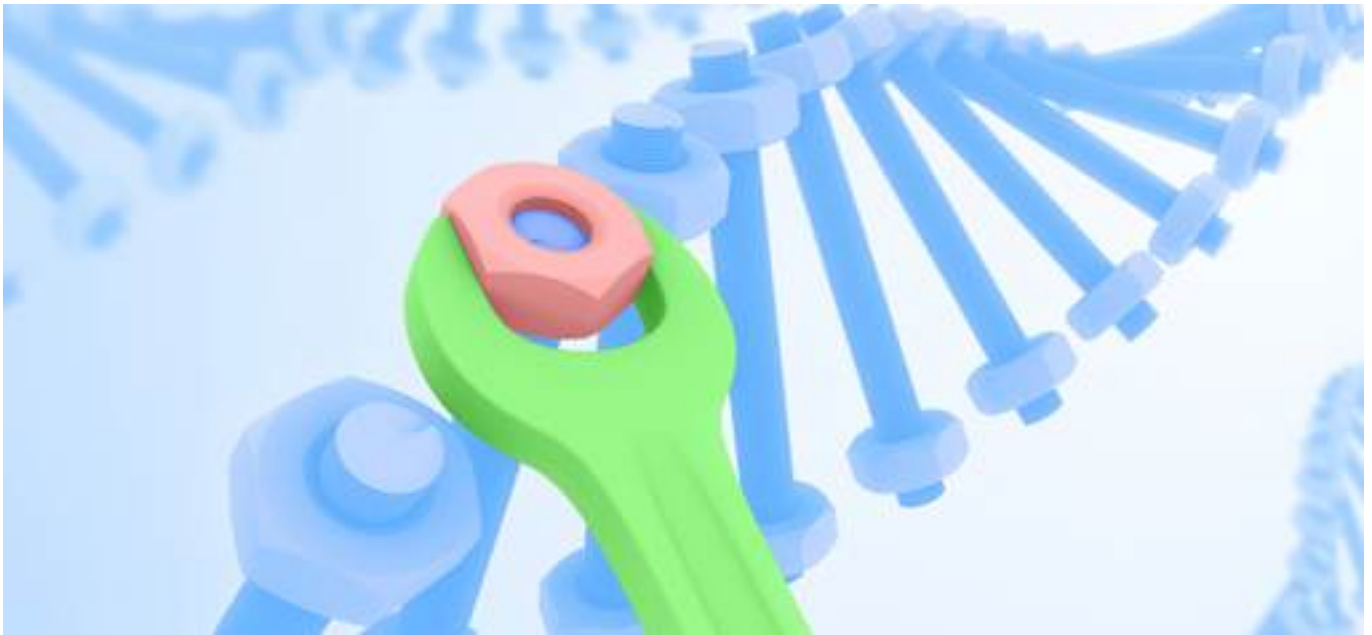
appreciate the available molecule, this includes the action of the molecule and also contribute to discovery of new molecule. With respect to the economy, today Indian reimbursed market is highly fragmented, and with the imminent influx of 2.5% of GDP in the healthcare space from the existing 1.5%, some of the procurement agencies are the people who process and publish government contracting information to announcements, will try and take collaborative decisions with Health Technology Assessment (HTA). HTA system is based on the translation of the molecular value to the actual monetary value of the payer. This kind of evaluation involves the

social, ethical and economic effect by the health technology and this evaluation feeds into the decision making policy. The current biotech graduates who have a specialization in HTA will be key contributors in developing the HTA dossiers but also defend the position based on science. The private market is moving towards relationship marketing, where the role of customers as strategic players in increasing supplies for the company is taken seriously. This essentially opens the scope of at least one medical expert for customers who can address scientific queries on behalf of biotech companies.

The biotechnology industry is flourishing today despite these hurdles. With more people understanding the value of innovations, biotechnology is set to bloom as a major field. Though opportunities are available across different areas, it is important for the academia to build a network with global and local biotechnology companies, hence creating an environment for mutual appreciation of outputs.

Cebin Varghese
Senior Manager Market Access
(Pricing & strategy).
Roche Products India Pvt Ltd.

Inception of a Revolutionary Tool- CRISPR



Recent advances in genome editing techniques have played a key role in finding therapies for numerous genetic disorders, viral infections and even cancer. In addition to gene therapy, engineered nucleases such as meganucleases, zinc finger nucleases, transcription activator-like effector nucleases, and the most recent adaptation, CRISPR-associated nuclease Cas9 are now gaining importance as tools for achieving the removal or correction of deleterious mutations or the insertion of protective mutations.

“CRISPR”, which stands for Clustered Regularly Interspaced -Short Palindromic Repeats, is the hallmark of bacterial defense system and forms the basis for CRISPR-cas9 Technology. Francisco Mojica, a scientist at the University of Alicante in Spain, was the first person to discover CRISPR in bacteria. He proposed CRISPR to be the bacterial defense mechanism against viruses and postulate that it is nothing but remnants of genetic code from the past invaders. Therefore this defense system acts as a genetic memory which helps the cell to detect and destroy the invading virus during the second

attack. A set of active genes called 'cas' (CRISPR associated) play an important role in the functioning of this system. Till date three different types of CRISPR systems (I - III) have been recognized. A number of studies indicate that horizontal transfer of CRISPR and cas genes takes place between strains and occasionally between distant species and genera. Scientists around the world now use this system to edit and express a gene in a controlled manner so as to study the architecture of the genome and its function.

The manipulator just needs to engineer the guide RNA according to the sequence of the gene to be modified

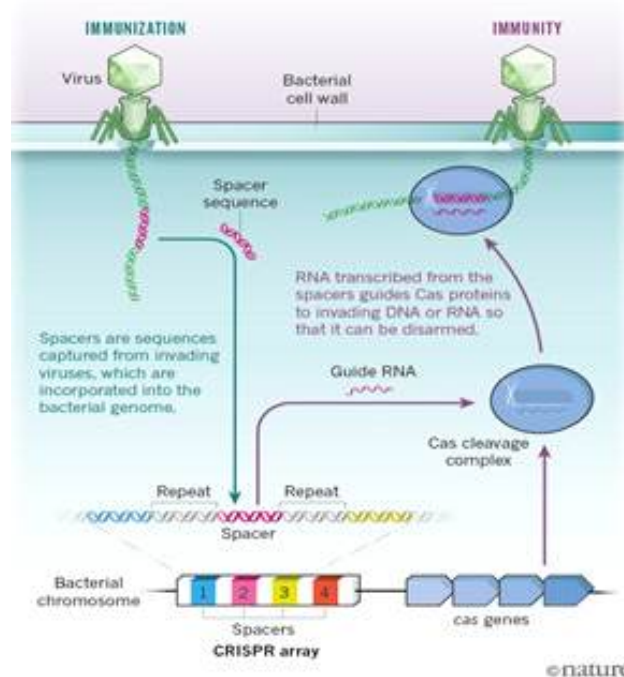
As quoted by one of the inventors of the CRISPR-cas 9 technique, Emmanuelle Charpentier, “The enzyme Cas9, an endonuclease, is programmed with a guide RNA to target and cleave a specific DNA sequence at two strands.

The manipulator just needs to engineer the guide RNA according to the sequence of the gene to be modified.”

In the year 2013 two groups of scientists' successfully engineered CRISPR system from *Streptococcus pyogenes* and *Streptococcus thermophilus* into mammalian cells for genome editing. The *Streptococcus pyogenes* cas9 has been the most efficient and it is used for genome editing in various cell types including human, yeast, bacteria, zebrafish, mouse, few crops, pig and monkey cells. The CRISPR system not only activates the cas genes but also the guide RNA. The role of the guide RNA is akin to that of Sherlock Holmes, in that its function is to find the target to be edited. One of the specialities of CRISPR-cas9 system is that it can target multiple sequences at a time. The cas9 mediated genome editing helps to develop novel transgenic models which depict genetic mutation found in the human population. In case of plants the genome could be edited in such a way that plants could over express a particular type of secondary metabolite, which is commercially important.

The cas9 proteins can be injected into fertilized zygotes to achieve a heritable change at one or more sites in the genome. This alteration experimentation by scientists has led to raising fears over safety and the potential to create "designer babies." The debate on banning CRISPR based research led to a summit in 2015, hosted by the National Academy of Sciences and the National Academy of Medicine's Human Gene-Editing Initiative USA, where experts from around the world gathered to discuss the scientific, ethical, and governance issues associated with human gene-editing research in . This global convention led to a few remarkable conclusions that have influenced the policies today.

One of the most important conclusions recorded was that intensive basic and preclinical research (subject to appropriate legal and ethical issues) should be applied to technologies involved in gene



Lasting Protection

About 90% of known archaea and one-third of bacteria have some form of CRISPR-Cas immunity. This is controlled by a cluster of short DNA repeats separated by 'spacer' sequences and a series of nearby genes that encode CRISPR-associated (Cas) proteins.

editing of human embryos and germline cells. Furthermore, these modified germline cells should not be used to establish a pregnancy.

Even though CRISPR has potential in formulating future therapeutics, this technology will need a robust methodology so as to optimize its efficiency, specificity, and safety.

There are limitations like generation of off target mutations. In order to have a successful therapy, the cas9 has to target the right sequence in the whole genome and at the same time avoid off target mutations which can be deleterious. The academia and the clinicians need to converge their ideas and experiments using CRISPR cas 9 to cure the most crucial human diseases with least risks involved.

- Abhilash Babu
Msc -II

Seeds of Uncertainty or Seeds of Belief



Genetically modified crops are plants which have been altered by genetic engineering. The aim of genetically engineering plants is to develop food sources which offer either an improvement over existing varieties or have health benefits. Characteristics like higher nutritional value, resistance to insects and reduction in the synthesis of lethal compounds are some of the modifications introduced into crop plants. However, the use of such technology comes with its own risks. It is a possibility that pollens from GM plants might get disseminated and cross-pollinate with traditional varieties. In reality, anemophily may occur but the production of a novel variety requires sexual compatibility. Even with the low possibility of gene transfer, contamination can be avoided by succession planting (plants having staggered maturity dates) which would result in pollination of different plants at different times.

At present, one of the arguments raised by anti-GMO activists is that genetic modification is transgressing the laws of nature. According to them, plant breeding at the genetic level is a threat to society and will harm the environment. However, widely consumed crops such as maize, are a result of cross breeding due to evolution.

In India, cotton is a cash crop and accounts for 26% of global production. However, there was a decline in yield due to damage caused by insects. To combat this, Bt cotton with the cry1Ac gene was

introduced in the fields. It gave the dual benefit of protecting plants from pests as well as reducing the requirement of pesticides. As of today, Bt cotton is the first and only genetically modified crop accepted in our country. Due to its release India has become one of the leading exporters of cotton. According to an International Food Policy Research Institute (IFPRI) survey, 86 % farmers reported higher yields and returns with Bt cotton seeds than its non-Bt variants and 99 % claimed reduction in bollworm attack. Despite the perceived benefits, Bt cotton has been mired in controversy. There have been reports about cotton farmer suicides but Bt cotton alone cannot be blamed. In 2008, the IFPRI faulted the changes in our country's government policy, cropping patterns and lack of dependable credit. Recently, the Maharashtra State government had solicited the Centre to withhold the Bt Bollgard II seeds which were succumbing to pink bollworms. An enormous number of crops were ruined in 2016 due to escalating resistance amongst pests and similar results were seen in the subsequent year. In order to prevent losses, the Centre recommended going back to the use of traditional seeds and impelled the denotification of the GM variety.

Golden rice, another GMO, is supplemented with pro-vitamin A. Since rice is a staple food in several south-east Asian countries where vitamin A deficiency (VAD) is prevalent, it was a suitable option for genetic modification.

Yet Golden rice has been facing opposition for over 10 years.

The resistance seems to come from factions who claim that consumption of a diverse diet rich in beta-carotene would help reduce VAD. However, it should be kept in mind that a large segment of population suffering from VAD cannot afford such diverse diets.

Another case worth noting is that of Bt brinjal which is resistant to infestation by eggplant fruit-and-shoot borers (EFSBs). Yet, it received a lot of resistance and as a result the then MoEF minister, Mr. Jairam Ramesh, placed a moratorium on its release in 2010. This was in spite of the fact that two expert committees (apart from the GEAC) were set up which approved of Bt brinjal. The logjam was attributed to several factors—opposition from brinjal producing state governments, no unanimity among the scientific community, questions raised about the safety and testing of the product, unfavourable bias and fear among the public and the lack of an independent biotechnology regulatory authority. Its release would also mean handing over the seed monopoly to the private sector, a scenario that was not favoured by the government. The government called for fresh scientific investigation into the matter until all parties were satisfied. However, seven years later, there does not seem to be any significant progress in this case and the 'temporary' ban still continues.

The BRAI would be an autonomous and statutory agency to regulate the research, transport, import, and manufacture of biotechnology products and organisms

DMH (Dhara Mustard Hybrid)-11, a hybrid mustard variety, claimed to give 25-30% higher yield than already existing varieties. This crop was

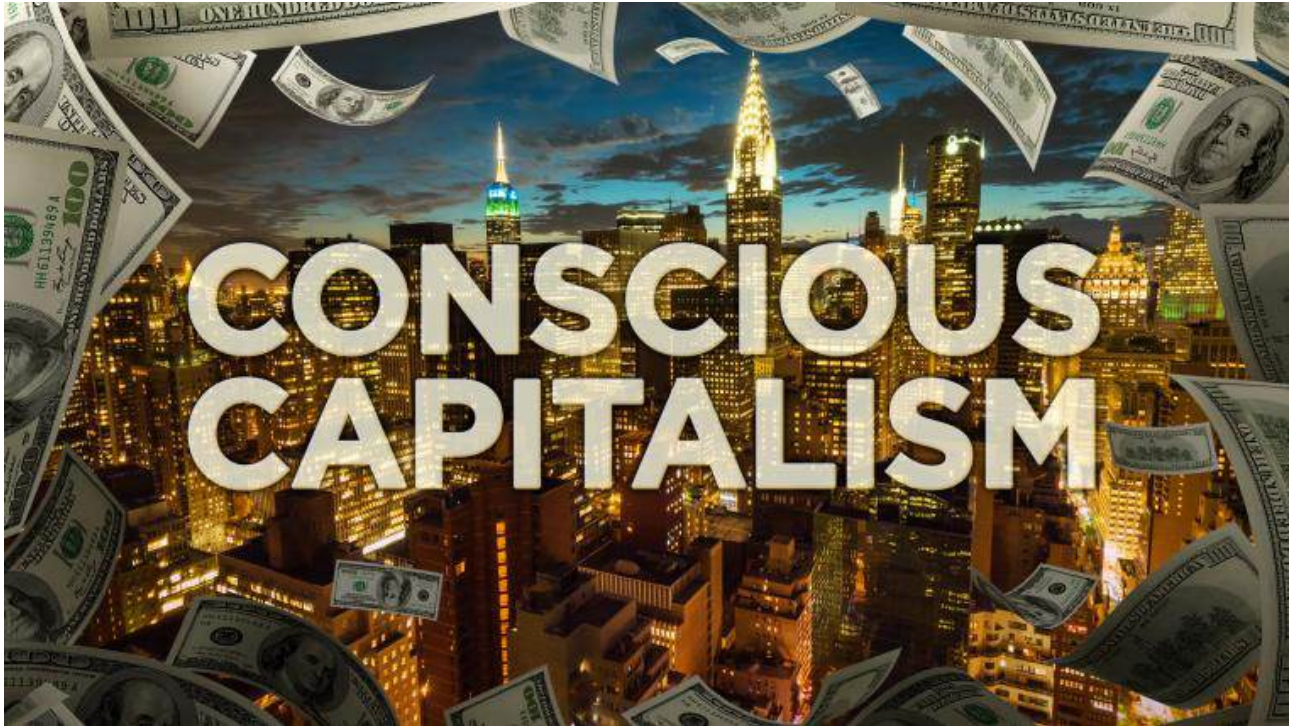
approved by the Genetic Engineering Appraisal Committee (GEAC), a regulatory body which works under the Ministry of Environment and Forests and plays an important role in commercialization of hybrid crops. GM mustard has gone through several toxicity experiments on mice as well as safety tests, but this is not being considered by the GM opponents as they demand for better safety assessment. The hybrid variety has still not moved to the fields. This will occur only after the current Environment Ministry sanctions it.

The Department of Biotechnology (DBT) is taking initiatives to help the stand of GMOs in the country. Firstly, it created a publically accessible online database called the Indian GMO Research Information System (IGMORIS) which provides information on GMOs and their products thereof. Secondly, the DBT drafted the BRAI (Biotechnology Regulatory Authority of India) bill in 2013, the objective of which was to promote safe use of modern biotechnology. This body would be an autonomous and statutory agency to regulate the research, transport, import, and manufacture of biotechnology products and organisms. However, the bill is yet to be passed by the Parliamentary Standing Committee.

India lags behind in the global yield of crops in spite of being an agrarian economy. Additionally, the agricultural sector is facing the menace of climate change, degradation of soil quality, lack of water resources and decreased land under cultivation. To fulfil the needs of a growing population, the government should boost and strengthen research in the field of plant biotechnology. Efforts have to be taken to popularise GM crops and quell oppositions that do not have any scientific base. There is also a need to put in place one regulatory body to oversee all issues and approvals relating to GMOs. It remains to be seen whether India will grow to accept GM as a boon for achieving food security or whether it will fall back on tried and tested methods.

- Jinal Mehta
MSc-II

Is the Desire for Profit and Fame Blinding Scientists?



It has been rightly said that “A country without innovation is like a car without an engine, it's never going to move ahead”. Anything and everything responsible for bettering the quality of life on the Earth, from electronic appliances and industrial machinery to pharmaceuticals and automobiles have been the brain-child of researchers over the years. Innovation should therefore be the main goal of the scientific community, but very few researchers in this day and age work towards innovative research. The goal has rather shifted to gaining maximum publications in reputed scientific journals and having more patents to one's credit. “Publish or perish” have become the latest buzzwords in the scientific community.

Capitalism could be very simply defined as a system in which the rights to produce and sell goods are owned by a small group of people, wholly based on earning profit. In recent years fields like research & development, education, information technology and the media also seem to

have succumbed to the malaise of amassing wealth.

The recession in 2008 served as a rude awakening to the world. The goal of maximizing profits had compelled many reputed companies known for their research and development, to suppress, manipulate and fabricate scientific data over the years. Big pharmaceutical giants were accused of misleading consumers, thereby, costing them a collective fine of over \$11 billion.

<.....>

*Competition compels
scientists to prefer
“capitalism over curiosity”*

<.....>

Academic publishing proves to be an ideal business model to generate huge profits. The number of papers published in journals of high impact factors and the number of citations the papers achieve has hugely influenced the career goals of the scientific community.

Though the number of papers published is abundant, the qualities of data they contain are highly questionable. Dr. Eric Smart from the University of Kentucky was studying the molecular mechanisms behind diabetes and heart diseases. His publications in this field garnered a huge number of citations. However, it was learnt in 2011 that he had forged 45 figures in a period of 10 years. The problem is huge, especially in the health care industry where the research is based on the requirements of companies that financially aid the research. Even clinical trial data is often tampered with or may lack important facts like whether the trial was randomized or the ethical considerations were met with.

<.....>

*Research carried out to
benefit the community by
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scientists and institutions
over benefiting an individual,
is what the scientific
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lacking today*

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Competition is another driving factor that compels scientists to prefer “capitalism over curiosity”. Initially, when modern science took shape after the Second World War, the number of scientists in the field was only a few hundred thousand. Today the numbers have raised to around 6 to 7 million researchers; this competition could be a reason for some of them losing their taste for quality and pursuing quantity instead. This has also led to lesser collaborations amongst researchers. Recently, there was a dispute in the US Patent and Trademark Office for claiming patent rights to the CRISPR- Cas9 gene-editing technology between two renowned institutions. The two institutions had filed for patent rights to the technology with similar uses just seven months apart. The dispute would not have occurred in the very first place, if the two institutions filed the

patent as co-inventors.

The patent could be licensed by other institutes cheaply, that could be used to fund an academic organization to study the technology and could also be licensed by industry to create a market for the technology that could further generate funds for academic research. Thus, research carried out to benefit the community by collaborative efforts between scientists and institutions over benefiting an individual, is what the scientific community seems to be lacking today.

Clearly, the world is in need of a system that keeps rethinking the fundamentals of research time after time. Research will only be helpful if it has some value in increasing job opportunities, bettering health care systems, protecting the environment, and enhancing the quality of life on Earth. As long as scientists are infatuated with metrics, and capitalism overpowers scientific curiosity, profit will be the only aim of every scientific endeavour.

-Evelyn D'Souza
MSc-II

OUT - OF - THE - WAY

Architecture is a mixture of arts and science. The aspects of designing, one is to keep beauty and elegance in mind and along with it applying mathematical and scientific knowledge to it. In setting up of research labs, architects focus and design the labs based on a research equipments. Therefore, there is a need for someone for creating a workplace, with people in consideration. This is where a biotechnologist comes into picture. They know the purpose of the labs and can effectively combine the required components and create a safe, sound and lasting spectacular lab.

ARCHITECTURE



LAW

To prevent innovative and novel ideas from being stolen thousands of patents are filed each day. Also, there is a steep increase in fake products nowadays. To protect your ideas from the violators, biotechnologist can pitch in as patent analyst. Patent analyst get to know about the latest technology in advance. So, if you are fascinated by recent technology, have a strong base in core concept and good analytical mind, this job is for you.



ARCHEOLOGY

Incomplete and even misleading pictures of past from archaeological sites is the main reasons for archaeologist to predict likely scenarios. Archaeologist aims to acquire ample evidences to interpret the event correctly. Sometimes it is tedious to know whether the interpretation is true or false. This is where a biotechnologist can pitch in and with the help of fingerprinting techniques, DNA analysis, and chemical residue analysis, to support concrete evidence or to reject a scenario.

Industries which supplies equipment, reagents etc. to labs in which research is conducted require people who combine management skills with basis of biological knowledge. So, a biotechnologist with a good background in biology and business can do well in this field. The sales person gets the first-hand knowledge of the product, the science behind it and meet laboratory managers to sell their projects. Thus, supporting a research work give rise to a different industry altogether.

BUSINESS



A YouTuber can be defined as the person who created content for a popular social media site – YouTube. It is a dream job of many people. The advantage of this job is along with this job they will be able to do whatever they want to do and a better option for the ones who don't like to go to office and do a repetitive task. As a biotechnologist one can create contents for science channels, present an interesting fact about the latest research and make the common people aware about the misleading facts with proper scientific justification.

YOUTUBERS



MOVIES

Biotechnological techniques like cloning has been the major source for science fiction movies. With all its near mythic nature of processes, questions of ethics and manipulation of nature makes biotechnology a staple of science fiction media. Science-fiction movies and stories are major influence of propagating complex biotechnological related terms and concepts into public. Many Science-fiction authors are scholars of their scientific fields. Lot of experts from field can serve as advisors on science-fiction movies to authenticate the scientific side of the movies. A lot of young people are in turn likely to develop a fascination for biotechnology because of movies such as Jurassic Park, Spider-Man etc.

-Jimcy Rajan
MSc-II

SCIENCE FOR ALL GETTING TOGETHER IN A CREATIVE WAY!

Science is that word which makes a lot of people uncomfortable who aren't familiar with it. The thought of science pops up the image of laboratories and the infamous white coat. It isn't that typical, if you have the genes of observation, if you are fathomed by nature or if you simply are inquisitive then the shoes of Citizen Science will be accurately fitting. There are many mainstream activities which are done for entertainment, research with scientists and non-scientists can also be done for the same purpose but this marks novelty. Though it sounds off-beat, citizen science is just another way of involving science and fun.

Citizen science is an exclusive concept that enables the general public to contribute to science at the same time discovers nature and its undying secrets through their own endeavours. Initiated in Mid 1990 in USA and then UK, notion of citizen science has been adopted by different countries and has been of great value in African and South American Countries. The fields that can involve citizen science are not restricted to Biology but also Ecology, Astrology, Psychology, Computer science, Engineering and many more. A citizen scientist is the one who voluntarily contributes time and resources to scientific research. The usual process in conducting research involves the public in data collection, analysis or reporting of different types of data.

This very interesting idea has begun to sprout in India. It all started by a project called 'Migrant watch' initiated by National Centre for Biological Science (NCBS) in 2007. Birders in India came together enthusiastically for the first citizen science endeavour. Around 350 Indians enrolled to submit data of spotting migratory bird species. A list of nine species of bird that flew all the way from Central Asia to different parts of India and the moved to North for breeding.

Ever wondered how Ronal Wesley from Harry Potter would react to following butterflies rather than Spiders? Well this would have been possible in Karnataka; here citizen science projects like butterfly surveys, bird surveys, and animal sightings are carried out. With the aim to protect wildlife and conserve nature these projects were also shared with Government and have resulted in important findings like the lack of preventive measures provided to people against loss of crops and livestock by animal attacks. These projects in Karnataka also helped villagers to file claims and compensation due to the impact of wildlife on people.

Man is a subset of nature; hence its connection to nature is strongly rooted. In any space a touch of green is always accepted. Be it open land or balcony, maintaining gardens has become part and parcel of a house. People with such interest got rolled in another project called 'Seeds for Needs' wherein different varieties of seeds were grown and tested for their yields.

An activity that looks nothing more than continuation of a hobby is the new way of getting people together and at the same time contributing to Science. Future projects like studying your pet behaviour, submitting soil samples, measuring nutrients in food can be taken up. In this it is not only primary scientific researcher's role in developing technology and understanding basic science but also the common public. It is enjoyment and learning, with such projects people are made aware, scientific attitude is instilled and more over the message of responsible citizen is sent across.

- Komal Mishra
MSc-II

Suspicious Science



'Science' is a word that everyone is familiar with and as a whole, it is subject to many different thoughts and opinions. It has given a lot of hope and expectation for a better future, including cures for life threatening diseases and a better quality of life. Researchers all around the globe devote years trying to come up with work which will benefit the society. A unique discovery would imply publications in reputed journals along with media attention and a lot of respect and recognition- not only in the scientific community but across the globe.

Consequently, it is possible that members of the science community might use unfair means to achieve that honour. These unfair means could be minor changes in data to falsifying entire results. Over the years several such cases have been reported; one of them being that of Dr. Raphael B. Stricker, a scientist at the University of California at San Francisco. In 1985 Dr. Stricker was working on thrombocytopenia in association with AIDS and related conditions. The research was carried out on two different groups of individuals (homosexuals and heterosexuals). In his findings he stated that out of the 30 homosexuals, 29 showed the presence of serum antibodies that attacked cells responsible for blood clot formation. However, there was no trace of antibodies in heterosexual patients. The findings gained a lot of

attention and were published in a popular journal of medicine. Later on, three principle investigators tried to reproduce the published result and found discrepancy in the data. According to their results, half of the population of heterosexual patients they examined, showed the presence of antibodies. It was reported that only 1 result out of the 4 results published by Dr. Stricker was positive. An enquiry was made and the application made by Dr. Stricker for the production of a drug which would suppress these antibodies was rejected. News of the results being retracted surfaced in 1991, however the original article submitted by Dr. Stricker still stands today.

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Research professionals are not the only ones that are involved in or responsible for such scandals; all stakeholders of research play an equally important role in allowing or disallowing such malpractices.
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Another case worth noting is related to cancer research and was reported in 2010. Professor Anil

in high-profile journals stating that certain gene expression signatures predict a patient's response to chemotherapy. Based upon his finding three clinical trials were in the process and it was supported by National Heart, Lung and Blood Institute (NHLBI), National Institutes of Health (NIH), National Cancer Institute (NCI) and accordingly grants were provided for the trials. However, two bio-statisticians soon raised concerns about the studies and investigation had been done. It was found that Dr. Potti had manipulated experimental results as he claimed 6 out of 33 patients responded positively to dasatinib while in actuality only 4 patients enrolled and none had responded. It was also found that he presented false research data in a grant application, a submitted manuscript and his nine research papers and had altered details on his resume as well. Following these investigations, the published papers were retracted by the journals.

While some individuals might try to gain a name by presenting manipulated data, there is assurance that others are making efforts to raise questions and replicate results due to which these cases of manipulation are reported

Research professionals are not the only ones that are involved in or responsible for such scandals; all stakeholders of research play an equally important role in allowing or disallowing such malpractices. One such example is of a commercially available antibiotic, Telithromycin, which was developed and released by a prominent pharmaceutical company. A turning point in the case came in 2001 when it came to light that one of the main researchers involved was distorting data but the company had not intervened. The research proceeded and the drug came to market around 2004. In 2007, 23 cases were registered for liver

failure which involved 4 deaths. After the cases were reported, the FDA retracted the drug from the market. In addition to this, the company was not held guilty by the court on the terms that the drug was not prescribed by the company but by doctors.

Scientists have been categorized as truth seekers however such misconduct erodes the truth. While some individuals might try to gain a name by presenting manipulated data, there is assurance that others are making efforts to raise questions and replicate results due to which these cases of manipulation are reported. Whether all scientific frauds come into light is a thought worth pondering upon. The answer to this is still very controversial and debatable. One way to avoid scientific misconduct would be to ensure elaborate cross-checking and verification of submitted documents. Consumers can also play their part by being alert and curious about scientific findings they come across.

-Aakanksha Chand and
Shruti Kharat
MSc-II

ETHICAL PRACTICES IN DATA GENERATION : AN INSIGHT

“Ethics is knowing the difference between what you have a right to do and what is right to do.”

-Justice Potter Stewart, Supreme Court of the United States (1915-1985)

We belong to the 21st century where everything is digitalised and modernised. Messages are sent via emails and text messages, books are read on kindles, we leave behind breadcrumbs like Hansel & Gretel with every online bank transaction we do. However being informed and conscious members of the scientific community, we must make constant efforts to apply the concept of data ethics in research practices for the betterment of the society.

As defined by Floridi and others in a widely accepted article, data ethics as a new branch of ethics that caters to moral problems related to data which includes a wide range of aspects such as data maintenance, storage, processing, accessibility, artificial intelligence, the algorithms of the program, hacking and last but not the least; the responsible way of using data.

National Institute of Health (NIH), The National Science Foundation (NSF), the Food and Drug Administration (FDA) etc. have defined guidelines which make sure that all research work is carried out in an ethical manner. Some of the main of the main attributes of ethical research

practices are:

- Honesty.
- Integrity
- Openness
- Confidentiality
- Social responsibility
- Abiding by the Law

Plagiarism is a major concern in current times. Plagiarism violates the intellectual property right of an individual i.e. stealing or using another individual's ideas, thoughts, research without his/her approved consent. It implies that the published information or ideas should be novel and not copied from anywhere else. Various tools like CrossCheck, Turnitin etc are designed to curb plagiarism.

There are various reasons due to which a researcher may turn to unethical practices. The most common reason is institutional pressures to meet the ever changing needs, demands and expectations. The second important reason would be to gain monetary benefits. Often in order to minimise the efforts and to gain easy information, the researcher tends to steal another's work and publish it as his/her work which is a criminal offense according to the law. A misconception within the scientific community is that results of research must be positive. However in reality, any results regardless of whether they are positive or negative are valuable and should not be manipulated.

In conclusion every individual must make responsible use of available data and follow ethical practices during data generation .

-Shalini Chowdhury
MSc-I

CHRONICLING A DECADE IN THE DEPARTMENT

**“YOU DON’T HAVE TO BE
CRAZY TO WORK HERE BUT
IT HELPS!”**



CHRONICLING THE

Established in
the year
2007



2009
Organised
first

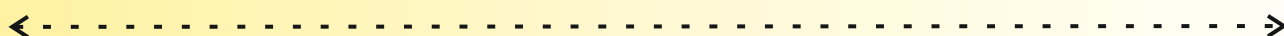


2010
FUNDING BY
DR. EDGAR DA SILVA

DEPARTMENT OF BIOTECHNOLOGY

DEDICATED TO
DR. EDGAR DA SILVA

Alumnus (1962) and Former Faculty of the
Department of Microbiology



2010

Establishment of Bioinformatics Lab



**Received
Autonomy
in the year
2012**

2014

**National
Entrepreneurship
Seminar**

2014
**Mrs. Norine
D'Souza**
received
**UGC MINOR
PROJECT
funding**

YEARS GONE BY



2015

*Grant in -
aid from
Sir Ratan
Tata trust*



2015- ESTABLISHED ATC LAB



2015

*2nd prize in
Indian
International
Science Festival*

2015



**FACULTY
WORKSHOP ON
BIOINFO AND IPR**



**2015- ESTABLISHED
INSTRUMENTATION LAB**

2016-17

**ONE TEAM IN TOP 20
BEST INDIA 2017
CONDUCTED BY
ABLE, DBT,
GOVT. OF INDIA**



-Mehvash Godiwala And
Nikita Bhosale
Msc-II



A Talk with Dr. Biswa Prasun Chatterji, Ex-faculty, PGDBT, St. Xavier's College (Autonomous), Mumbai

Q) Describe your experience at Xavier's in 3 to 5 words.

A) Very satisfying and fruitful.

Q) What is your fondest memory in the years you spent here?

A) An average student whom I encouraged a lot during a paper presentation came up to me and said that it was the first time any teacher had noted anything good about her. She promised me that she would do better and she did. Later on she joined a prominent bio-pharmaceutical company and her success made me feel satisfied. Another memory I hold dear is my last lecture with the 2014 batch during their 4th semester, where the students spontaneously stood on their chairs and bowed down to me. The batch of 2017 also repeated this when I was leaving college earlier this year. While they did give me standing ovations at the end of every semester, this was a special moment which still gives me goose bumps.

Never stop dreaming of a better future, dreams are your inner strength. And lastly, as the saying goes "do with might whatever thy hands findeth"

Q) How was your experience with the students of St. Xavier's College?

A) Excellent, I got the best of Bombay. My students came from all over the place and with different grades, but in the end the training they

received from me in theory and in the lab made a mark. They were all a little uneasy in the lab at first, but in the end they learnt so well that I received good remarks from scientists. Particularly, their writing skill improved which made me very happy.

Q) What scope do you see for students of biotechnology in India as well as abroad?

A) There isn't too much scope in India but there are a lot of prospects abroad both in research and in the industry. In the Indian biotech industry the unemployment is very high; hence students are more inclined towards medical writing and other allied careers. Abroad the scope is huge, there is no chance of regret if one takes up a job abroad.

Q) 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?

A) Students should be a good apprentice first. They should work on their research skills and writing skills and hone them to be better than the rest to do well.

Q) Lastly, would you like to give any advice to your students here?

A) Make sure you take up a job- the first one you lay your hands on! Don't think too much about the starting salary, it will improve with experience. And never stop dreaming of a better future, dreams are your inner strength. And lastly, as the saying goes "do with might whatever thy hands findeth"- plan properly to prosper but don't shy away from hard work. All my good wishes are with you and all my help is an email away.



Back in 2013 when I was deciding on a career path, I was not too aware of the field of Biotechnology. After choosing to pursue this subject, it still took me a generous amount of time- three years of my graduation to be precise- to understand the broader meaning of biotechnology. When the time came to think about pursuing further studies, I found it hard to choose my path right off the bat since many people around me were telling me that this field did not have much scope in India. Now, however, I am glad that I chose to do a M.Sc. in Biotechnology from St. Xavier's College because it has helped change my perspective.

Soon after the course began, it became apparent that before I could learn anything new, I would first have to unlearn a lot of what I had picked up so far in my education; more importantly I had to cultivate a new thought process and develop a new approach to tackling questions. Over the years, I had developed the attitude of studying for the sake of marks, but doing this course has instilled in me the habit of reading for the sake of increasing my knowledge. I have been introduced to crucial areas of science like ethics and policy making. Not only did I gain technical skills, but I also got several opportunities to hone my time-management skills, multi-tasking ability and critical thinking ability. This journey has also afforded me new friendships and taught me how to work well with people coming from different backgrounds and schools of thought.

The biggest take-away for me has been the realization that I have the power to ask questions- something we tend to miss out at times. Over the last one and a half years I have realized that hard-work, perseverance and believing in myself can take me a long way. All-in-all, pursuing this course has been a steep learning curve in both academic and personal spheres, and one that I am deeply grateful for.

Froila D'costa
Msc - II

Cherishing Xavier's

As a Student and as a Professor

An interview with Dr. Hrishikesh Pandit, Alumni PGDBT (Batch of 2007-09)



Q) How was your experience at Xavier's and what was your take away from it?

A) My educational experience at Xavier's was far superior as compared to the schooling I received earlier because of the holistic freedom Xavier's provided to each of its students. I was a part of the first batch of this department. Faculty from different departments came together and we were taught by 24 Professors with immense experience in various fields of biotechnology. My deep passion for science was inculcated right here and there has been no looking back ever since. Apart from academics, Xavier's has given me my most cherished memories and I am sure all my batch mates would vouch for the same.

Q) Did you get time to hang out on campus and which were your favourite spots in and around college?

A) We got to spend a lot of time on campus

after lectures and looked forward to doing lab work, which often ran late into the evening. The perks of being the first batch were many, one of which was that we got thorough hands on training in the lab. Right from cleaning to preparing media, we made the most of our time and the department was one of our favorite places on campus. There was also the basketball court, where we would hang out especially during the full moon nights. Around college, Marine Drive was a pretty popular spot and the sandwich stall just outside the Xavier's gate was frequented by us as well.

Q) How has your journey been after Xavier's and what are you doing currently?

A) After Xavier's, I began my Ph.D. journey at the department of Innate Immunity at the National Institute for Research in Reproductive Health (NIRRH). Whilst pursuing my doctorate I also obtained a diploma in Chemical Technology Management from the Institute of Chemical Technology (ICT). Currently, I am working as a Research Associate on a project at NIRRH. I also teach Management and Leadership to M.Sc. students as a guest lecturer at Xavier's. I am planning to pursue a post-doctoral in the near future.

*Apart from academics,
Xavier's has given me my
most cherished memories*

Q) You were here as a student in 2007-09 and are now here in the capacity of a teacher, how has the department changed in the years gone by?

A) The department has grown immensely with respect to the space, facilities and the number of students. I am extremely proud and glad to witness the enrollment of focused and ambitious students every year. However, it saddens me to see the reduction in the diversity of faculty members. We benefitted a lot under the guidance of teachers with diverse backgrounds and I wish that had continued.

Q) How do you think the students graduating from St. Xavier's College compare with others in terms of lab work etc.?

A) I have closely observed that students graduating from Xavier's excel much more in comparison to students from other universities. And it's because of what you all are put through in these two years; it might seem frustrating or like too much work at the time but I think it's definitely worth it. When I see students from the department as trainees in my lab, they require less explanation and help and they come across as enthusiastic individuals with good acumen.

Curiosity is the key. Be anxious and have that restlessness to find something

Q) Going abroad to pursue higher studies is becoming a popular trend amongst students. As a researcher how do you think students can be encouraged to stay in our country?

A) There is obviously a reason why people go abroad-because it is more definitive. Without being negative, I would like to say that the quality of research is usually good, there are state-of-the-art facilities, and in general the system there is very well developed. Overall, it is a good experience to go abroad and study. India does have good

facilities, but it tends to be limited and getting access to them is extremely competitive.

Q) How conducive do you think the Indian socio-economic environment is for entrepreneurial ventures in the bioscience sector?

A) It is in a very good space right now. There are a lot of companies ready to offer seed money to start and support independent ventures. Students are coming up with interesting entrepreneurial ideas and the opportunities available for translating those ideas into a product are abundant. However, students must believe in the idea/product they have and go ahead with it confidently.

Q) What is your advice to budding biotechnologists to stay at the top of their field?

A) Curiosity is the key. Be anxious and have that restlessness to find something. Even though we are biotechnologists, we are technologists and we should continuously be seeking answers for the numerous questions that are coming up. Always aim high and look for wider and better opportunities. Do not get intimidated by setbacks and make the most of every opportunity provided.

Life at St. Xavier's College

St. Xavier's College is a world in itself- full of vitality and motivation. After my bachelor's, I dreamt of securing admission here and when I finally did, it felt like the sky was the limit. Since my first day here, I was thrilled to be a part of this glorious institution, with its extensive list of prodigious alumni. Soon after we fell into our academic routine, a special bond developed between the students and teachers. I would often stay back after college hours with my friends to catch up on work and we'd enjoy this time even more because of the beauty of the campus. Discussions we had with our professors about future prospects and career opportunities were always a great source of motivation. The several group assignments given to us were not only something I enjoyed working on, but they also helped enhance my communication and presentation skills. Organizing Palindrome 2016 was another enriching experience that left me with memories I will always cherish. It also gave me the opportunity to develop my team building and leadership qualities.

The time I spent went by swiftly and as my masters came to an end, I realised that the world has a lot more to offer and that there is still a lot left for me to learn. It was during my internship at IIT Bombay that the knowledge I gained here was put to test. I found that the values of punctuality, discipline and team work inculcated in me during my time here enabled me to transition smoothly from an academic environment to a professional one.

The people around me and the nurturing environment of this college have truly helped me grow into the person I am today. I am grateful to have been part of the Biotechnology Department at St. Xavier's College and I feel that I can now sing the college anthem with pride- 'Xavier's gave me roots and wings...opened my eyes to things...and somewhere along the way, you taught me how to fly and how to stay in a world outside so differently...you helped me to become more me...'

-Ketaki Bachal
Alumni'17

HOLDING HANDS TO HELP

Reflections from the students

I never thought our visit would make the children so happy. We played, danced and taught them a lot of things and they had an amazing grasping power. I had so much tension in my mind regarding a lot of things but all of that just vanished and those two hours were simply amazing.

- Amrita Suresh

It was an amazing opportunity to interact with the kids. They seemed to be genuinely interested in learning new concepts. All in all, it was a great chance and I am happy Palindrome chose to partner with Sparsha this year due to which I got this opportunity.

-Advait Kayal

Volunteering at Sparsha was an amazing experience. Small things like taking a photo or dancing made them so happy! They taught us to celebrate every moment. We went with the aim of giving back to the society however it was more of a learning experience for me.

-Minal Nenwani

After interacting with the children I realized that no matter what situation one is going through- never give up. Rather, fight to achieve your goal and make it happen. The almighty God has given us the gift of a beautiful life and it is our responsibility to make each other's life as happy as possible.

-Hanzel Saldanha

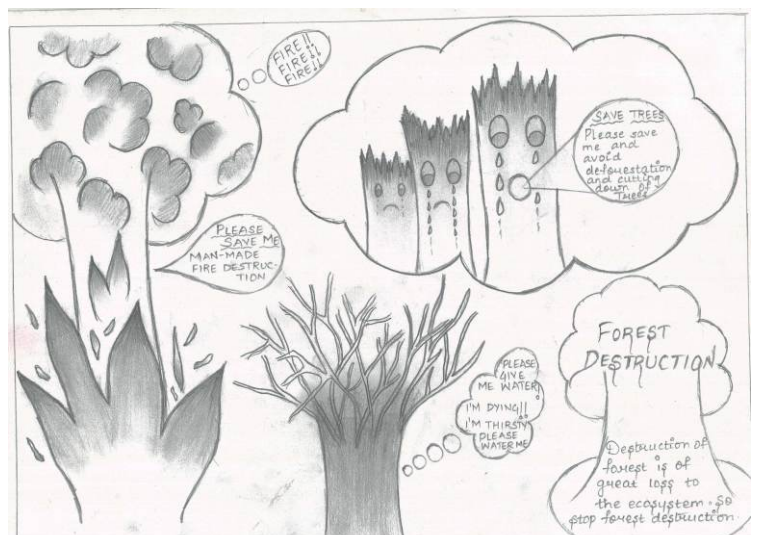
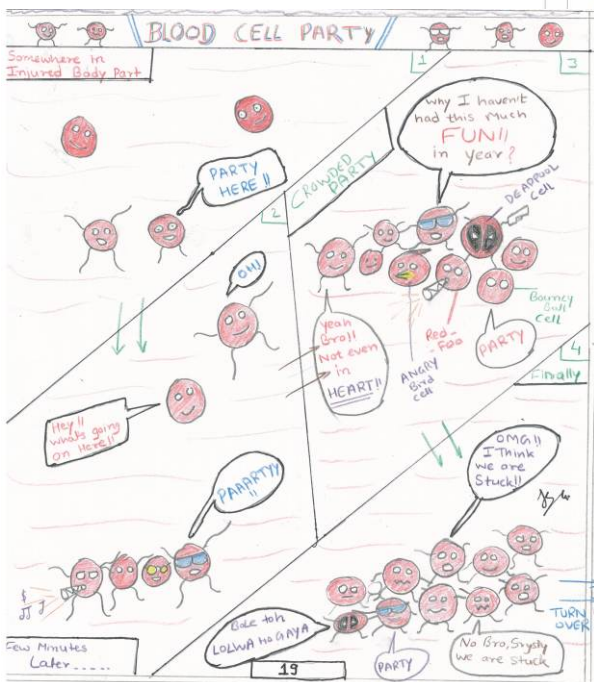
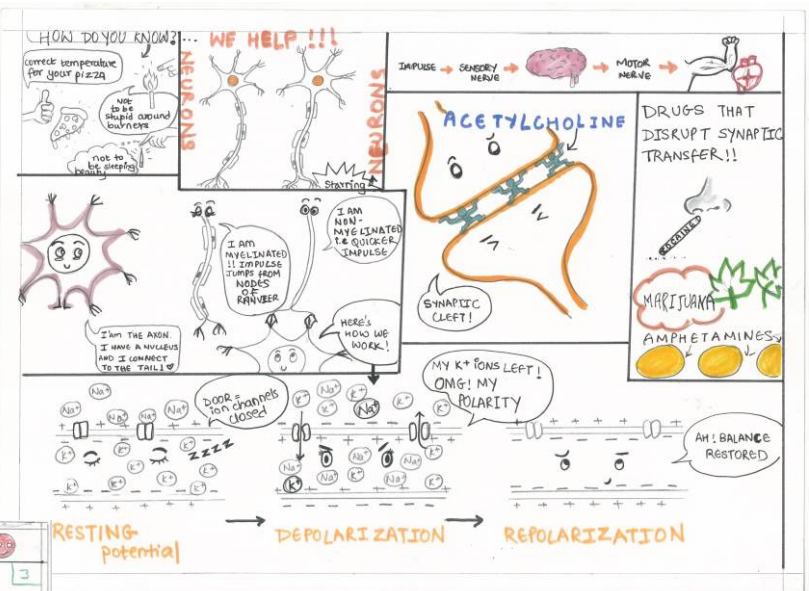
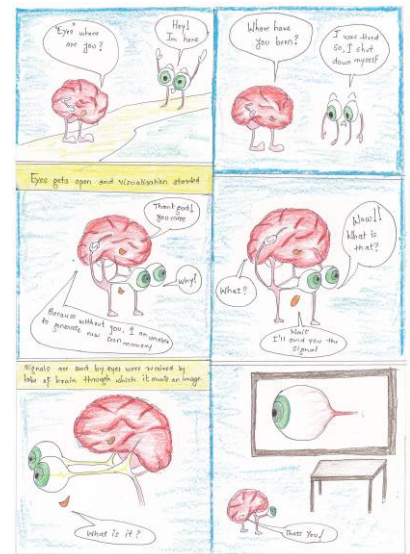
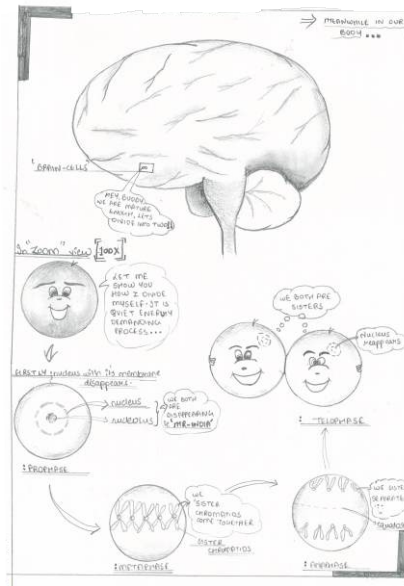
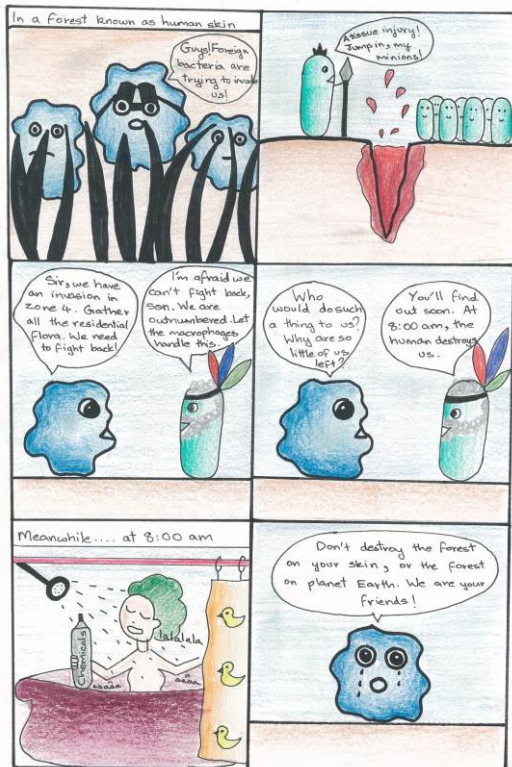
This being my first visit to an NGO, I learnt a lot. The children there were not only very welcoming and grateful but just as much talented and delightful. They spoke for themselves, didn't shy away from showcasing their talents. They may not have the best of facilities but they have learnt to use to the fullest every resource available to them.

-Tanvi Kaku

As soon as we reached, the lovely kids and teacher-in-charge welcomed us warmly. Though less in number they all were so curious to know what we had to offer, I asked myself am I this curious every morning I get up be it for a lecture or for life? I personally enjoyed with them.

-Joice Matthew

CANDID COMICS



The Department

Asst Professor

Mrs. Norine D'souza



HOD, Asst Professor

Dr. Shiney Peter



Asst Professor

Dr. Biswaprasun Chatterji



Asst Professor

Mrs. Ira Vashisht



Lab assistant

Rajesh Mahadeek



Lab assistant

Prashant Manchekar



Class of 2016-18



LUPIN



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