St. Xavier's College (Autonomous), Kolkata
POSTGRADUATE DEPARTMENT OF BIOTECHNOLOGY
EDITION XII

CHIASMA 2022

A CROSSOVER OF MINDS

THE NEXT PANDEMIC : MICROBES AT WAR

St. Xavier's College (Autonomous), Kolkata

POSTGRADUATE DEPARTMENT OF BIOTECHNOLOGY

CHIASMA 2022

A CROSSOVER OF MINDS

ABOUT THE THEME

With the continued threat that antibiotic resistance poses, our issue for this year aims to elucidate the advancements in research underscoring the various mechanisms behind the development of one of the most pressing issues in the modern medical world. Disseminated by WHO as one of the top ten global public health menaces facing humanity- Antibiotic Resistance demands urgent yet coordinated action using a multisectoral front. This edition touches upon a number of different alterations that these minuscular organisms have undergone, in quite a brief period of time, to evolve as one of the most persistent organisms. We have delved deeper into the plausible causes for its rise and drivers of antibiotic resistance through the cover article, and this is our humble attempt to create awareness in hopes of implementation of a more comprehensive global action plan.

EDITORIAL BOARD

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MESSAGE FROM
THE PRINCIPAL

I am pleased to know that the Postgraduate Department of Biotechnology of St. Xavier's College, Kolkata, is sustained in its commitment to publish their annual magazine "Chiasma" 2022. This effort is indeed an efficient way of exchanging scientific thoughts and ideas among young minds.

The Department has been instrumental right from its inception on July 2006, in imparting quality teaching, reflected by the students' performance, both nationally and internationally. The faculty members are involved in intense research and have published their works in peer-reviewed journals. Such scientific research parallel to teaching motivates the students to pursue research after their post-graduation from the department.

I understand and appreciate the relentless effort undertaken by the magazine committee members in editing articles and giving a final form to the magazine . I acknowledge their dedication and hard work.

Finally, I congratulate all the faculty members, support staff and students of the department and wish them all success in their concerted efforts. God bless you all. Nihil Ultra!

Rev. Dr. Dominic Savio, SJ
Principal
St. Xavier's College (Autonomous), Kolkata

Message From
THE VICE-PRINCIPAL (ARTS AND SCIENCE)

The fact that Chiasma, the annual magazine published by the Postgraduate Department of Biotechnology, is now in its twelfth year of publication is evidence enough of the department's absolute commitment to academics, research and publication.

The magazine provides a space not only for articles related to the discipline but also, I believe, for literary and artistic expression. This is what makes Chiasma a bespoke magazine, designed to shape and develop a holistic development in the students of the department.

I further applaud the decision to augment the publication with an accompanying website which, I am told, may well fulfil the criteria of an e-magazine, something which might increase visibility, reach and impact.

Congratulations to the department on one more notable accomplishment.

Prof. Bertram Da' Silva
Vice Principal (Arts and Science)
St. Xavier's College (Autonomous), Kolkata

MESSAGE FROM
THE DEAN OF SCIENCE

Congratulations to the Postgraduate Department of Biotechnology for bringing out the twelfth volume of their annual magazine 'Chiasma'. Biotechnology is an integrated multi-disciplinary subject and is well-reflected in the spectrum of articles published in this magazine. I expressed my heart-felt appreciation to the students and faculty members of the department for their endeavour.

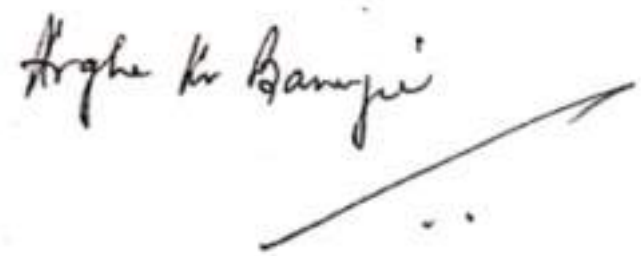
Dr. Tapati Datta
Dean of Science
St. Xavier's College (Autonomous), Kolkata

MESSAGE FROM
THE DEAN OF ARTS

Being a member of the Humanities department, I feel extremely privileged to be requested by a science department to pen a message for their journal. 'Chiasma' is an earnest endeavour of the Postgraduate Department of Biotechnology, St Xavier's College (Autonomous) Kolkata, which showcases the scholarly research conducted by its faculty members and students.

It is my deep conviction that this annual invigorating experience of putting together a journal would encourage more students and faculty members to tread the path of research in the coming years. I hope, like yesteryears, this year's issue too will explore new fields of research and make a substantial contribution to the relevant domain.

My sincere best wishes are both with the faculty members and students of the Biotechnology department. I once again thank them for their gracious thinking in involving me to be a part of their glorious journey towards excellence.



Dr. Arghya Kr Banerjee
Dean of Arts
St. Xavier's College (Autonomous), Kolkata

MESSAGE FROM
THE HEAD OF THE DEPARTMENT

It gives me immense pleasure to announce the release of the 12th issue of the departmental magazine, 'Chiasma'. Our magazine provides a platform for articles and exchange of ideas, both academic and literary, contributed by students, research scholars, and faculty on topics of both biological and general interest.

I express my heartfelt gratitude to Rev. Dr. Dominic Savio, SJ, our Principal, for his continuous encouragement, guidance and constant support. I express my sincere gratitude to Prof. Bertram Da' Silva, our Vice Principal, Dr. Tapati Dutta, Dean of Science and Dr. Argha Banerjee, Dean of Arts, for their constant support. I express my sincere appreciation and thanks to Dr. Priyanka De and Dr. Sayak Ganguli, whose constant guidance and untiring efforts have seen this magazine in final form. I take this opportunity to congratulate our dynamic editorial board, whose untiring endeavour and dedicated efforts over the last few months have culminated in this year's magazine, carrying forward the decade long tradition of the Postgraduate Department of Biotechnology. I sincerely thank our entire departmental faculty, research scholars and students of our department for their contributions and for their enthusiastic support, without which such an undertaking could never have been successfully accomplished.

May our journey continue! Nihil Ultra!

Dr. Jhimli Dasgupta
Head of the Department
Postgraduate Department of Biotechnology
St. Xavier's College (Autonomous), Kolkata

FROM THE EDITOR'S DESK

The twelfth volume of 'Chiasma - A Crossing over of minds' gladly embraces the post pandemic transformations of the year 2022. The pre-pandemic 'old normal' is slowly replacing the devastating pandemic driven 'neo-normal'. Once again, there are daily urban hustle-bustles, symphony of human interactions, chatters of blooming ideas in the educational institutions with crowded benches and corridors, thus, breaking the reign of silence. It seems like a war in which humanity has prevailed thus far.

As millennials we still remember the horrid images on Doordarshan, where the Scud missiles of the allied forces were destroying Iraqi targets and thus as we get accustomed to the averted threats of the viral pandemic, a silent and indiscernible war still wages on. Alarmingly, both millennials and generation Z folks are in an era of antibiotic resistance and in this coevolutionary conundrum, bacterial infections again have become life threatening. Scientists can never stop tinkering on this inevitable truth of life, leading to 'always on' response system.

If we take a glance into history, we might excavate the relevance of the subject. Though often misrepresented and misinterpreted these days, human history is patched with many devastating events. The first reports of penicillin resistant *Staphylococcus* was reported as early as 1940 followed by tetracycline resistant *Shigella* in 1959. Sir Frank MacFarlane Burnet, Director of the Walter and Eliza Hall Institute of Medical Research and co-winner of the Nobel Prize in Medicine in 1960 (along with Sir Peter Medawar) for the discovery of immunological tolerance, after winning the award, wrote the following in 1962: "*One can think of the middle*

of the twentieth century as the end of one of the most important social revolutions in history, the virtual elimination of the infectious diseases as a significant factor in social life". This statement was to be proved wrong in 1965, when the pendulum swung back and experts around the world agreed that there was urgent need to increase the repertoire of our antimicrobial arsenal as pandrug-resistant (PDR) and extensively drug-resistant (XDR) phenotypes emerged one after the other, as if programmed along an evolutionary timescale.

If we want to evade a postantibiotic era, we need to fundamentally modify our practices. There is an urgent need to usher change and long-standing assumptions and cherished beliefs need to be challenged. There is also a need to push out reflexive resistance and excuses. It's depressing when we learn that India has been termed as the 'AMR capital of the world', an achievement we cannot be proud of. Reversing the use and misuse cascade also calls for alternative therapeutic approaches and the future holds promise for combinatorial therapies incorporating specific antibody, organism-specific bacteriophage, small molecules (or antisense small interfering micro-RNAs) that inhibit specific virulence factors, and drugs that counter antibiotic resistance mechanisms (such as, new ß-lactamase inhibitors, efflux pump blockers). Gradually we need to come out of self-denial and accept that there is actually no 'end game'; it's improbable to win a war against microbes and thus reconceptualisation of our relationship with microbes is the call of the hour, so that the eventual goal is to stop seeking their destruction and instead seek to achieve peaceful coexistence. We sincerely hope that the national action plan set up by the national centre for disease control of India, which works in close quarters with GLASS (Global AMR surveillance system) will be able to spread public awareness and necessitate proper action.

As we wait and watch the duel of 'our wits, against their genes', the Postgraduate Department of Biotechnology is ready with the 12th edition of the 'Chiasma - A Crossing over of minds', the annual magazine; which has carved out a niche for itself since its inception in 2010. The veracity and versatility of the contents have diversified over the years, with exciting scientific and literary articles waiting to stimulate the agog reader and to inculcate fresh and innovative thought processes. 'Chiasma' continues to be digital and is available in its accompanying website.

The entire Magazine Committee has worked tirelessly, without their hard toil, the publication of the present volume would have been next to

impossible. In spite of having a packed class schedule, the members worked in unison, participating in virtual and in person meetings, editing articles, designing the layouts and contents.

We sincerely thank our respected Father Principal Rev. Fr. (Dr.) Dominic Savio, SJ, from the core of our heart for being the source of constant motivation and encouragement. We would also like to extend our heartfelt gratitude to Prof. Bertram Da' Silva, our Vice Principal, Dr. Tapati Dutta, the Dean of Science and Dr. Arghya Banerjee, the Dean of Arts for rendering their valuable advice. We also thank our Head of the Department, Dr. Jhimli Dasgupta, our departmental colleagues, research scholars, students and laboratory staff members, who all have been a constant source of support in this endeavour.

Dr. Priyanka De
Assistant Professor and Joint Editor,
Chiasma Volume XII
Postgraduate Department of Biotechnology
St. Xavier's College (Autonomous), Kolkata

Dr. Sayak Ganguli
Assistant Professor and Joint Editor,
Chiasma Volume XII
Postgraduate Department of Biotechnology
St. Xavier's College (Autonomous), Kolkata

DEPARTMENTAL DIARIES

Dr. Chandana Barat

Research Interest:

Study of interaction of ribosome with unfolded protein and protein aggregates

The ribosome is the translational machinery of the cell. However, it has multiple other important functions like: acting as a chaperone, acting as a platform for other cellular chaperones and stress factors, co-translational protein folding etc. The protein folding ability of the ribosome is unique because it functions as an ATP independent chaperone. In unfolded protein mediated dissociation of the 70S ribosome its subunits, the unfolded protein acts as an anti-association factor to the 50S subunit. This results in creation of a sustained pool of dissociated subunits which are prone to degradation by cellular nucleases. During stress conditions, along with the increase in the concentration of unfolded proteins, there is an increase in the expression of stress factors also. Some of these factors include stationary phase factors like HPF, RMF and YfiA. These might act by inhibiting the unfolded protein mediated 70S dissociation and subsequent degradation. Recent studies in the laboratory have shown that aggregating proteins are capable of sequestering ribosomes leading to ribosome-protein co-aggregate formation. Both amorphous and disease associated amyloid aggregates are capable of sequestering ribosomal RNA as well as proteins. The ribosomal RNA can also assist the aggregation process both for amorphous and amyloid aggregation systems.

Selected publications:

1. Ferdosh S, Banerjee S, Barat C. Amplification of Amyloid Protein-induced Aggregation of the Eukaryotic Ribosome. Protein Pept Lett. 2022 Sep 5. doi: 10.2174/0929866529666220905112156. PMID: 36065931.
2. Ferdosh S, Banerjee S, Singh J, Barat C. Amyloid protein-induced sequestration of the eukaryotic ribosome: effect of stoichiometry and polyphenolic inhibitors. FEBS Lett. 2022 May;596(9):1190-1202. Impact Factor: 4.124
3. Ferdosh S, Banerjee S, Pathak BK, Sengupta J, Barat C. Hibernating ribosomes exhibit chaperoning activity but can resist unfolded protein-mediated subunit dissociation. FEBS J. 2021 Feb;288(4):1305-1324.
4. Banerjee, S., Ferdosh, S., Ghosh, A. N., & Barat, C. Tau protein-induced sequestration of the

eukaryotic ribosome: Implications in neurodegenerative disease. Scientific reports, 2020, 10 (1), 1-15.

5. Pathak, B. K., Mondal, S., Banerjee, S., Ghosh, A. N., & Barat, C. Sequestration of ribosome during protein aggregate formation: contribution of ribosomal RNA. Scientific reports, 2017(1), 1-14.

Department: Biotechnology
Email ID: usiddhanta@sxccal.edu
usiddhanta@gmail.com
Phone: +91-33-22551275
Designation: Assistant Professor
Qualification: M.Sc., Ph.D.
Thesis Title: Active-site mapping of UDPglucose 4-epimerase from Escherichia coli. Thesis work carried out under the guidance of late Prof. Amar Nath Bhaduri, at Indian Institute of Chemical Biology (CSIR), Kolkata. Degree awarded in 1994 by Jadavpur University

Dr. Uma Siddhanta

Post-doctoral research experience:

1995–1996: Department of Immunology, Cleveland Clinic Foundation, Ohio, USA
1997-2005: Department of Molecular Pharmacology, Department of Medicine & Department of Developmental and Molecular Biology, Albert Einstein College of Medicine, New York, USA

Publications & Abstracts (from Ph.D. and post-doctoral work):

Publications:

1. Identification of a biochemical link between energy intake and energy expenditure. Silvana Obici, Jiali Wang, Rahena Chowdury, Zhaohui Feng, **Uma Siddhanta**, Kimyata Morgan and Luciano Rossetti (**2002) J. Clin. Invest.** 109(12), 1599.
2. An Arginine Residue is Essential for Stretching and Binding of the Substrate on UDP-Glucose 4-Epimerase from Escherichia coli: Use of a Stacked and Quenched Uridine Nucleotide Fluorophore as Probe. **Uma Bhattacharyya**, Gautam Dhar and Amar Bhaduri **(1999) J.Biol. Chem**. 274 (21), 14573.
3. Distinct Roles for the p110a and hVPS34 Phosphatidylinositol 3´-kinase in Vesicular Trafficking, Regulation of the Actin Cytoskeleton, and Mitogenesis. **Uma Siddhanta**, James McIlory, Amishi Shah, Yitao Zhang and Jonathan M. Backer **(1998) J.Cell Biol**. 143 (6), 1647.
4. Domain swaping in inducible Nitric Oxide Synthase: Electron transfer occurs between flavin and heme groups located on adjacent subunits in the dimer. **Uma Siddhanta**, Anthony Presta, Baochen Fan, Dennis Wolan, Dennis L. Rousseau and Dennis J. Stuehr **(1998) J.Biol. Chem.** 273(30), 18950.
5. Comparative functioning of dihydro- and tetrahydropterins in supporting electron transfer,catalysis, and subunit dimerization in inducible Nitric Oxide Synthase. Anthony Presta, **Uma Siddhanta**, Chaoqun Wu, Nicolas Sennequier, Liuxin Huang, Husam M.Abu-Soud, Serpil Erzurum and Dennis J. Stuehr **(1998), Biochemistry 37**, 298.
6. Heme iron reduction and catalysis by a Nitric Oxide Synthase heterodimer containing one reductase and two oxygenase domains. **Uma Siddhanta**, Chaoqun Wu, Husam M.Abu-Soud, Jingli Zhang, Dipak K.Ghosh and Dennis J.Stuehr **(1996) J.Biol.Chem**. 271 (13), 7309.

Abstracts:

1. Heme iron reduction and catalysis by a Nitric Oxide Synthase heterodimer containing one

reductase and two oxygenase domains. Uma Siddhanta and Dennis J. Stuehr (1996); in the Annual Meeting of American Society for Biochemistry and Molecular Biology, New Orleans,LA, USA

2. Functional asymmetry of the two potential active sites of Escherichia coli UDP-gluose 4-epimerase: Chemical modification of arginine residues. Amar Bhaduri and Uma Bhattacharyya (1994); in the XVI International Congress of Biochemistry and Molecular Biology, New Delhi, India

Workshop & Symposium Attended:

'Bioinformatics in Genomic and Proteomic', offered by the Indian Institute of Technology, Kharagpur, September 22 – 23, 2006.

'Life Science at Cross Road', Refresher Course in Life Science, organized by UGC Academic Staff College and Department of Botany, University of Calcutta, February 1-20, 2010.

Research Interest & Research Projects Undertaken/on-going:

1. 'Multiple drug resistance' is threatening the future continual use of antibiotics. Attempts to fix this problem will definitely include search for new antibiotics and modification of the existing or the newly discovered antibiotics. But these will turn out to be a temporary fix until and unless more is learned about antibiotic resistance – its origins and evolution. Soil-dwelling actinomycetes are probably the most relevant class of microorganisms to expand our knowledge on soil resistome. Most clinically relevant antibiotics originate from them. Consequently they, as a group, possess a myriad of antibiotics evasion strategies. My research interest is directed at sampling the soil antibiotic resistome - an under-recognized reservoir for resistance genes that has already emerged or has the potential to emerge in clinically important bacteria. The study could provide an early warning system for future clinically relevant antibiotic resistance mechanisms and serve as a foundation for new antibiotic development.

Concluded projects:

1) Minor research project from UGC [PSW-052/08-09 (ERO)]
Title: Search for Novel Antibiotic Resistance Gene(s) from Soil-dwelling Actinomycetes.
2) Minor research project UGC [PSW-45/12-13 (ERO)]
Title: Identification and Characterization of Actinomycetes Isolated from Soil and Exhibiting Intriguing Antibiotic Resistance Profiles.
3) In order to establish infection, intracellular bacteria like Mycobacterium tuberculosis, or parasites like Leishmania donovani, prevents fusion of phagosome with lysosome within the macrophage cells of its mammalian host. Logically it becomes relevant to understand the mechanism of the phagolysosomal fusion step and how these infectious agents successfully avert this. Thus the focus area of current research is to shed some light in the complex signaling events involved in the phagolysosomal fusion process taking Leishmania donovani as a prototype of intracellular parasites.

Concluded projects:

Major research project from DBT-WB [234 /Bt (Estt)/RD 12/2015]
Title: Elucidation of the Role of Differentially Phosphorylated Dok-3 (Downstream of Kinase 3) in the Biogenesis of Phagolysosome in Leishmania donovani Infected Macrophages.
Modules taught in the 'Five Year Integrated M.Sc. Course in Biotechnology', St. Xavier's College, Kolkata:

- Biological Macromolecules – Nucleic Acids

- Enzymology
- Bioenergetics & Metabolism
- Molecular Biology – DNA Replication
- Cell Signaling
- Immunology
- Virology

FACULTY PROFILES

Dr. Sudipa Saha

Area of Research Interest: Structure function studies of proteins.

List of Publications:

- Ashis Biswas, **Sudipa Saha** and K. P. Das. "Structural Features of Molecular Chaperones: A Possible Micellar Connection". J. Surface Sci. Technol., Vol. 18, (2002), 1-24.
- **Sudipa Saha** and K. P. Das. "Relationship between Chaperone Activity and Oligomeric Size of Recombinant Human αA- and αB-Crystallin: A Tryptic Digestion Study". Proteins, Vol. 57, (2004), 610-617.
- C. Bhattacharjee, **Sudipa Saha**, A. Biswas, M. Kundu, L. Ghosh and K. P. Das. "Structural Changes of β- Lactoglobulin During Thermal Unfolding and Refolding- An FT-IR and Circular Dichroism Study". The Protein Journal, Vol. 24, (2005), 27-35.
- **Sudipa Saha** and K. P. Das. "Unfolding and refolding of Bovine α-Crystallin in Urea and Its Chaperone Activity". The Protein Journal, Vol. 26, (2007), 315-326.
- Ashis Biswas, Srabani Karmakar, Victor Banerjee, **Sudipa Saha**, Madhuchhanda Kundu, Jaya Bhattacharyya, Dipak Chandra Konar and K. P. Das. "Biophysical studies on the molecular chaperone function, structure and interaction of eye lens protein α-crystallin – A Review". J. Indian Chem. Soc., Vol. 88, (2011), 1827-1855.
- **Sudipa Saha** and K. P. Das. "Structure and interactions in α-crystallin probed through thiol group reactivity". Advances in Biological Chemistry, Vol. 3, (2013), 427-439.
- **Sudipa Saha** and K. P. Das. "Effect of thermal treatment on the oligomeric size and chaperone activity of α-crystallin". J. Indian Chem. Soc., Vol. 92, (2015), 1531-1536.
- **Sudipa Saha**. "Oligomeric structure and molecular chaperone function of eye lens protein α-crystallin – A Review". J. Indian Chem. Soc., Vol. 93, (2016), 1233-1242.
- **Sudipa Saha** and K. P. Das. "Hydrophobicity of α-crystallin and its relationship with chaperone activity- bis-ANS binding study". J. Indian Chem. Soc., Vol. 94, (2017), 959-970.
- **Sudipa Saha**. "Eye lens protein α-crystallin and cataract – A Review". J. Indian Chem. Soc., Vol. 96, (2019), 239-253.

Research Projects:

1. Project Title: Preparation and properties of molecular chaperone α-Crystallin from easily available sources
Granting Agency: University Grants Commission (UGC)
Period of Sanction: 09.01.2009-08.07.2010.

2. Project Title: Comparative studies of molecular and functional properties of eye lens proteins from some Indian fishes
Granting Agency: University Grants Commission (UGC)
Period of Sanction: 27.02.2013-26.02.2015.

3. Project Title: Comparative studies on biochemical and physicochemical characteristics of lens α-crystallin from habitat-specific fish
Granting Agency: West Bengal Department of Higher Education, Science & Technology and Biotechnology
Period of Sanction: 2018-2021.

Research Scholars: Sushmita Nandy and Aparajita Chakraborty

Invited talks/ Papers presented at Conferences/ Seminars:

- Presented paper entitled "Studies on the Oligomeric Structure of α-Crystallin- Effect on Chaperone Function" in "38th Annual Convention of Chemists, 2001" held at Jai Narain Vyas University, Jodhpur, Rajasthan during December 26-29, 2001 organized by Indian Chemical Society.
- Presented paper entitled "Relationship between Chaperone Activity and Oligomeric Size α-Crystallin- A Tryptic Digestion Study" in "40th Annual Convention of Chemists, 2003" held at Bundelkhand University, Jhansi, Uttar Pradesh during December 23-27, 2003 organized by Indian Chemical Society.
- Delivered invited lecture on the topic "Structure and interactions in α-crystallin probed through thiol group reactivity" in "50th Annual Convention of Chemists 2013" held at the Department of Chemistry and Centre for Advanced Studies in Chemistry, Punjab University, Chandigarh during December 04-07, 2013 organized by Indian Chemical Society.
- Presented poster on the topic "Relationship between Chaperone Activity and Oligomeric Size of α-Crystallin by Unfolding and Refolding study" in 33rd Annual National Conference of Indian Council of Chemists held at the Department of Applied Chemistry, Indian School of Mines, Dhanbad during December 15-17, 2014 organized by Indian Council of Chemists.
- Presented poster on the topic "Study of chaperone activity and hydrophobicity of α-crystallin in presence and absence of urea" in "52nd Annual Convention of Chemists and International Conference on Recent Advances in Chemical Sciences" held at JECRC University, Jaipur, Rajasthan during December 28-30, 2015 organized by Indian Chemical Society.
- Presented poster on the topic "Study of oligomeric structure of α-crystallin by using denaturant" in "National Seminar on Current Trends in Chemistry-VII (NSCTC-VII)" held at University of Kalyani on 24th February, 2016 organized by Department of Chemistry, University of Kalyani.
- Presented poster on the topic "Hydrophobicity- the important determinant of chaperone activity of α-crystallin" in "23rd West Bengal State Science and Technology Congress, 2016" held at Presidency University, Kolkata during 28-29 February, 2016 organized by Presidency University.
- Presented poster on the topic "Recognition of substrate binding site in α-crystallin" in "National Symposium on Recent Advances in Chemistry & Industry 2016" held at University of Calcutta during 02-03 August, 2016 organized by Indian Chemical Society.
- Presented poster on the topic "Study of oligomeric structure and chaperone activity of α-crystallin under heat stress condition" in 35th Annual National Conference of Indian Council of Chemists held at Haribhai V. Desai College, Pune in association with College of Engineering, Pune during December 22-24, 2016 organized by Indian Council of Chemists.
- Delivered talk on the topic "Determination of molecular chaperone function of α-crystallin using tryptic digestion study" in "International Seminar on Recent Advances on Chemical Sciences and Allied Areas (RACS2A-2018) and 55th Annual Convention of Chemists 2018" held at Department of Chemistry, G. B. College, Naugachia (T. M. Bhagalpur University), Bhagalpur, Bihar during December 28-30, 2018 organized by Indian Chemical Society.

FACULTY PROFILES

Dr. Aniruddha Banerji

Areas of Research and Academic Interest

Primary area of research interest: Cancer biology

- Study of cell surface receptors (integrins, EGFR) and their roles in tumour biology.
- Study of cellular signalling pathways which are dysregulated in cancer to promote invasion and metastasis.
- Study of matrix metalloproteinases (MMPs) and the crucial roles they play in tumour invasion and metastasis.
- Study of the anti-tumorigenic and anti-invasive effects of natural compounds and the molecular mechanisms by which such effects are exerted.

Additional areas of research and academic interest include:

- Wildlife biology: Study of biodiversity and conservation.
- Evolutionary biology: Study of human, mammalian and vertebrate evolution.
- Animal behaviour and ecology
- Genetics and genetic analysis
- Comparative anatomy
- Environmental biology

Publications (July 2021 onwards)

Journals

1. 1A. Roy, I. Chakraborty, A. Banerji. Natural Compounds as Potential Regulators of the Phosphatidylinositol 3' Kinase (PI3K) Pathway in Breast Cancer. South Asian Journal of Experimental Biology (2021) vol. 11(5), pp. 524-538.
2. A. Banerji, P. Ghoshal. The COVID-19 Pandemic: Some Perspectives of Demographic and Epidemiological Transition. Magis – Xaverian Journal of Education (2022) vol. XI, pp. 20-29.

Book Chapters

1. P. Ghoshal, A. Banerji. Studies on Some Issues Specific to Demography during COVID-19 Pandemic. Issues and Development in Health Research Vol. 3, pub: Book Publisher International (2021) pp. 1-9; Print ISBN: 978-93-91595-14-2, eBook ISBN: 978-93-91595-16-6.
2. A. Roy, I. Chakraborty, A. Banerji. Determination of Phytochemicals as Potential Inhibitors of Matrix Metalloproteinases (MMPs) with Special Reference to Breast Cancer. Issues and Development in Health Research Vol. 5, pub: Book Publisher International (2021) pp.72-81; Print ISBN: 978-93-91882-30-3, eBook ISBN: 978-93-91882-32-7.
3. P. Ghoshal, A. Banerji. Agriculture in COVID-19 Pandemic: The Indian Perspective. New Innovations in Economics, Business and Management Vol. 8, pub: Book Publisher International (2022) pp. 77-86; Print ISBN: 978-93-5547-510-7, eBook ISBN: 978-93-5547-518-3.

Posters Presented at Conferences/ Seminars by Research Scholars (July 2021 onwards)

1. A. Roy, A. Banerji. "Regulation of Focal Adhesion Kinase and Phosphatidylinositol 3' Kinase Pathways in Breast Cancer: The Role of Natural Products" at 41st Annual Conference of Indian Association for Cancer Research (IACR-2022) organized by Amity University, Noida, March 2022.
2. A. Roy, A. Banerji. "Phytochemicals as potential Matrix Metalloproteinase (MMP) inhibitors in

breast cancers" at International Conference (Online) on Biomolecules to Biome, organized by Presidency University, Kolkata, Aug 2022.

3. I. Chakraborty, A. Banerji. "All-trans retinoic acid (ATRA) as an inhibitor of cell signalling in melanomas" at International Conference (Online) on Biomolecules to Biome, organized by Presidency University, Kolkata, Aug 2022.

Research Guidance
Ph. D Awarded
1) Dr. Aheli Majumder: Awarded Ph. D from University of Calcutta, Dept. of Zoology, 2022.

Current Research Scholars
1) Mr. Anirban Roy: Registered for Ph. D under Dept. of Biotechnology, St. Xavier's College (Autonomous), Kolkata.
2) Ms. Indira Chakraborty: Enrolled for Ph. D under Dept. of Biotechnology, St. Xavier's College (Autonomous), Kolkata.

FACULTY PROFILES

Dr. Jhimli Dasgupta

Department: Biotechnology
Qualification: M.Sc (Chemistry), Ph.D (Structural Biology)
Contact Details:
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Honors/Awards

1. '**Innovative Young Biotechnologist Award (IYBA 2010)**' from the Ministry of Science and Technology, DBT, Govt. of India;
2. '**Sir P. C. Ray Research Award-2004**' for best thesis from University of Calcutta, India;

Research experience:

- Postdoctoral Research Associate, University of Southern California, CA, USA
- Postdoctoral fellow, Kasha Laboratory, Florida State University, USA
- PhD in Structural Biology, Saha Institute of Nuclear Physics, India

Teaching

(a) Theory modules:

1. Chemical kinetics and Structural Enzymology
2. Protein chemistry and Biophysical techniques to understand protein-protein, Protein-DNA interactions
3. Bioinformatics
4. Protein crystallography and structure function paradigm
5. Proteomics

(b) Practical modules:

1. Recombinant DNA technology
2. Enzymology
3. Bioinformatics project

Research interests and the projects running in the lab

1. **Structural and functional insights of molecular motors such as bacterial enhancer binding proteins (bEBPs) involved in flagellar gene transcription:**
(a) Structural and functional aspects of AAA+ ATPase FlrC and its cognate kinase FlrB of Vibrio cholerae that control flagellar synthesis and biofilm formation.
(b) FlrA, the master transcription regulator of Vibrio cholerae flagellar synthesis: Structural insights, oligomerisation, functional implications and regulation by the second messenger c-di-GMP.
2. **Nutrient uptake by pathogenic bacteria using ABC transporters to target 'Trojan horse mechanism' of drug delivery:**
(a) Structural and functional insights into the periplasmic Fe(III) and heme binding proteins FhuD and HutB of Vibrio cholerae to unravel the mechanism of iron uptake in survival strategy.
(b) Unravelling the molecular mechanism of vitamin B12 and norspermidine uptake by Vibrio

cholerae periplasmic binding proteins BtuF and NspS.
3. **Understanding the role of multiple copies of chemotaxis response regulators (CheYs), their interactions with kinase CheA and motor protein FliM.**

Journal Publications

1. Saha I, Chakraborty S, Agarwal S, Mukherjee P, Ghosh B, Dasgupta J. Mechanistic insights of ABC importer HutCD involved in heme internalization by Vibrio cholerae. **Sci Rep. 2022** May 3;12(1):7152. doi:10.1038/s41598-022-11213-9.
2. Chakraborty S, Biswas M, Dey S, Agarwal S, Chakrabortty T, Ghosh B, **Dasgupta J**. The heptameric structure of the flagellar regulatory protein FlrC is indispensable for ATPase activity and disassembled by cyclic-di-GMP. **J Biol Chem. 2020** Dec 11;295(50):16960-16974. doi: 10.1074/jbc.RA120.014083.
3. Nsp7 and Spike Glycoprotein of SARS-CoV-2 are envisaged as Potential Targets of Vitamin D and Ivermectin. **J Dasgupta**, U Sen, A Bakshi, A Dasgupta, K Manna, C Saha, RK De, ...**Preprints. 2020** May 5. doi: 10.20944/preprints202005.0084.v1
4. Agarwal S, Dey S, Ghosh B, Biswas M, **Dasgupta J.** Mechanistic basis of vitamin B12 and cobinamide salvaging by the Vibrio species. **Biochim Biophys Acta Proteins Proteom. 2019** Feb;1867(2):140-151. doi: 10.1016/j.bbapap.2018.11.004.
5. Agarwal S, Dey S, Ghosh B, Biswas M, **Dasgupta J**. Structure and dynamics of Type III periplasmic proteins VcFhuD and VcHutB reveal molecular basis of their distinctive ligand binding properties. **Sci Rep. 2017** Feb 20;7:42812.
6. Dey S, Biswas M, Sen U, **Dasgupta J**. Unique ATPase Site Architecture Triggers cis-Mediated Synchronized ATP Binding in Heptameric AAA+-ATPase Domain of Flagellar Regulatory Protein FlrC. **J Biol Chem. 2015** Apr 3;290(14):8734-47.
7. Agarwal S, Biswas M, **Dasgupta J**. Purification, crystallization and preliminary X-ray analysis of the periplasmic haem-binding protein HutB from Vibrio cholerae. **Acta Crystallogr F. 2015** Apr;71(Pt 4):401-4.
8. Biswas M, Dey S, Khamrui S, Sen U, **Dasgupta J**. Conformational barrier of CheY3 and inability of CheY4 to bind FliM control the flagellar motor action in Vibrio cholerae. **PLoS One. 2013** Sep 16;8(9):e73923.
9. Richards KF, Bienkowska-Haba M, **Dasgupta J**, Chen XS, Sapp M. Multiple heparan sulfate binding site engagements are required for the infectious entry of human papillomavirus type 16. **J Virol. 2013** Nov;87(21):11426-37.
10. Dey S, **Dasgupta J**. Purification, crystallization and preliminary X-ray analysis of the AAA+ σ54 activator domain of FlrC from Vibrio cholerae. **Acta Crystallogr Sect F. 2013** Jul;69(Pt 7):800-3.
11. Majumder S, Khamrui S, **Dasgupta J,** Dattagupta JK, Sen U. Role of remote scaffolding residues in the inhibitory loop pre-organization, flexibility, rigidification and enzyme inhibition of serine protease inhibitors. **Biochim Biophys Acta. 2012** Jul;1824(7):882-90.
12. Biswas M, Khamrui S, Sen U, **Dasgupta J.** Overexpression, purification, crystallization and preliminary X-ray analysis of CheY4 from Vibrio cholerae O395. **Acta Crystallogr Sect F. 2011** Dec 1;67(Pt 12):1645-8.
13. **Dasgupta J**, Bienkowska-Haba M, Ortega ME, Patel HD, Bodevin S, Spillmann D, Bishop B, Sapp M, Chen XS. Structural basis of oligosaccharide receptor recognition by human papillomavirus. **J Biol Chem. 2011** Jan 28;286(4):2617-24.
14. Khamrui S, Biswas M, Sen U, **Dasgupta J**. Cloning, overexpression, purification, crystallization and preliminary X-ray analysis of CheY3, a response regulator that directly interacts with the flagellar 'switch complex' in Vibrio cholerae. **Acta Crystallogr Sect F. 2010** Aug 1;66(Pt 8):944-7.
15. Khamrui S, Majumder S, **Dasgupta J**, Dattagupta JK, Sen U. Identification of a novel set of

scaffolding residues that are instrumental for the inhibitory property of Kunitz (STI) inhibitors. **Protein Sci. 2010** Mar;19(3):593-602.
16. Tsai SJ, Sen U, Zhao L, Greenleaf WB, **Dasgupta J**, Fiorillo E, Orrú V, Bottini N, Chen XS. Crystal structure of the human lymphoid tyrosine phosphatase catalytic domain: insights into redox regulation. **Biochemistry. 2009** Jun 9;48(22):4838-45.
17. Orrú V, Tsai SJ, Rueda B, Fiorillo E, Stanford SM, **Dasgupta J**, Hartiala J, Zhao L, Ortego-Centeno N, D'Alfonso S; Italian Collaborative Group, Arnett FC, Wu H, Gonzalez Gay MA, Tsao BP, Pons-Estel B, Alarcon-Riquelme ME, He Y, Zhang ZY, Allayee H, Chen XS, Martin J, Bottini N. A loss-of-function variant of PTPN22 is associated with reduced risk of systemic lupus erythematosus. **Hum Mol Genet. 2009** Feb 1;18(3):569-79.
18. Thomas M, **Dasgupta J**, Zhang Y, Chen X, Banks L. Analysis of specificity determinants in the interactions of different HPV E6 proteins with their PDZ domain-containing substrates. **Virology. 2008** Jul 5;376(2):371-8.
19. **Dasgupta J,** Dattagupta JK. Structural determinants of V. cholerae CheYs that discriminate them in FliM binding: comparative modeling and MD simulation studies. **J Biomol Struct Dyn. 2008** Apr;25(5):495-503.
20. Bishop B, **Dasgupta J**, Klein M, Garcea RL, Christensen ND, Zhao R, Chen XS. Crystal structures of four types of human papillomavirus L1 capsid proteins: understanding the specificity of neutralizing monoclonal antibodies. **J Biol Chem. 2007** Oct 26;282(43):31803-11.
21. Zhang Y#, **Dasgupta J#**, Ma RZ, Banks L, Thomas M, Chen XS. Structures of a human papillomavirus (HPV) E6 polypeptide bound to MAGUK proteins: mechanisms of targeting tumor suppressors by a high-risk HPV oncoprotein. **J Virol. 2007** Apr;81(7):3618-26.
22. Bishop B#, **Dasgupta J#**, Chen XS. Structure-based engineering of papillomavirus major capsid l1: controlling particle assembly. **Virol J. 2007** Jan 8;4:3.
23. **Dasgupta J**, Khamrui S, Dattagupta JK, Sen U. Spacer Asn determines the fate of Kunitz (STI) inhibitors, as revealed by structural and biochemical studies on WCI mutants. **Biochemistry. 2006** Jun 6;45(22):6783-92.
24. Khamrui S, **Dasgupta J**, Dattagupta JK, Sen U. Single mutation at P1 of a chymotrypsin inhibitor changes it to a trypsin inhibitor: X-ray structural (2.15 A) and biochemical basis. **Biochim Biophys Acta. 2005** Aug 31;1752(1):65-72.
25. Sen U, **Dasgupta J**, Choudhury D, Datta P, Chakrabarti A, Chakrabarty SB, Chakrabarty A, Dattagupta JK. Crystal structures of HbA2 and HbE and modeling of hemoglobin delta 4: interpretation of the thermal stability and the antisickling effect of HbA2 and identification of the ferrocyanide binding site in Hb. **Biochemistry. 2004** Oct 5;43(39):12477-88.
26. **Dasgupta J**, Sen U, Dattagupta JK. In silico mutations and molecular dynamics studies on a winged bean chymotrypsin inhibitor protein. **Protein Eng. 2003** Jul;16(7):489-96.
27. **Dasgupta J**, Sen U, Choudhury D, Datta P, Chakrabarti A, Chakrabarty SB, Chakrabarty A, Dattagupta JK. Crystallization and preliminary X-ray structural studies of hemoglobin A2 and hemoglobin E, isolated from the blood samples of beta-thalassemic patients. **Biochem Biophys Res Commun. 2003** Apr 4;303(2):619-23.

Book Publication:

Chapter 3. Structural Insights of Cobalamin and Cobinamide Uptake by ABC Importer of Vibrio Species. Arunima Bhattacharya1#, Samriddhi Bhattacharya1#, Shubhangi Agarwal1,2 and Jhimli Dasgupta1. 1Post Graduate Department of Biotechnology, St. Xavier's College (Autonomous), Kolkata, West Bengal, India; 2Weill Cornell Medicine, Department of Anaesthesiology, New York, USA. In: Advances in Health and Disease. Volume 57; Editor: Lowell T. Duncun. ISBN:979-8-88697-098-2. © 2022 **Nova Science Publishers, Inc.**

 # Equal contribution.

Research Grants

Running:

(1) Investigating the mechanistic basis of downstream-enhancer-binding and c-di-GMP mediated transcription regulation of Vibrio cholerae FlrC. Granting agency: DAE(BRNS).

(2) Investigating structure function relationship of the ATPase-GTPase duo FlhFG that critically regulates flagellar gene transcription and chemotaxis of Vibrio cholerae. Granting agency: MHRD-STARS.

Completed:

1. Understanding the molecular basis of autophosphorylation and phosphotransfer activities of a unique cytosolic sensor Histidine kinase, FlrB, that regulates flagellar synthesis and colonization in Vibrio cholerae. Granting Agency: WBDBT
2. Investigating the molecular mechanism of heme uptake and translocation by ABC transporter system HutB-CD of Vibrio cholerae. Granting Agency: UGC(DAE)-CSR, Duration: 2016-2021
3. Structural and mechanistic insights of the bacterial enhancer binding proteins FlrA and VpsR of Vibrio cholerae and their regulation by second messenger c-di-GMP. Granting Agency: DST(SERB), Duration: 2016-2019
4. Structure and functional insights into the periplasmic Fe(III) and heme binding proteins FhuD and HutB of Vibrio cholerae to unravel the mechanism of iron uptake in survival strategy. Granting Agency: DAE (BRNS), Duration: 2013-2016
5. Structural and functional studies on transcriptional activator FlrC and its cognate kinase FlrB in V. cholerae: a step to understand their role in motility and colonization. Granting Agency: DBT (IYBA), Duration: 2011-2015
6. Understanding the role of multiple copies of chemotaxis response regulators (CheYs) present in Vibrio cholerae, and their interactions with motor protein FliM: Structural and functional studies. Granting Agency: CSIR, Duration: 2009-2012

Current Lab Members:

Shrestha Chakraborty
SRF: DST (SERB), DAE(BRNS)

Peeali Mukherjee
DST-INSPIRE Fellow

Indrila Saha
SRF: UGC(DAE)

Ruchira Das
DST-INSPIRE Fellow

Lab Alumni:

Dr. Maitree Biswas
PhD awarded: 2016
Current position: Postdoctoral fellow, University of British Columbia, Canada

Dr. Sanjay Dey
PhD awarded: 2016
Postdoctoral fellow, IGBMC, Alsace, France; Former Postdoctoral fellow, Penn State University, USA

Dr. Shubhangi Agarwal
Ph.D. Awarded: 2018
Postdoctoral fellow, Cornell University, USA
Former Postdoctoral fellow, University of Stuttgart-Hohenheim, Germany

FACULTY PROFILES

Dr. Aryadeep Roy Choudhury

Dr. Aryadeep Roy Choudhury, currently Assistant Professor in the Department of Biotechnology is involved in teaching several disciplines like Cell Biology, Genomics, Bioprocess Technology, Microbial and Plant Biotechnology, Ecology and Evolution, Skill Enhancement courses and Generic electives. He is also involved in active research and has supervised 5 Ph.D. students so far. Dr. Roy Choudhury has published around 200 scientific articles and book chapters as well as edited 8 books till date. He has guest edited special issues of several reputed journals and is a regular reviewer for many international journals. He has overall Google Scholar citations of 7657 with h-index of 39 and i-10 index of 99 (https://scholar.google.com/citations?user=2z52kIAAAAAJ&hl=en). His name is also included in the list of top 2% most influential scientists, as published by Stanford University, USA, for two consecutive years, 2021 and 2022, the links are as follows:

1 . https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/4?fbclid=IwAR1Wcc0_gzO27Eg1tY8j7-iwsKm9zVJ13al3Q4Nq1NkLH1iVb1iu-T97UmY

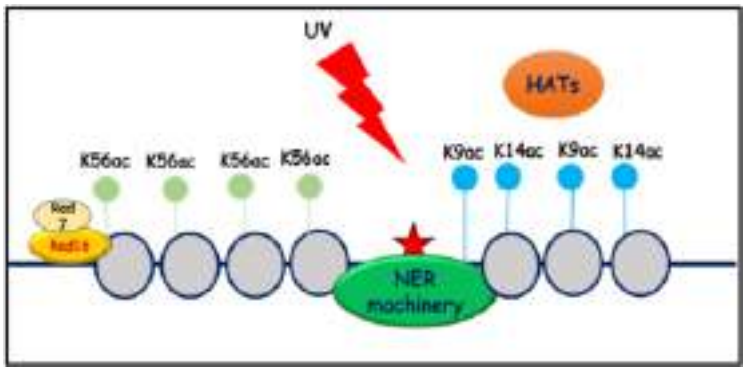
2. https://doi.org/10.1371/journal.pbio.3000918

Detailed publication list of Dr. Aryadeep Roy Choudhury is available at Google scholar link:
https://scholar.google.com/citations?user=2z52kIAAAAAJ&hl=en

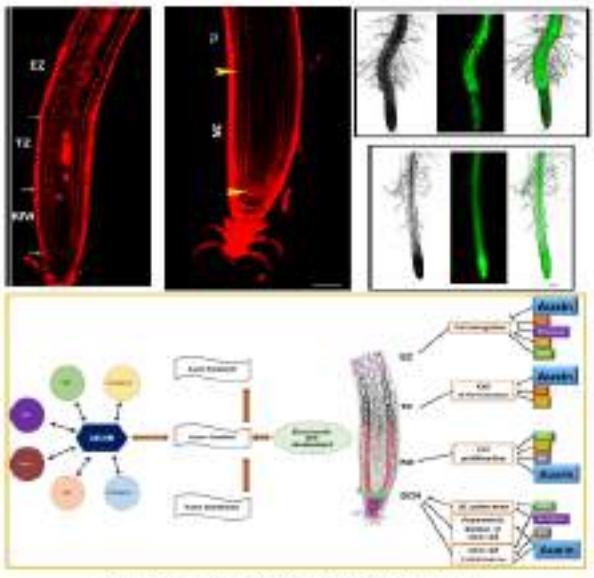
Dr. Ronita Nag Chaudhuri

RESEARCH INTEREST

- *Epigenetic regulation of DNA damage response and Gene expression*



- *Genetic and epigenetic basis of modulation in root system architecture*



FACULTY PROFILES

LAB MEMBERS:

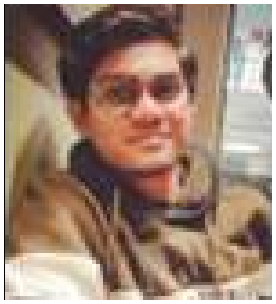
PRESENT:

Preeti Khan (CSIR-Net Fellow, SRF)
Project: Role of histone acetylation in Nucleotide Excision Repair and gene expression regulation.

Drishti Mandal (SERB Project Fellow, SRF)
Project: Cross talk between hormone signaling pathways in modulation of root system architecture

Saptarshi Datta (CSIR-Net Fellow, JRF)
Project: Genetic and epigenetic regulation of root system architecture and its dynamism in response to abiotic stress signals

Priyabrata Singha (DBT Project Fellow)
Project: Elucidating the significance of crosstalk between histone modifications and DNA methylation in Nucleotide Excision Repair and gene expression regulation



Sicon Mitra (SERB Project Fellow)
Project: Transgenic approach to improve quality traits for better adaptation to stress conditions

PAST:

Dr. Sonia Bedi

Genome Solution Specialist, Molsys Ltd. Bangalore

Dr. Anagh Ray

Post-Doctoral Fellow, National Cancer Institute, NIH, Bethesda, MD, USA

Dr. Sourabh Sengupta

Post-Doctoral Fellow, Levy Lab, University of Wyoming, Wyoming, USA

RECENT PUBLICATIONS

- **RAV1 mediates cytokinin signalling for regulating primary root growth in Arabidopsis**. Drishti Mandal, Saptarshi Datta, Giridhar Raveendar, Pranab Kumar Mondal and Ronita Nag Chaudhuri*. **The Plant Journal (Accepted), 2022.**

- **Acetylation of H3K56 orchestrates UV-responsive chromatin events that generate DNA accessibility during Nucleotide Excision Repair.** Preeti Khan and Ronita Nag Chaudhuri*. **DNA Repair (2022)** https://doi.org/10.1016/j.dnarep.2022.103317

- ***DNA methylation and regulation of gene expression: Guardian of our health.*** Gaurab Aditya Dhar, Shagnik Saha, Parama Mitra and Ronita Nag Chaudhuri*.**The Nucleus (2021). https://doi.org/10.1007/s13237-021-00367-y** Invited Review as a part of Special Thematic Issue

FACULTY PROFILES

DR. PRIYANKA DE

Teaching areas:

Physiology, Animal Biology, Metabolism, Ecology, Evolution & Behavior.

Research Interest:

Cardiology, Neurobiology, Ethology, Environmental biology, Trans-disciplinary Research

Book Publication:

- Book entitled 'The Ultimate Query', A translation work based on Sarat Chandra Chattopaddhya's Sesh Prasna (ISBN: 978-93-83548-89-7). January 2016.
- Book entitled '*Dodo Kothai Tui*', a bengali story book for children (ISBN: 978-93-84184-41-4). December 2016.
- Motivational book entitled '*The Enigma of Human Existence: An Odyssey of Survival* (ISBN 978-81-940456-4-9). April 2019.
- Book entitled '*Bigyaaner Antoraale*', a collection of scientific articles (ISBN: 978-93-84184-87-2). August 2021.

Notable Book chapters:

- 'At the Bend of the path', published in book 'Poetry World' (Vol IV),2013, published on the eve of '7th World Poetry Festival 2013'.
- 'Cognizance', published in book 'Poetry World' (Vol V), 2014, published on the eve of '8th World Poetry Festival 2014'.
- 'Bonding', published in book 'Poetry World' (Vol VI), 2015, published on the eve of '9th World Poetry Festival 2015'.
- "Diverse Facets of Physiological Ailments in the Light of Health Geography" as part of Book "Geography in the 21st Century: Emerging Issues and the Way Forward".
- "Enigma of Indian Tradition of Healing: A Phytomedicinal Perspective" as part of Book "Handbook of Agriculture & Plant Sciences".
- Poem entitled 'Protikhhya' as part of Book "Karonakaler Kobita". 2021.
- "How Covid-19 Changed the Consumer Behaviour in India" .
- "Post-Pandemic Health Communication: Significance and Emerging Prospects" as part of Book "Opportunities in Media Industry Post-COVID-19" (Vol 2), 2021.
- "Enigma of emotion-cognition interactions in the contemporary COVID-19 based educational arena" as part of Book 'COVID-19 & YEAR 2020 (Voll), 2021.

Notable Publications: Scientific Journals

- The Indian Genome Variation Database (IGVdb): a project review. The Indian Genome Variation Consortium. Human Genetics 2005, 118: 1-11. (Worked as a team member in this consortium).
- Altered Expression of the Genes in Hypertrophied Heart by Glucocorticoid. **De P**, Roy SG and Bandyopadhyay A. Perspectives in Cytology and Genetics 2007, 13: 152-157.
- Stimulation of salmon calcitonin on secretion of 17 β-estradiol by the ovarian follicles of common carp, *Cyprinus carpio*. Paul S, Mukherjee D, Pramanick K, Kundu S, Bhattacharyya SP, **De P** and Mukherjee D. Journal of Endocrinology 2008, 196 (2): 413-424.
- Noise Pollution-A testimony on heart disease. De P. Everything about environment 2008, May-June, 58-61.
- Excess of glucocorticoid induces cardiac dysfunction via activating Angiotensin II pathway. Roy SG, **De P**, Mukherjee D, Chander V, Konar A, Bandyopadhyay D and Bandyopadhyay A. Cellular Physiology and Biochemistry 2009, 24 (1-2): 1-10.
- Excess of glucocorticoid induces myocardial remodeling and alteration of calcium signaling in cardiomyocytes. **De P**, Roy SG, Kar D and Bandyopadhyay A. Journal of Endocrinology 2011,

209: 105-114.
- Enigma of Slumber. **De P.** Austin Journal of Biotechnology & Bioengineering 2014 (ISSN 2378-3036), 1(5): 4.
- Diverse Facets of Lipid Metabolism in Cardiac Pathology. **De P**. Journal of Enzymology and Metabolism (ISSN: 2455-4774); 2015;1(1): 105.

Notable Invited talks:

- On 'Language of Literature', Bhasha-Shilpo-Sahityo Gabeshana Kendra, Kolkata. 2017.
- On 'Excavating significance of emotion-cognition interactions in the contemporary educational arena', Jadavpur Univ & Byanjanbarna Foundation, Kolkata. 2017.
- On 'Mantra in life' and felicitation at Behala Sahityo Songshod, Kolkata. 2019.
- On '*Bornomoy Vidyasagar*' at Brihottoro Behala Boimela, Kolkata. 2020.
- On '*Lock down stress relievers - a focus on emotional health*' as part of International Webinar Series - Genesis, Revelation in a Post-apocalyptic world, 2020, hosted by Postgraduate Dept of Zoology, Asutosh College, Kolkata. 2020.
- On '*Enigma of Pain: A Neurocognitive Perspective*' as part of Alumni Scientific Interactives, hosted by Postgraduate Dept of Zoology, Vivekananda College, Kolkata. 2020.
- On '*Insidious Depression: A Neurocognitive Perspective*' hosted by Postgraduate Dept of Zoology, T.H.K. Jain College, Kolkata. 2020.

Notable Cultural and Literary Pursuits:

International Literary Publication: International e-paper: Poem 'Kabyik Bastob' published on July 26, 2020 in Daily e-paper (Daily Bahadur) from Bangladesh.

As Performer:

- Invited Performer in the International Program entitled '*Kothay o Kobitay Rabindranath Tagore*' as part of International Festival-2021, organised by International Culture Centre (ICC). 8 August, 2021.
- Invited Performer in '*Thailand: Bangladesh Bharat International Sanskritik Jot*'. 15 August, 2021.
- Invited Performer in International cultural program entitled '*Tumi acho Chirodin*' organised by The Global TV (UK). 25 August, 2021.
- Invited Performer in '*Murshidabad Bharat Bangladesh International Sanskritik Jot*'. 12 Sep, 2021.
- Invited Performer in '*Dhaka Mahanagar Dakshin: Dhaka Kolkata International Sanskritik Jot*'. 15 Sep, 2021.
- Invited Performer in International cultural program entitled '*Banglar Kristi*' organised by Early Star TV (Italy). 18 September, 2021.
- Honorary Position as Associate Producer in the Television Channel from UK, 'The Global TV'. (16 Oct 2021 onwards).
- Invited Performer in '*Thailand: Bangladesh Bharat International Sanskritik Jot*'. July 25, 2022.
- Invited Performer in International cultural program entitled '*Progotir Nokhotro*, Kaji Najrul Islam Shorone', ANTv, UK, Aug 23, 2022.
- Invited Performer in International cultural program entitled '*Amader Sanskriti*', Banglavashi Media, UK, Aug 4, 2022.
- Invited Performer in International cultural program entitled '*Sure o Chonde*', organised by Swopner Shako Foundation, UK, Oct 20, 2022.

FACULTY PROFILES

Assistant Professor (Stage 2),
Post-Graduate & Research Department of Biotechnology,
St. Xavier's College (Autonomous), Kolkata

Ph.D. (Microbiology), M.Phil. (Microbiology), **M.Sc. (Microbiology, 1st Class 1st, GOLD-MEDALIST), B.Sc. (Microbiology, 1st Class 1st, GOLD-MEDALIST)**, Joint CSIR-UGC NET qualified, GATE-qualified, 75th All-Bengal Rank Holder in Madhyamik Examination

DR. SOUVIK ROY

souvikroybiotech@sxccal.edu

https://orcid.org/0000-0001-5102-1889

https://www.researchgate.net/profile/Souvik-Roy-11

HONOURS/ACHIEVEMENTS [2021 -2022]

- Awarded with the **"BEST TEACHER AWARD" (National Level Award)** from Microbiologists Society, India (MBSI; Reg. No. MAHA/4814/SAT), in recognition of contribution towards Academics & Research for over the past 18 years.
- **Vice Deputy President**, Entrepreneurship Development Cell (EDC), St. Xavier's College (Autonomous), Kolkata.
- **Faculty (Marketing Advisor)**, Enactus, St. Xavier's College (Autonomous), Kolkata.
- **Member** of the College Magazine Committee (CMC), St. Xavier's College (Autonomous), Kolkata.

PROFESSIONAL COURSE COMPLETED [2021 -2022]

- Participated and successfully completed the **UGC-sponsored Refresher Course in Life Science**, organized by UGC-Human Resource Development Centre (HRDC), **University of Calcutta**, from 5th January 2022 – 18th January 2022, with **Grade A^{+}**

RESEARCH PROFILE [2021 -2022]

- **Research experience**: 2006-till date.

- **Present Research Interests:**

1. **Assessment of the microbiological quality of various street-vended and shop-sold food and aromatic beverages:** In a country like India, especially in Kolkata, owing to the excessively humid weather, a consequently high discomfort index, and hugely exhausting lifestyle, consuming food and aromatic beverages from itinerant street vendors and roadside stalls is very common, particularly during lunch, evening tiffin and dinner hours. As these unhygienically-sold consumables are very prone to huge microbial contaminations,

including notorious pathogens, a periodic assessment of their sanitary qualities, and tracing down ways to maintain their hygiene status as far as practicable, should always be in the top priority list of Food and Industrial Microbiologists for an overall societal benefit.

2. **Different aspects of Clinical/Medical Microbiology:** Urinary tract infections (UTIs) are a very common disease in people of all age groups, particularly women and young girls. This bacterial disease is contracted principally from unhygienic public washrooms visited by them. Although commercially-available toilet-seat sanitizers claim to be effective in killing the responsible uropathogens, their efficacies need to be checked periodically and compared, particularly keeping in mind the rapid emergence of MDR- and new uropathogens.

PUBLICATIONS [2021-2022]

- **Roy, S**., Laha, I., Ray, D. and Choudhury, L. (2022) Influence of Climate Change & Environmental Toxicants on Epigenetic Modifications. World Journal of Environmental Biosciences (UGC approved). In Press [ISSN (Online): 2277-8047; Impact Factor = 0.976].
- **Roy, S.**, Bhoumick, P., Mukherjee, P., Dey, K. and Choudhury, L. (2022) Mucormycosis in COVID-19 patients: a fungal disease decoded. International Journal of Biology, Pharmacy and Allied Sciences (UGC approved). 11(11):4979-4995 [ISSN (Online): 2277-4998; Impact Factor = 1.892].
- **Roy, S.**, Banerjee, A., Mullick, S. and Choudhury, L. (2022) Hunt for non-antibiotic antibacterial approaches: A possible game changer? International Journal of Biology, Pharmacy and Allied Sciences (UGC approved). 11(8):3643-3656 [ISSN (Online): 2277-4998; Impact Factor = 1.892].
- **Roy, S.** and Roy, L. (2022) The symbiotic relationship between fungi and plants. Sustainable Utilization of Fungi in Agriculture and Industry) (Series - Mycology: Current and Future Developments). Bentham Science Publishers Pte. Ltd. Singapore (Ed. Shanthipriya Ajmera, B. Bhima, Krishnappa M. and Ramchander Merugu). Volume 4. 52-74(23) [ISSN (Online): 2452-0780; ISSN (Print): 2452-0772; ISBN (Online): 978-981-5040-34-0; ISBN (Print): 978-981-5040-35-7; ISBN (Paperback): 978-981-5040-36-4] DOI: 10.2174/9789815040340122020009.
- **Roy, S.**, Nag, S., Saini, A. and Choudhury, L. (2022) Association of human gut microbiota with rare diseases: A close peep through. Intractable Rare Disease Research (UGC approved). 11(2):52-62. doi:10.5582/irdr.2022.01025. [ISSN (Print): 2186-3644; ISSN (Online): 2186-361X; Impact Factor = 1.295].
- **Roy, S.** Roy, L., Khatun, Z. and Sarangi, N. (2022) Gut Microbiome Therapy: A Future Biotechnological Wonder. Aviskaar: A Xaverian Journal of Research [ISSN (Print): 2277-8411; ISSN (Online): 2278-1048].
- **Roy, S.**, Choudhury, L., and Sarangi, N. (2022) COVID-19, Long COVID and its Neurological Effects. International Journal of Biology, Pharmacy and Allied Sciences (UGC approved). 11(3):1151-1165 [ISSN (Online): 2277-4998; Impact Factor = 1.318].

RESOURCE PERSON [2021 -2022]

- **Delivered a Talk** on the Topic "Microbiologically-fermented Food" at the Science Club Program of Rotary Club of Calcutta, Jadavpur [Rotary International District (RID) 3291] in 2022.
- **Judge of the Online Debate Competition** titled "The Stage is Yours", organized by the InquiScitive Blog in 2021.

NATIONAL MEDIA RESOURCE PERSON [2021 -2022]

- Participated in an **Invited Panel Discussion** on 'Liberalism in Tagore's Work', broadcasted on **Akashvani Kolkata B and FM GOLD (Prasar Bharati)** in 2022.

CO- AND EXTRA-CURRICULAR PROFILE [2021 -2022]

- Participated as an Organizing Committee Member, at "Convocation 2022", held on 19th February, 2022 at St. Xavier's College (Autonomous), Kolkata.

MEMBERSHIP [2021 -2022]

- Life Member (Life Membership No. MS/LM/663) of Microbiologists Society, India (MBSI; Reg. No. MAHA/4814/SAT)

Assistant Professor
Department of Biotechnology
St. Xavier's College (Autonomous)
Kolkata - 700016
Email: sayakganguli2@gmail.com

DR. SAYAK GANGULI

About:

Biologist, with background in Plant Biology, specialization in Plant Tissue Culture and Micropropagation; Bioinformatics, Computational Biology, Genomics and Machine Learning

Current Work Area(s):

1. Plant environment interactions in the Indian Sunderbans; a UNESCO World Heritage Site to formulate proper conservation and habitat restoration strategies for reducing the impact of climate change
2. Gut Microbial interactions with traditional diet practices of tribal members of Savar, Bhutia, Mech, Lodha, Toto etc. For predicting new measures for assessment of malnutrition among children and adults.
3. Genomics Guided Drug Screening
4. Waste water microbiome to establish a source sink relationship for transmission of antimicrobial resistance and devising a strategy for rapid public health monitoring.

Summary of Publications and Scientific Contributions:

1. International Publications: 75 {Last Two Years: 15; Average IF - 2.07}
2. Book Chapters in International Publishing Houses: 17
3. Poster Presentations (National and International): 112
4. Accession Numbers in Databases: 16 (CDS; Transcriptome and Metagenome)
5. Invited Talk and Oral Presentations (International): 7
6. Invited Talk and Oral Presentations (National and State Level): 14

For Details Visit: Google Scholar/ ORCID/ RESEARCHGATE

Academic Achievements and Awards:

1. Aurobindo Guha Life Science Endowment (GOLD MEDAL) for Highest marks in BSc. Examination (2003)
2. **DST Award** for Invited lecture at Next Generation Sequencing Congress Asia (2012) at Singapore
3. **BEST POSTER AWARD** for the poster titled: "**Rhizospheric Metagenome Dataset of the terrestrial mangrove Nypa fruticans Wurmb from Indian Sunderbans**" at the National Seminar on Water Conservation and Harvesting: Focusing Biodiversity Issues and Management held on 8th February 2020 at Jadavpur University, Kolkata.
4. **BEST POSTER AWARD** as Senior Author, for the poster titled "*An insight into the Rhizospheric Metagenomic Analysis of Excoecaria agalollocha from Indian Sunderbans Mangrove Forest*" at APBGE, April 8 - 10 2021 (Poster presented by Mr. Subhadeep Manna)
5. Selected and participated as an **Early Career Researcher** in the Newton Bhabha Researchers

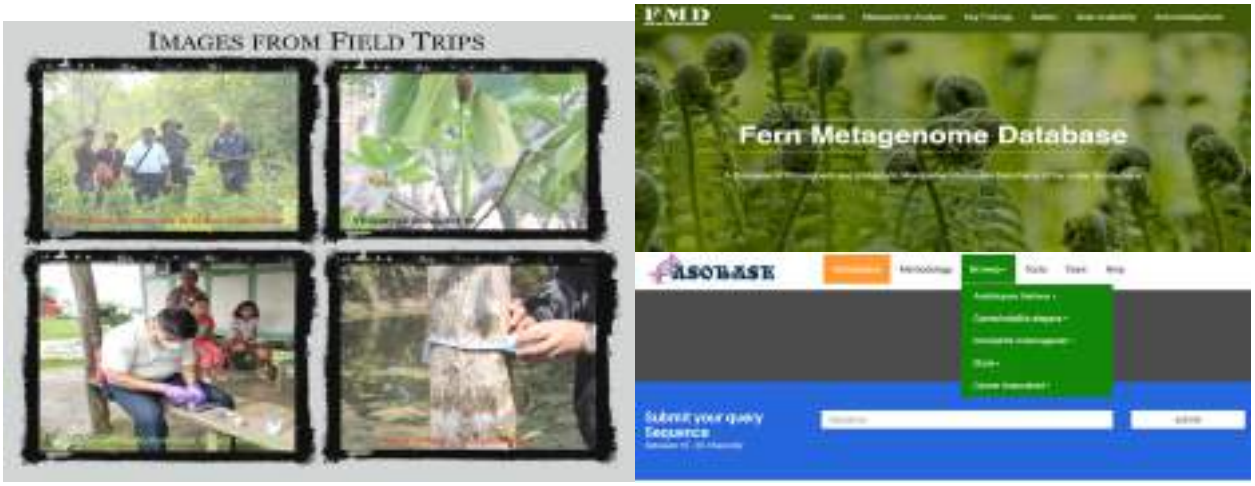


Figure: Images depicting field collection images and databases developed

Link Workshop titled "Building Ecological Resilience in Vulnerable Mangroves of the Indian Sundarbans: Sustainable and Equitable Management of Biodiversity and Ecosystem Services in the era of Climate Change"jointly organised by WBSU, INDIA and NEWCASTLE UNIVERSITY, UK, funded by DBT - GoI and British Council held in Indian Sunderbans 2nd to 6th January 2022.
6. **BEST POSTER AWARD** for the poster titled "*Evaluating the impact of tropical cyclones on the soil microbiome of Indian Sunderbans*"at One Day International Seminar on Recent Trends in Microbiology on 18th May 2022 at VJRC, Kolkata [Poster presenter Mr. Rohan Pal, BMBT Dissertation trainee]

Supervision:

1. Ms. Meesha Singh, Ph.D. Scholar (Registered under Department of Microbiology, SXC Kolkata with Dr.MM Ghosh as PI)
2. Ms. Sarmistha Mukhopadhyay, Ph.D. Scholar (Enrolled under Department of Biotechnology, SXC)
3. Final Year Dissertation Project Trainees: SXC, Kolkata (4); MAKAUT (1); and Delhi University (1)
4. Summer Interns: SXC - Kolkata (8).

Courses Taught:

1. Plant Biotechnology, Plant Tissue Culture. (Theory and Practical)
2. Plant Breeding, Genomics and Bioinformatics, (Theory and Practical)
3. Quantitative Genetics and Biostatistics (Theory)
4. Computer Aided Drug Discovery (Theory and Practical)
5. Plant Anatomy, Plant Taxonomy, Plant Pathology. (Theory and Practical)

Fellowship:

Research Fellowship funded by the Department of Biotechnology - Biology Teaching Through Bioinformatics Scheme (DBT - BTBI; Govt. of India) from 2007 to 2015 at Presidency College and Presidency University, Kolkata

Experience [Before Joining Current Position] [Teaching and Industrial Consultancy - 15 Years]

1. 2005 to 2014 at Barasat Government College (Visiting Faculty UG and PG).
2. 2006 to 2010 at Indian Institute of Social Welfare and Business Management (Visiting Faculty).

3. 2015 to 2016 at St. Xavier's College (Dept. of Microbiology) (Visiting Faculty - PG).
4. 2015 to 2019 at Lady Brabourne College (Visiting Faculty - PG).
5. APT Software Pvt Ltd. Kolkata (2010 to 2012).
6. ABPL (2016 - 2019).

Funding:

Collaborative Projects funded by DST – Government of West Bengal; DST – SERB; with University of Calcutta (Anthropology and Biotechnology, PG Department of Microbiology, SXC Kolkata; PG Department of Zoology, Rammohan College, Kolkata)

Life Member:

1. Alumnorum Societas, Kolkata (ALSOC)
2. Indian Science Congress Association (ISCA)
3. Social Environment and Biological Association (SEBA)

Hobbies:

Collecting Folk Songs; Playing/Watching Cricket and Football, NGO activities.

RESEARCH SCHOLARS

CURRENT RESEARCH SCHOLARS

Aparajita Chakraborty
PI/Co-PI: Dr. Sudipa Saha, Dr. Priyanka De
Research Interest:
Protein Biology
MSc. in Biotechnology

Sushmita Nandy
PI/Co-PI: Dr. Sudipa Saha, Dr. Priyanka De
Research Interest:
Protein Biology
MSc. in Microbiology

Indira Chakraborty
PI: Dr. Aniruddha Banerji
Research Interest:
Biotechnology, cell biology, cancer biology.
MSc. in Microbiology

Anirban Roy
PI: Dr. Aniruddha Banerji
Research Interest:
Cancer Biology.
MSc. in Microbiology

Shrestha Chakraborty
PI: Dr. Jhimli Dasgupta
Research Interest:
Structural biology, biophysics, biotechnology
MSc. in Botany

Peeali Mukherjee
PI: Dr. Jhimli Dasgupta
Research Interest:
Structural biology
MSc. in Biotechnology

Indrila Saha
PI: Dr. Jhimli Dasgupta
Research Interest:
Structural biology.
M.S. (Pharm.)

Ruchira Das
PI: Dr. Jhimli Dasgupta
Research Interest:
Structural Insights of Vibrio cholerae flagellar proteins.
MSc. in Microbiology

Ankur Singh
PI: Dr. Aryadeep Roychoudhury
Research Interest:
Toxic effects of fluoride stress on various.
MSc. in Biochemistry

Preeti Khan
PI: Dr. Ronita Nag Chaudhuri
Research Interest:
Role of histone acetylation in Nucleotide Excision Repair and gene expression regulation.
MSc. in Microbiology

Drishti Mandal
PI: Dr. Ronita Nag Chaudhuri
Research Interest:
Cross-talk between hormone signaling pathways in the modulation of root system architecture.
MSc. in Zoology

Sicon Mitra
PI: Dr. Ronita Nag Chaudhuri
Research Interest:
Role of histone acetylation in Nucleotide Excision Repair and gene expression regulation.

RESEARCH SCHOLARS

Saptarshi Datta
PI: Dr. Ronita Nag Chaudhuri
Research Interest:
Genetic and epigenetic regulation of root system architecture and its dynamism in response to abiotic stress signals.
MSc. in Biotechnology

Swarnavo Chakraborty
PI: Dr. Ronita Nag Chaudhuri
Research Interest:
RGenetic and epigenetic regulation of plant development during the abiotic stress response.
MSc. in Biotechnology

Priyabrata Singha
PI: Dr. Ronita Nag Chaudhuri
Research Interest:
Elucidating the significance of crosstalk between histone modifications and DNA methylation in Nucleotide Excision Repair and gene expression regulation.
MSc. in Biotechnology

Sarmishta Mukhopadhyay
PI: Dr. Sayak Ganguli
Research Interest:
Shigella genomics and computer-aided drug discovery.

RESEARCH SCHOLARS

ALUMNI RESEARCH SCHOLARS

Dr. Senjuti Banerjee
PI: Dr. Chandana Barat
Ph.D.: Awarded

Dr. Bani Kumar Pathak
PI: Dr. Chandana Barat
Current Affiliations:
Assistant Professor, Department of Biotechnology
MAKAUT WB
Ph.D.: Awarded

Dr. Surojit Mondal
PI: Dr. Chandana Barat
Current Affiliations:
Senior Officer,
Genetic Toxicology.
JDM Research Pvt Ltd
Vadodara, Gujarat
Ph.D.: Awarded

Dr. Sehnaz Ferdosh
PI: Dr. Chandana Barat
Ph.D.: Awarded

Dr. Aheli Majumder
PI: Dr. Aniruddha Banerji
Ph.D.: Awarded

Dr. Suparna Datta
PI: Dr. Jhimli Dasgupta
Ph.D.: Awarded

RESEARCH SCHOLARS

Dr. Maitree Biswas
PI: Dr. Jhimli Dasgupta
Current Affiliations:
Postdoctoral fellow, University of British Columbia, Canada
Ph.D.: Awarded (2016)

Dr. Sanjay Dey
PI: Dr. Jhimli Dasgupta
Current Affiliations:
Postdoctoral fellow, IGBMC, Alsace, France;
Former Postdoctoral fellow, Penn State University, USA
Ph.D.: Awarded (2016)

Dr. Shubhangi Agarwal
PI: Dr. Jhimli Dasgupta
Current Affiliations:
Postdoctoral fellow, Cornell University, USA
Former Postdoctoral fellow,
University of Stuttgart-Hohenheim, Germany
Ph.D.: Awarded (2018)

Dr. Saikat Paul
PI: Dr. Aryadeep Roychoudhury
Current Affiliations:
Postdoctoral Research Associate at National Institute of Plant Genome Research (NIPGR), India
Ph.D.: Awarded

Aditya Banerjee
PI: Dr. Aryadeep Roychoudhury
Ph.D.: Awaiting

Santanu Samanta
PI: Dr. Aryadeep Roychoudhury
Ph.D.: Awaiting

Dr. Puja Ghosh
PI: Dr. Aryadeep Roy Choudhury
Ph.D.: Awarded

Dr. Sonia Bedi
PI: Dr. Ronita Nag Chaudhuri
Current Affiliations:
Genome Solution Specialist, Molsys Ltd. Bangalore.
Ph.D.: Awarded

Dr. Sourabh Sengupta
PI: Dr. Ronita Nag Chaudhuri
Current Affiliations:
Post-Doctoral Fellow, Levy Lab, University of Wyoming, Wyoming, USA
Ph.D.: Awarded

Dr. Anagh Ray
PI: Dr. Ronita Nag Chaudhuri
Current Affiliations:
Post-Doctoral Fellow, National Cancer Institute, NIH, Bethesda, MD, USA
Ph.D.: Awarded

FIFTH YEAR

FOURTH YEAR

THIRD YEAR

SECOND YEAR

FIRST YEAR

CHIASMA COMMITTEE

RESEARCH SCHOLARS

SUPPORT STAFF

DEPARTMENTAL ACHIEVEMENTS

An investment in knowledge pays the best interest. – Benjamin Franklin

We are all within a space where we are trying to process what happened to us over the last 19 months. Success now is no longer solely about only earning a handsome amount at the end of the year. It is now about investing ourselves into knowledge and wisdom where we can reflect what we would like to do professionally and be able to collectively question about everything.

The lives of college students have been rough post-pandemic, but our students of the Department of Biotechnology have courageously kept going by investing themselves into setting new goals based on the present condition around the world. Their strong involvement in both academics and extracurricular activities demonstrates their tenacity, perseverance, dedication, and holistic development.

Given below are the achievements of the students for the year 2021-22, which has made us all, as a department, proud of them

ACADEMICS

List of students qualified in CSIR-NET (Life Sciences), June 2021

2017-22 Batch

Name	Qualified for	Rank
Sanjana Mullick	JRF-Lectureship	28
Deboshmita Sil	JRF-Lectureship	107
Dharitri Chaudhuri	JRF-Lectureship	118
Kankan Datta	Lectureship	41

2018-23 Batch (SEMESTER IX)

Name	Qualified for	Rank
Navaneel Sarangi	JRF-Lectureship	96
Nabarun Roy	JRF-Lectureship	112

DEPARTMENTAL ACHIEVEMENTS

List of students qualified in CSIR-NET (Life Sciences), June 2022

2018-23 Batch (SEMESTER IX)

Name	Qualified for	Rank
Nabhonil Chatterji	JRF-Lectureship	143
Abhinanda Adak	Lectureship	64

2019-24 Batch (SEMESTER VII)

Name	Qualified for	Rank
Uttirno Nath	JRF-Lectureship	142

List of students qualified in GATE (Biotechnology) 2022

2017-22 Batch

Name	Rank
Deboshmita Sil	12
Dharitri Chaudhuri	126
Kankan Datta	455

List of students qualified in GATE (Life Sciences) 2022

2017-22 Batch

Name	Rank
Deboshmita Sil	9
Dharitri Chaudhuri	19
Sanjana Mullick	31

2018-23 Batch (SEMESTER IX)

Name	Rank
Nabarun Roy	10

List of students qualified in DBT BET JRF 2022, Category I

2017-22 Batch

Name
Kankan Datta
Dharitri Chaudhuri
Sanjana Mullick

List of students involved in PhD Programs: 2017-22 Batch

Name	Institute
Arunima Bhattacharya	University of Bordeaux, Bordeaux, France
Nilasha Chakrabarty	New Jersey Institute of Technology, Newark, NJ
Dharitri Chaudhuri	Indian Institute of Science, Bangalore
Shreyasi Mitra	Shiv Nadar University, Greater Noida
Dipti Bhattacharya	Indian Institute of Science Education and Research, Bhopal
Sanjana Mullick	National Centre for Biological Sciences (NCBS), Bangalore

DEPARTMENTAL ACHIEVEMENTS

List of students secured jobs: 2017-22 Batch

Name	Institute
Dishari Paul	Cognizant (Lab Data Analyst)
Sinjini Sinha	Cognizant (Lab Data Analyst)
Rohan Pal	Cognizant (Lab Data Analyst)
Sayani Shyamal	Cognizant (Lab Data Analyst)
Sombuddha Roy Bhowmick	Karkinos Healthcare (Research Assistant - Bioinformatics)

1. **Arunima Bhattacharya** (2017-22 Batch) presented a poster titled "**Predicting Drug Targets from Hypothetical Proteins of Pseudomonas sp. released from Permafrost Thawing under Impact of Climate Change**" in International Conference on Climate Change: Global Cooperation, along with Sarmishta Mukhopadhyay and Dr. Sayak Ganguli, and received the 1st prize in UG and PG categories among 57 participating teams.

2. **Sanjana Banerjee** (Sem 9) received IASc-INSA-NASI Summer Research Fellowship to work under the guidance of Dr. Uma V Manjappara at CSIR - Central Food Technological Research Institute.

3. **Tannistha Das** (Sem 9) received IASc-INSA-NASI Summer Research Fellowship to work under the guidance of Dr. B Anand at Indian Institute of Technology, Guwahati.

4. **Zainab Khatun** (Sem 9):

    a. IASc-INSA-NASI Summer Research Fellowship to work under the guidance of Dr. Chandan Sahi at Indian Institute of Science Education and Research, Bhopal.

    b. JNCASR Summer Research Fellowship 2022 to work under the guidance of Dr. Kushagra Bansal at Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru.

5. **Souptik Ghosh** (Sem 9) and **Nabarun Dawn** (Sem 9) resented a poster titled "**Microbial Enrichment in Global Wastewater Niches under Impact of Climate Change: A Computational Study**" in International Conference on Climate Change: Global Cooperation, along with Souradip Basu and Dr. Sayak Ganguli, and received the 2nd prize in Young Researchers Special Awards and 5th prize overall among 57 participating teams.

6. **Nayanika Pramanik** (Sem 7) received IASc-INSA-NASI Summer Research Fellowship to work under the guidance of Dr. Mayurika Lahiri at Indian Institute of Science Education and Research, Pune.

7. **Swayambhik Mukherjee** (Sem 5)

   a. Qualified for in-silico project on Class A □-lactamases at Indian Institute of Technology Roorkee.

   b. Qualified for Industrial Implementation of biocatalysis involving Transaminase (TAm) and Transketolase (TK) enzymes and their combined reaction at Newcastle University, UK.

   c. Published an article titled "I**nsight into the Natural and Synthetic Factors Responsible for Cell Regeneration in Various Organs**" in the European Journal of Molecular Biotechnology, Volume 9, Issue 1. DOI: http://dx.doi.org/10.13187/ejmb.2021.1.37

8. **Kristina Das** (Sem 3) receive Bigyani Kanya Medha Britti Scholarship 2021.

BEYOND ACADEMICS

1. **Souptik Ghosh** (Sem 9)

   a. 5th Position in KIQF Grand Bronze Plate Open Quiz at Kolkata International Quiz Festival 2022.

   b. 4th Position in Under-25 Quiz in Kolkata Sports Quiz Festival.

   c. 3rd Position in Under-25 Quiz in North 24 Parganas Quiz Festival.

2. **Souptik Ghosh** (Sem 9) and **Uttirno Nath** (Sem 7) secured 4th Position in College Quiz representing St. Xavier's College (Autonomous), Kolkata at Kolkata International Quiz Festival 2022 along with Dayita Saha.

DEPARTMENTAL ACHIEVEMENTS

3. **Ankita Nanda** (Sem 7) received distinction in Sangeet Visharad Final (5th Year) Examination of Rabindra Sangeet (Vocal), Pracheen Kala Kendra, Chandigarh.

4. **Anushree Sadhu** (Sem 5) and **Nandini Jaiswal** (Sem 5) were placed 1st runners-up in Eastern Group Dance event 'Nritya Abhaya' in the inter-college fest Milieu'22, organised by Presidency University.

5. **Anindya Ghosh** (Sem 5) placed runners up in the XPL chess, organised by Department of Sports, St. Xavier's College (Autonomous), Kolkata.

6. **Koyena Nandi** (Sem 5) won 3rd prize for Digital Art at Ignation Year 2022.

7. **Shweta Mallick** (Sem 3) received 1st Runners up in Eastern Group Dance event 'Nritya Abhaya' at Milieu'22, organised by Presidency University.

DOWN THE MEMORY LANE

A Tale of Two BMBTs – Memories Offline and Online

Arunima Bhattacharya (Batch of 2022)
Current Position: Doctoral Researcher, Université de Bordeaux, CNRS, INSERM, ARNA, UMR 5320, U1212, F-33000 Bordeaux, France

To pen down the experience of half a decade, half of which was again during the pandemic, is quite an uphill task. While the first two-and-a-half years are brimming with so many memories, the second half mostly seems like a blur – but I believe as the batch which spent five semesters in class and five at home, we got the best (and the worst) of both worlds.

The week I walked into BMBT (panting for breath every day after climbing the infamous flight of stairs), I remember being awestruck the most during the class on amino acid structures where in less than 30 minutes, we were shown the easiest way to remember the structures, properties, three-letter and one-letter codes of all 20 of them. Little did I know that these 20 little friends would remain indelible throughout my research career ahead.

My academic memories in the department are endless, to be honest – be it listening in awe and actually understanding the prokaryotic translation in just one class, solving Punnett squares of complex genetics problems, imagining the nucleosome as a computer mouse wound by a wire, solving problems on the effects of mutant cell-signalling proteins, modelling new proteins, finding new drug targets, learning in detail about the circadian rhythm (and how mine was badly messed up), appreciating the potential of stem cell research, understanding the antibiotic resistance crisis (this was instrumental in choosing my PhD lab), or even knowing about Coronaviruses before it became the talk of the world. I especially have fond memories of the practical classes, ones where we were allowed to team up with our friends and do and learn pretty cool science together. Before the world shut down, my last lab memory was isolating plasmids and transforming competent cells with them. If I remember right, we were supposed to prepare a fresh set of competent cells the next week – the week that finally never came during our course.

The online version of BMBT unfortunately did not bring many vivid memories. While it is true that online classes allowed sharing of videos from YouTube and easier presentations from our own familiar devices, it could not compete with the dynamicity and depth of in-person classes. Besides, of course, WhatsApp chats cannot replace

the knowing stares from friends and the highly engaging conversations between offline classes. However, I remain grateful to all our professors who gave their all to make the classes as productive as possible during such difficult times – I am sure talking to blank screens every day was more difficult and frustrating than we can ever understand as students.

In conclusion, all the events, committees, debates, classes and exams - both offline and online - have not only helped me grow a scientific temper and propelled me towards a career in research but have also shaped me as a confident person to tackle all the odds in the highly competitive "real" world out there. The journey has not been a bed of roses, of course – there have been extremely long syllabi, difficult papers to prepare for, and challenging topics to give succinct presentations on, but I believe each played a role in preparing us for the future, and I would say this despite the risk of glorifying the near-workaholic nature expected of students in several instances. While it is true that our department is mostly an academics-centred one, I feel blessed to have met and known so many talented friends, seniors and juniors, who have also supplemented my growth as a person beyond academia.

Finally, to the professors, who are at the core of the department, thank you for the overall training, academic and beyond, which I now realise has been of utmost importance, while I work and must keep calm as an independent "adult" in a foreign setting.

The feeling of being out of college and out in the world is still sinking in for me, and despite all the grievances I might have had in the last five years, I am somehow more grateful to SXC BMBT. Thank you for the experience, the memories, and the friends, and for helping me find my place in the scientific world.

Reminiscences

Dharitri Chaudhuri (Batch of 2022)
Current Position: PhD Scholar,
Indian Institute of Science, Bangalore

"Two roads diverged in a wood, and I—
I took the one less travelled by,
And that has made all the difference."

It only seems like yesterday when I stepped into 30, Mother Teresa Sarani for the first time with quite an unsettled mind (to be honest) of whether I had taken the correct decision in choosing to pursue a career in basic science or whether I should sit for the medical entrance exams the next year. However, soon after I started attending the classes of my professors in the Department of Biotechnology, I realised that I had fallen in love with the subject. Since then, there was no looking back. I was convinced that the road I had taken was indeed the right one for me.

I can never thank my professors enough for instilling in me a passion for research and a curiosity to seek answers to all the unknown questions in the vast ocean of science. As a PhD scholar at another institution, I now realise even more what a pivotal role our professors played in clearing our basic concepts. The knowledge they infuse in us so dexterously and passionately strengthens the foundation for pursuing a career in academia in the future. Our professors always encouraged us to ask questions and not take anything for granted, which, I feel, really helps in shaping one's scientific bent of mind.

When I was in school, I heard others say that college is very different from school and has a very professional environment, and that students are just roll numbers to the professors. However, I beg to differ, as the Department of Biotechnology, St. Xavier's College, Kolkata, was nothing less than a second home to me, where our professors knew each of us by name, cared for us just like our parents, and always endeavoured to bring out the best in us.

As I look back, I fondly remember the beautiful memories I preciously gathered in this department- the fun we had staying back after class hours making props for the Departmental Sports parades and preparing months in advance for FiB and Chiasma.

I met some of my best friends, seniors and juniors in this department, and

I have nothing but gratitude towards every one of them for making my five-year-long stay here so beautiful and memorable.

It is unfortunate that we had to spend the last two years of our college lives in front of our laptop screens because of the pandemic. However, I am happy that things have now returned to normal and that my juniors are getting to experience the true essence of college life.

Memory is a diary we all carry with us

Shreyasi Mitra (Batch of 2022)
Current Position: PhD Scholar, Shiv Nadar Institute of Eminence

Nostalgia is delicate, but a potent feeling. And it is this potent pull at the strings of my heart which have brought me to my laptop to pen down a few words about a 200 year-old institution situated at the heart of Park Street, that happens to be a place where I have treasured the best five years of my life. St. Xavier's College has been a dream for many, as it was for me until I was called for orientation after joining the Department of Biotechnology. I remember trying extremely hard on the first day to understand AB Sir's accent as he briefed us about the course. And hence started a five year long journey, with all its highs and lows and occasional harsh blows.

I was well-known in college for all the wrong reasons. I was part of the usual trouble-making group of backbenchers, got a lot of reprimands from our teachers for mostly non-academic reasons, fluttered around the 4th floor always chattering and got into a few infamous fights. Let's put it this way; during every semester of these five years, we got into some drama or the other. Even though I am giggling at the thought of it now, back then they were indeed significant happenings, that taught me few very important life lessons.

Other than lessons of adulthood, BMBT indeed gave me a repertoire of knowledge that is like no other. Even though I would constantly complain about the intensive course, lengthy papers and such a wide array of subjects, studying the same for five years has given me a competitive advantage which I realise only when I have stepped out in the world and am competing with students from similar educational backgrounds. Indeed no one could have given us a better flavour of epigenetics that RNC Ma'am, complex cell signalling would be a mumbo-jumbo without the US Ma'am's very interesting lectures, AB Sir's widely spanning knowledge is something I haven't come across in anyone else and crystallography was indeed made crystal clear by JD Ma'am. SG Sir has been a true guide in having our backs during any academic or non-academic problems that we have faced, PD Ma'am's jokes did lighten our moods after tiring classes, and ARC Sir has always motivated us to think in an experimental approach-oriented manner. Microbes are indeed ubiquitous, and we have understood them so well because of SR Sir's detailed teaching methodology, and even though

life's chemistry was a little haywire back then, but SS Ma'am's chemistry lessons are helping us with our basics even now, as are CB Ma'am's cell and molecular biology lessons. I still go back to the presentations and read up whenever I need a better understanding of specific topics, and I have never been more grateful to have these aids.

If my previous paragraph has convinced you into believing that I used to be a very studious kid, let me tell you my friend, you are wrong. I have on occasions taken a stroll at maidan when I probably should have been academically engaged and I have been made to sit away from my friends because of my incessant giggling in class. As much as I would like to apologize for such a nuisance, I never regret enjoying my time at college. We would dress up at every cultural event, have an entire portfolio worth of photographs clicked at FIB, and try to outdo ourselves during every Sports day in order to win a prize for the department. The most awaited event however was the departmental excursions, because that was the day we could enjoy with our professors outside the 4 walls of the classroom. We were never diverted from the academic intent of these tours even when they allowed us to have a little fun.

If I start digging at my college memories, I'll probably write a 50 page thesis at the moment, but to summarize it all, I've had the best and worst days of my 23 year-old life at Room no. 407,408 and 409 of 4th Floor, 30 Mother Teresa Sarani. I have grown from a teen to an adult in those five years, gathering a treasure chest of experiences and stories to tell my future generation about. Sometimes I wish I could go back to those familiar rooms, sip on a glass of iced tea which belongs to someone else , or sit on the terrace between practicals and whine about how hard MBCR4502 is, gossip with friends. Some of them became family while others turned into strangers, and at that point, I did not realise I was making memories worth a lifetime. I hope I can go back to this glorious institution at some point of my life, as these memories flash in front of my eyes, and feel like I have come back to where I belong.

Here's wishing I've done justice to "down the memory lane", while all my juniors walk down the same lane. Relish this wonderful feeling as long as you can, because trust me, you are gonna miss this when it's gone.

Memory of a Lifetime

Kankan Datta (Batch of 2022)

On July 3rd, 2017, I walked through the green back gate of SXC as a full-time student. With lots of expectation and excitement, I started my journey of collecting moments, which eventually got engraved in my memories. Five years seemed like a considerable time in the beginning, and yet here I am standing to talk about this beautiful journey of a lifetime.

Being a hosteller, I never felt the morning hustle and day-to-day shenanigans of people in metros. However, the journey from the hostel to college was not any less exciting. Amongst people gathering for their morning tea in front of ATS, never-ending traffic in front of Minto Park crossing, or gatekeepers forcing us to show ID cards, again and again, every day, life has passed a major milestone. Our day in college used to end with a gossip session at the 4th-floor canteen or "poori-sabji" at Chotu's.

Choosing over a particular academic moment or memory is very difficult as there are numerous incidents to tell. Be it CB ma'am telling us to remember all 20 amino acid structures, AB sir's interesting life lessons and fact discussions, RNC ma'am's quiz sessions or SR sir's microbiology practical, we learned some of the most valuable lessons of our lives. Coming from a WBCHSE board and background, I never once felt like I did not belong here, thanks to my supportive classmates and professors. I feel that for most of us, the fondest non-academic memory will be "Frontiers in Biotechnology". Loads of different events, adda sessions, and cultural programs were enough to give us a relief amongst all the hectic day to day schedule.

Being a 2022 batch, we all have lost 2 major years of our lives in COVID pandemic. The 15 days long vacation that began on 15th March, 2020, was extended for almost 2 years, forcing all of us to be contained within our homes. Besides wishing to get those 2 years back to spend in college once again, I am happy that the usual life at college has resumed.

I am extremely grateful to all my professors and classmates for making me who I am today. SXC made me realize that scientific discussions can go hand in hand with gossip sessions and tiffin snatching during a 30-minute break. Rooms 47, 48, and 49 will hold lots of happiness, tears, drama, and confessions in the coming years as they always have. Just the faces will change.

Maybe, this is how life goes on!!!

Memories

Atreyi Dutta (Batch of 2021)

It seems like yesterday when I was in college, flipping through 'Chiasma', reading this section with awe and interest. It makes me nostalgic to write this one now.

The five years that I spent at Xavier's were undoubtedly the happiest and best years of my life.

Before joining the department, I was a bit unsure if I would fit in and if the course would suit me. Little did I know that I had made the best decision of my life. Our professors were amazing and boosted our love for and interest in the subject. I am beyond grateful for my friends, who still mean the absolute world to me. There are so many things that I miss. My classmates made the long class hours, huge syllabus, and intense pressure bearable. Whenever I take the metro now, I feel sad that I have to travel alone and not while chatting with my friends. I miss the excitement of sports day preparation, the perfect fests including the craze of Xavotsav. I wish COVID had not robbed us of our excursion and an official last day of college. Oh, and I think my biggest takeaway from college is the nickname I got for my antics, and I think I will always respond to it, even if I am in a public place.

It has not been long since I graduated from college, so I am not sure if I am the right person to give any advice here. However, I would like to take this opportunity to tell you a few things that I wish someone else had told me during college. If anyone who feels lost in the department or the course is reading this, I would like to tell them that - It is okay, it really is. You will figure it out. Everyone does. It takes courage to travel a path that is normally not taken by all the students in the department. However, if you put your heart and soul into it, it is achievable because, although you may not know it right now, a lot of us are carving out our own niches for ourselves. I would also ask you to enjoy your life while it is still under a proper structure. Work hard but also go to the movies with your friends, have fun, and do crazy things because you need to have memories that will make you smile when you look back on your college days. Hug your friends a little tighter every day because you never know when you will see them for the last time or which part of the world they will move to.

- Love, Atreyi

Reminiscences

Maheli Banerjee (Batch of 2021)

Before embarking on the journey of a five-year integrated Masters in St. Xavier's College we had been warned in our orientation that five years is quite a long time and there is no turning back in the middle. Even after this clear warning, forty-one brave students and I decided to wander and make our way through. I walked in through the gates with a nervous smile as I clutched onto the string of my new ID card. The hardest part about college was running up the "stairway to heaven" when I was late for a class. When I finally reached the class (just in time!) panting against the door I was let into a world of biology, but these were not just your regular classes. We saw proteins, receptors and ligands come to life. We did not only study 2 dimensional slides we were allowed to imagine way beyond. We built up from the basics and created a strong foundation. One of our professors told us that in research it is not about how many different things you know it is about how deep you know of one topic. Through packed schedules and fear of exams looming over my head I delved deeper into what interested me. I went back and forth on my interests and to my surprise when I was applying for my doctoral position, I knew exactly what I was looking for.

We did learn a lot through lectures but as we stood at our assigned group microscopes, we also started applying what we knew. It was almost like walking for the first time. At first my ideas were a bit wobbly and I often had this "okay.. and what next" look on my face but as time went by it turned into a confident set of expectations from my experiments. I remember, even amidst hectic laboratory periods and a crowd of college students, our laboratory attendants were always smiling and helping every student in need. Sometimes the laboratory classes would run long, and our group would leave college when it was almost dark, a little tired but smiling. I believe that I've done some of my best thinking as I sat dangling my feet on the bench next to the autoclave while sterilizing our lab equipment.

I enjoyed my academic experience here, but I think the secret ingredient to remaining sane while completing a master's degree is: great friends. Friends who would send their notes on the day before the exam, bring extra lunch just for you because they accept the fact that you're going to eat their lunch, make your birthday special even though you are supposed to be an "uninterested-

in-your-birthday" adult, you can call up before the exam and say "I don't think I can finish the syllabus", you can go out with when a class in cancelled to eat paneer butter masala and naan under a tree and basically make the difficult parts of college easier.
Today, after surviving those five years, I can gladly say I would not have it any other way. I have come across some amazing experiences and human beings which has shaped some part of me in what I believe is a good way. Covid might have taken away a part of the experience away and forced us to say goodbye to five years of experience in front of a laptop screen but the college will always be like G protein coupled receptor, embedded in us.

The Road that was Fortunately Taken

Moubani Chakraborty (Batch of 2016)

Hello, I am Moubani, a student of BMBT 2016 batch! Most of you would not know me, so I will begin with a brief introduction! I joined this amazing, fancy course in 2011, started the journey by feeling like a fish out of water who was desperately trying to become at least a salamander and then in due course of time, got enchanted by the magic of the BMBT department and ended the journey as an evolved human being!

Jokes apart, I am extremely happy to share some of my memories and insights with you, through this fantastic magazine, which was also a dear part of our lives when we were students! Let me summarise my stay in the beautiful roof-top Biotechnology department in one of Kolkata's best institutions in a format familiar to you.

Aim: Attainment of a master's degree in Biotechnology (and hopefully beginning the story of becoming a scientist one day).

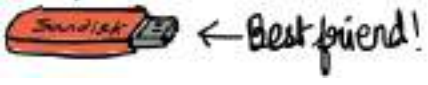
Principle: One must attend all classes, study whatever is being taught and then apply their brains and give lots of exams and eventually get the degree.

Materials required: Presence in all classes (proxy doesn't work in a class of 30 kids!), perseverance throughout five years, lots of patience, sincerity and dedication to excel in the thousands of subjects that are taught to us (which saves your neck at different levels of life, mind you!), not worrying about time and learning what is taught in the practicals (that is the fun part), being persistent in collecting question papers, presentations, etc. so that you are ready when suddenly a class quiz or a mid-sem hits you, and most important is the presence of good friends in your life and the belief that you can do it! (When there is a shortage of resources, researchers are known to improvise and find alternatives to get the job done!).

Protocol:

1. Classes to be attended and enjoyed from 10 am to 5pm (upto 8pm on days of lab work).

- You must listen to CB ma'am and not take notes! You can't blink or yawn as well! Anyhow, the way she narrates won't let you get distracted, you can only fall in love with science!
- In AB sir's class you would probably spend all the time just admiring how much he knows and what a photographic memory he has!
- In US ma'am's class, it is all about the way she will tell you the story of



such complex things! It is more like a "Let me tell you about my friend, the bacteriophage!", interspersed with thoughtful questions and interesting stories about her life.

- JD ma'am appears strict kind of, (maybe she is fed up with blank stares when she introduces us to fundamental biochemistry and life-changing methods) but teaches some of the most difficult topics with such elegance, that you are left feeling awed!

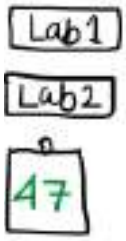
- PD ma'am has her way sorted. Nobody dares to interrupt what is happening to the muscles, or silkworms! The effort she puts in to teach us things that appear slightly boring sometimes will be reflected throughout your life, because you will end up remembering several fancy facts, just because of the amazing way she taught it!
- If SS ma'am didn't teach all that, you won't believe what you will miss if your future involves any sort of biochemistry! Hats off to her patience with kids who think they don't need chemistry!
- ARC Sir and DC Sir have been the legends of plant bio in our department! Starting from teaching you basic lab work, to extracting rice DNA or culturing chickpeas, they know it all!
- SR Sir's way of getting information through our skulls is unbeatable. No wonder I still remember how to make cheese and also about antibody response! Love the way he made us all sit till the bell rang, like school kids!
- RNC ma'am and her stares (almost as if wrapping our minds like DNA with histones!), hypnotises students into understanding whatever she says! The stepwise questionnaire finally leading to the climax of the topic that is being explained, makes everything appear so easy and clear!
- SG Sir hadn't taught us, but I do know that he is an outstanding chef! His polite and nice personality is obvious, and I am certain he teaches well too!
- Our department has an amazing pack of trump card professors who come and teach us a plethora of subjects and trust me, they are not trivial!
- You must do other extracurricular activities to make the stay more enjoyable! Not just for those stupid credits, but for yourself! I loved participating in cultural and sports events, and those Balarampur visits are to be cherished forever…

2. It is a family, and this will be your home for FIVE years, so behave like it, enjoy the time there and you will automatically learn a lot (I have the fondest memories of Akali Da, Biddesh Da, Rajkumar and Shreyashi).

3. Try and understand what is being taught, it will always seem unfathomable, but take one bite at a time and don't worry, you will do

well in the end! Professors are always helpful and can guide you when you need it!

Observation: I will tell you what I observed after the course ended. I had an average score, most of my friends did better than me! But the BMBT course work gave me enough fuel to jet through some of the entrance tests and thus I landed up in IISc Bengaluru, to do a PhD! I also finished with a lot of love and respect for all faculty and staff and last but not the least, I made friends for life…



Conclusion: It is not really Nihil Ultra (Haha!), it is all about being ready for what is beyond. Think of it as the stocking of a new device with all the software that you can think of! What doesn't matter much is marks and where you get placed next, because there is no end to software updates, and you just got to keep making lemonade out of the lemons hurled at you!

P.S. Many things might seem redundant at that time, but trust me, you don't know what will prove useful when, so just gather and roll till you end this journey as a big powerful snowball! If you think you can't make it, begin with baby steps towards making it! Another aspect which I can tell you about is what getting a PhD means. If you are in love with science, just go for it! Those three letters are not just a thing to flaunt, they showcase a person's growth through lots of failures, some significant successful milestones and about the way they stayed true to their passion and persevered through time… If you want other alternate careers (industry, law, business, teaching), you are not wrong, just enjoy what you are doing (everyone's journey is unique, so don't compare). If it is a PhD you want, it is not easy and you don't get fancy textbook results every day, but each time you ask a question, you get to find something new!

Ending this with much gratitude and love for the department…

SCIENTIFIC ARTICLES

Antibiotic Resistance - The War For Survival

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Antibiotic Resistance among the pathogens causing some of the most serious bacterial illlnesses, has long been recognised as a serious hazard to human health on a global scale. Multidrug-resistant organisms are increasingly common as seen in community settings in addition to hospitals, suggesting that there are other locations where antibiotic-resistant microbes are stored.The accumulation of genetic material, or changes in gene expression, may create resistance to nearly all antibiotics currently used in medical care. The bacterial response to the antibiotic "attack" is the pinnacle of evolution and the best-known example of bacterial adaptability. The result of the enormous genetic plasticity of bacterial pathogens causes specific responses to lead to mutational adaptations ultimately pointing towards the concept of "Survival of the fittest". It is essential to comprehend the biochemical and genetic underpinnings of resistance in order to create methods to stop the emergence and spread of resistance as well as new therapeutic approaches against multidrug-resistant organisms. Consequently, we shall concentrate on antimicrobial resistance in this article.

Due to their extraordinary genetic adaptability, bacteria can react to a variety of environmental hazards, along with the presence of drug compounds that could threaten their survival. Since they have evolved defenses against the antibiotic molecule, resistant bacteria that dwell in the same biological niche as organisms that produce antibiotics can endure and even thrive there. When an antibiotic "attacks," bacteria respond to it using three main genetic strategies:

(i) mutations in gene(s) frequently linked to the antibiotic's mechanism of action; and

(ii) uptake for DNA from foreign sources which transcribe into resistance determinants through Horizontal Gene Transfer (HGT).

Apart from these genetic modifications, resistance may arise from:

(iii) Changes at the molecular level pertaining to antibiotic transport, targets and the compounds themselves.

- Heritable Mutation:

In this case, a subgroup of bacteria

that were isolated from a population that was susceptible to the antibiotic undergoes gene alterations that impact the drug's efficacy, preserving cell life in the presence of the drug molecule. As soon as a resistant mutation appears, the antibiotic kills off the susceptible population, leaving just the resistant bacteria. In many cases, mutational modifications of cell physiology that result in resistance are expensive to cell homeostasis and are only maintained, if necessary, in the presence of the antibiotic. Thus, the diversity and complexity of resistance resulting from acquired mutational alterations vary. The significance and implications of the mutations increase almost exponentially when the mutational changes become heritable and are expressed in the progeny.

- Horizontal Gene Transfer (HGT):

One of the most significant forces influencing bacterial evolution is the acquisition of foreign DNA by HGT, which frequently results in the emergence of antibiotic resistance. The majority of antibacterial substances utilized in clinical settings are made from substances that naturally exist in nature (mostly soil). There is strong evidence that the "environmental resistome" is a significant source of the transfer of antibiotic resistance genes in therapeutically relevant bacteria since bacteria that share the environment with these compounds carry intrinsic genetic determinants of resistance. Additionally, it has been proven that the spread of antibiotic resistance is a result of this genetic exchange.

Traditionally, there have been three main ways for bacteria to take in foreign genetic material: transformation (the incorporation of bare DNA), transduction (mediated by phages), and conjugation (bacterial sexual reproduction). Only a few clinically significant bacterial species are capable of naturally integrating naked DNA to evolve resistance, making transformation probably the easiest form of HGT. Conjugation is frequently involved in the emergence of resistance in the hospital environment, a very effective type of gene transfer that includes cell contact in actual physical proximity and is anticipated to happen at high rates in the gastrointestinal tract of individuals receiving antibiotic therapy. Mobile genetic elements (MGEs) are typically the means by which important genetic information is transferred during conjugation. Plasmids and transposons are the two most significant MGEs because they both significantly contribute to the emergence and spread of antibiotic resistance in clinically relevant organisms.

Finally, integrons, which are site-specific recombination systems capable of enlisting open reading frames in the form of mobile gene cassettes, represent one of the most effective ways for amassing antimicrobial resistance genes. Integrons offer a reliable method of genetic exchange and one of the primary forces behind

bacterial evolution. They do this by providing the machinery to ensure the expression of newly added genes as well as an efficient and relatively straightforward mechanism for adding new genes to bacterial chromosomes.

Apart from genetic changes, other changes in the molecular level also affect antimicrobial resistance in bacterial species like:

- Changes in the Antibiotic Drug molecule
- Stops the compound from reaching its targeted site of action
- Modification of target

I. Changes in the antibiotic drug molecule

One of the most common mechanisms that most bacteria adopt are the modifications on the molecule of the antibiotic itself. Various defensive enzymes secreted by these resistant bacteria are responsible for modifying the antibiotic in such a manner that they are rendered a loss of function. These changes can be chemical with modifications like acetylation, phosphorylation, and adenylation taking place. However, it is prudent to take note that these enzymes are very specific, even within families. If one family of enzymes works on a few specific drugs in one particular gram-positive bacteria, it is not necessary that the same enzymes will have the capacity to chemically modify the same drugs on the Gram-negative bacteria. This could be due to the obvious difference in Gram positive and negative bacteria's cell membrane composition. The presence of complex transmembrane proteins on the gram-negative bacterial cell membrane compared to their absence in simpler gram-positive bacterial membranes could be the reason why a particular enzyme works on one but doesn't work on the other even when administered the same drugs.

Another nuanced mechanism that can be used is the complete degradation of these drugs by a specific group of enzymes called ß-lactamases. These enzymes target the ß-lactam rings present in the antibiotic and degrade them rendering the antibiotic mostly ineffective.

II. Stops the compound from reaching its targeted site of action

In most cases, the outer membrane or the plasma membrane is responsible for posing as the first line of defense against antibiotics. If the bacteria are capable of stopping the passage of the antimicrobial compound across the cell membrane into its cytoplasm, then there is a high chance that they won't reach their intended targets and will be rendered useless. This exact phenomenon is exhibited by vancomycin which is incapable of acting on Gram negative bacteria because it is incapable of passing through its complex outer membrane. Changes in various hydrophilic molecules of the membrane can also have a change in the permeability of the cell. These

act through various kinds of porin proteins and modifying them in any way(modification in expression or function) results in a rise in resistance to the antibiotics which now become incapable of reaching its target. It could also be achieved by physically removing the protein from its target via efflux pumps. For example, tetracycline is a class of drug that is rendered useless by this resistance mechanism of literally kicking the molecule out of the cell with the help of ion exchange.

III. Modification of targets

Some bacteria do not like taking risks, so instead of waiting for the cell's defense to protect it from antibiotics, it shields itself from them in a James Bond-esque style. Just like the protagonist changed his identity to combat a villain in his movies sometime, these bacteria alter their target sites to ensure that even if the killing drug does teach the intended target, there won't be a target to work on at all. This can be done by either protecting the target or modifying the target site. In the first case, the target is guarded such that the drug is incapable of binding to it completely. Rebinding is also prohibited by changes in ribosomal structures. The target site could also be manipulated with a mutation or with an alternate target creation which binds the molecule but does not incur the toxicity associated with it due to the change in target. It could also be modified by enzymes where structural changes render the target useless for the antibiotic and the organism becomes resistant to that particular agent.

- Resistance Due to Global Cell Adaptations:

In order to prevent the disruption of critical cellular processes including the production of cell walls and membrane homeostasis, bacterial pathogens have developed extremely sophisticated strategies. The most clinically significant examples of resistance phenotypes that develop from a universal cell-adaptive response to the antibacterial attack are the development of resistance to daptomycin (DAP) and vancomycin (low level in *Staphylococcus aureus*). DAP is a lipopeptide antibiotic that functions as a bactericidal agent by changing cell membrane homeostasis. It is related to cationic antimicrobial peptides made by the innate immune system. There are four crucial steps needed for DAP to have bactericidal activity . DAP first forms a compound with calcium, which makes it positively charged. Then, through electrostatic interactions with the normally negatively charged cell membrane (CM), DAP is guided to its target. Second, once the antibiotic molecules enter the CM, they first oligomerize at the CM's outer leaflet and then proceed to the inner leaflet as DAP oligomers. Another phospholipid (cardiolipin), whose involvement is not well known, also appears to be crucial in the translocation of DAP oligomers.

In addition, there is evidence to back up the theory that high levels of cardiolipin might inhibit DAP oligomers from translocating into the inner leaflet of the phospholipid bilayer. Third, the DAP oligomers organize and form transmembrane pore-like structures once they reach the inner leaflet of the CM. These structures are likely to change the CM's physical and chemical characteristics and encourage the outflow of ions from the cytosol, leading to significant electrochemical changes. Finally, these structural and functional CM modifications result in bacterial mortality without cell lysis through as-yet-unidentified mechanisms.

Bacteria possess a variety of regulatory systems that are essential in defending the cell membrane when attacked by cationic antimicrobial peptides(cAMP), and they have evolved ancient defense mechanisms to survive the impact of cAMP. According to whole-genome sequencing of a clinical strain-pair of *Enterococcus faecalis*, it was shown that DAP resistance (DAP-R) developed over the course of therapy. Changes in a three-component regulatory system known as LiaFSR (which coordinates the cell-envelope stress reaction in Gram-positive organisms) are essential for the formation of DAP resistance (DAP-R) in *Enterococci*. The homologous LiaFSR system in *S. aureus* and other Gram-positive bacteria, as well as *Bacillus subtilis*, where the system was first identified, are made up of three proteins:

i) The transmembrane protein LiaF (VraT), which appears to be adversely regulating the system

ii) LiaR (VraR), the system's response regulator, and

(iii) LiaS (VraS), a traditional sensor-histidine kinase protein that phosphorylates it.

These 3 proteins are highly conserved in these bacteria and are associated with the development of resistance by redistribution of cardiolipin microdomains from the septum to the other CM areas.

The use of antibiotics is a fairly new aspect in the medical world as compared to the existence of the bacteria. So, it is obvious that bacteria through generations have devised intricate bypass mechanisms to combat antibiotics since the discovery of penicillin. However, it is only recent that the bacteria's capacity to defend its own survival has reached an extent where it poses to be a future pandemic in the modern world. For example, in *S. aureus*, drug resistance to vancomycin was almost in half the Indian population. Tetracycline, a very common drug has been rendered useless in almost three-fourth of the Indian population due to *Vibrio cholerae* and other microbes' resistance mechanisms. Research and development efforts need to be greatly intensified and encouraged if we are to successfully address this issue. Discovering new tactics to address the danger of resistance to antibiotics necessitates an in-

depth knowledge of the mechanisms by which bacteria develop antibiotic resistance. Antibiotics must be created with the knowledge that microorganisms will react to them and acquire resistance (an evolutionary fact). Therefore, ongoing, tenacious, and constant efforts should be made to create antibiotics and research the causes of resistance. This "war" against living things that have a lot of adaptability and survival potential is probably going to last for a while.

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Rediscovering the Ancient "Miracurall"

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I believe almost all of us have had a tryst with Professor Trilokeshwar Shonku and his groundbreaking discovery of a pill, with the ability to cure almost all diseases known to man - *the Miracurall*. What if I tell you that such a sample exists in the real world in the form of a plant - richly documented in ancient roman chronicles as "**Silphion**".

A dive into History:

If you navigate around in ancient roman history, you will find the mention of a golden flowered plant called silphion documented not only for its medicinal properties (wart removal, stomach pain etc) and thus revered by greek physicians but also for its use by roman chefs to spice up their delicacies ranging from regular pot of lentils to the exquisite scalded flamingo. It is reported that Julius Caesar, maintained a thousand pound storage of this plant alongside gold in the treasuries of Rome and valued it equivalent to silver. The first documented data in terms of the natural habitat of the plant dates back to 638 B.C. along the coast of Cyrenaica (modern Libya). However, the entire stockpile along with what was once a luxuriant spread of Silphion, disappeared mysteriously seven centuries later as "Pliny the elder" a roman chronicler states the gifting of the last stalk to the plant to emperor Nero. Since then, botanical explorations along the area over the years have not yielded any results and the scientific world almost came to the conclusion that we have been robbed of this opportunity to explore this wonder plant.

Serendipity and Luck:

We time warp from 60 A.D. to 1983 where we join the journey of Professor Mahmud Miski, of Istanbul University, who is being guided by two local village boys from a small Cappadocian village along the precipitous dirt road to the slopes of Mount Hasan, in search of freshly grown barley and chickpea. Suddenly, they stumble across a plant, tall in habit exuding a pearl coloured acrid tasting sap later identified to be composed of resin. Miski was excited as the plant bears resemblance to the image of the silphion depicted in Cyrenaican coins. So he collects a sample by

pulling out the plant from the rocky soil and voila a smell starts to emanate from the root ball - almost midway of resembling Eucalyptus on one hand and pine sap on the other. He also observes that sheep and goats gorge on the leaf of the plant and the sap stimulates mating behaviour in insects both signature effects of Silphion chronicled in Pliny's Natural History "of sheep being fattened on silphion" and its use as an aphrodisiac.

A true "Chemical Gold Mine":

Initial explorations lead Miski to identify that the plant which he was able to collect on that trip, was last identified as *Ferula drudeana* (Apiaceae) in 1909 collected from a site 150 miles to the east of Mount Hasan. Miski's started exploring the chemical properties of the plant and he was able to identify 30 secondary metabolites from the root extracts. Among the compounds, many of which have cancer-fighting, contraceptive, and anti-inflammatory properties, was **shyobunone**, which acts on the brain's gamma-aminobutiric acid (GABA) receptors and may contribute to the plant's intoxicating smell (Table 1).

The Path Ahead:

Several workers, over the years have projected three related Ferula genera as potential Silphion - *Ferula tingitana; Cachrys ferulacea* and *Margotia gummifera*. However, all of the three have some distinct morphological dissimilarities with the originally described Silphion which the current Ferula plant of interest, resembles the most. As we dig deeper into the functional and organizational behaviour of the plant we will find more evidences which will enable us to authoritatively say that indeed the lost miracurall has been rediscovered.

Secondary Metabolite	Biological Activities
Spathulenol	Immunomodulator, anti-nociceptive, antimicrobial, alleviates cardiac fibrosis, antioxidant, antiproliferative, antimycobacterial, anti-inflammatory, antitumor.
Preisocalamendiol	Positive $GABA_A$ receptor modulator.
Shyobunone	Positive $GABA_A$ receptor modulator, insect repellant and insecticide.
Isoshyobunone	Positive $GABA_A$ receptor modulator, insect repellant and insecticide.
Acorusnol	Anti-inflammatory, germination inhibitor.
Teucladiol	Cytotoxic against MCF-7 (estrogen-responsive mammalian adenocarcinoma), MDAMB- 435 (estrogen non-responsive mammalian cancer), HCT116 (colon cancer) cell lines.

Chrysothol	Cytotoxic against MCF-7 (estrogen-responsive mammalian adenocarcinoma), MDAMB- 435 (estrogen non-responsive mammalian cancer) cell lines.
Umbelliferone	Anti-inflammatory, alleviates liver fibrosis, bone loss prevention, partial restoration of erectile dysfunction, antioxidant, urease inhibitor, anti-bacterial, anti-fungal, antidiabetic, neuroprotective, anti-cancer, molluscicidal.
Umbelliprenin	Antigenotoxic, antioxidant, anti-inflammatory, lipoxygenase inhibitor, matrix metalloproteinase inhibitor, antitumor, cytotoxic activity against CH1 (ovarian), A549 (lung), SK-MEL-28 (melanoma), M4Beu (metastatic pigmented malignant melanoma), QU-DB (large cell lung), and UO31 (renal) cancer cell lines, modulator of melanogenesis, antihypertension, cancer chemoprevention, antiangiogenic, antimetastatic and immunostimulatory.
Conferone	Urease inhibitor, cytotoxic activity against CH1 (ovarian), A549 (lung) and SK-MEL-28 (melanoma) cancer cell lines, cancer chemoprevention, antiangiogenic.
Feselol	Cancer chemoprevention, potential aphrodisiac.
Chlorogenic Acid	Antimicrobial, hepatoprotective, antihypertensive, vasodilator, antitumor, antiinflammatory, improves late diabetes, protects against cholestatic liver injury, neuroprotective, antiviral activity against influenza A (H1N1/H3N2) virus, anti-diabetic and anti-lipidemic, inhibits hepatocellular carcinoma, anxiolytic and antioxidant, antihyperalgesic, cardioprotective, neuroprotective and cognitive improvement, improves hepatic steatosis and insulin resistance, alleviates obesity and modulates gut microbiota, ameliorates ulcerative colitis, inhibits glioblastoma growth, induces 4T1 breast cancer tumor's apoptosis, strong matrix metalloproteinase-9 inhibitor.

Table 1: Insights into the Major Secondary Metabolites identified from Ferula. [Adapted from doi: 10.3390/plants10010102. PMID: 33418989]

Figure: Habit and habitat of *Ferula drudeana* (Apiaceae) and the engraved Cyrenaican coins [Image taken from: https://www.downtoearth org.in/news/ wildlife-biodiversity/ancient-plant-silphionknown-for-curing-many-diseas-es-probably-still-around-expert-85143]

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"Doing Good - Only Better"

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এ বিশ্বকে শিশুর বাসযোগ্য করে যাব আমি, নবজাতেকর কাছে এ আমার অঙ্গীকার- সুকান্ত ভট্টাচার্য | ছাড়পত্র was published in the year 1948. If we take a look into the major achievements of humankind after this time period we will encounter some really memorable ones such as the landing on the moon, ending of the apartheid, discovery of internet and establishment of world wide web and many more. From the perspective of a student of biology the discovery and use of different classes of antibiotics, structure of DNA, polymerase chain reaction, RNAi, CRISPR CAS9 system, Computational Biology etc., have revolutionised the way we can intervene and analyse a biological problem. This has lead to the world becoming a better place not only in terms of social and demographic improvement but also towards maintenance of a more healthier population. Invariably there has been intermittent conflicts which has cost us lives, there has been rise in terrorism bought about by the ever increasing economic disparities. Along with this this we have managed to challenge the well being of our planet by fiddling with natural resources, destroying them in our quest for colonization, a character which is dominant in the human race; thus ushering the climate crisis and serving ourselves a collective conundrum where we are stuck between saving and delaying the inevitable. I wonder what the perspective of the poet would have been, if he was alive in today's world. This is exactly where the longtermists come in with their philosophy of effective altruism (EA) which by definition "aims to identify the world's most pressing problems and the best solutions to them, and a practical community that aims to use those findings to do good." Their effort is directed towards the identification of issues which are big in scale, tractable, and unfairly neglected. The aim is to find the biggest caveats in current efforts, in order to find where an additional person / perspective can have the greatest impact. Interestingly, the possibility of a pandemic was identified by the US government as early as 2014 and they spent a whopping 6 billion dollars in biosecurity (https://www.openphilanthropy.org/research/biosecurity/). The result as we have

all endured were obviously ineffective around the world. Interestingly if we compare the budget that was spent over this time period on counterterrorism ($280billion) we find a huge disparity. The people of EA may identify a potential area for intervention here. Very recently Will MacAskill, Associate Professor of Philosophy at the University of Oxford in his book "What we owe the future" compares the human civilization to a reckless teenager. He explains that there are two ways of looking at the scenario. The first where the teenager has a long life ahead of him; comparable to the sustenance of a mammalian species which is around a million years and Homo sapiens having lived for 300000 only, have around 700000 years ahead of them as a species. The second is regarding the decisions that the teenager makes which at one point can be reckless and at other instances can be mature. If we take a quick time warp to the realms of evolutionary biology we find that *Homo sapiens* have in a conservative estimate over the past 10,000 years, evolved as much as 100 times faster than at any other time since the split of the earliest hominid from the ancestors of modern chimpanzees. Harpending and Hawks's team attributed this quickening pace to the variety of environments humans moved into and the changes in living conditions brought about by agriculture and cities [Further reading: "Traces of a Distant Past," by Gary Stix]. We might be passing through a phase of "unnatural selection" as during the past century, our "species' circumstances" have changed. The mobility and ease of transport and gradual removal of social barriers havebroughtgeographicallyisolated populations closer and many racial groups are in close proximity. The human gene pool has undergone a rapid admixture of what were heretofore isolated populations of our species probably leading to an interesting homogenization of our species. At the same time, we have been able to challenge natural selection in our species by advances in our technology and medicines. In most parts of the globe, babies no longer die in large numbers. People with genetic damage that was once fatal now survive and have children. We may believe that the next century of genetic research could unlock numerous genes controlling many aspects of aging which could be manipulated. With gene manipulation gradually becoming acceptable under law, someone interested to play god, may tinker their unborn children into having better IQ and increased lifespan, which may lead them to accumulate greater wealth, form a niche for themselves, cause their genes to drift and give rise to a completely new species who might be interested in merging their collective intelligence into machines thus creating a human-machine symbiosis an idea that was invoked by George Dyson in his book "Darwin among the Machines"

where he states that "Everything that human beings are doing, to make it easier to operate computer networks is at the same time, but for different reasons, making it easier for computer networks to operate human beings.... Darwinian evolution, in one of those paradoxes with which life abounds, may be a victim of its own success, unable to keep up with non-Darwinian processes that it has spawned." Thus, again enter the longtermists who believe that in the near future we would need to colonise space for sustaining the newly born human beings since our planet would become inhabitable; an idea which led Elon Musk to donate around 1.5 million US dollars to the Future of Humanity Institute (FHI) in support of the EA movement recently. In many ways, longtermism reflects the Seventh Generation Principle held by the indigenous Haudenosaunee (a.k.a. Iroquois) people, which urges people alive today to consider the impact of their actions seven generations ahead. MacAskill echoes the defining problem of intergenerational morality — people in the distant future are currently "voiceless," unable to advocate for themselves, which is why we must act with them in mind. Whether it transgresses ethical boundaries the jury is still out.

In our lifetime, we will face challenges – like the development of advanced artificial intelligence,
and the threat of bioweapons – that could prove pivotal for the entire future of the human race.

What should not change is our will to do good in a better and more informed manner as it is up to
us to make sure we respond to these challenges wisely. If we do, then we can leave our descendants a world that is beautiful and just – one that can flourish for millions of years to come.

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Viral Mood Swings!

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"Temperament is the thermometer of character"
- Honore de Balzac

True is the above saying, but is it always so? No, it is not.
We study animal behaviour and diseases separately, hence, we often fail to realise that there might lie a correlation between the two. Behaviour of an animal to a great extent depends on its health and the underlying medical conditions. If the medical condition is a neurological, metabolic or endocrine disorder that might lead to pain related conditions, there is a more prominent change, observable in the animal behaviour. These behavioural changes need to be understood by both pet keepers and veterinarians for timely treatment. One example of such a condition is canine distemper, which is a contagious viral disease in dogs caused by Canine distemper virus (CDV), which leads to increased aggression in dogs, resulting in dog – bite related injuries.

How did it Start?

In 1761, the first case was reported in Spain, Europe. The disease was described in 1809 by Edward Jenner. The viral cause of the disease was discovered in 1905 by Henri Carré, which was later confirmed in 1926 by Patrick Laidlawand and G.W. Dunkin. Until 1926, there were significant disputes with Carré's findings in England.
Vittorio Puntoni was the first to develop a vaccine against canine distemper. He added formalin to the brain tissues of affected dogs, and found that it actually helped significantly to prevent the disease in healthy dogs. In 1950, a commercial vaccine was developed, but owing to its low usage, the virus and the disease still dominate in many groups of the population.

What is this Virus?

The Canine distemper virus (CDV) belongs to the family of Paramyxoviridae, and is a single stranded RNA virus. It is closely related to the groups of viruses causing rinderpest in animals and measles in humans. Geographically differentiated lineages show prominent genetic diversity, arising

mainly from mutation. Interestingly, if two genetically different viruses attack the same cell, they undergo homologous recombination, adding to the diversity.

Virus classification

(unranked): Virus
Realm: Riboviria
Kingdom: Orthornavirae
Phylum: Negarnaviricota
Class: Monjiviricetes
Order: Mononegavirales
Family: Paramyxoviridae
Genus: Morbillivirus
Species: *Canine morbillivirus*

The virus affects a large group of animal families namely - Viverridae (palm civet, raccoon-like South Asian binturong), Procyonidae (coati, raccoon), Pinnipedia (sea lion, seals, walrus, etc.), Hyaenidae, Elephantidae, Ailuridae (red panda), Canidae (fox, wolf, Chinese raccoon dog, dog), Felidae (large cats, except domestic ones.), etc. The family Felidae was thought to be resistant to canine distemper, until research showed the occurrence of the virus in large cats. Now, both large and small cats are equally capable of getting the infection, either from transfusion of infected blood or close contact with dogs. But, they are largely asymptomatic and limited to themselves. In China, a population of captured giant pandas infected with CDV were found to have died, except for one who was vaccinated against the disease.

The CDV can spread across all body systems and has the capability to affect them, especially newly born puppies. It spreads via contact with bodily secretions (can be ocular or nasal, urine, faeces), or aerosols or via contaminated food and water. After the initial exposure, it takes a time of about 6 -22 days to spread and 14-18 days to establish the infection, with an intermittent fever in between. It replicates in the respiratory tract's lymphoid tissues, initially, and then spreads via the bloodstream to affect the central nervous systems (CNS), respiratory, epithelial, gastrointestinal, optic nerves, and urogenital systems. Due to the unique characteristic of the CDV to replicate in the lymphoid tissues, there is severe immunosuppression which results in a host of secondary infections, a phenomenon called lymphoid depletion. Other major infections are hyperkeratosis of the foot pads and nose, interstitial pneumonia, encephalitis accompanied with demyelination. It is suggested that the demyelination is chronic and due to a bystander mechanism which is linked to a virus induced immune response, and is under the control of antibody dependent cell-mediated reactions.

Is my Pet a Victim of CD?

In the initial stages, victims develop a watery pus like discharge from the eyes and nose, followed by coughing, sneezing, high fever and

lethargy which is often confused with any other viral or bacterial infections like that of parainfluenza, influenza or *Bordetella*. Thereafter or concomitantly, GI tract abnormalities come into the picture with vomiting and diarrhoea which may seem to recover later on serving as a cloak to the virus.

Soon after one to three weeks of the infection, neurological signs develop leading to the 'viral mood swings' of the infected canines including increased temper and aggressiveness, which are often mistaken as Rabies. Major neurological signs, however, include myoclonus, seizures, circling, muscle twitches, convulsions, head tilt, involuntary eye movements, and partial paralysis.

Exclusive signs of the disease include 'chewing gum fits' which are convulsions with periodic jaw chewing movements accompanied by salivation; hardening and thickening of the food pad, leading to the nickname 'hard pad disease' and sometimes permanent damage to the enamel of the teeth.

Rules as in has its own exceptions thus, the chronology is not necessarily followed all the time with some dogs only developing a particular set of symptoms, skipping the rest, which makes it a subject of negligence. Hence, any of the aforementioned symptoms in younger canines should be suspected of CDV.

Is there a Solution?

Canine Distemper has been seen occurring worldwide in dogs of all breeds and populations, from wild to domesticated but its prevalence has significantly decreased after the 1970s with the advent of vaccines.

There is still no specific treatment against the disease. The treatment given are to handle the secondary infections like administering fluids, analgesics, broad-spectrum antibiotics, electrolyte solutions, parenteral nutrition, nursing care, anticonvulsants and antipyretics.

Proper hygiene by routine cleaning with detergents, disinfectants, or drying is very essential as the virus cannot survive at room temperature (20–25 °C) for more than a few hours, alongside quarantining the infected animal. Prevention is always better than cure, hence, in this case too, maintaining the proper vaccine schedule and completing it is the only possible way out to eradicate this viral disease. In case of pet dogs, this awareness among the pet keepers is very important, to complete the vaccine doses after the dogs are sold, as it is this reason for which canine distemper still is prevalent among dogs and the spiral of outbreaks continues throughout the world.

How far can Ailments swing Moods?

Unspeakable as it gets, behaviour has its own language bridging communication gaps across species. It is the only way man's best friend can reach him. Every swing in its mood may mean something, which may not be necessarily an ailment directly or indirectly but in certain

cases is. Hence, negligence is the last thing we can afford.

The most common sign of discomfort or pain in dogs is a change in its behaviour. Sleep-wake cycle happens to be one of the basic things yet a very significant one that can change an animal's behaviour, quite in frame with its closest inhabitant. It affects any kind of injurial pain that the dog might be already having and vice versa. Although, the effect of the former seems to be more detrimental. Imbalance in the levels of the thyroid hormone can affect the extent of aggressiveness in dogs, and in certain cases exclusively due to a deficit of the hormone, there can be a decrease in tolerance towards cold and physical stress, along with apathy, lethargy and a decreased libido. Other neurologically invisible problems that affect the behaviour are tumours in the CNS silent zones like the prefrontal cortex, ischemic attacks and epilepsy. Hence, these problems have to be exclusively identified by change in behaviour.

Behaviour being both a subjective and a relative attribute, often becomes an ordeal as a mode of diagnosis, what may be perceived as unusual by some, may be in the books, whereas something well anticipated, may be due to some physiological distress. Examinations of almost all sorts, thus, become obligatory to confirm the advent of any ailment. But, a change in behaviour is the first indication almost always of any kind of disease, which when studied extensively might help us in drawing correlation to the human mind, and in the long run may help in psychiatric medicine.

In conclusion, we can say that dogs aren't just our best friends in showing us loyalty but their behavioural studies may pave the way for understanding the mammalian brain at large. So, the least we can do is to understand what their repeated wagging of tails, incessant chewing and long stares try to convey, just to prevent any forthcoming ailments in the future, because who knows the next variant may cross this barrier.

potential is probably going to last for a while.

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Kingdom of Zombies

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As young adults, we have all watched our fair share of zombie movies and drama series, the most recent of which has been the South Korean coming-of-age zombie apocalypse web series 'All of Us Are Dead' which has taken the world by storm with its high viewership ratings. A mythical undead corporeal beast generated by reviving the dead, most frequently, zombies appear in horror and fantasy genres. The original stories of these undead beings feasting on the brains and hearts of the living, come from Haitian rural folklore, wherein a dark sorcerer, called a *bokor*, uses black magic or voodoo to revive dead people through necromancy. The second half of the 20th century saw the emergence of pop culture, with the typical portrayal of the zombie heavily influenced by George A. Romero's 1968 film 'Night of the Living Dead', which was in part influenced by Richard Matheson's novel 'I Am Legend'. The zombies became instant hits among the masses, so much so that even Michael Jackson's music video 'Thriller' is still a fan favorite. Not surprisingly enough, the creation of zombies was even scientifically documented by a Harvard ethnobotanist, Wade Davis, who later went on to write a few books on them. The process Davis described was an initial episode of suspended animation resembling death, followed by re-awakening into a psychotic state—typically after being buried. Davis proposed that the psychosis brought on by the medication and psychological trauma would contribute to solidifying culturally taught views and lead the person to reimagine themselves as zombies. Even though tetrodotoxin is one drug that could cause zombie-like manifestations, the scientific community has rejected tetrodotoxin as the origin of this condition, and according to psychologist Terence Hines, Davis' analysis of the details of the accounts of Haitian zombies is seen as being unduly credulous. But what could be considered science fiction is in fact quite possible, and the best place to search for them is the tropical jungles of the Amazon.

The winner of the 2022 BMC Ecology and Evolution photography competition, Roberto García-Roa, a prominent figure in the

conservational and evolutionary biology world, had taken the world by storm with the gruesome picture of the zombie fungus erupting from a fly head. The world's most sinister examples of mind control are seen to be exhibited by a fungus, *Ophiocordyceps unilateralis*, that manifests itself on carpenter ants. After infecting an insect's body, the fungus takes over the insect's nutrient-sucking role, completely draining the insect and hijacking its mind. Over the course of just a week, it forces the infected ant to leave its colony and ascend a nearby stem, where it then clings onto the central vein of a leaf with clamped jaws. Interestingly, the mind-control works just like voodoo magic, with the zombie-ant stopping approximately at a height on the plant stem where both the temperature and humidity are perfect for fungal growth, with the ant permanently closing its mandibles on the leaf vein. At some point, it pushes a long stalk through the ant's head, which develops into a bulbous capsule that contains spores. Additionally, because the ant usually climbs a leaf that hangs above the foraging routes in its colony, the fungal spores rain on its sisters below, turning them into zombies. The scary nightmare does not end here. Eventually, the whole colony is turned into a kingdom of ant zombies, and then, there's just another frantic episode of 'The Walking Dead' playing on.

David Hughes, an entomologist at Pennsylvania State University, has been studying *Ophiocordyceps* for years and his experiments are related to understanding how the fungi control their puppets in such a ghoulish manner. His student, Maridel Fredericksen, while working on juvenile infected ants, sectioned them to study their anatomy, revealing through her own words that "something much more intricate must be going on" inside these mind-controlled zombies. These fungi infect and then circulate as single cells in the ant body, but at some point, they form conidial anastomosis tubes (CATs), formed from the conidia (a type of fungal asexual spore), for communication before the stage where they must infect the plant stem to draw nutrients from the leaf veins. They also begin to penetrate the ant's muscles by either growing into the gaps between the muscle cells or piercing the cells themselves, an extremely unique feature of *Ophiocordyceps*. Thus, these microscopic cells that were initially independent eventually work together to form a superorganism, and then the brain-less cells control the brains of a much larger species.

If this is not like some chapter of the popular Japanese manga, Tokyo Ghoul, what's even more heinous is that these fungi can perform mind-control without ever physically touching the ant brains. Even after infiltrating the whole insect body, the fungi manipulate their victims without damaging their brain cells. The research of Charissa de Bekker,

from the University of Central Florida, has pointed out the secretion of a wide range of fungal chemicals that could perhaps influence the brain from afar. Accordingly, shortly after an infection, the neurons in the ant's body that allow its brain to regulate its muscle coordination begin to die. Hughes thinks the fungus takes over. By inserting itself there and effectively severing the ant's limbs from its brain, it causes the muscles to contract. If this is accurate, the ant will die naturally imprisoned inside its own body. The fungus is in control of the wheel, while the ant is the zombie car being driven around at its whims.
Over 200 *Ophiocordyceps* species that can infect hosts from 10 different insect groups, as well as spiders, have been discovered by researchers, although not all of them can alter a host's behavior. In an unlikely turn of events, symbiotic bacteria that helped Japanese cicadas digest sap's nutrients might even have been replaced by *Ophiocordyceps* species that live there. Matt Kasson has spent most of his life chasing cicadas across northern Virginia forests, and his work at West Virginia University has focused on one exceptionally peculiar species called *Massospora cicadina*, which has a periodical Brood X that emerges every 13 or 17 years and is only infected by *Ophiocordyceps*. Healthy male cicadas sing to entice females, who flap their wings to show that they are open to mating. But if a female is unlucky enough to fall for an infected male's mating call, she will not only fail to have her eggs fertilized (the male's genitals having long since fallen off because of the fungal infection) but also catch the infection herself. Thus, the infection gets sexually transmitted. The kingdom of this puppeteer does not end here and even delves into the realms of humans. *O. sinensis*, a related species, colonizes the larvae of ghost moths and sprouts like a unicorn horn from their heads. Traditional Tibetan and Chinese medicinal practices esteem the fungus-caterpillar husk combination as an immune booster, cancer therapeutic, and aphrodisiac. In the human realm, the various myco-metabolites produced by *Ophiocordyceps* like naphthoquinone derivatives and polyketides, have been investigated for immunomodulation, antitumor properties, hypoglycemia, and hypocholesterolemia targeting. Red naphthoquinone pigments produced by *O. unilateralis* have been investigated for application as a coloring agent in the production of food, cosmetics, and medications because of the varied coloring characteristics shown by the derivative at a wide range of pH conditions. So, are we unintentionally also coming into the grips of this zombie-creating fungi?
The modulation of the host brain has been attributed to sphingosine and guanidinobutyric acid (GBA). It is documented that these substances contribute to a number of neurological disorders. However, additional investigation is

required to ascertain if other myco-metabolites interact with the host brain to increase sphingosine and GBA levels. Some studies have also pointed out the role of hypoxanthine, which impairs cerebral cortical neural tissues; thus, it may be possible that by secreting such secondary metabolites, the fungus changes an ant's motor neurons and hence modifies its behavior, becoming the master puppeteer.

These Amazonian zombie-creating necromancers have only one goal, self-propagation, and dispersal. An intricate example of behavioral manipulation involving coordinated changes to host behavior and morphology, much of the future research ought to focus on the genetic foundation of such extensive phenotypes. Maybe then we will finally start talking like Rick Grimes and remember his golden lines from 'The Walking Dead', "You don't know what it's like out there. You may think you do but you don't. It's only a matter of time. There's too many of those things."

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The Cure in Our Star(s)

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Dostarlimab, the drug that went viral overnight after a news article claimed that it 'cured' cancer, is biochemically a monoclonal antibody (mAb) that targets PD-1 (programmed cell death protein-1), a cell surface receptor. The article was based on a study conducted at Memorial Sloan Kettering, where they observed that in patients with locally advanced mismatch repair deficient (dMMR) rectal cancer, a complete clinical response could be obtained in just 6 months of treatment [1]. dMMR tumors have an abnormal DNA repair machinery and genes responsible for maintaining the cell in its healthy state, by correcting any inappropriate functions, are absent in these cells. About 5-10% of all rectal cancer cases show the presence of this mutation. Of the 12 patients that were treated with Dostarlimab in this study, none required additional chemoradiotherapy or surgery. This new approach has been termed as "immunoablative" therapy-immunotherapy to replace surgery, chemotherapy and radiation for the elimination of cancer [1].

In order to understand the biology behind this drug, we will need to clarify a few terms. To do this, let's answer a few questions:

What is PD-1?

-PD-1 is an inhibitory immune checkpoint receptor, similar to CTLA-4 (cytotoxic T-lymphocyte-associated protein-4), and it plays an important role in bringing the immune functions of the cell to a halt. PD-1 (CD279) inhibits both the adaptive and the innate immune responses, and is found on a number of cells like the activated T cells, natural killer cells, B lymphocytes, dendritic cells and macrophages. Its transcription is triggered by several transcription factors such as NOTCH, NFAT (nuclear factor of activated T cells) and IRF9 (interferon regulatory factor 9) [3]. This pathway regulates the function of effector T cells during acute and chronic inflammation, cancer, autoimmunity and a variety of different physiological responses.
-Mice that are deficient of the *Pdcd1* gene, have been seen to develop autoimmunity rapidly.
-The PD-1/PD-L1 pathway is responsible for regulating the induction and maintenance of

immune tolerance within the tumor microenvironment. This signalling pathway activates T cell activation, proliferation and cytotoxic secretion in cancer to degenerate the anti-tumor immune responses.[3]
-PD-1 has two contrasting roles. Its positive effect reduces the ineffective or harmful immune response and thus, monitoring immune tolerance. However, in cancerous cells, it interferes with the body's protective immune response [3].

What is PD-L1's role in cancer?

PD-L1 is expressed by tumor cells to escape anti-tumor immune responses. It acts as a pro-tumorigenic factor and binds to its receptor, PD-1, to activate proliferative and survival signalling pathways. This implies that PD-L1 is associated with tumor progression [3].
It can also induce epithelial-to-mesenchymal transition and stem cell-like phenotypes in renal cancer cells [3].
Tumor cells tend to have a high expression of PD-L1 and this allows the cancer cells to escape immunosurveillance and enhances their metastatic potential [4].

How does PD-L1 get upregulated in cancer cells?

Histone acetylation is often involved in the upregulation of PD-L1. An example would be of BRD4 (Bromodomain-containing protein 4) which associates with the CD274 locus to increase transcription of PD-L1. Blockage of such bromodomains and extraterminal proteins with the CD274 locus increases immunosurveillance by reducing the PD-L1 expression [4].
Structural variation in the 3'-UTR of CD274 also increases the production of PD-L1, enhancing cancer immune evasion. Additionally, disrupting the 3'-UTR by CRISPR/Cas9 can induce the overexpression of PD-L1 [4].
MicroRNAs such as the miR-34a and miR-200 bind to the 3'-UTR of CD274 and are often associated with suppression of PD-L1 expression. Both of these miRNAs are regulated by p53 and hence in tumors with loss of p53, these miRNAs are also dysregulated, leading to overexpression of PD-L1 [4].

What is Dostarlimab?

Dostarlimab is a humanized mAb of the IgG4 isotype which is produced recombinantly in the Chinese hamster ovary (CHO) cells. It assists the body's natural anti-tumor response and it inhibits the interaction of PD-1 with PD-L1/ PD-L2 (programmed death-ligand 1/2). The heavy chain plays a role in the interaction between PD-1 and Dostarlimab, however, the light chain majorly blocks the interaction of PD-L1 with its receptor, via steric hindrance [1].

Now that we have a basic understanding of what the PD-1/PD-L1 signalling pathway

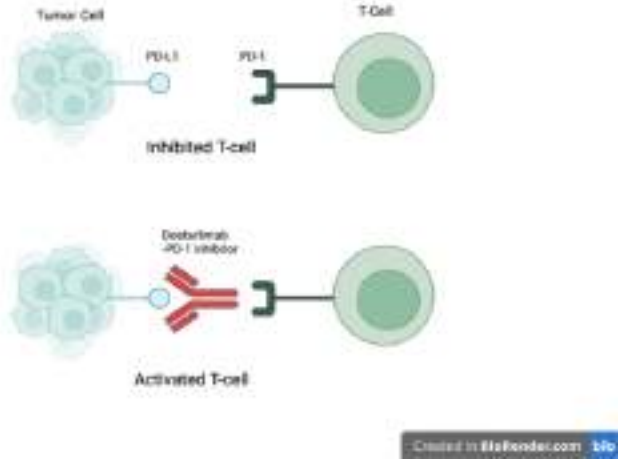

Fig 1: Mechanism of action of Dostarlimab

encompasses and a brief idea of what dostarlimab is, we can delve into the mechanisms of this drug. With the increasing importance of immunotherapies, checkpoint inhibitors have revolutionised cancer therapeutics. Dostarlimab blocks the PD-1 receptor, an important immune checkpoint inhibitor of the cell, by binding to it and preventing PD-L1 or PD-L2 from interacting with their receptors. This then leads to release of the immune suppressive tumor microenvironment, allowing the immune system to combat cancer, once again. A comprehensive mechanism of this drug has been provided in figure 1.

This drug is an impressive example underscoring the effectiveness of personalised treatment for cancer however, this remains unapplicable to a vast majority of the highly heterogeneous assemblage of different cancers. Hence, the quest for a more generalised therapeutic continues. Furthermore, patients with dMMR tumors tend to be more sensitive to immunotherapies which is a probable reason for such strong positive responses. Despite all this, the observed results of this phase II trial are exemplary and exceedingly encouraging.

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Bacteria as Large as your Eyelash?

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When we think of bacteria, we think of unicellular organisms that are so small that they cannot be seen with the naked eye. However, this bacterium changed our conception.

Discovery:

Hiding on rotting leaves, sunken in the mangroves of Guadeloupe in the Caribbean, live some extraordinary thread-like creatures. These filament-like organisms, named *Thiomargarita magnifica*, up to a centimetre in length, are the biggest single-cell bacteria found till date. They live by oxidizing sulphur and are 50-times bigger than any other known bacteria. Biologist Olivier Gros, at the University of the Antilles in the French West Indies in 2009, discovered this bacterium while exploring the mangroves of Guadeloupe. On getting back to his laboratory at Pointe-à-Pitre in Guadeloupe, Gros examined his discovery under a microscope and was shocked by the results. He mistakenly thought it was a eukaryote. In 2018, marine biologist Jean-Marie Volland at the Lawrence Berkeley National Laboratory in California, examined the bacteria more closely using a range of methods, including transmission electron microscopy, X-ray crystallography and an imaging technique, fluorescence in situ hybridization (FISH). His examination helped in confirming that it was in fact a single cell.

Characteristic Features:

Thiomargarita means "sulphur pearl" in Latin. This refers to the appearance of the cells as they contain microscopic sulphur granules that scatter incident light, lending the cell a pearly texture. The name *magnifica* means "magnificent" and was chosen by researcher Silvina González Rizzo, who finally identified the organism as a bacterium. It is a species of sulphur-oxidizing gammaproteobacteria.

Why is the Bacteria so Unique?

Unlike bacteria and archaea, which are simple microorganisms, eukaryotes — which include animals and plants, are far more complex. *Thiomargarita* has features similar to a eukaryote. In the central part of the bacterium is its vacuole — an inert, fluid-filled membrane. Around

the edge of this are membrane-bound structures, called pepins and are described as being similar to the organelles found mostly in eukaryotic cells. *Thiomargarita magnifica* is remarkable for not only its size but also other features. In other bacteria, genetic material usually floats freely inside the cell, in the form of just one circular chromosome. In contrast, a team of scientists found that the genetic material in *Thiomargarita magnifica* was stored in hundreds of thousands of pepins. Each of these contain DNA and ribosomes, molecular machines that translate instructions from DNA to make proteins. The pepins collectively host up to 11 million copies of the genome. The vacuole of *Thiomargarita magnifica* is most likely filled with nitrate and the thin layer of cytoplasm contains sulphur granules, which are involved in metabolism. Adenosine triphosphate (ATP) synthesis is localised to the intracytoplasmic membrane network which functions to increase the surface area available for generating ATP.

Some Important Facts:

- The bacterium attaches to oyster shells, rocks and glass bottles in swamps because it requires a solid substrate to grow.
- These bacteria surprisingly grow up to a large size which was estimated to be on an average of a third of an inch i.e., 0.9 centimetres.
- Earlier it was either thought to be a fungus or a multicellular filamentous bacterium, however it was later found to be a single celled one.
- Scientists have not yet been able to grow it in lab culture, but researchers say that the cell has a structure that's unusual for bacteria.
- According to Manuel Campos, a biologist at the French National Centre for Scientific Research, the presence of its large central vacuole helps the cell bypass physical limitations on how big a single cell can be.
- Researchers said they aren't certain why the bacterium is so large, but Volland hypothesized that it may be an adaptation to help it avoid being eaten by smaller microorganisms.

Genome of the Bacteria:

The bacterium displays unprecedented polyploidy of more than half a million copies of the largely sized genome, and undergoes a dimorphic life cycle with asymmetric segregation of the chromosome into daughter cells. Compartmentalization of genomic material and ribosomes into translationally active organelles bound by bioenergetic membranes indicate a gain of complexity in the bacteria lineage and challenge the traditional concepts of bacterial cells.

Why the Bacteria dwell only in Mangrove Forest?

Guadeloupe, the French Caribbean

tropical islands in the Lesser Antilles in the Eastern Caribbean is situated just north of Dominica and southeast of Puerto Rico, where the bacteria was first discovered. Caribbean mangrove swamps are packed with organic matter and the microbes in the sediment degrading this matter produce high concentrations of sulphur. The sulphur rich environment provides an energy source for *Thiomargarita magnifica*. With the passage of time there may be a possibility to detect the bacteria in other similar conditions as such.

Is the Bacteria harmful to Humans?

Despite its alarming size, *Thiomargarita magnifica* has been found to not be harmful to humans or other living organisms, except in the case of immunocompromised people. Further studies may reveal more about its virulence.

Conclusion:

In conclusion, it can be stated that very little is known about this newly discovered bacteria and studies continue. It is difficult to culture this bacterium in the laboratory conditions and hence a detailed study about its physical, genetic and metabolic conditions is difficult. Even then, this discovery has exposed us to the unexplored side of microbial diversity that exists. We are possibly just scratching at the surface, and only time can tell what discoveries are yet to be made!

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Strategies for Bacterial Dormancy- 'The VBNC State'

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The environment in which microorganisms survive undergoes perpetual fluctuations and consequently, they face continuous selective stress which has led to rapid adaptations for long-term survival. Bacteria, especially, are ingenious survivalists and one of their most impressive adaptive strategies is to enter a dormant state in adverse conditions.

Early research in biological sciences assumed that bacterial cells were dead when they were no longer able to grow on routine culture media, but as this rather rudimentary idea developed further, they were able to characterise a novel state- the "viable but nonculturable" (VBNC) state in bacterial cells. These bacteria are generally thought to be in a state of very low metabolic activity and do not divide but can be resuscitated to become viable and potentially be able to grow. VBNC state is thought to be a survival strategy, although many other interesting alternative explanations for this state and its consequent role have been suggested. It is notable that the VBNC state shows a drastically increased tolerance against antimicrobials including antibiotics.

In 1982, Xu et al. who were studying the survivability of nonculturable *Escherichia coli* and *Vibrio cholerae* cells in estuarine and marine environments showed that these cells could enter a distinct state where these VBNC bacteria remain viable for long periods of time but lose the ability to form colonies on classic culture media.

A growing culture of *Vibrio cholerae* or *Escherichia coli*, was incubated in a nutrient-free microcosm at low temperature and showed declining culturability but a portion of them still remained viable and could be detected by the direct viable count procedure. They were metabolically active and could elongate on addition of nutrients like yeast extract and nalidixic acid. This showed that they could divide but still not form visible colonies. It is notable that this was one of the first attempts to distinguish viability from culturability in cells.

It has been demonstrated that cells enter the VBNC state as a response to varied chemical and environmental stress which can include nutrient starvation, changes in pH, salinity

temperature UV irradiation outside the permissive range.

VBNC Cells Vs Normal Culturable Bacterial Cells

VBNC cells share many general characteristics with viable, culturable cells but they also have marked differences in cellular morphology, chemical resistance, and physiology. VBNC cells can also show changes in properties like adhesion and virulence. They have reduced cell size which increases the surface area to volume ratio and minimizes energy requirements. Research showed VBNC state in *Campylobacter* spp. changes to a coccoid shape from its characteristic spiral shape in the exponential phase of growth. VBNC bacteria also show variations in cell wall and membrane composition of proteins, fatty acids, and peptidoglycan. For example, an increase in peptidoglycan cross-linking was observed in VBNC cells of *Enterococcus faecalis*.

As already mentioned, VBNC cells when compared to the dividing culturable cells have a lower metabolic rate and thus a different protein profile. Studies have found that the expression of ompW was quite significantly induced in VBNC cells of E. coli., while another study reported a reduction in 16S rRNA and the mRNA level of tuf, rpoS, and relA genes. VBNC cells have a higher tolerance to temperature, salinity, and pH extremes as well as chemical, oxidative, and osmotic stress which is most probably due to their reduced metabolic rate and increased peptidoglycan cross-linking in the cell wall which provides additional strength.

Just as VBNC cells cannot be equated to culturable live cells, they also differ from dead cells as they have intact membranes which retain plasmids as well as genomic DNA and are still metabolically active- they continue transcription, utilize nutrients, and show high ATP levels.

Antimicrobial Resistance of VBNC Bacteria

Persister cells in a bacterial population are viewed as a phenotypic variation and refer to the nongrowing subpopulation which is antibiotic resistant whereas the majority are sensitive to it. VBNC cells are considered to be variants of the same phenomenon and are also similarly tolerant to antibiotics as well as heavy metal, temperature, and pH extremes and other adverse conditions. Evaluation of novel antimicrobials in eradicating antibiotic-tolerant cells commonly uses culturability as a measure of viability and in doing so overlooks the presence of drug-tolerant VBNC cells in the persister subpopulation. This is a critical oversight since these cells likely contribute to antibiotic failure. Thus, both viability and culturability should be quantified, for the enumeration of both persister and VBNC cells.

This widespread occurrence of bacterial cellular dormancy can pose serious diagnostic and

safety problems especially because bacteria in the VBNC state represent a diagnostic challenge, as most current testing measures are culture based with some cultivation steps which cannot detect the non-growing VBNC cells. The absence of growth however does not always mean non-viability, but can be due to incorrect medium, damaged cells, low population density, or very slow-growing cells

Several approaches that can be explored for testing of antimicrobial effectivity in VBNC bacteria include quantification of cell proliferation after resuscitation, EMA/PMA-PCR, and staining procedures to identify cell membrane integrity in combination with fluorescence microscopy. Experiments based on detecting the respiratory activity and membrane potential using flow cytometry and fluorescent dyes can be used to quantify viable as well as VBNC cells. On combining it with plate count methods and additional staining methods, the number of VBNC and culturable cells and dead cells from the same sample can be distinguished and quantified.

There exist well-established, standard procedures for testing culturable bacteria and as we understand the role of VBNC bacteria in public health and safety, we must extend this to establish standard protocols regarding VBNC tolerance testing and for decontaminating methods to mitigate the effectiveness of the VBNC state.

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The Rise Of Micro Robo Mailman

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Abstract

Microrobots are up-and-coming candidates for theranostic applications. Loaded with the necessary drug, these magnetically equipped tiny bots can roll and navigate through artificial blood vessels in the presence of an external magnetic field to successfully release the required drug to the targeted site. Nobel-winning physicist Richard Feynman's talk, "There's Plenty of Room at the Bottom ", delivered at Caltech in 1959, inspired this research project(1). In his talk, he envisioned how minuscule machines could travel inside the human body and carry out operations. Here, we discuss an in vivo method of targeted active drug delivery in the human circulatory system as designed by the Max Planck Institute of Intelligent Systems researchers.

Introduction

Wouldn't it be nice if robots delivered drug molecules to unreachable areas inside the body? Scientists over the years have worked to create microrobots, which provide great potential for active and efficient targeted drug delivery with decreased side effects(2).

The circulatory system is an excellent route for transport. However, microrobots with sizes less than ten μm face resistance in their motion—the blood flow and the heterogeneous composition of blood cause this resistance. So, scientists have found out that the mode of movement of leukocytes on the walls of blood vessels can be the mechanism of action in the case of microrobots due to the decreased blood flow velocity near the walls. This mechanism would ensure efficient propelling through the blood flow to their targets via their rolling motion on the walls of blood vessels. Thus, they named these bots micro rollers (3).

Inspired by leukocytes, the scientists used multifunctional micro rollers of 3.0 and 7.8 μm diameters.

Results

1. Movement of Microrollers:

These micro rollers have a magnetically responsive nanofilm with a Ni/Au layer on half-side and a silica-layered half-side having DOX (doxorubicin) molecules and antibodies to target specific types of cells. The Au layer protects

the Ni layer from oxidation and ensures compatibility of the bots with the biological systems(4). Scientists observed that the Janus microparticles could roll on available surfaces while undergoing linear translation when applying a vertically rotating magnetic field. Here steering is achieved by manipulating the orientation of the rotating magnetic field.

2. Targeting of Microrollers:

Recognition of target cells occurs via cell-specific antibodies that have been functionalized on the surfaces of these micro rollers. To achieve this, scientists grafted amino groups on the silica half-side of these bots via 3-aminopropyltrimethoxysilane (APTES). This functionalized the drug molecules and the antibodies on the micro rollers-making them effective for targeting(4). Then biotinylated N-hydroxysuccinimide (NHS) was conjugated to these amino groups. This caused the binding of biotin-conjugated human epidermal growth factor receptor 2 (HER2) antibodies (anti-HER2) through biotin-avidin-biotin coupling - which is one of the strongest noncovalent interactions in nature. Hence it is used in this case to enable efficient targeting of these bots under high-speed blood flow conditions.

3. Release of Drug molecules at the Target Location:

Researchers functionalized DOX molecules on the same silica half-side via an o-nitrobenzyl linker, which gets cleaved on exposure to light (photon)- thus ensuring the cue-dependent release of the drug(5).

Next, the scientists tested these bots' targeting and light-triggered drug release capability in vitro.

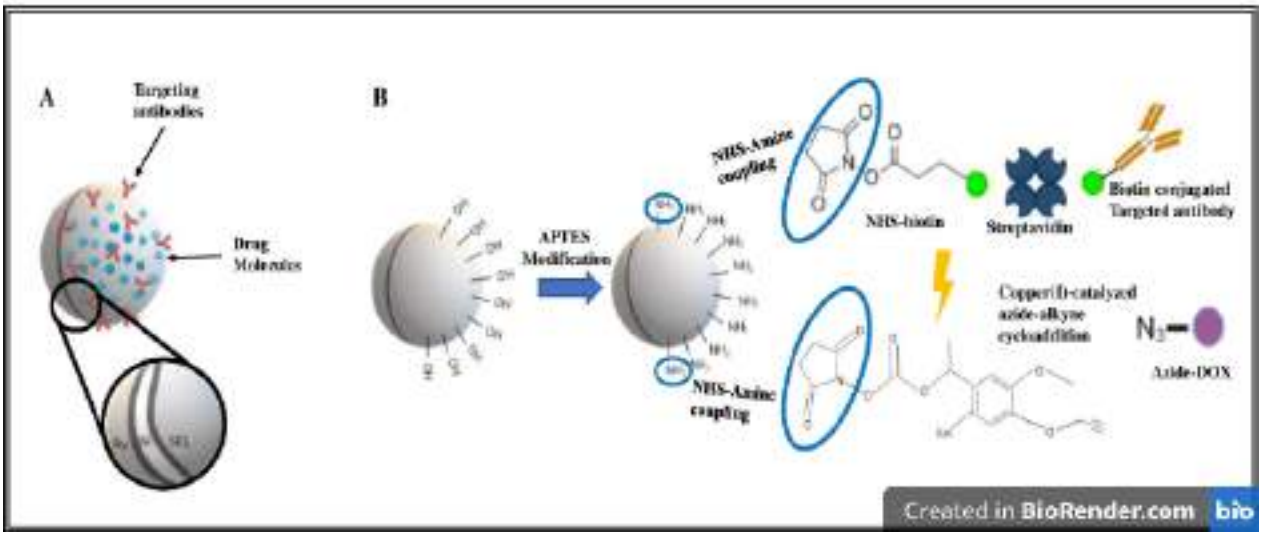

Fig: Design of Microrollers to facilitate Recognition of the Specific Target

4. Test of Targeting Capability:
Scientists added bare and anti-HER2–functionalized micro rollers on HER2-expressing SKBR3 breast cancer cells from their silica side having functionalized antibodies. Micro rollers having HER2 antibodies could bind to the SKBR3 cells, while the bare particles could not. When they incubated the micro rollers in whole blood for 30 minutes and administered it along with the blood, they observed no corresponding effect on its targeting capacity(4). Confocal microscopy helped confirm the binding of micro rollers to the cells from their silica side having functionalized antibodies.

5. Test of Light-triggered Release of Drug Molecules:
Scientists used 365-nm ultraviolet (UV) light to photocleave the linker holding the DOX molecules to the micro roller, thus releasing the DOX molecules. They witnessed characteristic burst release of DOX molecules upon light exposure, whereas no release occurred without the UV trigger.
Next, scientists tested the targeted drug delivery potential of these micro rollers.
They treated SKBR3 cells with DOX and anti-HER2–functionalized micro rollers. They observed targeted binding to SKBR3 cells(4). Upon exposure to light, scientists observed a decrease in fluorescence in the micro rollers and an increase in DOX signal within the target cells.
Without this cue, the DOX signal remained confined to the micro roller.

6. Surface Locomotion Behaviour of the Microrollers:
The scientists then studied the locomotion of these micro rollers. They found that it depends directly on the strength of the magnetic field and the particles' magnetic properties. They magnetized the micro rollers beforehand toward their metallic cap under a uniform magnetic field of 1.8 mT. They saw that the micro rollers retained their magnetization direction under external fields up to 20 mT. When the external uniform magnetic field was applied, these
magnetic micro rollers underwent rotating motion.
A nearby hydrodynamic boundary disrupts the balance of hydrodynamic mobility between the microparticle's top and bottom surfaces. This disruption causes the translation of magnetic torque into linear motion(6). Orientation of the rotational magnetic field directed the micro roller motion.
Thus, scientists found that the translational speed of these micro rollers depends almost linearly on the frequency of rotation of the applied magnetic field. This dependence exists until the magnetic field frequency reaches a critical threshold called the step-out frequency.

7. Study of Selective Targeting of Cancer cells by Mobile Micro Rollers in a heterogeneous cell population:
The micro rollers had HER2 antibodies. When they were actively rolling on cell monolayers, the scientists saw these micro rollers bind to HER2-expressing SKBR3 cells. No such interaction occurred when these same micro rollers moved on endothelial cells [human umbilical vein endothelial cells (HUVECs)].
On a heterogeneous cell layer composed of SKBR3 cells and HUVECs, scientists saw selective targeting of the SKBR3 cells by these micro rollers(4).

8. Study of the locomotive behavior of Micro Rollers under Flow conditions:
First, the researchers tested the upstream motion of these bots in phosphate-buffered saline (PBS) within microfluidic channels. These channels resembled the postcapillary venules and veins' physiologically relevant wall shear stress values. Without any magnetic torque, the bots drifted along the flow direction. A rotating magnetic field made the micro rollers move against the flow(4). Further studies revealed a decrease in upstream propulsion speed with increased wall shear stresses. They also tested these bots on endothelial cells under physiological flow conditions by designing a branching microfluidic system. Here too, the bots could move in a controlled way through PBS.
To check the propulsion capacity of the micro rollers under more realistic conditions, they used fresh whole blood (mouse CD1 whole blood), where the bots moved and navigated without any static. Further tests showed that these bots could also locomote upstream at 120 Hz for 1.2 dyn/cm2 wall shear stress. The upper threshold of the wall shear stresses these bots can tolerate was also tested and determined. With the increase in stress values, these micro rollers faced increasing difficulties in maintaining their position and drifting in the flow direction(4). Besides upstream locomotion, these bots' precise navigation via controlled movement is also crucial.
The next challenge was the 3D nature of the vascular system.
The micro rollers, as designed by the Physical Intelligence Department at Max Planck Institute for Intelligent Systems, rely on the boundaries provided by the platforms for their movement. So, they designed different types of platforms to test the manner of their motion and to modify them accordingly.

9. Drawbacks of the Design of the Microrollers:
1. The size of the micro rollers described till now is similar to that of the blood cells. However, as they are at the upper limit of the diameter of the capillaries, they may cause blockage due to their rigid nature. Thus, scaling down the size of these bots without affecting their functionality is a problem that needs to be solved. Till then, we cannot use these micro rollers under

real-life circumstances.
2. The amount of drug delivered to the target by these bots is insufficient. While a microbot is less than ten μm in size, the organ tissue has a size around a thousand times greater. So many microbots need to move to their target to release and deliver the required amount of drug to achieve a good effect.

Thus, this design approach has laid a solid groundwork that will help develop next-generation microrobots (4).

Conclusion

Despite development in Microrobotics, it is still in the infancy stage. Scientists have seen that magnetic microrobots resembling microscopic animals like crabs and fish respond to low pH and release the drug molecule to kill cancer cells in the vicinity. The feasibility of this concept in in-vivo will only be possible if better imaging and tracking techniques develop along with even smaller-sized microrobots(7). Advancements are needed to overcome challenges in terms of lifespan, ethics, and complexity of microrobots. With further developments in the miniaturization technology field, we hope these microrobots will truly be able to heal the world from within.

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ALAN: Bane of Insects

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Introduction

Light (the sun) has been the sole source of energy since abiogenesis. It has played a fundamental role in the perception of the biological world throughout the course of development. The growing anthropogenic intrusions in various sectors, including the natural light environment, have imposed a greater impact on all species that have evolved there.

All around the world insects face grave endangerment. This may be due to never-ending factors like pesticide use, habitat loss, drastic climate change, and invasive species. In recent years, another major factor has added to the cause. ALAN, Artificial Light at Night, often overlooked, is posing a rising threat to the insect population. Exposure to artificial light has detrimental effects like developmental interference, declined reproductive success, and hindrance in mobility and foraging. The drop in insect population can interfere with the stability and dynamics of the ecological communities. Consequently, ALAN, the harbinger of insect apocalypse, can hamper the sustainable balance of flora and fauna.

Types of ALAN

There are mainly two kinds of light that constitute ALAN. Firstly, the direct light from different sources, like street lights and lamps, which cause unevenly lit patches. The second category consists of skyglow. It occurs due to the scattering of light by suspended dust particles and clouds. It is a more evenly spread phenomenon, particularly common in urban areas.

Effect of ALAN on insects

Several meta-analyses have been performed to reveal the effect of artificial lights. The greatest impact of ALAN is on the physiology and behaviour of the organisms, by altering their hormonal balance, the onset of daily activities, foraging, and reproduction. The position of insects in relation to light sources is crucial; downwelling light may have a greater impact on ground-dwelling species than on aerial ones, but upwelling light (streetlights, tree lights, etc.) is more likely to have an impact on flying insects.

A very prominent effect on insects is

their attraction toward light sources. It is further inferred that the insects expend much energy in repeated flying. They may also be easily vulnerable to predators, such as spiders, bats, and lizards.

Effect on nocturnal insects

Laboratory experiments have shown that artificial lights can cause build-up of melatonin which might hinder a variety of biological activities in nocturnal insects. The constant light can inhibit secretion of female sex hormones in moths, in turn there is reduction in male attraction, induction of male sterility and disrupted female oviposition.

Moths, nocturnal bees, crickets, and other insects begin their foraging activities when the intensity of ambient light decreases to the respective species-specific thresholds. Some insects have highly sensitive eyes, which can discriminate colours in low light. Some use optic flow and visible landmarks, such as trees and flowers, for navigating. Nocturnal bees and ants also use canopy patterns, silhouetted branches, and shape of the leaves, which are specific to the site, for their sense of direction. Because of patchy lighting, artificial illumination poses a problem in such forms of wandering. Skyglows block the nocturnal light sources and astronomical cues which are exploited by the dung beetles in navigation, affecting their foraging and reproductive success.

Effect on bioluminescent insects

Bioluminescent fireflies use a wide range of courting signals for their sexual communication. In some taxa, the static females create long lasting glows to attract the flying males, who might not produce light themselves. In another taxa, both the sexes employ flash signals for communications, precisely timed responses indicate their species and sex.

Because of their temporally constrained courtship activity durations, fireflies are very receptive to ambient light cues that indicate the time of day. Reduction of ambient light intensity cues are also needed for the beginning of their courtship. The eyes require a few hours to become fully adapted to the darkness. The bright LED lamps can impede this process. Moreover, the extremely sensitive visual systems make them susceptible to being blinded by bright ALAN sources. Artificial lighting may hinder the perception of male signals by receptive females, or vice versa, reducing the success of courtship.

Conclusion

The number of plausible reasons why insects are declining is endless. ALAN is possibly the simplest and most easily reversible driver among these. ALAN is only a small component of human urbanization and growth. It has a significant impact on light pollution in regions

other than cities and suburbs as well, extending to areas with heavy human intervention, like roads.

The rate of decrease can be handled with great effort, and benefits can be seen right away. These insects' survival, feeding, mating success, and in turn its population persistence will be lowered if they can't overcome the aforementioned difficulties. The consequent host-predator-prey phenological mismatches will have a cascade of impacts on pollination success, host-parasite relationships, and eventually affect the entire food web.

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Non-coding RNAs as the calibrators of Epigenetics

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Not all RNAs are translated to proteins. These RNAs are called Non-coding RNAs (ncRNA). These ncRNAs can be classified into housekeeping ncRNAs and regulatory ncRNAs. The regulatory ncRNAs are sometimes called 'Riboregulators'. Recent analyses have shown that up to 70 % of the mammalian genome is transcribed however, only 1–2% of these transcripts encode for proteins. The remaining vast majority are transcribed as ncRNAs as shown in Fig (1).

The regulatory ncRNAs can regulate

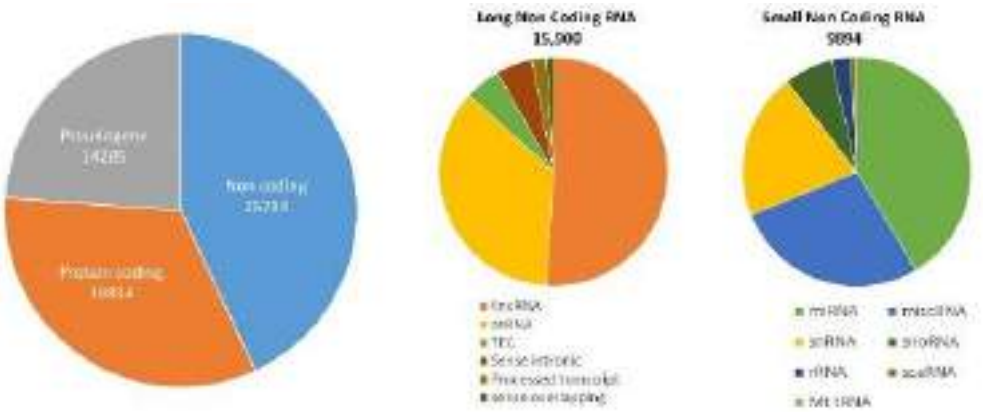

Fig 1: The approximated number of genes encoding a protein has been shown. The rest are non-coding or pseudogenes. The non-coding genes have been further analyzed to long non-coding and small non-coding RNAs and their subdivisions.

transcriptional or post-transcriptional expression of a gene, modulate protein activity, and determine the distribution of RNA and protein within the cell.

Some functionally important and abundant non-coding RNAs include ribosomal RNAs (rRNAs) and transfer RNAs (tRNAs), as well as small ncRNAs such as small interfering RNA (siRNAs), micro RNA (miRNAs), Piwi-interacting RNA (piRNAs), small nucleolar RNA (snoRNAs), small cajal body-specific RNA (scaRNAs), extra-nuclear RNA (exRNAs), small nuclear RNA (snRNAs) and the long non coding RNA (lncRNAs) such as HOX antisense intergenic RNA (HOTAIR) and X-inactive specific transcript (Xist).

Some riboregulators regulate gene expression in the processes of dosage compensation and X-chromosome inactivation in mammals and Drosophila. The key gene within the X-inactivation center (Xic), Xist encodes X-inactive specific transcript (Xist RNA), a long non-coding nuclear RNA. The Xist RNA shuts off transcription from one of the X chromosomes by recruiting silencing factors as shown in Fig(2).

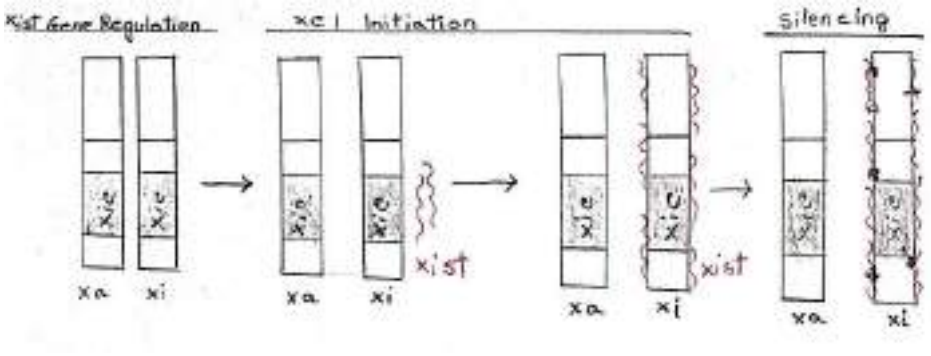

Fig 2: X linked Inactivation mediated by Xist RNA which is a non coding RNA.

Another lncRNA, HOX antisense intergenic RNA (HOTAIR) originating from the HOXC cluster appears to be misregulated in different types of cancers and plays a critical role in chromatin dynamics and gene regulation. HOTAIR can silence gene transcription in a 40kb HOXD gene locus. The mechanism of action is through the recruitment of a complex called Polycomb repressive complex PRC2 to HOXD through HOTAIR, which then triggers heterochromatinization and transcriptional gene silencing via H3K9 trimethylation as depicted in Fig (3).

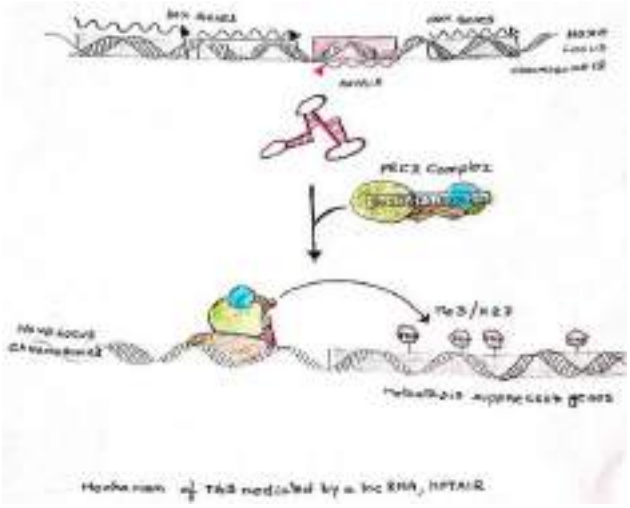

Fig 3: Mechanism of TGS mediated by a lncRNA, HOTAIR

HOTAIR also interacts with HMTs like PRC2 and HDMs like LSD1 and regulates gene silencing.
The miRNA is also a chief ncRNA responsible for a plethora of cellular and extracellular activities. The classical miRNA-RISC-Ago complex mediated hybridization and degradation of complementary mRNA is a prime example of post-transcriptional gene regulation. The 'seed region' comprising 2–8 nucleotides from the 5' ends of the miRNA is the decisive factor in the selection of the target as it is responsible for binding as depicted in Fig (4).
Recent studies reported the crucial role played by miRNAs during the occurrence of various diseases (like

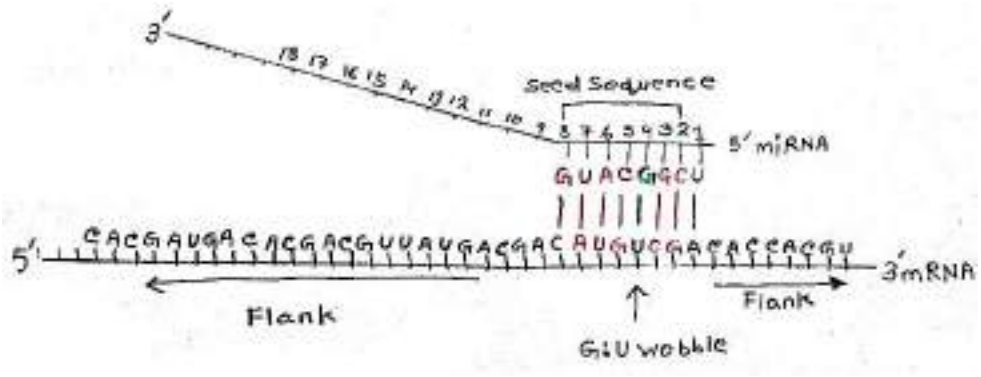

Fig 4: mi-RNA mediated complementarity to the mRNA using the seed sequence

cancer) and can also directly regulate major chromatin-modifying factors such as DNMT3A, DNMT3B, DNMT1, and EZH2,
For instance, miR-152, a tumor suppressor miRNA, is frequently down-regulated in Hepatitis B Virus (HBV) -related Hepatocellular carcinoma (HCC) and this has an inverse relation with DNMT1. Experimental studies of over-expression of miR-152 in hepatocyte cell lines have shown a marked reduction of the expression of DNMT1 at both the mRNA and protein levels which in turn led to a decrease in global DNA methylation, whereas inhibition of miR-152 caused global DNA hypermethylation and increased the methylation levels of two tumor suppressor genes.
Experiments of Benetti et al. and Sinkkonen et al. on mouse embryonic stem cells lacking Dicer showed that the downregulation of DNMT3a and 3b activity depended on the miR-29 family. The mechanism relied on Retinoblastoma-like protein 2 (Rbl2) which inhibited the activity of DNMT3a and DNMT3b. The miRNA-29 can inhibit Rbl2, but the miRNA-29 family was downregulated in the absence of Dicer, so hypomethylation.

Moreover, in mouse embryonic cartilage tissue miR-140 targets

Histone deacetylase 4 (HDAC4), as shown in the original experimental analysis of Fig(4). The Wild-type (WT) and a Mutated (MUT) 3′ UTR region of HDAC4 are shown together with the mir-140 sequence. The predicted target site and the mutated nucleotides are bolded and underlined respectively.
The WT and MUT miR-140 target sites were cloned into a plasmid having the luciferase gene upstream and they were transfected with siRNAs (siRNA-140) or without siRNAs (scrambled siRNA; siRNA-SCR) into 3T3 cells. Luciferase activity is downregulated by a miR-140 mimicking siRNA (siRNA-140). Analyzing the Western Blot of total protein clearly showed HDAC4 downregulation by siRNA-140 which could be seen by the decrease in band intensity. B-actin was used as a loading control.
Many such recent experiments suggest that a plethora of miRNAs have prime roles in the epigenetic control of gene expression.

Another type of small ncRNA is the Piwi-interacting RNA (piRNA). piRNAs interact with Piwi proteins under physiological conditions as suggested by various experiments. The Piwi protein binds PcG response elements together with Polycomb

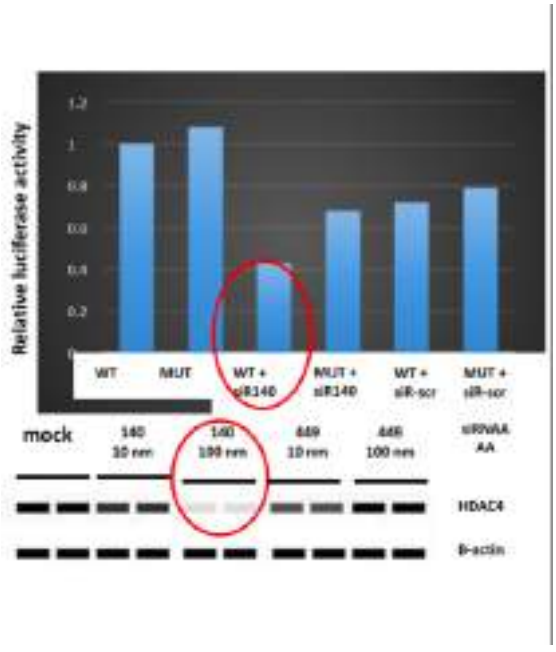

Fig 5: Downregulation of luciferase activity by a miR-140 mimicking siRNA (siRNA-140). Western Blot of total protein clearly showed HDAC4 downregulation by siRNA-140 specifically.(https://doi.org/10.1093/nar/gkg124)

group proteins (PcGs) and silences the homeobox gene.

Therefore, ncRNAs are one of the chief components of epigenetic regulation of gene expression, as they play a vital role in organ development and functioning. Understanding their involvement in pathogenesis and psychiatric disorders can be a solution for the early detection and remediation of several fatal diseases.

Fig (6) depicts the Central Dogma from the point of view of ncRNA.

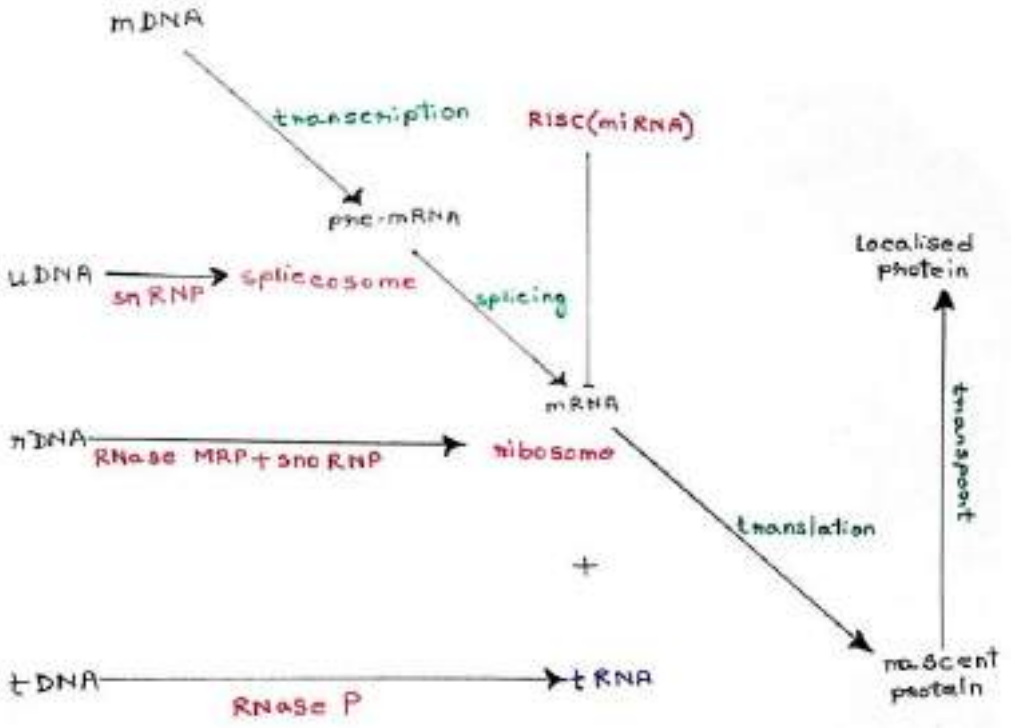

Fig 6: Central Dogma from the point view of various ncRNA

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When a Whale Dies, everything is Born - Exploring an Ocean-Floor Ecosystem

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An ecological review of whale-falls and its impact on biotechnology

The death of every organism serves as a nutrient source for scavengers and decomposers. But in the depths of the ocean, also called the deep-sea 'desert area' due to its lack of sunlight and food, the death and sinking of a whale serves as an oasis for the deep-sea life.

Ecological Significance of Whale falls

The process of a whale dying, eventually sinking to the ocean floor, and giving rise to an ecosystem is summarized by the term "Whale-fall". The average density of whales' bodies being greater than that of seawater leads to the sinking of whales' corpses due to gravity. But because the sea also flows and there are rising undercurrents, it takes a period of time before the carcass reaches the ocean floor.

Together with hydrothermal vents and cold seeps, whale falls are the leading source of nutrients and energy that give rise to life on the ocean floor. Another significant source is marine snow - a shower of biological debris from the upper waters to the deep ocean that resembles an underwater snowstorm because of the 'snowflakes' formed by the coagulation of the organic material.

Whale falls were first discovered in 1987, when a 21 m-long blue whale skeleton was discovered off the coast of California. A 'biological carpet' on the skeleton, including bacteria and worms, was found. Over the course of the research, 38 whale carcasses have been sunk to study the surrounding ecosystem. While there are also 45 natural whale falls known to scientists, the advantage of studying implanted carcasses is that 'time zero' is accurately recorded. The current distribution of whale falls is shown in the figure below, with most located in the Atlantic Ocean and a few in the Pacific Ocean.

The Different Stages in Whale-Fall Community Succession

Whale falls are unevenly distributed in space and time, creating resource patches on the ocean floor. There are four basic stages to a whale-fall

community succession.
1. The mobile scavenger stage where large mobile scavengers are drawn to whale-falls rapidly, like lithoid crabs, sharks, and hagfish, and lasts from 4 to 24 months.

2. Enrichment or Opportunist stage where smaller organisms like gastropods and polychaetes exploit organically rich compounds. A characteristic polychaete observed is the bone-eating snot flower worm, *Osedax*. This worm has in its roots a symbiotic bacterium that digests the surrounding bone and releases collagen and lipids for it to consume. This stage may last up to two years.

The first two stages immediately following a whale-fall witness a short-term reduction in surrounding diversity. Over time, their haphazard feeding and high activity levels disperse whale biomass over and into the surrounding sediments. This prompts an immediate microbial response, causing a bull's-eye of increased microbial enrichment and degrading activity in the sediment.

3. Sulphophilic stage - The high oxygen consumption of microorganisms is conducive to the formation of anoxic conditions for anaerobic processes such as sulfate reduction and methanogenesis. Thus, we see a growth of chemolithoautotrophic microorganisms.
Until the whale biomass is fully utilized, whale-fall habitats experience a temporal microbial succession from largely heterotrophic to more heterotrophic/ chemosynthetic metabolisms. The whale-fall sediment microbial community becomes dominated by methanogenic archaea (*Methanomicrobiales* and *Methanosarcinales*) and sulfate-reducing bacteria (*Desulfobacteraceae* and *Desulfobulbaceae*). For years following the arrival of the carcass, mats of filamentous chemolithoautotrophic sulfide-oxidizing bacteria, such as *Beggiatoa* species, are seen on deep-sea whale bones and nearby sediments. This stage is characterized by high biomass and species diversity and can last between 50 and possibly 100 years.

4. Reef stage - In this final stage, the organic compounds have been fully utilized and only minerals remain in the bones, which provide a hard substrate for suspension and filter feeders.
The most durable energy sources at whale falls are huge adult bones. The lipid-rich whale bones, which have been exposed by scavengers, offer a home for microbes. Bone lipids contain energy but are challenging to access since they are encased in a collagen and apatite-based bone matrix.

Microbial colonization and bone degradation in adult whale bones happen gradually from the outside to the centre. Sulfate reducers and

other heterotrophic microbes, such as collagen-degrading actinomycetes, eventually occupy the entire bone to exploit the organic materials, according to specific bacterial lipid biomarkers discovered in the middle of fossil whale bones. In the presence of bone-eating metazoans, like Osedax, the penetration of microorganisms into bones may be greatly increased.

Applications in Biotechnology and Forensics

The ecological studies of whale falls have also led to a search for novel microbial species that could be of commercial use. Of the variety of bacteria that colonize the whale carcasses, the decomposers are frequently psychrophilic (i.e., they grow best below 20 °C) or psychrotrophic (i.e., they are facultative psychrophiles). The enzymes of psychrotrophic bacteria are of considerable commercial interest as they are ideal for use in cold-water detergents, food processing, and the pharmaceutical industries.

Using recombinant cloning techniques, Diversa, a biotechnology company, discovered several bacterial clones with cold-adapted lipase activity from whale carcasses. This method enables immediate access to the genomic information of natural microbiological assemblages, where 99% of the diversity is still not cultivable. Some of the whale-carcass lipases show potential as detergent enhancers, possibly improving the effectiveness of stain removal from clothing during cold-water washing. The successful use of such enzymes in detergents could result in significant energy savings and financial gain.

Whale-fall studies can serve as an ecological basis for human forensic investigations since the broad term of 'food falls' which occurs in oceans, could, ecologically speaking, include human bodies. Human bodies can be deposited into the ocean due to mass casualties and individual events. While the scale is an obvious issue, given how vast whales are, the relevance of whale-fall research to humans provides an understanding of how time and environmental factors influence the condition of human bodies submerged in the ocean.

There's still a lot to learn about the microbiological mechanisms, reproductive tactics, population genetics, and biogeography that lead to whale fall despite great advances in this research. Therefore, it is crucial that we investigate a number of mysterious and uncharted deep-sea habitats, namely, whale falls, and comprehend the intricate dynamics of community change in the deep-sea environment.

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HeLa Cell: First Discovered Immortal Human Cell

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Introduction:

Have you ever thought about how scientists analyze human tissue in the lab?

They accomplish this with the assistance of real human cells. But, normal cells within the human body have a finite lifespan (the Hayflick limit), after which they die, and therefore can't be experimentally used for long-term research work. So, ideally, in such cases, cell lines that can remain immortal over a long span and can replicate endlessly to maintain a constant supply of quickly growing cells should be used. And here comes the story of Henrietta Lacks.

In 1951, an African American woman (31 years old) named Henrietta Lacks visited The Johns Hopkins Hospital complaining of vaginal bleeding. Upon examination, Dr. Howard Jones discovered a large, malignant tumor in her cervix – indicating an aggressive form of cervical cancer. As a result, she started undergoing classical Radium treatments.

Months later, for further testing, during a biopsy, a sample of her cancer cells was sent to Dr. George Gey's nearby tissue lab, which was working on cancer and used to collect samples from different patients having cancer to help in his experimental research studies.

But, until then (before 1951), whichever sample of cells with cervical cancer he studied, died after a specific period of time. But, in 1951, amazingly for the first time, he discovered that – "Mrs. Lacks' cells were unlike any of the other cells he had ever worked: where other cells would die, Mrs. Lacks' cells doubled every 20 to 24 hours. Her cells turned out to be the first human cell line that has an extraordinary capacity to survive, grow, reproduce, and divide endlessly in a laboratory, leading scientists to label these cells as "immortal"."

These cells were nicknamed - "HeLa" cells - from the first two letters of her first name Henrietta and last name Lacks.

Although Mrs. Lacks ultimately passed away on October 4, 1951, at the age of 31, her cells continued to stay alive and impact the world. HeLa cells were the first human cells to survive and grow in vitro outside of the body.

Applications of HeLa Cells:

Since 1951 until today, these incredible cells have been used to study the effects of toxins, drugs, and hormones on the metastasis of cancer cells without experimenting on humans, the effects of radiation and poisons, the human genome, and how viruses and bacteria invade and infect. These cells played a crucial role in the development of the polio vaccine and even the COVID-19 vaccine. They have been involved in crucial discoveries in the fields of cancer (oncology), immunology, genetics, cell biology, and infectious disease.

Although many other cell lines are in use today, the longevity of HeLa cells contributed to their worldwide application as an efficient human cell line of choice for most biomedical research and medicine.

1) DEVELOPMENT OF POLIO VACCINE:

HeLa cells were found to be easily infected by poliovirus, causing infected cells to die. The feature that HeLa cells can replicate indefinitely makes them highly desirable for Salk's polio vaccine testing – making it an effective tool for growing large quantities of poliovirus (the cause of poliomyelitis, or polio disease), which paves the pathway for the eventual development of the polio vaccine.

2) STUDY OF BACTERIAL PATHOGENESIS:

HeLa cells provide faster and more cost-effective ways to test how *Salmonella, Mycobacterium tuberculosis,* and other bacteria infect the body, which aids in the development of new methods to diagnose and treat the diseases.

3) STUDY OF VIRAL PATHOGENESIS:

Scientists use HeLa cells to know how the presence of the Human Papilloma Virus (HPV) [Henrietta Lacks' cells contained the HPV virus], Ebola virus, and Human Immunodeficiency Virus (HIV) that can lead to certain types of cancer (ex: HPV causes cervical cancer). They also use HeLa cells to identify mechanisms of invasion and infection or other serious diseases in humans, which paves the way for the adoption of new strategies for developing more effective anti-cancer vaccines and drug

To test and develop new vaccines and drugs, HeLa cells have been infected with various types of viruses, including HIV, Zika, herpes, and mumps. Some findings are -

- CD4 protein if added to HeLa cells, could be easily infected with HIV, allowing the virus to be studied.
- When the measles virus infects HeLa cells, it constantly mutates.
- Zika cannot multiply in HeLa cells.

4) STUDY OF PATHWAY OF ENTRY OF CORONAVIRUS INTO HOST CELLS:

Scientists started studying COVID-19 using HeLa cells but soon found that the virus did not infect them. This curiosity made them look for the viral entry port that was apparently missing on the

HeLa cells. In normal human cells, ACE2 receptors are displayed on the surface of the cells to which ACE2 binds, and this binding helps the coronavirus enter the cell. As normal HeLa cells lack these receptors – this binding and downstream signaling was not happening. So, scientists engineered HeLa cells to have ACE2-receptors on their surface, and it was observed that the novel coronavirus could then enter and infect the cells. So, it is evident that ACE2 acts as an entryway for any SARS-CoV-2019 particles to recognize and bind to those cells. After entry, it can use the cell's machinery to replicate and spread, causing the disease – COVID-19. The use of HeLa cells in COVID-19 research has provided insights into the molecular mechanics of infectivity by SARS-CoV-2019, viral spread, and other components required for infection.

5) FOR TREATMENTS FOR BLOOD DISORDERS:

The efficacy of the drug "Hydroxyurea" against certain blood cancers and sickle cell anemia has been examined by its application on HeLa cells (cancer cells). It showed that with the application of this drug, cancer growth slows down. It's also been shown that hydroxyurea helps prevent the misshaping of red blood cells caused by the inheritable genetic mutation responsible for sickle cell anemia.

6) FOR STUDYING SPACE MICROBIOLOGY:

In the 1960s, HeLa cells were sent on the Soviet satellite Sputnik-6 and human space missions to find out the long-term effects of space travel on living cells, tissue, and the human system.

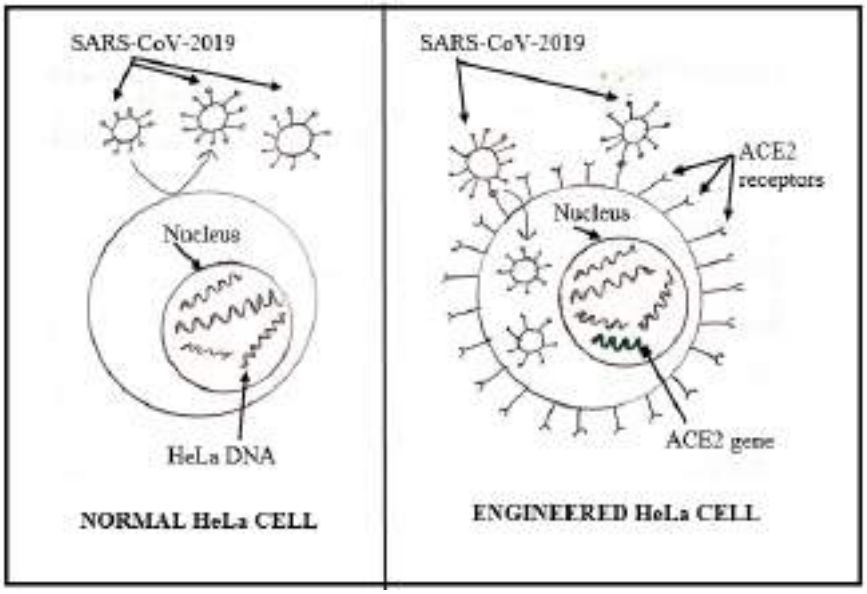

Figure: ACE2 receptors are present on HeLa cells to promote infection. HeLa cells do not display high levels of ACE2 receptors on their surface, thus preventing infection by SARS-CoV-2 particles. However, when researchers engineer HeLa cells to display the ACE2 protein, the vital particles gain entry into the cells and start their cycle of infection

7) TREATMENT OF TUMOUR CELLS:

HeLa cells have also been used to study the canine distemper virus' ability to induce apoptosis in cancer cell lines, which could play a pivotal role in killing tumor cells resistant to radiation and chemotherapy.

8) SLOWING CANCER GROWTH:

Scientists discover that when HeLa cells are treated with a drug called Campothecin, uncontrollable cancer cell growth slows - suggesting camptothecin as a potent drug to inhibit cancerous growth.

9) UNDERSTANDING THE EFFECTS OF X-RAYS ON HUMAN CELLS:

The negative effects of high and frequent exposure to ionizing radiation (e.g., X-ray) on human health and the way X-rays damage cells have been deciphered by exposing HeLa cells to X-rays for long durations.

10) IN THE PREVENTION OF BIRTH DEFECTS:

Researchers use HeLa cells to explain how birth defects were caused by the drug, thalidomide. Applying this knowledge, the progression of certain cancers like multiple myeloma can be halted.

11) LEARNING ABOUT THE AGING OF CELLS:

Research involving HeLa cells shows that the telomerase enzyme replicates the telomeric portion on the ends of DNA chromosomes that prevents them from getting shortened over time. This is often important for understanding the underlying biology of aging as well as the diseases that cause premature aging.

12) FOR DIAGNOSIS AND TREATMENT OF CANCER:

- HeLa cells are used to test whether a cell line is cancerous or not.
- Effects of steroid hormones (e.g., estradiol, estrogen), flavonoids, and antioxidants with estradiol on neoplastic cell proliferation have also been found by the use of HeLa cells.

13) GENOME MAPPING:

In 1965, the first human-animal hybrids were made by fusing HeLa cells with mouse cells. This accomplishment paved the way for significant improvements in gene mapping to individual chromosomes and, later, the Human Genome Project.

14) GENETICS:

In 1953, unintentionally by mistake, HeLa cells were somehow mixed with a liquid and that mistake allowed researchers to see and count each chromosome clearly in the HeLa cells they were working with. This accidental discovery led scientists to develop better techniques for staining and counting chromosomes - demonstrating that human somatic cells have 23 pairs of chromosomes, not the previously believed 24. This has had important implications for the study of varied developmental genetic disorders such as Down syndrome (Trisomy 21), which include abnormalities in chromosome number like deviations from 23 chromosome pairs.

15) INNOVATING SINGLE-CELL IMAGING TO UNDERSTAND VIRUS INVASION:

Scientists use HeLa cells to develop a new and innovative single-cell microscopic imaging method that allows scientists to see the mechanism by which viruses enter cells and allows for a clearer view of the inner workings of a living cell.

Conclusion:

- Telomerase: HeLa cells are of such great importance because of their ability to replicate infinitely and this ability is due to the enzyme telomerase which copies telomeres over and over again during cell division. This prevents the incremental shortening of telomeres preventing cell aging and eventual cell death (solves "End Replication Problem). In this way, the cells circumvent the Hayflick limit (limited number of cell divisions after which normal cells undergo senescence). This activity of Telomerase results in unlimited cell division and immortality.
- Chromosome number: The number of chromosomes in the cancerous HeLa genome varies during cancer formation and cell culture. The current estimate is a "hypertriploid chromosome number (3n+)" which means the total no. of chromosomes is 76 to 80 (rather than the normal diploid number of 46) with 22–25 clonally abnormal chromosomes, referred to as "HeLa signature chromosomes" demonstrating that chromosomal abnormalities may be indicative of advanced cervical carcinomas and were most likely present in the primary tumor.

Even though there are multiple advantages of HeLa cells, a few problems arise while working with them. HeLa cells adapt to new growth media very easily and can also invade and outcompete other cell lines. If not properly maintained, they can contaminate other cell cultures. This cross-contamination by HeLa cells has become a major pervasive worldwide problem. This leaves a question mark on the validity of the research done with these contaminated cell lines.

In today's world, thousands of distinct proliferative human cell cultures called "cell lines" are in use as biospecimens, among them the first discovered cell line is - "HeLa cells". Among the many important scientific discoveries of the last century was the discovery of the first immortal human cell line - "HeLa"- a remarkably durable and prolific line of cells.

So, altogether, HeLa cells have advantages as well as disadvantages. In spite of the disadvantages, this HeLa cell line still lives today and is serving as a tool to uncover crucial information about many pathogens and their mechanisms of infection, among many others.

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The Parasites might be Controlling your Behaviour

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When we hear the word Parasite, we might anticipate an organism that gets its food from or at the expense of its host. But a recent study by the researchers of University of Colorado has made a very unexpected and ground breaking discovery, that these parasites might even lead you to start a business or become more of a risk taker in life.

A study conducted on 1500 undergraduates by the researchers at the University of Colorado Boulder's Leeds School of Business, found that individuals infected with a parasite called *Toxoplasma gondii*, were roughly twice as likely to have an emphasis on entrepreneurship and management and around 1.4 times more likely to pursue a business major.

The researchers further analysed individuals of around 42 different countries, and discovered that people in those nations which had the highest infection rate were also less likely to say that they would not start a business because of "fear of failure."

Dr. Jose Christopher Mendoza, a museum officer and curator of Crustacea at the Lee Kong Chian Natural History Museum, claims that the single-celled protozoa *T.gondii* which reproduces solely in feline intestines, has been seen to deprive a cat's prey of the ability to experience fear. He further explained that as *T. gondii* doesn't always finds a cat to infect instantly, the protozoa will infect other mammals first and then slowly move up the food chain. When a small rodent, such as rat or mouse, becomes infected, it eventually ceases showing signs of anxiety when around cats. This makes it easier for the cat to capture it, which helps the parasite to reach its intended host.

Another parasite that has the power to affect its host's brain is the horsehair worm. In its larval form, the worm enters the body of a grasshopper, usually through being eaten by the insect. Once inside, the worm feeds on the grasshopper's fat to grow before starting to work on devouring and controlling the brain. But the worm's end destination is not the grasshopper. A body of water where it can lay eggs and reproduce is all it needs. The worm can influence the behaviour of its grasshopper host by transmitting

signals to its brain, causing it to dive into a lake or pond it might otherwise avoid. When the grasshopper dives in, it meets a watery demise, and the worm emerges out through the host after having arrived at its destination. According to Ms. Kate Pocklington, a senior conservator at the Lee Kong Chian Natural History Museum, the reasons why parasites employ intermediary hosts and modify the behaviour of its inhabitant are linked and demonstrate how well adapted and developed they are. She explained that these changes allow parasites to spread beyond the organisms they can directly infect and reach out to those farther up the food chain. Some, such as the lancet liver fluke, will go through two discrete hosts before landing on its intended prey—cows. Snails devour its eggs, which are then shed in the slime they produce. The ant then consumes the larvae and the fluke thereby nests into the host's (in this case, ant's) brain, turning it into a zombie. The zombie ant crawls up a blade of grass where it has a greater probability of being eaten from herbivores like cows, instead of staying on the ground where it would be safe. The fluke's eggs are subsequently dispersed through the cow's faeces, and the cycle is repeated.

The *Cordyceps* fungus, highly valued in conventional Chinese medicine, may be the most expensive parasite. Only a single strain of the fungus is collected for sale and costs about $30,000 per kg. At least 57 different species of caterpillars that live underground on the Tibetan plateau are affected by the strain, *Cordyceps sinensis*. The fungus infects caterpillars, slowly spreading throughout their bodies and eventually compelling the insects to travel to the surface and die, whilst *Cordyceps* fungus ultimately erupts through the head and releases its spores above ground.

Hence, we can see how the parasites have an impact on not only animal health but as well as on complex animal behaviour. So far, we have had evidence of parasitic infection having impact on business, entrepreneurship and economic productivity. Studies in the future may work towards revealing other effects that parasite infestation may have on animal behaviour and social interactions.

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Nanotechnology vs HIV/AIDS: An Ongoing Battle and A Hope for Future

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More than 35 million people were found to be infected with HIV/AIDS around the globe in 2021. There is no permanent cure or vaccine yet. The introduction of Highly Active Antiretroviral Therapy (HAART) has improved treatment but has various side effects like heart diseases, diabetes, cancer, and accelerated aging. Moreover, it is ineffective for patients when the virus develops resistance.

Nanotechnology is revolutionizing the field of medicine in the 21st century and it holds promise for the treatment of HIV/AIDS.

How is Nanotechnology a boon to medicine?

Nanotechnology can be applied in various ways in the field of medicine, for example:

- Imaging
- Diagnosis
- Drug delivery

Nanomedicine, produced using nanoparticles, is safe to be introduced into the body and can specifically target cells or tissues. They can release the drug in the cells in a controlled manner when triggered by internal mechanisms or external stimuli. Nanotechnology provides the ability to manipulate the properties, structures, and composition of cellular components, genetic material, and even viruses, at a nanoscale.

Role of Nanotechnology in Fighting HIV

Delivery systems based on nanotechnology and created on a nanoscale modulate the distribution of hydrophilic and hydrophobic drugs due to their small size. Specific targeted delivery of antiretroviral drugs to CD4+ T cells and macrophages ensures that drugs reach the reservoirs of HIV. Some examples of nanotechnology-based platforms for targeted drug delivery are:

- Nanosuspensions of indinavir, stabilized by Lipoid E80 were loaded into macrophages and injected into mice. High distribution of the macrophages was observed in the lungs, liver, and spleen, thereafter. Intravenous injection of these macrophages resulted in significant antiviral activity in the brain.

- Drug stavudine, encapsulated in liposomes and conjugated with mannose and galactose resulted in increased cellular uptake of the drug with its increased generation in the spleen, liver, and lungs.
- Dendrimer nanocarrier delivered the drugs efavirenz and lamivudine in vitro resulting in a higher anti-HIV activity.

Thus, nanocarriers have better and improved target specificity for drug delivery as compared to free drugs, and they also potentially reduce the viral load.

Nanotechnology-based therapeutics to combat HIV

- Nanoparticles targeting HIV viral fusion to immune cells - silver nanoparticles bind to gp120 preventing CD4-dependent virion binding, fusion, and infectivity. They act as an antiviral agent in the early stage of viral replication and inhibit further stages of the life cycle of the virus. Hydrophobic polymeric nanoparticles reduce SEVI-mediated infection of the HIV virions by reducing their affinity for the target cells.
- Improvement of gene-editing techniques using nanoparticles - gold nanoparticles can safely deliver the components of CRISPR-Cas9 to the targets with lower toxicity. They could penetrate the CD34+ hematopoietic cell line.
- Inhibition of reverse transcriptase activity in HIV-1 using nanoparticles - a reverse transcriptase inhibiting drug was conjugated on the surface of graphene quantum dots and significant anti-reverse transcriptase activity was observed due to polycarboxylate mediation of the enzyme during viral fusion.
- Better penetration into the blood-brain barrier (BBB) - HIV-1 may also persist in microglial cells of CNS. Nanodiamonds, known for their low cytotoxic profile can improve the bioavailability of the drug efavirenz when complexed with it. Gold nanoparticles provide other nanoplatforms to penetrate the BBB with antiviral efficacy when conjugated with HIV integrase inhibitors.

Challenges and prospects - Nanotechnology has paved the way for discovering new probable therapeutics. However, there are still some obstacles in the path:

- CRISPR-conjugated nanoparticles, though with better penetrating effect, have an overall lower gene-editing efficacy.
- Nanoparticles can deliver drugs effectively due to high target-specificity. However, due to the short shelf-life and term of the drugs, the nanoparticles must be injected several times in short intervals.

There are many more challenges that are yet to be faced. Further research is needed for understanding the role of nanotechnology-based treatments for HIV like targeted co-delivery of two or more drugs using nanoparticles, and nanoparticle-

based vaccines.

So far nanotechnology-based therapeutics and drug delivery systems hold promise for the future. However, a major hurdle is that most of them are in the pre-clinical trial stage. It may be a long time before they are made available in the market. Nevertheless, they can become a reality with more in-depth and extensive research on their properties and by solving the existing challenges.

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Cold Drinks: The Current Hot Topic

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Introduction

There has been a constant debate over the health effects of soft drinks on the human body. Soft drinks are carbonated water-based beverages that have been sweetened by adding sugars or artificial sweeteners, along with colourings and preservatives. All these ingredients have been linked to one or more adverse effects on human health. In this article, certain important data, facts, and corresponding scientific analyses made by researchers around the globe have been highlighted.

The ingredients and nutritional information of packaged foods are available on the packaging material. So, next time you buy a soft drink, just read the label on the bottle. Let us have a look at some of the ingredients of these soft drinks, individually, and what effects they may produce in the human body.

Added Sugars

It is quite evident from the nutritional information data that soft drinks contain a large number of sugars. If a person consumes a single can of Coca-Cola, he or she would take in 31.8 g of sugar at once. This pertains to a lot of calories as well. A 300 mL can of Coca-Cola has 132 kcal. However, these calories will not make you feel as full as a plate of solid food like masala dosa would have done. Instead, these are just useless calories for your body without any nutrients, and thus soft drinks are not considered food.

Now, if you are a soft drink consumer or have observed someone who consumes soft drinks frequently, they generally develop a habit of drinking soft drinks. This is termed "Sugar Addiction." Yes, you read that right- "Addiction.". People with sugar addiction have excessive sugar intake due to their bingeing and cravings for sugary foods and soft drinks are one of them. These, if consumed regularly for a long period lead to severe problems.

Artificial Sweeteners

The advent of consumption of "Calculated Calories" in the fitness freak society led companies to manufacture Diet Soft Drinks, which do not contain added sugars in them. In turn, the sweetness is maintained by artificial sweeteners. E955 or Sucralose and E950 or Acesulfame

potassium are used as sweeteners in zero-calorie soft drinks.

Sucralose administration caused a strong drop in hemoglobin (Hb) during studies with mice. Sucralose or stevia administration significantly reduced RBC count, and Hematocrit (HCT) was significantly reduced after sucralose administration. Sucralose administration led to oxidative stress in both male and female mice, which was obvious by the elevated level of NO and the reduced level of SOD and also showed significantly increased levels of liver function enzymes (ALT and AST), urea, creatinine, cholesterol, LDL, and free fatty acids. The kidney section of sucralose-administrated mice showed small-sized glomeruli with wide Bowman's space, proximal tubules with markedly oedematous epithelial lining, loss of brush borders, and areas of haemorrhage.

Aspartame is another non-caloric sweetener with some adverse effects on human health, including an elevated risk of early menarche among girls aged 9–10 years. Hence, non-caloric sweeteners are not good for consumption in the long run.

Preservatives

E211 or Sodium Benzoate is the most commonly used preservative in many food items. Studies with Sodium Benzoate have shown DNA damage in lymphocytes, including sister chromatid separation. Incubation of lymphocytes with Sodium Benzoate has shown micronucleus formation. A micronucleus is a small nucleus that forms whenever a chromosome or a part of it is not integrated into one of the daughter nuclei during cell division. It occurs in case of genotoxic events and chromosomal instability.

In 2005, the US FDA reported low amounts of Benzene gas in some soft drinks. Benzene gas was liberated when Sodium Benzoate reacted with Ascorbic Acid under heat or light. Benzene is a highly toxic gas and a carcinogen.

Acidity Regulator

E338 or Phosphoric acid used as an acidity regulator in most soft drinks has been the cause of many teeth problems. This is the main reason why children are recommended to not consume soft drinks. Phosphoric acid weakens and softens enamel leading to plaque formation. The softened enamel along with the huge amount of sugar from the soft drinks provides *Staphylococcus mutans* with a suitable environment for its growth and causes dental carries.

E330 or Citric acid is also used as an acidity regulator in some soft drinks, giving them a sour taste. Citric acid has very little to no side effects on the human body.

Artificial Colourings

Most common soft drinks have a brownish-black colour. Earlier, this colour was obtained from caramel, which was essentially 4-methylimidazole (4-MI), yielded when sugar is heated with ammonia and sulphides.

The Centre for Science in the Public Interest (CSPI) petitioned the United States Food and Drug Administration (US FDA) in February 2011 to withdraw its authorization for caramel colourings that contain 4-Methylimidazole. 4-Methylimidazole has been added to California's list of possible carcinogens. Consequently, leading manufacturers of cola soft drinks declared to change their recipes to avoid a cancer warning label in compliance with California law in March 2012.

Nowadays, artificial colouring such as E150d is used in leading soft drinks. E150d is an artificial colour and it again contains 4-methylimidazole, a cytotoxic molecule for both animal models and humans. Adverse effects of E150d have been studied in Zebrafish (*Danio rerio*) embryos.

For soft drinks that have an orange colour, E110 or Sunset Yellow FCF which is an orange azo dye, is added to them. This colour has been linked to increased hyperactivity in children upon consumption. Studies have concluded that in *ovo* administered Sunset Yellow FCF has undesired effects on embryonic development of the Bursa of Fabricius, spleen, thymus, and spleen volume.

Conclusion

There have been several lawsuits against the soft drink companies for the ingredients they used. Soft drink companies have only taken action in those countries where legal action has been taken. In India, all the above-mentioned additives are still being used.

So, what is the solution? You might be thinking of some alternative. Yes, there is a very simple alternative- 'water.' Just have water whenever you feel thirsty while having your favourite food in a restaurant. It would be quite hard to make your taste buds get rid of the urge to have that sugary water, but if you manage to control your urge, congratulations! you have won the fight.

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Scared of Dengue Fever? These Bacteria can Protect You

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Introduction

"Deaths due to Dengue Fever", "Several died due to Malaria", "Rise in Chikungunya cases." These have been common headlines in the newspapers recently. Tropical and sub-tropical countries experience a wide range of diseases that are spread by mosquitoes and in most cases are fatal.

In 2021, 1,64,103 dengue cases were reported in India. Insecticide-based elimination of mosquitoes is quite prevalent. However, it is expensive, and also the effectiveness of such programs has been greatly reduced because of insecticide resistance in mosquitoes. Also, this has environmental problems and is unsustainable.

The bacterium *Wolbachia* which is present in a vast majority of arthropods (76% of the estimated 2 million–5 million insect species on Earth) is an endosymbiont and is inherited maternally, i.e., through the eggs of the arthropods. It can manipulate host reproduction in many ways, all of which in nature are favourable for females. First discovered in the ovaries of *Culex pipens* by Hertig and Wolbach in 1924, it was later named *Wolbachia pipientis*. It cannot make humans or animals (for example, fish, birds, and pets) sick. So, it can be safe for application.

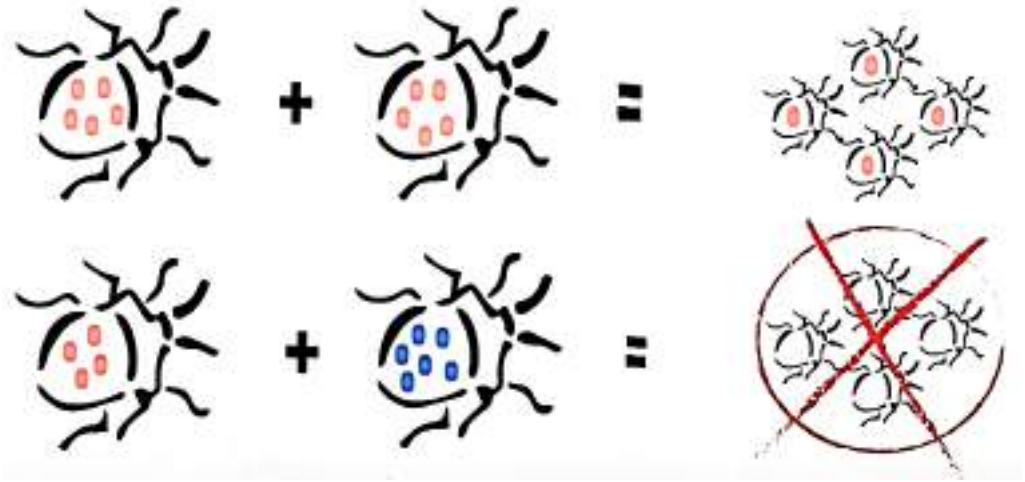
In this article, the role of *Wolbachia* in disease control and its operational implementation have been discussed.

Wolbachia pipientis and Disease Control:

- CYTOPLASMIC INCOMPATIBILITY

Cytoplasmic Incompatibility (CI) does not allow viable offspring to form after mating between insects of the same species but different *Wolbachia* strains.

So, the operational utility of CI is such that an invasive mosquito species which is not native to a particular region can be eradicated. In Southern California, Asian Tiger Mosquitoes, which are not a native of the region was capable of spreading diseases to which the locals were never been exposed.



Asian Tiger mosquitoes are naturally infected with the *Wolbachia* strain unique to their species. Researchers have used antibiotics to remove the naturally occurring strain from male mosquitoes. Then a different strain of *Wolbachia* is injected into them and allowed to breed, producing an army of male mosquitoes. These were then released in nature. Since male mosquitoes do not bite humans, they will only mate with the females with the native strain of *Wolbachia*. This will eventually lead to the production of eggs which will be non-viable, thus reducing the mosquito population.

- HOST IMMUNE GENE UP-REGULATION

The presence of *Wolbachia* Strain wMelPop in mosquitoes has resulted in the upregulation of immune gene expression in the host cells. When *Anopheles gambiae* was infected with the strain, genes LRIM1, TEP1, CEC1, DEF1, CTL4, and CLIPB3 were found to be upregulated as shown by genome analysis. Genes LRIM1 and TEP1 when upregulated inhibit the *Plasmodium* development by interfering in the opsonization pathway.

Culex quinquefasciatus mosquitoes when infected with natural *Wolbachia* strains have shown resistance to the West Nile virus.

The infection of the wMelPop strain in mosquito *Aedes aegypti* causes up-regulation of immune effector molecules, namely, C-type lectins, defensin, thio-ester containing proteins, diptericin, SPZ1A, GNBPB1, cactus, and cecropin.

- INHIBITION OF VIRAL REPLICATION

Wolbachia wMelPop infection in *Drosophila melanogaster* triggers an antiviral response to the Drosophila C virus in their hosts. The vectors for dengue fever (*Aedes aegypti*) and malaria (*Anopheles* spp.) are not naturally infected by *Wolbachia*. These observations led the researchers to introduce *Wolbachia* strains in *Aedes aegypti*. The walbB strain introduction in *A. aegypti* significantly reduces dengue virus

proliferation. The introduction of the life-shortening strain also reduces the life span of the mosquito thus altering the extrinsic incubation period of the dengue virus and thereby inhibiting its transmission to a new host.

Immunofluorescence staining of the ommatidia of *Aedes aegypti* was performed and studied in the following categories-

1. Uninfected mosquito (No DENV, No *Wolbachia*)
2. DENV (Dengue Virus) infected mosquito
3. Wolbachia-infected mosquito
4. Wolbachia-infected mosquito, 14 days post-infection with DENV

It was found that DENV levels are dramatically reduced by the presence of *Wolbachia* and no DENV signal is detectable.

This property of the *Wolbachia* strains can be utilised in controlling other virus-based mosquito-borne diseases such as Chikungunya.

Methodology for Implementation

Several organisations like the Centre for Disease Control and Prevention, USA and the World Mosquito Program have implemented the application of mosquitoes with *Wolbachia*-

- Using microneedles, *Wolbachia* strains are extracted from *Drosophila*.
- Next, the bacterium is transferred to the young mosquito eggs.
- Once the mosquitoes carried *Wolbachia*, they naturally passed on them to their offspring by maternal inheritance and maintaining Cytoplasmic Incompatibility. There is no need for the re-inoculation of more eggs subsequently.
- Mosquitoes are studied by infecting them with parasites that cause the disease, say, Dengue Virus.
- *Wolbachia*-containing mosquitoes are released once a week for 10 – 20 weeks in regions where Dengue has been a problem.

Within a few months, close to 100% of the mosquitoes had *Wolbachia* strains in them. Even after years, *Wolbachia* mosquitoes are still there in those communities. It was found that Dengue cases were reduced dramatically in those regions.

Conclusion

The exact biochemistry by which these bacteria do all these marvels is not yet known in great detail and this opens the doors for research in the coming years.

In conclusion, it is opined that *Wolbachia* offers a biological way to control the mosquito population and lessen the burden of human illness and disease transmission. In a country like India, which faces a lot of fatalities due mosquito-borne diseases, use of *Wolbachia* can be an effective solution if implemented with proper planning.

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Spider-silk: A Journey from Lab to the OT table

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Introduction:

The word spider connects us to the popular movie franchise "The Spiderman." In the movie, Peter Parker is bitten by an American house spider and as a result of the genetic mutations, he became the friendly neighbourhood superhero. What if a spider from the same genus, but belonging to a different species, had bitten him only to cause alternative manifestations in the body, such as anti-inflammation against foreign agents or wound healing properties? Spider silk, often known as spider web, is a thin thread-like material intricately spun into specified shapes by most spider species. Spider silk has received a lot of interest due to its biodegradability and biocompatibility. The silk is mainly composed of proteins, the most prominent of which are glycine and alanine. Spidroin, a component of a broad group of proteins known as scleroproteins and the major component of silk, has recently been discovered to have a medicinal use that benefits the biomedical research. The main focus is on understanding how spider silk can be artificially generated and used in biomedicine.

Artificially engineered spider silk protein:

Recent research has demonstrated the significance of spider silk in drug delivery systems since it is biodegradable and biocompatible, as well as its potential contribution to wound healing and surgical sutures. Such assistance would necessitate a high amount of silk proteins to be produced, which spiders cannot generate naturally. The demand can be met by genetically engineering silk in the lab.

To do so, the bacterium *Escherichia coli* was chosen since it has a shorter life cycle and is simple to operate. It is done by sequencing the DNA of the protein and cloning it into an expression vector, forming a seamless clone. It is accomplished by sequencing the gene coding for the protein of interest and cloning it into an expression vector, resulting in a seamless clone. This, in conjunction with the DNA sequence from the functional peptides, results in the recombinant DNA, which, when processed produces the needed silk protein.

The freshly generated silk proteins are functional, but they must be

modified prior to being used further. It is clear that utilizing functional fusion peptides to generate recombinant spider silk protein can significantly enhance its performance and character.

The silk protein's CT or carbon terminal, R or repeating sequence, and NT or nitrogen terminal had been cloned and expressed as a fusion protein (CT R1 NT, CT R4 NT, CT R8 NT).

As a result, the protein contains more flagelliform silk protein and is more substantial, which in turn improves the mechanical properties of the newly formed silk protein.

Medicinal usage:

To be utilized as a medicinal material, silk must be sterile, have anti-inflammatory properties, and promote wound healing. Spider silk contributes to these and has potential applications in the biomedical field.

Silk proteins have been shown to offer a matrix for cell culture and, as a result, to drive cellular proliferation, suggesting its utility as a repair material. When it comes to understanding the utilization of these silks in medical lines, biocompatibility is critical. It can be employed as a cost-effective material for wound healing and dressing in the form of sutures with silk, spider silk, RGD, and antimicrobial peptides, as well as growth factors.

Furthermore, these proteins have been shown to stimulate cell migration. As these proteins are readily biodegraded, they may aid in the removal of stitches. Kuhbier et al. demonstrated two methods for braiding multifilament sutures, using spider silk.

Despite the fact that braided sutures were more biocompatible than nylon and had higher mechanical strength, they had an uneven texture that could cause additional wound damage.

There have been reports of silk being used to repair or replace the retina of the eye. The spider silk proteins Masp1 and Masp2 provide special contributions in this scenario. These proteins can also be employed to synthesize the Brush membrane. An experiment to create a nerve graft by combining spider silk in its natural form, acellular vein, and Schwann cells with matrix gel revealed the possibility of a spider silk-neuron contact.

Conclusion:

Because of the difference in molecular weight and certain characteristics, the silk obtained is not in its best condition when compared to natural silk. Apart from these, artificially produced silk has been discovered to be more potent than steel in terms of sturdiness and is known to have a pretty high moisture content.

Assuming that the silk can be manufactured into a single strand rather than a braided one, which has high mechanical strength and is antibacterial, it has the potential to reduce the reliance on antibiotics.

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An Infectious Protein?

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The term "disease" is generally correlated with a causative organism, not unlike Robert Koch's very first germ theory of diseases. As time progressed, our knowledge in the field of medical science grew, and we came across several instances that were exceptions to that theory. One such instance is our Prion protein.

Prions are not bacteria or viruses, and unlike other pathogens, they do not contain any nucleic acids and are simply proteins. But interestingly, these proteins do reproduce, and hence they can neither be designated as non-living nor can they be called living.

'**Pr**oteinaceous' 'Infect**ion**' - that is where the name Prion was derived from. The name was coined by Stanley B. Prusiner in 1982 to distinguish the agent that causes scrapie disease in sheep. These prion proteins, when in their infectious state, fold abnormally and cause a domino effect in the surrounding proteins, which start misfolding as well. Personally speaking, it sounds like a zombie infection among proteins. What is worse is that these misfolded structures are stable, and they degenerate neural tissues, making 'holes' in the brain of the infected organism. So eventually, these prion proteins turn our brains into Swiss cheese.

Structure of Prion Proteins

Prion proteins, or Prp, are found in all individuals all throughout their bodies. In a healthy animal/person the proteins exist as Prp^C meaning cellular. Prp^C is a membrane protein that contains 209 amino acid residues and has an alpha-helical structure. From in vitro analysis, it was observed that Prp^C is not sedimentable and therefore can't be isolated by centrifuging. It has also been observed that the enzyme Proteinase K digests the normal protein. Although it is theorized that the protein might play a role in cell adhesion and intracellular signaling, its exact role has not been completely understood yet.
From experimental analysis, Prps has been found to regulate cell death and activate myelin repair. A protein called CPEB that has a structure similar to that of yeast Prp

is also seen to be associated with long-term memory.

Now, some prion isoforms are proteinase K resistant and are called Prp^{RES} but they are not necessarily pathogenic. The enzyme resistance is the result of any misfolding that might have occurred in vitro. Whereas, Prp^{SC} is the infectious prion protein and the object of our concern. Sc refers to "scrapie" which is the disease that originally led to its discovery. In this form, its structure is only poorly understood as of now. A higher ratio of beta-pleated sheets has been observed in place of the normally present alpha helix. It also shows enzyme resistance. In this abnormal form, the Prp^{SC} aggregate into amyloid fibers that form plaques.

Prion Disease

After being exposed to the concept of this usually harmless protein that can mutate into something savage, a few questions came up:

- How does the mutation occur in the first place?
- How are the Prp^{SC} molecules transmitted from one organism to another?
- What does the infectious prion protein do after it enters our body?

Conversion of Prp^{C} to Prp^{SC} can be due to 3 possible reasons- genetic, acquired, or sporadic. Prion diseases can be classified based on this.
In humans and animals, the PRNP gene codes for Prp. Germ-line mutations in this gene lead to misfolded Prps. Around 20 mutations in the PRNP gene have been identified. These mutations are associated with diseases like Creutzfeldt-Jakob disease (CJD), Gerstmann-Straussler-Scheinker (GSS), and Fatal Familial Insomnia (FFI) in humans. In animals, diseases like Scrapie in sheep, and Bovine Spongiform Encephalopathy (BSE) in cows are observed.

Prp^{C} spontaneously converts into Prp^{SC} on exposure to an infectious prion from an external source. There are two theories about the mechanism of this replication.
The first hypothesis assumes that prion replicates in a protein-only manner. A Heterodimer model was suggested, wherein a single Prp^{SC} molecule binds to a Prp^{C} molecule and catalyzes its conversion. The model, however, failed to explain a few factors. Firstly, it requires Prp^{SC} to be an extraordinary catalyst, and it requires Prp^{SC} to exist in monomeric forms.
The second hypothesis is the Fibril model of Prion Propagation. The prion proteins are assumed to exist as fibrils. Fibrillar ends bind to Prp^{C} and convert it to Prp^{SC}. The problem that arose with this theory was that it implied that the fibrils would keep increasing linearly with the addition of prions in a never-ending manner. In experimental analysis, an increase in the quantity of infectious particles was observed that did not conform to this idea of the linear

increase of the fibrils. This was then explained by taking into account the breakage of the fibril after a certain increase. The mathematically predicted data was seen to coincide with the experimental data recorded in transgenic mice.

This ability of prions to self-replicate without using genetic material defies central dogma and differs from all other particle infections. Prions also inhibit the ubiquitin-proteasome complex, which identifies and destroy malfunctioning proteins allowing Prp^{SC} formation.

Prion transmission occurs either genetically or through food and water. It causes Transmissible Spongiform Encephalopathies (TSE) in the infected organism. In TSE, the normal tissue structure of the brain is disrupted. It is characterized by the extracellular deposition of amyloids (Prp^{SC} aggregates) as plaques, the formation of vacuoles in neurons that are referred to as 'holes', and results in the sponge-like structure of brain.

The cause of prion diseases like CJD has been a mystery for years. During the outbreak of Kuru disease amongst New Guinea highlanders in 1950, William Hadlow suggested its similarity to Scrapie. Years later, D. Carleton Gajdusek established the transmissibility of diseases like Kuru and CJD by inoculating extracts of the brain prepared from the victims of these diseases in the brain of chimpanzees. Later on, researchers also found similarities in patterns in other diseases like GSS, FFI, and even Alzheimer's and Parkinson's disease.

Is There Any Treatment?

Unfortunately, there is no abatement for prion diseases yet. "The Family That Couldn't Sleep" is a book by D.T. Max where he writes about the rare case of FFI in an Italian family and their efforts to find a cure.
The diseases are rare, and prions are resistant to degradation; hence, clinical trials have not been successful to date. But research showed that mice lacking normal prions were resistant to prion diseases, and vaccines for prion diseases are a possibility in the future.

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Human Genetic Aspect of Malaria

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Exploring the aspects of genetic factors associated with malaria using applications of recombinant DNA technology.

Malaria is a major health burden affecting about 50% of the global population mainly in the tropics and subtropics affecting millions of people worldwide and causing a high rate of childhood mortality. *Plasmodium falciparum* and *Plasmodium vivax* are two major causative parasites which spreads through the bite of an infected female *Anopheles* mosquito. Despite a decade-long malaria eradication program, the disease still remains as a global threat as the clinical variability of malaria caused by the different species is poorly understood. Therefore, a critical evaluation of the biological basis of host mechanisms controlling the extent of *Plasmodium* pathogenesis is an urgent priority. The difference in severity and susceptibility of the disease is assumed to depend on the host's genetic variation. The severity of the disease is greatly dependent on Human genetic factors and the genetic polymorphism of the immune system. Several susceptibilities and resistance determinants that may be related to polymorphisms of erythrocytes, endothelial receptors, or the immune system have been already defined. The most challenging obstacle however is the antigenic diversity of malaria antigens. The surface exposed antigens (including those on the sporozoite and merozoite surface of the parasite) also display a certain degree of polymorphism, an important issue which needs to be resolved.

Immune System Evasion

The human immune system can identify *P. falciparum* while it is in the bloodstream. The circumsporozoite protein (CSP) (produced by the initial infective stage) and the thrombospondin-related anonymous protein (TRAP) are capable of binding to the hepatocytes, thus entering the cells. TRAP and other secretory proteins allow the sporozoites to move through the blood, avoiding the immune cells. As a result, they can penetrate the hepatocytes.

During erythrocyte invasion, merozoites release several essential proteins. Of these 'merozoite cap protein-1 (MCP1), apical membrane antigen 1 (AMA1), erythrocyte-binding antigens (EBA), myosin A tail

domain interacting protein (MTIP), and merozoite surface proteins (MSPs)' are the essential ones responsible for avoiding immune cells. These are produced inside the erythrocytes and are displayed on the membrane. These proteins can function both as an antigen and adhesion molecules like PfEMP1, the most important erythrocyte membrane proteins.

CD14 and Its Role in Host Protection against Infections and Metabolism Regulation

The innate immune system has developed to react to a wide range of microorganisms. Pattern-recognition receptors (PRRs) refer to a group of specialized receptors which mediate microbial detection. They are capable of recognizing microbe-associated molecular patterns (PAMPs).

The sentinels of the immune system like the dendritic cells and the macrophages have the PRRs expressed on the cell surface which send a signal to the interior of the cell to produce an immune response after the PAMP recognition. Among the best characterized PRRs, TLRs or Toll-like receptors are the pilot regulators of immune responses elicited by bacteria and viruses. They form the first line of defense by eliciting the innate immune response against the invading pathogen by identifying distinct pathogen-associated molecular patterns. There are 11 types of TLRs that play a very important role in inflammation, immune cell regulation, survival, and proliferation. Out of these, TLR1, TLR2, TLR4, TLR5, TLR6, and TLR11 are located on the cell surface while TLR3, TLR7, TLR8, and TLR9 are localized to the endosomal/ lysosomal compartment.

CD14, the first identified marker of monocytes was classified as a PRR. It is a 55 kDa glycoprotein expressed on the myelomonocytic cell surface as a glycosylphosphatidylinositol (GPI). After recognizing a vast range of bacterial products including lipopolysaccharides (LPS), CD14 is capable of signaling intracellular responses. CD14 plays many roles in microbial recognition and signaling. It helps TLR1, 2, 3, 4, 6, 7, and 9 in the recognition of ligands. The signaling pathway which is activated in response to LPS is initiated by CD14 in at least three different ways. It also activates various signaling pathways in response to microbial stimuli. CD14 of the TLR pathway plays a principal role in malaria caused by *P. falciparum*. The genetic association of the CD14 gene with *P. falciparum* severe malaria also has a functional basis.

The Host Genetic Diversity in Malaria Infection

The severity of the disease caused by the parasite *P. falciparum* is partly dependent on host genetic factors and to a large extent on the efficient immuno-evasive mechanisms of the parasite. The spread of the disease can be controlled by disrupting certain activities like cytoadhesion and resetting promoted by the parasite-derived proteins expressed

on the pRBC surface. Identification of the proteins involved in these events is fruitful in the development of anti-severe malaria interventions. For therapeutic interventions, several sophisticated methods such as genome sequences, bioinformatic tools, and high-throughput technologies are utilized. This provides an integrated picture of the genome and the expression profiles at different stages of the parasite life cycle of *Plasmodium*. Major genetic alterations in the human host which are associated with the clinical spectrum of malaria infection and disease development have been studied. It is important that for developing new strategies to prevent malaria and/or for the host genetic treatment, better understanding of the genetic alterations and an immune response is required.

Genetic Regulation of CD14 in Malaria Patients

Host genetic factors account for one-quarter of the total variability in malaria infection and severity. In the present study, the whole genome approach was used to study specific perturbation of expression of the gene in the peripheral blood mononuclear cells (PBMC) of *P. falciparum*-infected malaria patients during the most severe phase of infection. This was done by using *P. vivax* infection as an important comparison group. CD14 is the most likely participating factor which marks the difference in the PBMC gene between *P. falciparum* and *P. vivax* infections, the microarray data were subjected to appropriate statistical analysis and functional annotation. To detect the possible molecular cause of transcriptional deregulation and its possible genetic connection, several experiments were conducted. A combination of genomic, molecular, genetic, and bioinformatic tools and their approaches were used in a logical progression for the identification and characterization of the key participating principles of host immune regulation in *P. falciparum* malaria. This often produces severe clinical outcomes. In addition, this study also provides a preliminary indication regarding how the host genetic constitution modulates the efficacy of artemisinin. CD14 gene promoter genotype modulates the clinical prognosis of malaria patients. 'A genetic association of CD14 promoter polymorphism, rs5744454 with *P. falciparum* mediated malaria severity has been deduced.'

Conclusion

Hence, it can be concluded that many essential biological pathways were altered in *P. falciparum* malaria infection which immune response and inflammation being the most highly affected function. Toll-like receptor (TLR) signaling pathway was observed to be most deregulated in the immune and inflammatory functions of hosts. A crucial gene named CD14 which is an essential inflammatory marker of the TLR pathway reflected maximum consistent deregulations

as compared to other genes in *P. falciparum* malaria. Additionally, interesting genetic polymorphisms were identified in its promoter region which showed a significant variation between mild and severe *P. falciparum* patients. Eventually, a difference in the gene expression level of CD14 was also observed which varied with the type of nucleotide constitution in the polymorphic site.

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Magic Berry

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Did the title spark your curiosity? Did it make you think, what could be so magical?

Allow me to introduce you to *Synsepalum dulcificum*, often known as the miracle berry or the magic berry, found in portions of West Africa. This berry has the ability to change sour-tasting foods into sweet tasting ones. Locals have been aware of this property and have used it to enhance the taste of sour maize bread. However, back then the characteristics of these berries were unclear to them. Later, researchers from Japan and France discovered that this fruit contains a substance called Miraculin, which is a homodimer of a glycoprotein, each consisting of 191 amino acids and 24.6 kDa by molecular weight. Depending on the pH, miraculin acts as both an antagonist and an agonist. Studies on the action of miraculin led to a hypothetical paradigm in which miraculin binds to the sweet taste receptor (a heterodimer composed of T1R2-T1R3) but remains inactive, due to the neutral pH within the taste buds of the tongue epithelium's plasma membrane. However, a change in the conformation of miraculin in the presence of protons, caused by the consumption of acid-containing foods, leads to a change in the conformation of sweet taste receptors as the histidine residues become protonated. This allows the binding of carbohydrate portions of miraculin to the receptor. The binding of these ligands activates the G-protein coupled receptors (GPCR), resulting in the perception of a sweet taste.

Individuals consuming too much sugar can end up with serious health issues like diabetes or obesity. Though serious health issues can be avoided by using sweeteners as substitutes, unpleasant side effects cannot. Hence, the search for alternatives is imperative. Studies on the miracle berry reported that this fruit has low-calorie content along with many health benefits.

Several factors have impeded the widespread use of this fruit such as its heat sensitive nature. Miraculin has been seen to lose its taste-modifying properties when heated over 100oC. Also, it is difficult to cultivate the miracle berries in a natural environment. Furthermore, the use of expensive storage

methods and the high demand for low production volumes contribute to increased costs. Research is underway to find alternative ways to produce miraculin at a lower cost, including the production of transgenic plants with miraculin.

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Brain Cells at Play!

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Brain cells playing video games – this may seem very Sci-Fi but this is something that has come up in the journal Neuron of the company Cortical Labs. They claim to have fabricated the first "sentient"
[In Latin 'sentient' means feeling] in-vitro grown 'mini-brain' in a Petri dish – hence they termed it DishBrain. DishBrain is an in vitro conglomeration of neural cells taken from humans and rodents which are further integrated with in silico computing across a high-density multielectrode array. By means of electrophysiological stimulation and recording, cultures are conceptualized in a simulated game world, mimicking the 1972 arcade-like game "Pong." In response to being subjected to a stimulated niche, the cells generated electrical activity of their own manifesting it further by expending less energy as the game continued, consecutively as the ball passed a certain paddle thereby restarting the game with the ball, now at a new random point, they expended manifold measures of energy trying to calibrate the new situation. DishBrain often missed the ball, but the success rate confirms that it is not a mere chance of probability.

DishBrain, a sentient system of 800,000 neural cells on a dish, under observation has apparently learned to play the game without being taught, so it is taken to be more flexible and adaptable. However, the entire event has been carried out by the cells with no consciousness as a human brain would, but it is claimed that it has responded in a way a human brain usually does. The scientific venture trained a considerate mass of connected human neural cells to react to the stimulations in the game or simply to what we say - playing a game.
The mass coined as a cyborg by the inventors was a result of placing stem cells of humans on the zeal of a micro-electric array, where they proliferated into brain cells. In their in vitro niche, the neural cells can both stimulate other neural cells and demark the activity or responses of others around them. Electrical signals are conveyed to the signal cue to guide them to the location of the ball. For example, if electrodes are to the left of a cluster fire, the neural cells on the petri dish know that the ball is to their right wing. The displacement of the signal cue

gives the neural cell the information regarding frequency. In the actual Pong game, the paddle is only capable of swaying left and right, and in line with the indigenous game, the specific goal is to move the paddle into the path of the ball.
The cyborg was trained to play the game in a similar fashion as humans are taught something—by playing the game a number of times to learn how to move the paddle in ways that result in the achievement of the goal. In this particular case of DishBrain, it was constructive feedback in the form of electronic signal cues in the electrodes.

The entire concept is aimed at opening new doors in the field of synthetic biological intelligence. The neural cell culture demonstrates the ability to undergo self-organization in a target-oriented manner in response to exiguous sensory signalling cues pivoting around the consequences of their actions, which we call synthetic biological intelligence – in simple words, it is competent to take in information from an external source, process it and formulate a response in real-time.

The model is aimed at studying the response of treatment procedures for neurodegenerative diseases such as Alzheimer's. The researchers plan to study the impact of alcohol on the efficiency of the DishBrain to play pong because the model is not merely aimed at looking for the presence of activity but to understand the ability of neural cells to process information. However, exploring the true functions of the 'mini-brain' will only highlight its prospects in the research field.

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Xenobots: A Cryptic Confluence of Organisms and Robot

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Introduction

What if we merge the current developments that have been made in the fields of molecular biology and artificial intelligence? – the lovechild of such a marriage would be a Xenobot. During the pandemic year 2020, researchers at Tufts University, the University of Vermont and Wyss Institute for Biologically Inspired Engineering at Harvard University successfully developed the first living robot! Yes, the Xenobots are entirely made up of organic cellular material. They can move, work together in swarms aggregating scattered debris in Petri dish into neat piles, self-heal, reproduce and survive for a specific time period without food. However, their bodies' configuration and locomotion styles are designed by evolutionary algorithms on a supercomputer using Artificial Intelligence. The first xenobot was built by Douglas Blackiston according to blueprints generated by an AI programme developed by Sam Kriegman.

Role of Biology:

Researchers took skin and heart muscle cells from stem cells harvested from the blastula stage of *Xenopus laevis* (African clawed frog) to obtain a functional structure with locomotive capabilities. These cells were incubated in a medium and adhered to form blobs composed of 2000 – 3000 cells. AI-aided supercomputers specified designs-based on which the forceps cut the cells and then joined them manually under a microscope according to the design. After being assembled into novel body forms, the cells began to work together. Thus, skin cells that tend to naturally bond and provide rigid support form passive architecture. In contrast, random contractions of heart muscle cells (act as small motors) created ordered forward motion allowing robots to move independently in a coherent fashion and explore their watery environment powered by embryonic energy stores.

Role of Artificial Intelligence:

AI team headed by Kriegman used an evolutionary algorithm to generate several candidate designs for the new life forms. VoxCad programme creates a virtual environment with real-life physics simulations (like

gravity, friction, surface tension, and liquid physics). Here small cubes called boxes represent the cells of a digital xenobot. Scientists started working with passive (skin) and contractile (cardiac) cells. The digital cubes were combined randomly by AI, and algorithmically, a digital xenobot evolved, creating iterations until it displayed desired behaviour. The first design of the xenobot was a little blob with leg-like appendages to scramble forward. When transferred into life, the designs created spheroid shapes that were less efficient. So, the computer suggested a C – shape (as in Pac-Man), which is highly efficient at corralling into heaps.

Emergent Behaviour:

Xenobots push particles by chance unless instructed otherwise by a programme, spontaneously creating an organized pile unless it becomes too large for them to push! The clue of this uncoordinated, random yet useful behaviour comes from the study of sensor less robots of 1999, which had a scoop in the front designed to move around and create piles. Similarly, xenobots can propel themselves, move in straight lines or circles, pile debris, and even flip back when turned upside down.

Kinematic Self Replication:

Xenobots have dubbed kinematic self-replication, which means reproducing by moving and compressing dissociated parts in the environment. Pac-Man-shaped (C-shaped) xenobots, when placed in a medium with desired stem cells of the frog, efficiently push loose stem cells into piles and assemble baby xenobots inside their C-shaped mouth.

About five days later, they become new xenobots like their parents and then undergo the same process to build copies of themselves. However, off-springs do not take on the C-shaped body type of parent generation but revert to a less efficient original spheroid shape.

Self Healing:

Xenobots can heal their wounds, restore their shape, and continue to work as before, as their building blocks are living cells from genetically unmodified frog embryos.

Metabolism:

The cells of a xenobot absorb and disintegrate chemicals working like tiny factories synthesizing and excreting proteins and chemicals. They survive at most ten days on embryonic energy stores and work without external energy sources. They survive for many months if kept in a soup of nutrients.

Potential Applications:

1. REDUCING WATER POLLUTION:

In the future, xenobots might be able to find and aggregate microplastics in the ocean into large spheres of plastic and bring them to a recycling centre. Compared to traditional technologies, xenobots do not cause pollution while working as they are biodegradable and use energy from fat and protein stored

in their tissues that can last for about a week. After about a week, they turn into dead skin cells.

2. MEDICAL SCIENCE:

Scientists may develop xenobots to detect and fight cancer or to use in targeted drug delivery (as anticloggers). It is because xenobots made from a human patient's cells can bypass the immune response challenges of other micro-robotic delivery systems when inserted into the patient's body. Xenobots can also be programmed to pick up and move specific cell types needed for regenerative medicines and aggregate cells from a body to regrow damaged tissues.

Xenobots 2.0:

Compared to Xenobots 1.0 (millimetre-sized automatons constructed in a "top-down" approach), the next version, Xenobots 2.0, adopts a "bottom-up" approach. Additionally, they produce cilia enabling rapid locomotion and recordable memory to store information (using fluorescent reporter protein EosFP) which can be used in future for detection and recording the presence of radioactive contamination, chemical pollutants, drugs, or disease. They are quicker, more efficient, have longer life spans and have better self-healing abilities.

Final Word:

Xenobots is a novel creation that has established a connection between genome hardware and cellular communications software. It made us redefine how we categorize living and non-living things. The plasticity of living cells freed from their evolutionary fate can make cells capable of performing various astounding things independently.

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Archaeogenetics – The Study of Ancient DNA

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All of us have wondered, at some point, about our ancestors and what characteristics we might have inherited from them. Numerous people have shown great interest and curiosity to find the differences between modern and ancient populations. Furthermore, this led us to decipher the link between modern humans and between humans and extinct hominin species such as - Neanderthals and the Denisovans.

Ancient DNA or aDNA genomics has helped us achieve this. This field of study can be applied to animals, plants, and humans through fossil extraction, preservation, analysis, and DNA sequencing. Recent studies have emphasized the demographic history obtained from exploring aDNA. Ancient DNA has also aided researchers in studying and understanding historical pandemics, phylogenetic studies, and epigenetic changes.

The first epigenetic study was done on a 4000-year-old Palaeo Eskimo, which showed a methylation pattern of the hair identical to humans today. Epigenetic changes affect various biological diseases, cancer in particular, and aging. If we can understand the pattern and study the cause of diseases arising due to such mutations, we might even add to their treatment.

The past decade has observed development in the field of aDNA genomics using the human remains excavated by archaeologists. Still, most studies have focused on mitochondrial DNA due to its abundance. Thus, making the data analysis and its retrieval effortless. Due to its unstable nature, no one has yet been able to retrieve RNA.

We can not only elucidate broad relationship patterns among populations but also comprehensively answer historical questions relevant to archaeology and palaeoanthropology.

Methods of studying ancient DNA:

1. Preservation of the fossilized DNA: The process begins with identifying a potential site from which the fossils can be excavated. Tools and technology used for this are - knives, brushes, trowels, gloves, portable X-ray fluorescence, and dense stereo reconstruction.
2. The bones extracted are ground into a fine powder; sometimes,

the DNA is also drawn out from preserved skin samples.

3. There is a very high chance of contamination as the soil contains several bacteria and fungi.
4. When the newly obtained sample is preserved and stored, its genetic material gets degraded. The temperature of the site, pH, sudden changes in environmental conditions, and chemical degradation are some factors that cause rapid DNA degradation.
5. Extraction: The method usually used here is silica-based DNA extraction followed by PCR (polymerase chain reaction) amplification of the sample. Due to contamination, researchers often find bacterial DNA along with the desired DNA. Sometimes compounds that may inhibit replication are also bound. Thus, precautions are taken to diminish such challenges.
6. After grinding the bone sample into a powder, an extraction solution is added. The released DNA is added to silica solution, which binds to the DNA, and the other unwanted particles are separated by centrifugation. A buffer solution is added to remove the silica, which is a PCR- inhibitor. Although the silica extraction method can only be implemented on bone and teeth and not on soft tissues, it is a quick and efficient way of extracting genetic material. The extracted DNA is amplified using PCR.
7. Methods of analysis: massively parallel sequencing is utilized to amplify and sequence the sample simultaneously. Non-specific primers are allowed to bind to the DNA, which is sequenced. The most common software used to identify the fossil and to compare the obtained DNA to already known sequences is BLASTN. Another method of identification is by using specific genetic markers. DNA hybridization can also establish a relationship between two samples by complementary pair bonding.

Archaeogenetic studies can be applied to the humans' domestication of plants and animals. With the help of NGS- next-generation sequencing methodologies, DNA sequences can be retrieved from the sample securely and cost-effectively. Researchers can trace the history of the domestication of animals and also get clues about human genome relationships.

The Nobel Prize for Medicine of the year 2022 has been awarded to Swedish geneticist Svante Pääbo for his pioneering contribution to the field of archaeogenetic studies of extinct hominins and human evolution.

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Microbots in drug delivery - How Fictitious?

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In recent times, the evaluation of nanoparticles and nanotubes in safe and specific drug delivery has been intense in the medical field, however, conventionally these nanoparticles are made up of carbon or gold, both of which are toxic to the human system. Nanoparticle drug delivery may seem to be a familiar term now because the covid vaccines developed by Pfizer and Moderna are packaged in nanoparticles, and the entire scenario has been a talked about topic. The manifold increase in efficacy of a drug when specifically administered in targeted cells is the driving point for researchers to bring out more possible ways for specific drug delivery and that is where the idea of fiction-like heroic microbots delivering drugs has emerged. Moving forward to the very recent advancements in targeted drug delivery-

- A publication from September 22nd, 2022, in Nature Materials by Zhang et al. from the University of California San Diego, has brought to light the use of a conglomerate of naturally occurring microalgae and antibiotic encumbered polymeric nanoparticle encapsulated with the membrane of the phagocytic cell - neutrophil, thus bringing to existence hybrid microbots for effectual dissemination of drugs in vivo. This cognition is at the proof-of-concept stage. The team has demonstrated this by treating mice which are experimentally infected by *Pseudomonas aeruginosa*, the causative agent of a fatal form of pneumonia that hurries patients into the Intensive Care Unit seeking Mechanical Ventilation. As the results turned out, on inoculating the microbots into the lungs of the infected mice, the microbots administered to infected mice showed clearance of symptoms within a week and survived in health past thirty days, however, the non-treated ones succumbed to death over the course of three days. This process shows better efficacy than Intravenous Therapy (IV) of antibiotics which involves dissipation of the drug throughout the bloodstream and also no substance, toxic or not, is left behind, all of it is sequestered by the body's potent immune

system.

- In another proof-of-concept study by Xin et.al that was first published in ACS-Nano on 19th October 2021. It was perceived that they were able to prepare shape morphing microbots- a classical demonstration of biomimetic robots, that can precisely deliver chemotherapeutic drugs to cancer cells without causing any adverse side effects, which are normally associated with conventional methods. For example, a fish-shaped microbot that is 4D printed using a pH-responsive hydrogel and immersed in a suspension having iron oxide nanoparticles has an adjustable 'mouth' that can open and close in response to changes in pH. This 'fish' can also be steered using magnets through simulated blood vessels to reach cancer cells in a petri dish. On lowering the pH of the surrounding medium, the fish opens its mouth and releases a drug that can kill cancer cells nearby. Although the experiments with this biomimetic robot have been successful and very promising in vitro, for in vivo experiments the microbots need to be even smaller in size allowing them to navigate through blood vessels and a suitable imaging method needs to be recognized in order to track their precise movements in the body.

- Scientists at the Massachusetts Institute of Technology have invented a robotic pill that can successfully cross through the mucus barrier of the gastrointestinal tract and deliver drugs that are usually very difficult to administer orally. This "RoboCap" capsule carries its drug load at one end and has tunnelling features at the other end. On oral consumption, this capsule travels to the alimentary canal where its gelatin cover dissolves upon encountering a specific pH. This change in pH also triggers a tiny motor inside the RoboCap to start spinning which helps the capsule to pass through the mucus barrier and displace it. It has small studs that 'brush' the mucus away. Once the drug is dispersed locally, the capsule passes through the digestive tract on its own, without causing any inflammation or irritation. It has been experimentally observed that we can deliver drugs like vancomycin and insulin easily this way. This revolutionary research was led by Shriya S. Srinivasan et.al and published on the 28th September, 2022.

These tantalising recent research works give us a taste of the advancements in biotechnological fields and related interdisciplinary fields imploring the boundaries in the fields of target drug delivery which increase overall efficacy, and minimal usage in a non-invasive highly penetrative drug delivery method. These methods need

more dedicated research to make these processes validated to scale up in larger animals and eventually in humans. These researches are stepping stones for the transformation of the death sentence giving diseases like cancer into livable chronic diseases with a high quality of life, as these conceptual approaches can potentially eliminate the concerning side effects which come intermingled with life-saving drugs.

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Art of Aquascaping

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Aquarium keeping is the second largest hobby in the world, after photography and the ornamental fish and aquatic plant industry is gaining importance due to its tremendous economic opportunities and prospects. This fascinating venture attracted me a few years ago, when the world was just going to witness the harsh effects of the COVID-19 pandemic. I never wanted to be involved in a start-up but as a hobbyist I definitely wanted to give it a try. Since then, I have been involved in Aquascaping. In recent years, the term Aquascaping has become better known to aquarists all over the world. Aquascaping has become a valued art. Aquascaping is the craft of arranging aquatic plants, as well as rocks, stones, cave work, or driftwood, in an aesthetically pleasing manner within an aquarium—in effect, gardening under water.

One of the best and quickest ways to do this is- "gardening in a fish tank". There are different styles of aquascaping such as Dutch style, Japanese style, Natural style, Iwagumi style, Jungle style, Biotype style and Paludarium. Although the primary aim of the process is to create an artistic water landscape, the technical aspects are also important. These include the substrate, quality of water, plants, fish and aquascape ornaments as well as proper maintenance of the environment. In the closed system of an aquarium tank many factors need to be balanced to ensure the success of the aquascape. I started my hobby in a 1.5 feet aquarium. I think that the substrate is the most vital thing when starting. The soil I used was Amazonia black fertilized substrate, which contained potassium, iron and essential bacteria to enhance the growth of aquatic plants. This was not enough as it was only a single layer of substrate. So, to enhance the beauty I used white sand as top soil. It is important that the substrate is of high quality. It will not only last longer but also supplement the essential nutrients to the plants for their proper growth and development. Superior quality substrates last throughout the life of an aquarium. There are different types of substrates used in the process, such as gravel and sand, crushed coral, limestone and marble, Peat, laterite and Soil. Among these

the most commonly used organic substrates include gravel and sand, as they imitate the natural conditions. The backbone of the aquarium is the hardscape. For hardscape I preferably use driftwood as it lowers the pH level of water and adds essential minerals to it. While selecting rocks, it is essential to confirm that it does not react with water. Cleaning and washing them properly before introducing them into the tank and getting rid of chemicals is also necessary. In spite of washing, some rocks still release tannins into the aquarium by leaching. Although tannins are not damaging to fish or plants, they might disturb the aesthetic of the aquarium. Driftwood makes a great choice as it replicates the natural sea ambience perfectly.

For plants, I used a lot of variety. For the background I used *Ludwigia atlantis*- (a plant with red leaves and stem) and *Cabomba aquatica*. On the driftwood I used Java moss and Chris moss which I attached with soft silk thread. Then for the foreground I used *Eleocharis parvula* (hair grass) which gave the aquarium a vibrant and natural look. Java fern and *Anubias nana* on the rocks and on the holes of the driftwood gave it a complete look - of the jungles of Amazon or the wild grasslands of Africa.

Most importantly, I cycled the tank for at least two weeks before releasing fish. It was a very crucial step for the activity of beneficial bacteria to break down the nitrates and phosphates which are harmful for the fish. It is a natural process and all we need to do is leave the aquarium as it is, with proper filtration and at least eight hours of sufficient light. Aquascaping is incomplete without a proper filtration system (both mechanical and biological) and a proper lighting system. Low light could lead to algal and fungal infestations.]I used liquid carbon, potassium and iron. These helped in vigorous levels of growth and colouration of the plants.

Fish are the heart and soul of an aquarium. Without fish, the entire setup will merely look like a tank of water. So, I decided to release a bunch of *Neon Tetras*, some colourful shrimps and two apple snails. These snails and shrimps did a great job in cleaning the algae from the glass and wastes from the substrate.

An aquascaped aquarium needs minimal maintenance. In my aquarium, once a month, I change the water by only fifty percent. Some scrubbing of aquarium glasses, cleaning the filter and trimming the plants (if needed) was more than enough for my fish and their ecosystem.

It can be concluded that aquascaping is gaining importance in the current scenario of urbanization as it mitigates the negative effects of modern cities on health. Aquascaping is one of the novel landscape concepts that is used to improve aesthetic view of the surroundings and also relieve stress. I personally enjoy this hobby and also encourage others to take it up. An aquascape is a combined effort- the result of appropriate selection of plants, fish

and other components in an aesthetic manner. Therefore, incorporating an aquascape ecosystem with land scape components also helps in making it more vibrant.

The Wonders of the underwater world. Clicked on 26.08.2022.

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QUIZ

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Can you seal the gaps by filling them up?

1. _____ _____ was the first woman to be granted a PhD by an Indian University. Her notable works include research on medicinal plants and vinca alkaloids.

2. Initially codenamed 6LL3, _____ was the first animal cloned from adult mammalian cells.

3. _____ _____ was the first woman to win an unshared Nobel Prize for Physiology or Medicine.

4. Commonly known as _____, it acts as a stimulant of the central nervous system and an antagonist to adenosine (which induces sleepiness in human beings).

5. The first successful heart transplant was performed by the South African cardiac surgeon _____ _____.

6. _____ is the largest protein in human beings. It is found in filaments of striated muscles.

7. Using *E. coli* mutants, _____ _____ proved that DNA polymerase I was not the major replicating enzyme in *E. coli.*

8. The enzyme _____ functions to protect the ends of DNA molecules after each round of replication.

9. The currently accepted biological definition of species was given by the German-American evolutionary biologist _____ _____.

10. _____ _____ was the first genetically modified food that was approved for human consumption by the FDA.

ANSWERS

1. Dr. Asima Chatterjee
2. Dolly the sheep
3. Dr. Barbara McClintock
4. Caffeine
5. Dr. Christiaan N. Barnard
6. Titin
7. Dr. Arthur Kornberg
8. Telomerase
9. Dr. Ernst Mayr
10. Flavr Savr

LITERARY ARTICLES

Dr. Chandana Barat, has requested the ardent readers of Chiasma to feel the languid ease of the free verse of Walt Whitman in the poem below:

When I Heard the Learn'd Astronomer

- Walt Whitman

When I heard the learn'd astronomer,
When the proofs, the figures, were ranged in columns before me,
When I was shown the charts and diagrams, to add, divide, and measure them,
When I sitting heard the astronomer where he lectured with much applause in the lecture-room,
How soon unaccountable I became tired and sick,
Till rising and gliding out I wander'd off by myself,
In the mystical moist night-air, and from time to time,
Look'd up in perfect silence at the stars."

Along with this she also wishes to excite the readers conscious self with this excellent piece from Anais Nin, in which the author attempts to forge a connecting synapse between the disturbed mind and our daily surroundings:

"Some never awaken. They are like the people who go to sleep in the snow and never awaken. But I am not in danger because my home, my garden, my beautiful life do not lull me. I am aware of being in a beautiful prison, from which I can only escape by writing."

Happy Reading Folks !

The Strange Case of Colonel Shy

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The year was 1864. After losing battle after battle to the North, the fate of the Confederacy lay in the hands of General John Hood, the leader of the Army of Tennessee. His mission was to regain control of Middle Tennessee. The General was both physically beaten and emotionally shattered at this point. Similar was the condition of the Army.

Despite these obstacles, by December 1864, the Army of Tennessee had battled its way to Nashville, and the campaign's success or failure depended on Gen. Hood's capacity to hold onto the hills south of the capital.

On December 15, 1864, the first day of combat in the Battle of Nashville, the Confederates were able to regain control of Compton's Hill. On December 16th, when the Union attacked, the defence offered by the rebels was weak. Compton's Hill was surrounded on three sides by Union troops. William Shy, the 20th Tennessee Infantry Regiment's commander at the time, resisted the Federal invasion by holding onto Compton's Hill despite bombardment of Federal fire. After a few minutes of ferocious combat, the Federals crushed Shy's army. Shy died from a close-range shot to the head at 26.

Shy was soon declared a Confederate Civil War hero and laid to rest at his family cemetery in Franklin, Tennessee.

Over a hundred years later, on the morning of Christmas Eve, 1977; a frantic phone call was made to the Franklin Police Department.

A woman cried, "A grave has been vandalised in our family cemetery. Who could possibly do something like this?"

When 2 officers reached the scene of the crime, they quickly realised that this was more than just a grave vandalism.

It was the grave of Colonel William Shy.

Officer Fleming called out to his partner, "Hey, you should come see this!"

Officer Earp's eyes widened as he tried to contemplate what was going on.

In front of him, lay a headless man on the casket of Colonel Shy. The body was showing signs of advanced decomposition.

Officer Earp exclaimed, "Looks like someone has placed a murdered man in this burial plot!"

Investigations started but there were no clues or leads. Too many questions were forming in the minds of the investigating officers, but they were no answers.

Who could the dead man be? Why was he murdered? Why was he left on the grave of Colonel Shy? What happened to Colonel Shy's body? Is there some hidden sinister motive?

The decapitated corpse was unrelated to any reports of missing persons the local authorities had on file. Wild rumours abounded; some said that the head may have been removed to prevent the corpse from being identified, while some others said the robbers came looking for hidden treasure.

Months went by, but every possible lead ultimately led to a dead end.

A newspaper headline at that time read, "Williamson County authorities investigating the tampering of a Civil War soldier's grave discovered that a second body had been placed in the grave probably within the last year. The body is an adult male, clad in what appeared to be a tuxedo."

Finally, the officers decided to call Dr. Bill Bass, Anthropologist and Head of the Anthropology Department, University of Tennessee, Knoxville for his help.

On-site, Dr. Bass performed a preliminary assessment of the body.

Although it was partially disarticulated and in an advanced state of decay, many of the joints and parts of the surviving flesh were still in good condition. With the exception of the skull, feet, and one hand, other remains could be recovered.

After closely examining the body, Dr Bass concluded, "The body is of a white male in his mid-twenties with a height between 5'9" and 6'. There is no obvious indication of the cause of death. But he has been killed within 2-6 months."

As to his presence in another man's grave, the team postulated that the grave robbers had opened the grave to remove any valuable grave goods they could find, and were in the process of secreting a body when they were interrupted and fled.

But some strange facts came to surface. Although the dead body looked new, the clothes he was wearing were a century old.

Re-examination of the burial site started. On closer examination, a broken skull was discovered inside the coffin. It looked that the grave robbers' attempt to cram the body into the coffin, had been interrupted and as a result, the head was dislodged. The cause of death was no longer a mystery because the skull had been broken into seventeen pieces by a massive gunshot.

Dr. Bass was beginning to suspect that the body was of William Shy. The gunshot wound and old clothes

were definitely indicating that. But how could a body that appeared to be less than a year dead be that of a fallen soldier, nearly 113 years in the grave?

By looking into the portraits of William Shy, it was proved that the tuxedo was definitely his. Further research done by Dr Bass concluded that Colonel Shy's body had been embalmed. The coffin was also fashioned of cast iron, which was so strong that it kept out not only the moisture from the body but also the oxygen and insect life that would have accelerated decomposition. The error was a turning point in Dr. Bass' career.

Even after working as a forensic scientist for more than 20 years, neither he nor any other expert in the area had sufficient knowledge of human decomposition to determine the exact amount of time since death.

He decided right there and then to fill that information gap.

Thus, what appeared to be such a twisted case, ultimately turned out to be a case of grave robbing. It was concluded that grave robbers dug Bass up to steal his valuables. While reburying him, they left the coffin open starting the decomposition process.

As of 2022, the robbers have not been apprehended yet.

World War N

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It is the year 5072, the Earth has seen significant alteration during this time. The sky, always blood crimson during the day and dusky at night. As far as the eye can see, everything is made of metal and concrete, and there are no other animals to be seen, except for the Homo sapiens. The circumstance does not disturb humans in the least. They are preoccupied with their own affairs.

There are still animals on the globe. They exist, but are only found in two locations; one half is in a region of Antarctica that has some vegetation due to weather changes, while the other half is in Greenland. These creatures were transferred there and cut off from the outside world. They can adapt to any environment, thanks to evolution, and they have developed a wide range of abilities. They are now larger, capable of thought, and interspecies communication. They don't like how things are right now.

One day, a bunch of snakes led by Kaa, the Python began debating taking over the planet and eliminating humans. Everyone supports the idea, but there is a problem with carrying it through; they will need the assistance of the animal kingdom of Greenland. Since Greenland is so far away, they decided to send Viking, the Eagle to deliver the plan's message. Viking can fly with incredible strength and speed for 30 hours straight.

To get to the realm of Greenland, Viking travels through continents and oceans. Some human folks are surprised when they see it.

Dr. Robert Stevenson, a scientist also observes this and said that "Something is gonna happen."

The proposition of the plan was made when Viking arrived at the kingdom. The emperor, Eddie, an elephant, initially objected. The Viking's eloquence moved Eddie, who agreed.

Their strategy calls for the Greenland kingdom to come through Elsmere Island in Canada and the Antarctica kingdom to invade through Chile. They will ruin the world of humans. They decided to get together on Kodiak Island to continue their invasion.

On the day of the invasion, the animals proceeded as planned. Nobody could predict what is going to happen in the next few hours. Animals began wreaking havoc as

soon as they reach the surface of the earth. Diseases are bred by bacteria and viruses.

Dr. Robert came to know about the situation. He notes that his forecast came true. Many people pass away, leaving their bodies lying on the streets. Along with other researchers from around the world, Dr. Robert and Daniel Richardson began to look for a cure for the illness and a way to put animals into a coma. The scientists were killed after being captured by tigers. Daniel and Dr. Robert manage to flee and find refuge in their underground headquarters. While their research is ongoing, animals are using human skin as carpet and nails as ornaments, exactly the way humans exploited them earlier. Ruthless animals destroyed every big city. Destruction surrounded the world with an eerie silence.

Dr. Robert and Daniel produced the antidote and the device effectively after six months of research. The sickness was stopped after the antidote was sprayed all over the earth. They soon issued a warning that all animals must surrender or they will all be put to death. The beasts didn't care about the warning calls and advanced while mowing down and destroying everything in their path. The coma-inducing gadget that has been developed is launched on the animals, and they fall asleep.

Both teams' post-apocalyptic scenario was far too perilous and terrifying. Eddie is terrified after witnessing so many fatalities and wishes the battle would end. Kaa uttered, "Do you not recall how they snatched our lives, imprisoned us, and destroyed our homes?" He said, "The conflict should continue until they surrender and we control the planet."

Eddie said "The two species were at fault for this World War in nature. For peace and harmony, we must halt and cede." The majority of animals believed they should give up, but Kaa disagreed. The animals disregarded Kaa despite his best efforts to pursue it. They trampled the snakes aside.

The next morning, the animals marched together. The scientists were astounded by this scene. The scientists were prepared for the worst but were not hostile.

Eddie broke the silence "We both made a mistake. We both thought to be a queen, happy so long as she is being served. We both are dependent on each other. We should focus on making this world ours, rather than mine or yours. We are prepared to surrender if you assure us that you won't hurt us."

Dr. Robert gave commands the army to disarm. Both teams approached each other and decided to be in peace and harmony with each other.

Animals and humans now communicate more effectively and as a result, nature recovered. Now, they are working toward a world that is harmonious and peaceful, with a balanced ecosystem. The sky is once again blue and the world

has turned green. The world will be perfect if this continues without creating any imbalances or damaging the environment. Animals are now returned to their natural habitats rather than being murdered. Human activities continue, but they do not harm the environment, wildlife, vegetation, or fauna. Everyone is interested in preserving wildlife because they have recognized its value.

First Day

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Why did it suddenly feel so suffocating?

Vikram turned on the air conditioner in the car and looked down at his trembling hands controlling the steering. He had to struggle to keep his feet working. If he didn't stop shaking soon enough it was going to be a nightmare.

"Papa", Rohini's timid voice startled him. "I don't want to go to school. I want to be with you".

Vikram looked at Rohini sitting beside him in her new uniform, staring at him with her hazel eyes. She was holding her school bag so tightly. He remembered how long he had taken to iron out her new uniform, minutely checking every fold for creases, how he had struggled to tie her hair in a ponytail and feed her at the same time, how exhilarating he had felt when she wore her little black school shoes that morning. Vikram took a deep breath. This was going to be way more difficult than he had imagined.

"Rohini, I will always be here for you. I just won't sit beside you at your desk."

Rohini was not convinced. "But, Papa, if you don't sit with me, how will I know you're there?"

This was going to be hard for Rohini, but it was important.

"I will be with you the same way Mumma is with us, beta."

Kriti was always the responsible one. She was kind, brave and always took care of everything. They had been married in a community hall and Kriti had prepared food for the kids of the orphanage she worked at all by herself. Vikram always told her that she ought to take some time out for herself as well but Kriti never listened. She was always there, ready to help, ready to do anything to see the people around her happy. They were so elated when Kriti had conceived Rohini. Every weekend Vikram would rent DVDs of old Bollywood movies and they would watch it together until Kriti got tired and slept with her head on Vikram's lap. Everything was so perfect until the doctor told them about the complications with her delivery.

Vikram remembered everything about the day Rohini was born like it happened yesterday. He remembered Kriti's water breaking, the wet clothes, the crowds in the

hospital, the commotion everywhere, the blood. He had felt so breathless when the doctor had told him that Kriti could not make it. It was as if something had torn into his skin and pulled everything out. He could not accept that he would be unable to hold Kriti in his arms any more, that he wouldn't be able to see her smile. Rohini had entered his life then. It was because of Rohini that he got up in the morning, took care of everything, and went to work. It was because of her that he came home happy. He lived for Rohini, for that one thread of his life that tied him to Kriti.

"You remember how I had told you that Mumma is with the stars?" He pointed towards the sky. "Well, Mumma is always watching us. She makes sure we wake up and brush on time every morning, have our meals and take bath and she makes sure that nothing bad happens to us, ever. In the same way, I will always be here, beta. Whenever you feel lost, all you need to do is close your eyes and remember that both of us are always there to support you and we will be there, right beside you."

Rohini smiled. "Promise?"

"Always", Vikram replied.

They had reached Rohini's school. Vikram parked, got out of the car and helped Rohini out. He knelt in front of her and held her.

"You will make so many friends today and I want to hear everything about them. The car will be parked right here and if you have any trouble finding it, go to that Security Guard Uncle over there and tell him your name, he will bring you to me, alright? Be good. I love you."

"I love you too, Papa", Rohini said and then touched Kriti's locket around her neck. "I love you, Mumma."

As she walked to the front gates, Vikram stood there, watching. He was going to stay there all day, waiting for the moment when he got to see his daughter again and make sure she was safe.

"Kriti", he murmured and smiled. "We made it to the first day of Rohini's school."

Hope

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The gentle smell of the morning mist filled my nose as I walked through the streets, exploring the paths even if I had memorized them by now. The air was chilly, as the auburn leaves swayed and danced on the trees. What a beautiful sight to behold! A squirrel dashed past my legs, jumping ahead, holding onto some pieces of nuts preciously. I stopped, I had some spare cashew nuts in my pocket, maybe another squirrel will come by and take it from me.

I waited as patiently as an elephant, for another squirrel to arrive. I had nowhere to be today. Or the next day for that matter. After all, it was Christmas morning, everyone was spending time with their family.

Instead of thinking about my impending loneliness, I just waited for the squirrel.

The clock ticked as minutes turned into hours, but to no avail. No-one came, not even a bird. I was greatly upset. Soon thoughts plagued me. The dark coat of loneliness, which I tried to shake off but it just would not budge! Maybe I was supposed to be alone. Even if its Christmas, just like the last five years, I will spend it alone, again.

The wind blew harshly, as my cheeks stung in the cold. The rosy-colored sky was slowly turning inky as the night fell around me. I started walking back home.

Dejected and with hot tears clouding my vision, I kept walking. Why did the walk feel like an eternity? Not even a single soul came to say anything. Had I turned invisible? I decided to buy myself a cake... maybe that could help pacify the deep longing for some kind of companion.

I opened the door to my one-roomed apartment - the place I have been calling home for a while. But it was not home, more like a place to live. Robotically, I warmed a cup of hot chocolate and cut a few pieces of cake. Even if my stomach churned at the thought of food.

I allowed myself to indulge in the dark and murky feeling of hollowness. The hot tears fell and they stung icily as they trailed down my cheeks. It was the only thing I could feel in those moments. I wanted to go back home. I wanted to have a place called home. Maybe I am an alien in this foreign country.

I should have listened to my mother and stayed at home. But now that's not an option anymore.

Ping! The hot chocolate was warmed now. I quickly finished the drink and food. The bed felt colder than normal and I tried to fall into an edgy sleep. As soon as my eyelids had closed, I could hear a soft sound amidst the quietness of the house. Who would be making noise at such an hour?

Quietly and cautiously, I walked towards the source of the sound. It was coming from outside the window. As I slowly opened the window, I could make a silhouette of something sitting there. And it was mewing louder now! It is surely a cat! But it was shaking and it sounds anguished. I cupped it close and brought it inside, where it was much warmer. I had noticed after I opened my window, that it was snowing.

The tiny cat was the color of the night- like obsidian. As I held it close, I felt like finally, that coat of loneliness was coming off.

I looked at the clock, it was one minute past twelve. For the first time in five years, I had not spent Christmas alone! The cat mewled again, her emerald eyes softly looking at me, as if saying, you are not alone anymore.

Maybe it was a new beginning. A new beginning that would finally mean the dark murky feeling would evaporate and ebb away.

The Night on the Street

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I took a quick glance at my wristwatch. 8pm. Although it wasn't very late, the street was almost deserted. People had already hurried their way back to the warmth of their homes. After all, it was a cold December night. A chilling gust of wind made me give my coat a hitch and dig my gloved hands into its pockets. There were only a few people on the street, faces unrecognizable under the dim streetlights. The trees by the side cast threatening, long shadows on the street, their branches eerily reaching out to me. Withered leaves covered the sidewalk, making crunching noises as I walked over them. I carelessly strutted down the street, whistling a random tune. I was in no hurry to get to my apartment. The heater was broken, so anyway it would be cold as death.

There were sounds of crunching leaves at some distance behind me, too frequent to be made by a walking person. I stopped and turned. A dog stood there, about 20 feet away. Its eyes seemed to be fixed on me, its black fur making it look menacing, devilish. It let out a low growl, followed by a loud bark. I took a step back and stopped again. The dog made no movements whatsoever. It stood there, looking at me intently. After a moment, I scoffed and turned to continue on my way.

I bumped into someone and landed on my back. I let out a grunt as I landed on the hard, cold pavement.

"I am so so sorry. Are you hurt?"

"What do you think, you-" I looked into a pair of brown eyes looking at me apologetically. The man offered me his gloved hand. I took it and stood up.

He was a handsome, young man, about my age and as tall as me, around 5'11"; I couldn't really tell the colour of his cardigan in the dark, I could tell it was dark coloured. I scoffed and brushed the leaves and dust off my clothes.

The dog still stood there, with that same, alarming glare. It snarled and let out another bark.

"Are you okay?" I turned and looked at the man.

"I'm fine. It's my fault really, I wasn't looking ahead. I'm sorry."

The man chuckled. "Well I wasn't either, so I guess we're even." He smiled at me. I smiled back.

"I'm Steven," he held out his right hand.

"David," I shook it.

"So I guess you're headed that way," Steven pointed ahead. I nodded. "Do you mind if I tag along?"

"Uh...,no."

I glanced over my shoulder. The dog was gone.

We walked quietly for a few minutes. The sound that could be heard was the moaning of the trees as the cold wind whistled through them. There was no one on the street now, apart from me, Steven and the dancing, creeping shadows of the trees and ourselves.

"I love the silence of the night, don't you?" Steven said out of nowhere.

"Yet you're the one to break it."

He chuckled.

No one talked. I shivered a bit from the cold. I took my hands out of my pockets and rubbed my palms together. I looked to my left. Steven walked quietly next to me, his head hung down, seemingly preoccupied with an intense piece of thought.

"I see now why you bump into people," I said jokingly. He looked up, startled, and laughed. He opened his mouth to say something, when a deafening howl tore through the silence of the night. We turned and saw the black dog, now a lot closer. The vicious canine looked dangerously at us, seeming ready to pounce anytime.

A hand fell on my shoulder. "Scared of dogs?" Steven asked.

"Uh, no," I said wryly. Steven put his arm around me and motioned me forward. I shifted uncomfortably under his touch, his arm was icy cold. We started walking again, while I could still sense the dog was behind us, following us like a hound after its prey, ready to rip it apart.

After a few more tense and cold minutes, I could see my building from around the corner of the street. The streetlight in front of the iron gate flickered. When we reached the front of the gate we stopped.

"Well, this is me," I said. I looked at my watch. 8:02 pm. Must have stopped. I looked up and gasped. There it was standing right in front of me, the big black dog. It let out a bark. I took a cautionary step back. I looked to my left to see Steven was gone.

The dog now ambled forward and whined. A few feet away from me, it stopped and sat down. I carefully took a step forward, slowly reached out and petted it. Its muscles seemed to relax under my touch. "Aww."

But where did Steven go? I petted the dog one last time and turned to enter the gate.

The next morning, I was rushing to get to work. But I stopped when I saw a small crowd gathered in front of the building. An ambulance was also there. I squeezed through to see what had happened. I saw the paramedics carrying a body into the ambulance. The gravel on the road

was blood-stained.

"Uh, Mrs.Hopper, what happened here?" I asked my landlady who was standing amidst the murmuring, sighing crowd.

"A guy was mauled by a rabid dog. Steven Hobbs. He lived down the street."

I gulped. I hurriedly squeezed myself out of the crowd and stood at some distance. I felt numb, but not from the cold. Suddenly, someone whispered into my ear from behind me.

"Still not scared of dogs?"

On Taking Care of Soft Things

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Softness isn't meant for everyday
It is thick skin, not silk,
That survives the daily grind

But while you put away the delicates,
There are tender occasions
To wear that lace,
And heart on your sleeve.

The wooden chest
Under lock and key,
Prevents wear and tear.

But stuffed away too long -
Everything will wither
Inside that chest of yours.

Spectrum

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Self-deprecating thoughts gulp the wings often,
Which butterfly has not even once, been restrained by hands of greed?
Colors are for us to keep, the dark is destined to rot,
Seldom do muggles envisage the greys.

Layered, filtered, and immaculate are opinions,
Thoughts are in schemes, rhythm, and sync.
Unfiltered is a social media fancy,
True raw reflections are disregarded in a blink.

Lust for power overpowers the being's reasoning,
Your reign today, hereafter your fragile self-conceit.
Venom is infused in every next bright flower's nectar,
Have butterflies stopped flying?

The wings are to fly,
The colours to be flaunted,
The greys to be grounded - the emblem of the realistic phases.
The spectrum has been broad since,
We are yet to acknowledge.

The World Today

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The world is shrouded by an inevitable circumstance,
Sufficient to cause reprehensible hindrance,
Truth is now blameworthy,
In a world which claims falsity-a victory.
In a controversy blending with the appropriate position of truth,
In a world where a duplicitous minister yearns to be a sleuth.
But the loyal guardian of truth
Is acknowledged to be the one lost in the medley of soot.
He remains without wealth and money and fame,
And this is how the fraudulent play the game,
In a world, where seeking truth and revitalizing a corpse are significantly same.
Helping others is a frivolous utopia,
In a world where help is coveted by many,
But unfortunately, the helped ones are
The first to acclimatize the spectacle of tyranny.
The ones who once remained lifeless,
When life was incorporated,
Without showing any responsibility and love selfless,
Are the ones first to have hated.
Using the help as a ladder,
They characterized affectionate bait,
To hunt the ones
Who helped them with customisable scatter

Impertinence is the constitution
Of their mindscape.
Richness is a quality transmogrified,
Into wealth and feature,
A classification of paradoxical sophistication,
Even in the insights of a preacher.
In the world cosmopolitan,
Administered by the spearheaded rich,
Success is only for them
Who have descended from the triumphant breach,
Of the arrogant rich,
Because they have chiromancy prominent,
Nevertheless
The poor along with the class labour,
Have to consider for them there is no saviour.
They cannot relish
Justice like the rich comfortably,
Because they do not have fingerprints embellished.
A satire in a form,
Has resulted in a typical status storm.
Cold and suppressed,
The labourers having themselves tossed,
With phlegmatic hearts stressed
On the extremities of the rich swarm sauced,
Unable to withstand the goodness dressed
By the people who caused,
Hypnotism and nepotism limits to have crossed.
Success only for the reserved,

Is the theory spontaneous,
However, the people who precisely deserved,
Are claimed to be erroneous.
The person who is the friend and philosopher,
And was considered your guide,
Was the one whom you first dismantled,
When the able you learnt the significance of the tide.
Dynamism is expected in every sphere,
However, every non-influential dynamic was reduced to tear,
In a world where personal opinion hardly matters,
The magnificent desires are first to shatter,
The eyes manipulated by a disguised figurine,
To influence others for the dishonest shrine,
Only the mendacious are always correct,
The honest are dishonoured in every perspective erect.
The infrastructure has withdrawn,
The monotheistic effect of many words running,
With effervescent transcendentalism undergone,
Elucidation is same for clever and cunning.
Non-violence is unacceptable,
Patience and preservation are non-quintessential,
Violence should be the fable,
Introduced in every curriculum and trial.
Interestingly enough,
The forefronts of violence and pioneers of aggression,
Are the ones to entourage when the situation is tough,
Around the constitution of protest for possession.
They cannot accustom to defence,

Because it is not that proud,
In an extraordinary association of human fence,
And the judgemental human crowd.
Consolidated with flaws and vices,
In the ebullioscopy chasm,
We live in a worthy world of morale traces,
This is the ultimate derogatory sarcasm.
The world is voracious,
With unsustainable sumptuousness,
We have accomplished it,
With a pessimistic essence of greatness.

Times New Calcutta

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Years passed by and here I come back-
Amidst the tall short buildings with cracks;
With their blue green windows and red brick walls
Reminds me of our history that stands tall,
Old and new cars running about the streets
Yet the yellow taxis never fail to screen out.
If the sun shines, it is too hot
And if it rains, then water gets logged;
Wide and narrow roads on all sides,
Hordes of people come by like tides
The buzzing ghats with ferries and fishermen
Get carried away by currents, time and time again.
Ganges and its serenity
Still embraces the old love ecstasy,
Coffee House carries on with its legacy
While College Street bears the musty aura exceptionally.

I return to the sacred hollow courtyard-
It was full of life once and now seems to be scarred;
Rings of laughter,
Drops of tears
Edges of tempers that had ebbed and flowed into the walls.
This house of mine stands vacant with old photographs covered in dust
While the desolate winds wrap me around like a shawl;

The wild rain enters and the sunset
Sighs in the chamber of loneliness.
These hallways stairways rooms and kitchens, bear the scents of life.
Today they might be just worn out bricks and mortar left behind,
But they witnessed the foundations of humankind.

Jagged edges made from moments;
One cannot be quite sure where they last.
Slicing memories open
Which were once healed,
As they attempt to slip right past.

If Not

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Who are you if not a moon lover?
Does the thought of something
With cracks and crevices
Shining with else's reflection
Bring in your insecurities?
What if it ceases to be admired?
Does the thought of the celestial
Not being throughout a full clock,
Makes way for fear to creep in.
Loving a piece of uncertainty
Sometimes, is mystic.
We love not just the moon,
But the hope of it, coming to us past dusk.
Nobody stays forever, nobody stays all day.
Nobody skips from the marks of flaws; nobody holds beauty as you see for eternity.
The moon has taken the heat with the light which it reflects,
We are all, the sum of what we face.
Why not take chances?
Behold what froze our glances.
Love whatever, however, we get.

Her's Ode

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The dusky sky
And the tunes of melancholy
The hidden enigma of the uprising moon
Oh what intrudes her soul tonight?
Is it the long lost love or the love that never arrived
The quixotical starry night?
That bothers her disquiet apprehension
She sees herself mislaying in the folds of perverting nature
The quite chaos of the prevailing wind
Plays a black magic on this wanderer
And she is lost amidst the inexplicable woods
Finally she discovers the shell in that abandoned lagoon.
The voices in it, subdued and pulpy
She kept on walking in search of destiny.
Until, she realized destiny is 'Roses With Pricks'
"Was I blinded by this kaleidoscopic World?" ran her realization
Now, she was left alone to survive in the dark.
But, she was a warrior strong and determined.
She fought, she broke, she stood up
Snapping all the social taboos
Once again came out with flying colors

Veronica

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You feel the weight of nineteen,
Sitting in an abandoned car
As the forest of Amsterdam
Screeched to make you their own.

The decrepit car
Longed to be fixed;
With its shabby worn out seats
And the engine desiccated of its heart and soul

Suddenly, I felt something near my leg
And I moved in a speedy way;
A grubby notebook fell
I picked it up
Tried to flip through its pages
Which were at its last legs.

I carried the notebook deep into the forest
Where I sat on the lushy green grass,
As the rays filled the spaces of my locks
The brownish tinge of my barnet,
Captivated the dinky moment of the cosmos.

The first page said " Hi, it's Veronica "

I proceeded her call,
" I'm nineteen,
Lost between the parallel universes
And the portal seems to be submerged
Betwixt the atomic habits "

I gasped in excitement,
Looked at her intricate details;
Wondered how she looked like
And was curious about her story.

The notebook remained blank for the next ten pages.
There was silence wrapped around those sheets
And then I found a statement
" If someone ever finds these last trails I have left behind
Know that the portal lies within you,
You connect the two universes
And your existence is a peculiar art of worth
I'm just nineteen!
Yet to bridge the shackles of my soul
Lying in the detritus of the cosmic glory
- Veronica "

I carried her notebook
Walked through the trench
As the dry leaves made a sound
While the fireflies glowed;
Amidst the crickets chirping

Somewhere I knew, I opened the portal
As that made nineteen immortal.

The Tale of the Supreme

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Beneath the sky, upon the earth,
There live some social creatures.
Creatures who can feel anger, fear, inspiration, and happiness.
Creatures who can fake their emotions.
Creatures who are guided by their greed not their need,
And realize when the alarm rings,
Oh! It can question their survival?
They will do something!
And again sleep in peace thinking they are the supreme.

What Came Next

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Often in my little life, I have thought
That those days which were a bit out of sort
Than the others were the worst;
Later only to be proved wrong,
When something happened the worst till date.
In destiny's fishing, my day is bait
For a fish of good or bad luck to be lured.
Wherever I may be, life can never be sure.

So friends, we can see how each fish
Good or bad, made such a dainty dish,
Whose taste we cherish in our memories.
Many of them have helped us in the battles we had,
Few will just make us sad, but don't try to control what fish you get
Or just like them you may fall into the bait.

Dusk till Dawn

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Standing alone in the crowd or out of it.
Grazing the day dreams.
Black and White the picture paints,
And the sorrow makes me thoughtless.

The horrible sound of the world terrifies me.
Am I a part of this world?
Why am I a part?
Shivering, but not cold.

What's wrong and why?
Can't see any Ray of Hope in these dark times.
Is the world yet so exciting or has the excitement started to fade away slowly?

Why did the world of love and affection start changing into hate and injustice?
Why did the colorful world change into a black and white misery?
Why have the wings been cut down leaving us not to fly?
In defiance of the pain and agony, we yet stand still to aim at the sky.

हम और बदलते गीत

श्रीजनी रायचौधरी
सेमेस्टर ३
स्नातकोत्तर विभाग, बायोटेक्नोलजी
सेंट जेवियर्स कलेज (स्वायत्त), कोलकाता

कुछ दिन पहले ही मुझे इस धरती पर आए 20 साल हो गया। मैं दो हजार फ़ीसदी की औलाद हूं और शायद आप भी।आज हम देखेंगे कि इन बीस सालों में हिंदी गीतों में क्या बदलाव आया है? किसी ने कहा था कि जब हम कोई पुरानी गीतसुनते हैं, और उस पर आनंद लेतेहै , इसका मतलब यह नहीं कि वह एक बहुत अच्छा निर्देशित गीत है बल्कि इसलिए किशायद हमारा उन गीतों से कोई यादें जुड़ी हुई है, वह कहते हैं ना अंग्रेजी में craze । बचपन में जब हम कोई गाना सुनतेथे ,शायद कोई बुजुर्ग ने तब आपसे कहा होगा ,"बेटा हमारे जमाने में ज्यादा अच्छे गाने बनते थे।" तब शायद ही सुन केहमें गुस्सा आया हो, पर कई दिन पहले मुझे एहसास हुआ कि मैंने भी आजकल के बच्चों को ऐसे बोला है कि आजकल केगाने बड़े फालतू है,2000 से 2015 के गाने अच्छे थे। पर यह इसलिए नहीं कि वह सच में ही अच्छे थे पर इसलिए किउसके साथ हुई यादें जुड़ी है। जैसे 90s के गाने हमारे अभिभावकों को बहुत अच्छे लगते हैं क्योंकि वह उनके यादगारपलों से जुड़ी है चाहे वह 'पायल है छनकाई','टिप टिप बरसा पानी',' तू चीज बड़ी '; नींद चुराई मेरी'| रोजा के गाने औरपहला नशा तो शायद 90s के सभी युवक को पसंद है। यह सब बजाने से उनके दिल झूमते हुए आप देख सकते हो। "हमारे जमाने" में आते हुए 'सूरज हुआ मध्यम' बॉलीवुड की सबसे हसीन जोड़ी से प्रदर्शित यह गाना सभी बड़े बुजुर्गको पसंद है । अब मैं आपसे यदि पूछूं कि अगर आपको कोई भी गाने का प्लेलिस्ट चलाना हो आप क्या चलाएंगे? मैं ऐसेकिसी भी दिन ,किसी भी वक्त अभिनेता इमरान हाशमी के चित्र के गाने सुनना पसंद करूंगी । मेरे हिसाब से वे गाने बहुत हीरोमांचक है । आपको नहीं लगता?'दिल इबादत' से लेकर'हां तू है "आशिक बनाया' से लेकर 'तू ही हकीकत' या फिर'झलक दिखलाजा'' फिर मोहब्बत' या ' मेरे बिना', सभी इतने अलग सुनने में परंतु इतने रोमांचक। यह सब ज्यादातरप्रीतम जी के निर्देशित गाने हैं और उस समय के के साहब (जिन्होंने कुछ दिन पहले ही स्वर्ग सिधार गए) या मोहित चौहानजी बड़े प्रसिद्ध हुए। दिल चाहता है

कि भी कई प्रसिद्ध गाने हैं और साथ ही वीर जरा , लक्ष्य इनके भी कई गाने हैं। सनूनिगम जी भी इस समय जाने-माने गायक थे । क्या आपको याद है कि उस समय मोबाइल फोन में गाने उतने उपलब्ध नहींथे परंतु टीवी में 9X एम नामक एक चैनल था? मुझे याद है उसमें 'नगाड़ा नगाड़ा' या 'मौजा ही मौजा' आते ही मैं नाचनेलगती थी। स्कूल में भी हम बच्चे तब इन्हीं गानों को गीत गाते थे। अंताक्षरी में या ऐसे ही बातचीत में। जब वी मेट के कईऔर गाने भी प्रसिद्ध हुए तुमसे ही 'यह इश्क हाय,' आओ मिलो चले' और एक एवरग्रीन गाना 'आओगे जब तुम'। Ra.one के मुक्ति पर उसके गाने जैसे 'क्रिमिनल' आदि हमारे दिल में मचलते थे। अब वैसे तो 2000 के कई गानेयादगार है पर लव आजकल के साथ 2000 में यह फीसदी खत्म हुई। ट्विस्ट या यह दूरियां बहुत ही क्रेज में थी इसकेबाद। परंतु 2007 के भूल भुलैया को भी इस लिस्ट से निकलना पाप होगा ' हरे राम हरे कृष्णा' और उसका hookstep आज भी सब करते हैं। इसके बाद 2012 में एक था टाइगर के गाने 'माशाल्लाह' तो शायद माशाल्लाह सभी बच्चों के मुंहमें था इसके। आगे बढ़ते हुए अरिजीत सिंह का उत्थान हुआ, उस समय 2013 में आशिकी 2 के कई गाने पूरे देश में लोगोंके दिल में जगह बनाया और ऐसा फिर चलता रहा । साथ ही याद है गाने- ब्लू आईज, लव दोस्त, देसी कलाकार ? जी हांहमारे लोकप्रिय यो यो हनी सिंह। 2015 में बादशाह भी इंडस्ट्री में आए और उन दोनों ने मिलकर देश में rap का प्रसिद्धता बढ़ाया। परंतु कुछ 2016 के बाद में मेरे हिसाब से गानों की क्वालिटी गिर गई है। इसके बाद हम लोग देख सकते हैं किरीमेक का सिलसिला शुरू हो गया और अच्छे खासे गानों की बेझिझक रीमिक्स होने लगा। इसमें ऐसा नहीं कि कोई भीगाना भी फिर अच्छा नहीं निकला। पर पंजाबी गाने और रीमिक्स ने एक तरह से गानों में से वह रोमांच जैसे छीन लियाI मेरेहिसाब से आजकल गानों से कोई भी कुछ यादें नहीं जोड़ सकते हैं । यह यादगार नहीं है ।1 महीने सब सुनते हैं दूसरे महीनेमें लोग भूल जाते हैं इस में आपका क्या ख्याल है?

आद्या

हिया गुप्ता
सेमेस्टर ३
स्नातकोत्तर विभाग, बायोटेक्नोलजी
सेंट जेवियर्स कलेज (स्वायत्त), कोलकाता

हमारे जीवन के सुर में
क्या उन्हें स्तंभित वह चीख सुनाई देती है ?
लकीरें हमें बांधकर रखती हैं,
हाथों पर चूड़ी के नाम पर बेड़ियां हैं
हमारे शक्तियों का एहसास उन्हें नहीं है
हमने मैदानों पर नहीं ,
ध्येय से जंग लड़ा है।
हमारे जठर से जीवन का सार है,
हम सिंदूर को राख में बदलना जानते हैं,
नीख को तूफान में बदलना जानते हैं,
गर्द को भूराल में बदलना जानते हैं,
हमने बेटी, स्त्री, मां बनकर अपना पूरा कर्तव्य निभाया
अब बराबरी की बारी है ,
अब नारी कि बारी है।

সৌভাগ্যের সোপান

ডঃ প্রিয়াংকা দে
সহকারী অধ্যাপক
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

কালের চাকায় পরীক্ষিত নৈপুণ্যে,
মানুষ আজ সুদক্ষ জীবনসংগ্রামী -
জীবন ও জীবিকা সংরক্ষণের পীড়নে ,
মানুষ আজ দৃঢ়প্রতীজ্ঞ সত্ত্বা ;
অসম অন্যায় ধনবণ্টনের কারাগারে,
মানুষ আজ ভ্রান্ত পথের পথিক;
বিধ্বংসী প্রলোভনের সুকৌশল বেড়া জালে -
মানুষ আজ অন্তর্দহনহীন জীব ;
সুনিশ্চিত সৌভাগ্যের সোপানের সন্ধানে-
মানুষ হোক শুভ বোধের শুদ্ধ সত্ত্বা।।

পড়ে আছে মন খারাপের মনটি

ডঃ সৌভিক রায়
সহকারী অধ্যাপক
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

যেদিন মেঘের ‘পরে মেঘ জমেছিল
চৌরঙ্গীর সর্বোচ্চ বহুতলটির মাথায় নীলাভ, কৃষ্ণকায়
মেঘপুঞ্জের ঘোমটা পড়েছিল সলজ্জ সূর্য্যিটা,
যেদিন একাকী থাকতে থাকতে অস্থিসার, ক্ষয়িষ্ণু বৃদ্ধ ভিক্ষুকটি,
আরো বেশী করে ফুটপাথে মিশে গেলেন আর,
আমরা বাস ধরতে দৌড়ে গিয়ে মাড়িয়ে
দিলাম তাঁর দুর্বল হাতটি,
যেদিন গালিবের গজলগুলি আশার কন্ঠমাধুর্য্যে এক,
কালো পোড়া বিকেলের গায়ে বুলিয়ে দিল
মনখারাপের আরো তমসা,
যেদিন অতি-অভিমানিনী সদ্য-তরুণীটি সদ্য-মৃত
হবু স্বামীর রক্ত চাদর পড়ে নিল লাল-টুকটুকে
বেনারসী করে,
কান্নার-রোলের সানাই নহবত বাজিয়ে
ঝুলে পড়ল আকাশ শামিয়ানা থেকে
যেদিন লক্ষ কোটি নরনারীর একে অপরকে বলা
মিথ্যা কথার সুবিশাল ফাঁকা ফানুসটি ফেটে গেল
রক্তাক্ত করলো, অপমানিত
করলো প্রথম প্রতিশ্রুতিগুলোকে,
যেদিন আমার নারকেল কুল খাওয়ার দৈনিক সাথী
আমার আদরের ঠাকুর্মা’র মিষ্টি নরম,
শ্বেতশুভ্র কোলটি গেল চিরতরে মুছে,
আর, মিটিং মিছিলের ব্যর্থতা গায়ে মেখে ধর্মতলায়

একপায়ে দাঁড়িয়ে কাঁদল শহীদ মিনারটি
সেইদিন আর আমার মনখারাপের মনের
বাড়ি ফেরা হল না।

ধর্মগুলো আসলে রূপকথা

দেবাশ্রিতা মজুমদার
সেমিস্টার ৯
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

- আচ্ছা, মা আমার সব বন্ধুদের বাড়িতে কি সুন্দর ঠাকুরঘর, কত ঠাকুর রয়েছে, ওদের বাবা-মায়েরা রোজ দুবেলা ঠাকুর পুজো করে, তোমরা করোনা কেন? আমাদের বাড়িতে কেন কোনো ঠাকুরঘর নেই? আমার বন্ধুরা বলেছে আমরা নাকি ধার্মিক নই, একথা সত্যি মা?

- একেবারেই ভুল মা। তুমি এখন বড্ড ছোটো, আর একটু বড়ো হলে নিজেই বুঝতে পারবে আমরাও ধার্মিক। খালি তোমার বন্ধুদের মতো করে নয়, অন্য ভাবে।

- কিভাবে? বলো না মা, প্লিজ।

- বেশ। তবে শোন। 'ধর্মগুলো আসলে রূপকথা', ভীষণ সুন্দর। ধর্ম আমাদের শেখায় আরাধনা মানে পুজো করা, নামাজ পড়া, চার্চে গিয়ে প্রার্থনা করা এগুলো। কিন্তু যার আমরা আরাধনা করব, যার সেবা করব, সে থাকে কোথায় জানিস?

-ঠাকুরঘর, মন্দির, মসজিদ, গুরুদোয়ারা, গির্জা এরম সব জায়গায়।

- না, হল না।

- তাহলে?

- তারা থাকে তোমার আমার মতো মানুষের মধ্যে। আজ তোকে একটা কথা বলছি, আজীবন এটা মনে রাখিস যে; আমদের একমাত্র পরিচয় আমরা মানুষ, আমাদের ধর্ম মানবতা, গোত্র মনুষ্যত্ব। তাই সবসময় মানুষের সেবা করবে। তোর বাবা বলে, "মানুষ বেঁচে না থাকলে ঈশ্বরও মরে যায়"। এটাই ধ্রুবসত্য। তাই কে কি বলছে তাতে কান দিও না। আমরা ধার্মিক কি ধার্মিক-নই { ধার্মিক নই-}সেই বিচার পরে করা যাবে। আমরা মানুষ এটাই যথেষ্ট। কি মনে থাকবে তো?

- হ্যাঁ, মা। মনে থাকবে। আমরা মানুষ, আমাদের ধর্ম মানবতা, গোত্র মনুষ্যত্ব। এবার থেকে কেউ কিছু বলতে এলে আমিও এটাই বলব।

প্রত্যেক রূপকথার গল্পেই রাজকুমার-রাজকুমারী, পরীদের সাথে মিশে থাকে এক ভয়ঙ্কর দৈত্যের বিবরণ। আমরা অপেক্ষা করি গল্পের একটা happy ending এর জন্য। যখন দৈত্যের বিনাশ শেষে জয় হবে শুভশক্তির। ধর্মগুলোও ঠিক রূপকথার মতোই, খারাপ ভালো মিলিয়ে মিশিয়ে থাকে। শুধু মানুষ হিসেবে আমরা যদি সামান্য একটু মানবিক হই, জাতপাতের ঊর্ধ্বে উঠে ভালোবাসা দিয়ে আপন করে নিই অন্যদের, মনে রাখি 'সবার উপরে মানুষ সত্য, তাহার উপরে নাই', তাহলে একদিন ঠিক সমস্ত ভেদাভেদ ভুলে, লড়াই-দাঙ্গা বন্ধ করে আমরা আমাদের এই মানব-ধর্মীয় রূপকথারও একটা happy ending দেখতে পাব।

অমৃতকুম্ভের সন্ধানে

দেবাশ্রিতা মজুমদার
সেমিস্টার ৯
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

"ও ঠাকুমা অনেকক্ষণ তো হল বই এর গন্ধ শুঁকছেন, কিছু কিনবেন না কিনবেন না?"- দোকানির বলা কথায় একটু লজ্জা পায় দিঠি, ডাঃ. দিঠি মিত্র। ঠাম্মুকে ফিসফিস করে বলে- "ও ঠাম্মু, এরকম কোরো না, সবাই দেখছে তো বলো! তুমি কোনটা কিনবে বলো না; সেটা কিনে নি।"

নাতনির কথায় একটা মিষ্টি হাসি হাসলেন সুলেখা। ব্যাস ঐটুকুই। তারপর আবারও একটা পাতা উল্টে নাকের কাছে মেলে ধরলেন সেটা। আহা কি সুন্দর! যেন হাজার গোলাপের সুবাস লেগে আছে, যেন লক্ষ্য টাকার আতর কেউ ঢেলে দিয়েছে বইগুলোয়। আজকালকার ছেলেমেয়েরা ডার্ক ফ্যান্টাসি না বার্বন কি যেন খায় তার মিষ্টি গন্ধটাও যেন লেগে আছে পাতাগুলোয়। আজ সুদীর্ঘ ১৫ বছর পর আবার সেই পুরোনো পাড়ার সামনে সুলেখা।

বছর ৫০ আগের সুলেখা মিত্র, থুড়ি তখন তো সুলেখা সেন, সে তখন প্রেসিডেন্সির প্রথম সারির মেয়ে। যৌবনকালের ওঠা-বসা, প্রেম, বন্ধুত্ব, বেড়ে ওঠা, বাস্তব চেনা সবটাই এই বইপাড়াকে কেন্দ্র করে, বইয়ের সাথে খেলা করতে করতে। কলেজ শেষে ইউনিভার্সিটিও এখানেই। নিয়মিত আড্ডা বসত কফি হাউসে। ধোঁয়া ওঠা চায়ের কাপের সাথে মাটন কাটলেট; আহা সেই স্বাদ যেন অমৃত, আজও মুখে লেগে আছে। এই বইপাড়ার সাথে সখ্যতা কি আজকের, মনে মনে ভাবেন সুলেখা, বরং বলা যায় এ সম্পর্ক জন্মাতীত। দিঠি আজকালকার মেয়ে, তার উপর দিল্লিতে বড়ো হয়েছে, এসব আবেগ ওর বোঝার কথা নয়।

তবু তো ও এসেছে কলকাতায়, এনেছে সুলেখাকে, নাহলে দীপ্ত, মানে দিঠির বাবা তো আজকাল নিজেরাও কলকাতায় আসতে চায় না আর সুলেখাকে তো একা ছাড়ার প্রশ্নই নেই। একটু বেশিই ওরা খেয়াল রাখে মায়ের। অতিরিক্ত আদর কখনো কখনো অবহেলার চেয়েও পীড়াদায়ক হয়ে ওঠে, সুলেখারও ইদানিং সেই দশা।

ইউনিভার্সিটি পাস করার পর পরই একটা কলেজে পড়ানোর ডাক পায় সুলেখা। মিষ্টি অথচ দৃপ্ত সুলেখা কিছুদিনের মধ্যেই ছাত্র ছাত্রীদের পছন্দের দিদিমণি।

লেকচারার সুলেখা সেন এর সাথে প্রফেসর দ্বৈপায়ন মিত্রের আলাপও এক আঁধার নামা কলেজ স্ট্রিটেই। ঝমঝম করে বৃষ্টি পড়ছিল সেদিন। আচমকা বৃষ্টি, ছাতা নিয়ে বেরোয়নি সুলেখা। বরাবরই একটু লক্ষ্মীছাড়া ধরনের। কফি হাউসের বৈঠকি আড্ডায় সেদিন রাতও

হয়ে গেছিল একটু। তখন এত অ্যাপ-ক্যাব না কি সব বলে সেসবও ছিল না মোটেই, ঐ বৃষ্টির মধ্যে শেষ আশার পিদিম, স্ট্যান্ডের শেষ হলুদ ট্যাক্সিটাও চলে গেছিল এক সুপুরুষ যুবকের হাতে। কিন্তু সে সুলেখার অসহায়তা বুঝতে পেরে এগিয়ে এসে বলেছিল - আমি গড়িয়ার দিকে যাব, আপনি?

- আমি টালিগঞ্জ। কিছু যদি মনে না করেন ট্যাক্সিটা কি শেয়ারে নিতে পারি আমরা?

- আমিও সেটাই বলতে যাচ্ছিলাম। এত রাতে আপনি বোধহয় আর কিছু পাবেন না।

- ধন্যবাদ। বাই দ্য বাই, আমি সুলেখা সেন। সুরেন্দ্রনাথ কলেজে বোটানির লেকচারার।

- নমস্কার, আমি দ্বৈপায়ন মিত্র। জেভিয়ার্সের অঙ্কের অধ্যাপক। আপনাকে কফি হাউসে প্রায়ই দেখি! থিয়েটার?

- ঐ আর কি! একটু আধটু! শখে। তা আপনিও কি...?

- হ্যাঁ, শখের দলবাজ।

সেই শুরু একসাথে পথ চলার। তারপর কবে, কিভাবে অচেনা সহযাত্রীটি অন্তরঙ্গ হয়ে উঠেছিল তা আর মনে নেই সুলেখার। বন্ধুত্ব, প্রেম, ভালোবাসা সবকিছুই হয়েছিল খুব তাড়াতাড়ি। বিয়ের পরের দিনগুলো মনে পড়ায় আজও হেসে ফেলে সুলেখা।

- কি গো ঠাম্মু, হাসছ কেন?

- জানিস দিঠি, তোর দাদুর আর আমার মধ্যে একটা সময় লড়াই চলত কে কাকে কত ভালো আর কত আলাদা বই গিফ্ট করতে পারে! জন্মদিন, বিবাহবার্ষিকী, পুজো যাই হোক না কেন, একে অপরকে আমরা আর যাই দিই না কেন, একটা না একটা বই ঠিকই জুড়ে দিতাম সেই উপহারের সাথে। কখনো তা অপর জনের পছন্দ মতো, কখনো আবার নিজের পছন্দের।

- নিজের পছন্দের কেন?

- ঐ যে উপহারের নামে যাতে নিজের পড়ার শখটা পূরণ হয়ে যায়, তাই।

কি সব দিন ছিল সেগুলো, বইপাড়া, বই — সেসব অবিচ্ছেদ্য অংশ ছিল তাদের হৃদয়ের। আরও একটা মজার বিষয় মনে পড়ে সুলেখার, কাউকে উপহার দেওয়ার হলে নির্দিষ্ট দিনের বেশ কিছুদিন আগে বই কিনে নিতেন তিনি, তারপর সেটা পড়ে নিয়ে রঙিন কাগজ মুড়ে অনুষ্ঠানের দিন উপহার হিসেবে দিয়ে দিতেন। এই সব অনুভূতি আজকালকার জেনারেশন জানে না। তারা তো ফোন, কম্পিউটারে অভ্যস্ত।

- চলো দিদিভাই, ঐ সামনের দোকানটায় যাই।

- চলো।

সামনেই রাখা একটা চাঁদ মামা, এখনো লোকে পড়ে এসব! ভারী অবাক হলেন সুলেখা। বিয়ের বছর চারেক পরে দীপ্ত হয়, ওর পাঁচ বছরের জন্মদিনে একগুচ্ছ চাঁদমামা উপহার দিয়েছিল দ্বৈপায়ন, সুলেখা দিয়েছিলেন একঝাঁক শুকতারা। খুব খুশি হয়েছিল ছেলেটা। আসলে বইপোকাদের সন্তান তো, খুশী না হয়ে যায় কোথায়! তারপর এভাবেই জন্মদিনের উপহারের ঝাঁপি ভরতে ভরতে দীপ্ত বড়ো হল, চাকরি নিয়ে চলে গেল দিল্লিতে। সুনয়না কলকাতার হলেও, সুনয়না-দীপ্তর দিল্লিতেই আলাপ,

কাজের সূত্রেই, সেখান থেকেই বিয়ে, দিঠির হওয়া। ওরা দিল্লিতেই থেকে গেল, আসত যদিও ন-মাসে, ছ-মাসে আর সুলেখারা কলকাতায়। দুজনে থাকাকালীনও সুযোগ পেলেই সুলেখা-দ্বৈপায়ন চলে আসত এই স্যাঁতস্যাঁতে, নস্টালজিয়া মাখা আদুরে বইপাড়ায়। দ্বৈপায়নের রিটায়ারের পর ও প্রায়ই বলত - সুলেখা, তোমার দিদিমণিগিরির পাঠ চুকলে সারাটা দিন আমরা ন্যাশনাল লাইব্রেরি আর কলেজস্ট্রিটে এসেই কাটাবো বুঝলে! আর বইমেলার সময়টা ঐ প্রাঙ্গণে।

- হ্যাঁ, নাওয়া খাওয়া, ঘরসংসার ভুলে তাই করব। তুমি বাউন্ডুলেই থেকে যাবে বলো সারাজীবন?

- হ্যাঁ, আর তুমি আমার লক্ষ্মীছাড়া।

চোখের কোণে একচিমটে সাদা বালি, চিকচিক করছে। বাউন্ডুলে-লক্ষ্মীছাড়াদের এই স্বপ্নটা পূর্ণ হয়নি; সুলেখার চাকরির আয়ু যখন আর দিন ছয়েক, স্বপ্ন যখন মাউন্ট এভারেস্টের শিখর ছোঁয়ার হাত কয়েক মাত্র দূরে, ঠিক তখনই পা পিছলে পড়ে সেরিব্রাল অ্যাটাকে দ্বৈপায়ন চলে গেছে সুলেখাকে ছেড়ে। দীপ্ত তার মাকে আর একা রাখতে চায়নি। অবসর জীবনে তাই বই-এর সান্নিধ্য পেলেও বইপাড়া আর বইপাগলটার সাথে কাটানো হয়নি সুলেখার। অনলাইনে বই আসলেও, কেনার আগে হাতে নিয়ে গন্ধ শোঁকা যায় না।

সামনেই সুলেখার পঁচাত্তরের জন্মদিন, নাতনি সেদিন কি বই উপহার চাই জানতে চাইলে, বাচ্চাদের মতোই আবদার করে তিনি বলেছিলেন এ বছর শুধু বই নয়, বইপাড়াকেও কাছে পেতে চাই দিদিভাই।

বইপাড়া? সেটা কি? আকাশ থেকে পড়েছিল তার নাতনিটি। যতটা সম্ভব বর্ণনা দিয়েছিলেন সুলেখা, বলেছিলেন কলকাতার কলেজস্ট্রিট এশিয়ার অন্যতম বৃহৎ পুস্তক বাজার, কলকাতার লোকেরা একেই আদর করে বলে বইপাড়া। ঠাম্মুর কথা শুনেই সবটা অ্যারেঞ্জ করেছিল মেয়েটা, ঠাম্মুকে আনন্দ দিতে। প্রথমে দীপ্ত রাজি না হলেও পরে দিঠিই বাবাকে রাজি করিয়েছে। আর তার ফলস্বরূপ আজ পনেরো বছর পর আবার সুলেখা আকাঙ্ক্ষিত অতীতের মুখোমুখি।

আজ সুলেখা কেমন যেন পাগলের মতো করছে। এই বই হাতড়াচ্ছে, গন্ধ শুঁকছে, ঐ বই নিচ্ছে, হাত বোলাচ্ছে, যেন ছোট্ট শিশু, কোনো দিকে কোনো খেয়াল নেই, খেলে বেড়াচ্ছেন বইয়ের রাজ্যে। আজ ভারি হালকা লাগছে তার, এক দমকা আনন্দে আত্মহারা লাগছে নিজেকে।

- থ্যাঙ্ক ইউ, দিদিভাই, থ্যাঙ্ক ইউ ভেরি মাচ।

- থ্যাঙ্কস টু ইউ ঠাম্মু, এমন একটা জায়গা চেনানোর জন্য। একসাথে কোথাও এতো বই থাকতে পারে এখানে না এলে তো জানতেই পারতাম না।

- বই-এর একটা বিস্ময়কর মাদকতা আছে দিদিভাই! এ এক অদ্ভুত নেশা। যে এই নেশায় একবার আসক্ত হয়েছে তার আর মুক্তি নেই জানো তো। এই যে জায়গাটা তোমাকে আজ চিনিয়ে দিলাম, এটা একটা অমৃত কুম্ভ। ঠিকমতো খোঁজ করলে তোমার অমৃতলাভ হবেই।

- সত্যি, ঠাম্মু, দিস প্লেস ইস গ্রেট।

- এবার আরও গ্রেট প্লেসে তোমায় নিয়ে

যাব, তার আগে এই বই গুলোর দাম দিয়ে দিই দাঁড়াও।

- আবার কোথায় যাব?

- কফি হাউস। কবিরাজি চেখে দেখতে হবে না!

- ঠাম্মু, তোমার কিন্তু হাই কোলেস্টেরল, বাবা জানলে রাগ করবে।

- জানলে তো রাগ করবে, কিন্তু আমরা তো কেউ বলবই না। এটা তো আমার প্রি-বার্থডে ট্রিট। তুমি খাওয়াবেনা দিদিভাই।

- হা হা হা। আচ্ছা বাবা চলো। তবে একটাই কিন্তু।

- বেশ, তাই হবে। আর বেরিয়ে একটু ফুচকা...

- আজ না, কাল।

- বেশ তাই। আমার ডাক্তার নাতনি বলে কথা, তার কথা একটু না শুনলে হয়!

- চলো এবার।

- হ্যাঁ, চলো দিদিভাই।

হাতে হাত ধরে এগিয়ে চলেছে দুই প্রজন্ম। কফি হাউসের সেই আড্ডা হয়তো আজ আর ফিরে পাওয়া যাবে না, তবু আরোও একবার সেই সোঁদা গন্ধ বুক ভরে নেওয়া তো যাবে। আজ অনেকদিন পর বইপাড়া সাক্ষী এক অমলিন ভালোবাসার। না, এই ভালোবাসায় কোনো দেখনদারি নেই, কোনো আঁতলামি নেই, শুধু নির্মল একটা ভালোরাখা আছে, আছে প্রাণ প্রিয় মানুষটার ইচ্ছেপূরণের একটা অদম্য ইচ্ছা...।

চল-ধ্রুবক

সৈকত সেতুয়া
সেমিস্টার ৭
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

আজ দ্বাদশী। সকাল থেকে বাতাসটা নিজের গায়ের জোর দেখিয়ে চলেছে। প্রমাণ করতে চাইছে বুঝি শীত-রাজত্ব আসন্নপ্রায়। সারাটা দিন জেসি সমরেশ মজুমদার পড়ে, ছাদের টবের গাছগুলোর সেবা করে, কিছুটা গান শুনে আর সামান্য কিছুটা ক্লাসের পড়া করে কাটিয়েছে। টবের গাছ গুলো বোধ হয় অনেকদিন বাদে ওকে দেখে খুশি হয়েছিল। আনন্দে ডালপালা নাচাচ্ছিল। কাবুলিওয়ালার 'খোঁখী' ডাক শুনে যেমন মিনি জানলা দিয়ে সহাস্যে মুখ বের করে দেখত তেমনই যেন ফুলগুলো বৃন্ত থেকে মুখ বের করে দাঁত দেখাচ্ছিল। বিকেলের পায়রাগুলো ওর রোজকার কাস্টমার। কিছুদিন ছাদে আসেনি বলে আজ ওদের ডিমান্ড বেড়েছে। বিকেলটা এল আর ব্যাস্ত আতিথির মতো চট করে রিটার্ন টিকিটে ফিরে গেল। কিন্তু কান্ড দেখ! পায়রাগুলোর বাসায় ঢোকার নাম নেই। সমস্ত অন্ন যেন আজই ধ্বংস করতে হবে। ব্রম্ভান্ডে হাজার হাজার প্রজাতির পাখি আছে, সবাই সন্ধ্যেয় ঘরে ফেরে। ওর কাস্টমার পায়রাগুলো লিবারাল নাকি?

সন্ধ্যের আধখাওয়া থিন অ্যারারুট বিস্কুটের মতো চাঁদটার দিকে তাকিয়ে জেসি ভাবল একবার কি মিহিদের বাড়িখান ঢুঁ মেরে আসা যায়? ওই ডেকেছিল জেসিকে। তারপর দুবার এটাও ভাবল যে আজ সন্ধ্যেটা যদি বাইরে কাটায় তবে কাল সন্ধ্যেয় যাদবপুরের 'শিরোনামহীন' আর 'জলের গান' এর লাইসেন্স পাওয়াটা চাপ হয়ে যাবে। তার চেয়ে মিহিকেই ডেকে নিলে হয়। চট করে একবার কল দিল। আজকাল মিহিটা এত বদ হয়েছে সারাদিন ফোনটা সাইলেন্ট, উফ্ আর পারা যায় না। চোখ বন্ধ করল জেসি। ওর কাছে যে ডেটাসেটটা আছে সেটাকে একবার মনে মনে অ্যানালাইজ করল –

"আজ রবিবার...কাল তিনটে ক্লাস... আবার বি.সি. নেবেনা, রইল দুটো... একটা মিহির পড়া হয়ে গেছে...আরেকটা চাপলেস, নতুন প্রফেসর জয়েন করছে, কালই প্রথম ক্লাস। সো, এখন মিহির নো পড়াশুনো।"

শ্বাস নিয়ে আবার ভাবল। আজ টি.ভি. তে কি সেরকম কিছু দেখার আছে? ইউ টিভি অ্যাকশনে ক্রনিকল্স অফ নার্নিয়া, স্টার মুভিজে মোয়ানা, সোনি মাক্সে খাট্টা মিঠা আর জলসা মুভিজে ঊমা — এই কটাই যা ভালো হচ্ছে কিন্তু সবকটাই মিহির ল্যাপটপে আছে। ওহ্ না আজ বিকেলে তো হাঁটতে বের হয়নি মিহি। ইস্, এটা আগে মনে পড়েনি কেন ওর?

নিশ্চয়ই বিকেলে 'বেটার কল সল' সিজন সিক্সের বাকিটা শেষ করেছে। ইস্, পায়রাগুলোকে আরেকদিন ডিচ্ করে মিহির বাড়ি গেলে সুন্দর দেখা যেত একসঙ্গে। তারপরই আবার ভাবল – নাহ্ এসব 'ফোমো'কে পাত্তা দিয়ে লাভ নেই। শেষ সিজন বলে কথা, একা হেডফোন লাগিয়ে মন দিয়ে দেখবে। আবার ব্যাক টু অ্যানালাইসিস। মাসিমারও আজ সেরকম কাজ থাকবেনা যে সাহায্য করবে মিহি। এরকম আরো সাত আটটা সম্ভাবনাকে নাকচ্ করে শেষমেশ এই সিদ্ধান্তে এল – হয় মিহি স্মরণজিৎ পড়ছে নয় ছাদে গেছে।

মিহিদের বাড়িটা ওদের গলি থেকে দুটো গলি পরেই। একটা দশের অরেঞ্জ আইসক্রিম আধখানা শেষ করতে যতটা সময় লাগে মিহিদের বাড়ি যেতেও এখান থেকে ঠিক ততটাই সময় লাগে। গলিগুলো আবার খুব দুরেও নয় একে অপরের থেকে, তাই ওদের ছাদ থেকে মিহিদের ছাদের মানুষগুলোর ফন্ট্ সাইজ খুব ছোট দেখালেও চেনা যায় দিনের বেলায়। এই সন্ধ্যেবেলায় যদিও বোঝা যাবেনা ওখানে মিহি আছে কিনা তবে ওর কাছে বোঝার অন্য উপায় আছে। টর্চের আলোটা মিহিদের ছাদের দিকে করে জ্বেলে রাখল। মিনিট দুয়েক বাদে ওপাশ থেকেও একটা আলো জ্বলে উঠল। কিছুক্ষণ জ্বলে রইল। এটার মানে এই যে মিহি খাতা পেন নিয়ে মর্স সিগন্যাল ইন্টারসেপ্ট করার জন্য রেডি। এভাবে আগেও ওরা রাতের বেলা টর্চের আলোয় মর্স কোডে কথা বলেছে। এসব পেলে হোয়াটস্যাপ্ ভুলে যায়। আলো জ্বেলে নিমেষে বন্ধ করে দিলে সেটা ডট্, আর এক দু সেকেন্ড জ্বালিয়ে রাখলে সেটা ড্যাশ। আর দু সেকেন্ড মতো আলো বন্ধ রাখা মানে প্রসিড্ টু নেক্সট্ লেটার। ও যা সংকেত দিল সেটাকে ডিকোড করলে দাঁড়ায় 'COME FAST'। ওপাশ থেকে উত্তর এল – পরপর তিনটে ড্যাশ, তারপর গ্যাপ, তারপর ড্যাশ-ডট্-ড্যাশ। এইবার হাওয়াটা একটু কমল। মেঘগুলো যেন খনিকের জন্য ওদের ম্যারাথন থামিয়ে অবাক হয়ে নীচে তাকিয়ে দেখল কীভাবে দুটো বাড়ির ছাদে দুটো প্রাণী সভ্যতার শত আবিষ্কারের মাহাত্ম্যকে জলাঞ্জলি দিয়ে নিছক মজার জন্য আলোর ঝিকিমিকি দিয়ে একে অপরকে তুইতোকারি করে যাচ্ছে।

কলিং বেলটা বাজতেই ছুটে গেল জেসি। দরজা খুলে অবাক হয়ে দেখল রিবন দাঁড়িয়ে। রিবন ওরই কলেজে আর্টস নিয়ে পড়ে, বি.এ. ইংলিশে। কাল সন্ধ্যেয় ওদের তিনজনেরই যাদবপুরের ফেস্টে যাওয়ার প্ল্যান। রিবন যে বাড়িতে একবার যায় তারপর থেকে ওই বাড়ির নিজের ছেলে বলে তাকে গণ্য করা হয়। এগুলোকেই বোধ হয় বলে সোশ্যাল স্কিলস্। সুতরাং, জেসির মুখে কোনো প্রশ্নের অপেক্ষা না করেই সে জুতো খুলে উপরে উঠে গেল। উপর থেকে হাঁক দিল – "আয়রে।"

"মিহিও আসছে; ও ঢুকুক, দরজাটা দিয়ে আসছি।" মিহিকে গলির মুখে দেখে জেসি বলল।

"ওত্তেরি! কী বলিস?"

মিহি ঢুকেই রিবনের গলা শুনে একগাল হেসে বলল – "ওহ্ এই ব্যাপার। এই জন্য আমন্ত্রণ?"

"আরে না আমাকেও জানায়নি। এইমাত্র ঢুকল।" জেসি দরজাটা লাগাল।

"মাসিমা? তোমার ঘরে আমাকে জানিয়ে আসতে হবে?" জোর গলায় নালিশ জানাল রিবন।

মায়ের কাছে সমস্ত ফর্ম্যালিটি চুকিয়ে ওরা ছাদে উঠল। এখনের হাওয়াটা বেশ মোলায়েম। কোনোরকম অভদ্রতা না করে চুপচাপ বইছে। ওরা কিছুক্ষন ছাদের একপ্রান্তে দাঁড়াল। দুরের ওই ব্লার হয়ে যাওয়া আলোগুলো দেখল। ওগুলো রোজ রোজ দেখেও ওদের একঘেয়ে লাগেনা। সামনের কিছু দোকানপত্রের নিয়ন আলগুলোও জ্বলে উঠেছে। এইসব এলাকাগুলোয় কিছু মানুষের নিজেদের বাড়ি ঘর আজও বেঁচে আছে। শ্বাস নিতে হয়তো কষ্ট হচ্ছে বাড়িগুলোর, তাও নিচ্ছে। কোলাহলটা কম। রাস্তায় এখানে এখনও গুটিকতক ধুতি পাঞ্জাবি পরা লোকজন খুঁজে পাওয়া যায়। পাশের বাড়ির আত্মীয়ের সাথে এখনও নিয়মিত গল্পগুজব হয়। পাড়ার মোড়গুলো এখনো বেঁচে আছে কিছু চায়ের দোকান আর কিছু গুলতানির ডেরা নিয়ে।

খালি ছাদে শুতে দেখলেই মা ক্যাজরা করবে তাই জেসি একটা বড় শতরঞ্চি পাতল। বেশ কিছু তারা আকাশটার মান বাঁচিয়ে টিকে আছে মেঘরাশির ফাঁকে ফাঁকে। গান চলল। সাহানা, চন্দ্রবিন্দু, সুবির সেন আরো কত কে ... একে একে সবাই এল। বাজল স্টিফেন স্যাঞ্চেজ, লিমন মিমি, ফসিলস্, আলি শাহ্, তাল পাতার সেপাই আরো কত কার গান। কথা চলল, বিষয় শেষ হলনা। কলেজের সামনের ফুডট্রাকে খাবার কেন কম দেয়, কোথায় ডিক্যাথলনের নতুন সোরুম খুলেছে, ব্রুকলিন নাইন নাইনে 'হোল্ট' বি ফ্ল্যাট স্কেলে 'সান্তিয়াগো'কে ডেকেছে কিন্তু আসলে নাকি ওটা সি মেজর ছিল, ছোটুর চা টা সেরা না হলেও মন্দ না ... এসব চলল আরো খানিকক্ষণ।

ফেরারি মন গানটার শেষে একটা অতৃপ্ত দীর্ঘশ্বাস আছে যেটা শুনে কেন কে জানে আনন্দ, দুঃখ দুটোই অনুভব হয়। আকাশের দিকে চেয়ে জেসি ভাবল তার দুপাশের দুজন সারাজীবন ওর সাথে কন্সট্যান্ট নয়। বুকটা একটু হয়ত ভার হল। কিন্তু এই যে মুহূর্তটা, এটাতো স্বপ্ন নয়, এখনের প্রতিটা মিলিসেকেন্ড ওর হাতের মুঠোয়, প্রতিটা নিশ্বাস প্রশ্বাস ও অনুভব করছে। মিহি, রিবনের কাছেও মুহূর্তগুলো সেই একি গতিতে পার হয়ে যাচ্ছে। এই গতিটাই বুঝি একমাত্র চলমান ধ্রুবক। ওর ভেতরের চাপলেস জেসিটা হেসে উঠল। কলকাতার খুশি থাকার ভান করা কয়েক লক্ষ ব্যাস্ত মানুষ টেরই পেলনা যে সেই একি তথাকথিত শহরে কোনো এক গলির ছোট্ট দুতলা বাড়ির ছাদে তিনজন কিশোর কিশোরী সত্যিকারের আনন্দের খোঁজ পেয়েছে।

নীলা

রিতম দাস
সেমিস্টার ৭
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

কথক : ডাক্তার রায় এর সঙ্গে রাউন্ডে যাওয়ার মুখেই জুহির ডেস্কের আড্ডা থেকে কানাঘুষো শুনছিল সঙ্কুনাথ সেন ওরফে শঙ্কু —

কোনো এক সরকারি ইন্সপেক্টর ইন্সপেকশনে এসে নাকি আকস্মিক ভাবে জ্ঞান হারিয়ে ফেলেছেন।

কোনরকম কানাঘুষো তে কানপাতার মানসিকতা বা প্রবণতা শঙ্কুর জীবনে যদিও এখনও তৈরি হয়নি কিন্তু ওই সরকারি উচ্চপদস্থ অফিসার কথাটা যেন তীক্ষ্ণরূপ বিধলো তার কানে।

ডাক্তার রায়, মানে এই ব্লক স্বাস্থ্য কেন্দ্রের ইনচার্জ, তাকে ও যেন কিছুটা উদ্বিগ্ন দেখালো আজ। এবং রোজ যে একই কথাটা বলে বিব্রত করেন তাঁর জুনিয়রকে- আজও তার অন্যথা হলো না ,শুধু মনে হলো স্বরটা তুলনামূলক একটু বেশি আজকে।

ডাক্তার রায়: আর কতদিন বলব তোমাকে একটু ভালো ইস্ত্রি করা জামা কাপড় পড়ে এসো। চুলটা কিরম এবড়োখেবড়ো, তোমাকে দেখলে তো এমনিতেই রোগীরা তোমার ছায়া মারবেনা।

কথক : নিজের অজান্তে যেন মিনমিনিয়ে বলে উঠল শঙ্কু—

শঙ্কু : নীলা আমাকে খুঁজে পেলেই সব ঠিক হয়ে যাবে স্যার!"

কথক : ডাক্তার রায় ধমক দিয়ে বললেন —

ডাক্তার রায়: কী?? মিন মিনিয়ে কি বলছ বলতো? কাজে মন দাও।

কথক : আর কথা না বাড়িয়ে শঙ্কু গুটিগুটি পায়ে লেগে পড়ল ডাক্তার রায় এর সঙ্গে।

কথক : তিন মাস হল বাঁকুড়া জেলার এই ব্লক স্বাস্থ্য কেন্দ্রের জুনিয়র ডাক্তার হিসেবে জয়েন করেছে। ডাক্তারি পাশ করেছে যদিও ১৩ টা বছর কেটে গেছে এখনও বোধহয় জুনিয়র লেখাটা বাদ পড়ার মতো মাপকাঠি পেরোতে পারেনি শঙ্কু।

'সে যাক গে যাক , বড় কিছু হবার মতো ইচ্ছে বা সেই ভাবনা পোষার মত জায়গা যতদিন নীলা না আসে, তার মনে তৈরি হবে না।'

—সে মাঝে মাঝেই আপন মনে বলে ওঠে।

শঙ্কু : নীলা একবার আমাকে খুঁজে পেলেই আমি একদম ঠিক হয়ে যাবো, সমাজে চলার যোগ্য করে তুলবে ও আমাকে..। আমার একার দ্বারা কি এতো কিছু হয় নাকি— জামা ইস্ত্রি , রোজ দাড়ি কামিয়ে ডিউটিতে আসা ,মানানসই

রঙের জামা পড়া— ধূর! নীলা যে আর কতদিন লাগাবে আমাকে খুঁজে পেতে কে জানে। সেকি বলেনি আমি নিজের পায়ে দাঁড়ালে আমাকে খুঁজে নেবে? বলেছিলে তো, আর আমার নীলার নীল দুটো চোখ তো কোনদিন মিথ্যে কথা বলে না। সেই শেষ সাক্ষাতের কথাগুলো—

নীলা : তুমি জীবনে দাঁড়িয়ে যাও একবার, আমি যেখানেই থাকি তোমার কাছে ছুটে চলে আসবো, তোমার ঘর কে নীলায় ভরিয়ে দেবো।

শঙ্কু : যাই হোক এতো লোকের মাঝে হয়ত খুঁজে পেতে সময় লাগছে ওর।

কথক : লাঞ্চ টাইমে যখন শঙ্কু রোজকারের মত তার গতানুগতিক খাদ্য জল মুড়ি খেতে বসে পাশের টেবিলে বসেছিল এখানকার দুই নার্স জুহি আর বর্ষা।

আড়চোখে দেখে মিটমিট করে হাসছিল, আর কি সব যেন আলোচনা করছিল।যদিও কারণটা সে জানত।

এই তিন মাসে তার নাম পাগলা সেন বলে রটে গেছে পুরো হাসপাতালে।

তার সাথে কেউ আগবাড়িয়ে কথা বলতে না এলেও সবাই তাকে দেখে হাসে, সে হাসুক গে।

সবাই বলে জুহি আর বর্ষা নাকি নার্সদের মোড়ল এবং ডাক্তার রায় এর পা চাটা। শঙ্কু যদিও ঐসবে কান দেয় না।

এরম দুজন সুন্দরী মহিলার ব্যাপারে এরম ভাবনা আসে না তার। যাই হোক, হঠাৎ দুজনে হাসতে হাসতে সঙ্কুর সামনে এসে দাড়ালো।

জুহি : আর কতদিন এই জল মুড়ি খেয়ে কাটাবেন শুনি, এবার একটা বিয়ে করুন না, অনেক কিছু রেধে

বেড়ে খাওয়াবে আপনাকে, ডাল , ভাত— হা হা হা!! (অট্টহাসি)

কথক : পাশ থেকে বর্ষা বলল

বর্ষা : আপনি কি সত্যি বিয়ে করেননি নাকি বউ — ফুড়ুৎ! (অট্টহাসি)

কথক : শঙ্কু ঠিক বুঝলো না কি বলতে চাইল ওরা।

শঙ্কু : নানা আমার বউ দেখা আছে, সে আমাকে খুঁজে পেলেই আইন মেনে বিয়েটা সেরে ফেলবো, আর হ্যাঁ ঠিকই বলেছেন রান্নাটা বেশ ভালোই পারে ও।

কথক : শঙ্কুর কথা শুনে ওরা যেন অবাক চিত্তে থ মেরে দাঁড়িয়ে রইল কিছুক্ষণ তারপর তাড়াতাড়ি চলে গেল। যাওয়ার সময় বলতে বলতে গেল—

জুহি : পাগল টা কোত্থেকে এসে জুটেছে বলতো?

বর্ষা : কে জানে!

কথক : শেষবার যেদিন দেখা করতে এসেছিল নীলা গ্রামের বুড়ো বট তোলার নিচে, তার নিজের হাতে রেধে আনা সুক্তর স্বাদ এখন ও মুখে লেগে আছে আহা।

আর ওই শেষ উপহারটি— তার নিজের হাতে সেলাই করে নীলা লেখা রুমালটি... আজও রোজ ওটা পকেটে নিয়ে ঘোরে শঙ্কু।

কথক: ক্লাস ১১ এ শেষ দেখেছিল ওকে, ও তখন ১০ এ পড়ে। গ্রামের সব থেকে যতটা উজ্জ্বল ছাত্র বলে পরিচিত ছিল শঙ্কু ঠিক ততটাই অন্ধকারে ডুবে থাকত তার ঘরের হেঁশেল। সম্বল বলতে ছিল মায়ের সবজি বিক্রি করে রোজ বিকেলে ঘরে আনা কয়েকটা পয়সা আর বাবার

মাতাল হোয়ে রোজ পরে থাকার কলঙ্ক। তার ওপর ছোটো জাতের হওয়ায় পড়শী দের কাছে অছুত।

জাতের সঙ্গে পেট— কোথাও যেনো উননে পোড়া কালশিটে হাড়ির তলানিতে ভাগ্য রেখেছিল শঙ্কু কে।

জীবনে ব্যতিক্রম বলতে শুধুই ছিল নীলা— শঙ্কুর মধ্যে কি যেনো খুঁজে পেয়েছিল ও, মন প্রাণ সব সোপে দিয়েছিল।

ক্লাস ১১ এ পড়তো যখন ওর বাবা মানে গ্রামের মোড়ল জানতে পারলো তাদের কথা। সালিশি বসিয়ে গ্রামের মাতবর দিয়ে শঙ্কু কে গ্রামছাড়া করিয়েছিল আর নীলা কে ঘরবন্দী। সালিশি সভায় নীলার বাবা শঙ্কুর মা কে খুব শাসিয়ে ছিল মনে পড়ে শঙ্কুর।

মোড়ল : তোরা তো নীচ জাত, নুন আনতে পান্তা ফুরানির ঘরে আমি আমার মেয়েকে পাঠাবো ভেবেছিস? তোর পাগলা ছেলে যদি আর একবার বামন হয়ে চাঁদে হাত দিতে চায় ছেলের মুখটা কোনদিন দেখতে পাবে না আর। আমার মেয়েকে আমি বড় সরকারি আপিসারের ঘরে পাঠাব। দূর হ চোখের সামনে থেকে।

মোড়ল : শেষবারের সাক্ষাতে নীলা রুমালটা দিয়ে বলেছিল

নীলা : আমার চোখের জলে যতদিন আমার নামটা লেখা থাকবে এই রুমাল দিয়ে মুছবে তুমি।

কথক : তারপর জানেন অনেক চেষ্টা করেও কোনো খবর পায়নি শঙ্কু।

ডাক্তার হওয়ার যেই স্বপ্ন ছোট থেকে দেখেছিল সেটাকে শুধু স্বপ্ন না ভেবে , নিজের জীবনের একান্ত প্রয়োজন বলে গণ্য করে এগিয়েছে।

শঙ্কু : একবার জীবনে দাঁড়াতে পারলে নীলা ঠিক খুঁজে বার করবে আমাকে। দিনের পর দিন শারীরিক এবং মানসিক যে সম্পর্ক হয়েছে আমাদের মধ্যে পরিণতি দেবে তাকে।

কথক : লাঞ্চ টাইম শেষ হতেই ডাক্তার রায় ডেকে পাঠালেন শঙ্কু কে আবার বোধহয় কোন রোগী নালিশ জানিয়েছে তার নামে।

শঙ্কু : এই এক ঝামেলা- ভালো লাগেনা আর-নীলা এলে আর- যাই হোক!

কথক : হনহনিয়ে যেতে যেতে হঠাৎ সিড়ির শুরুতে ওয়ার্ড বয় সুকান্তর সাথে একেবারে সজোরে ধাক্কা।

সুকান্ত শাসিয়ে বলে—

সুকান্ত : আপনি কি দেখে চলতে পারেন না। সারাদিন কি ভাবেন এত? খেয়ে দেয়ে কাজ নেই।

কথক : সুকান্ত একটা বাক্স করে কি সব নিয়ে যাচ্ছিল। সব পড়ে ছড়িয়ে গেছে — ঘড়ি ,দুটো দামি মোবাইল, দুটো পেন , নোট বই ,সরকারি স্ট্যাম্প আর একটা রুমাল— কি একটা যেন সেলাই করা ওতে I চোখ কচলে ভালো করে দেখল শঙ্কু।

সুকান্ত : ইন্সপেক্টর যিনি এসেছিলেন তার জিনিস এগুলো— তার জ্ঞান ফিরেছে তাই তাকে দিতে যাচ্ছিলাম। হাঁ করে কি দেখছেন বলুনতো। আপনি মেজাজটাই বিগড়ে দিলেন !

কথক : ডাক্তার রায় এর ডাক আর

মাথায় নেই। স্বাস্থ্য কেন্দ্রের দোতালার একমাত্র সিঙ্গেল বেড চেম্বারে অনুমতি না নিয়েই শঙ্কু ঢুকে দেখে একজন প্রায় তারই সমবয়সি ভদ্রলোক চোখ খুলে শুয়ে আছেন আর জুহি তার গায়ে কিছুটা হেলে পড়ে প্রেসার মাপছে। শঙ্কু কে দেখে দুজনেই যেন কিছুটা অপ্রস্তুত হয়-

জুহি প্রশ্নসুচক মুখে তাকিয়ে শঙ্কুকে জিজ্ঞাসা করলো—

জুহি : আপনি আবার কি করছেন এখানে?

কথক : তার কথাকে অগ্রাহ্য করে বেডের কাছে গিয়ে নিম্নস্বরে ভদ্রলোককে বললো—

শঙ্কু : এখন সুস্থবোধ করছেন তো স্যার?

অফিসার : হ্যাঁ সে করছি....তবে আপনি কে...এই সময় হঠাৎ ঢুকে পড়লেন....!

কথক : তাকে আর কিছু বলার সুযোগ না দিয়ে আরো হালকা স্বরে বললো শঙ্কু—

শঙ্কু : নীলা কে বলবেন তার শঙ্কু এখন ডাক্তার। জুনিওর—তবে দাড়িয়ে গেছে পায়ে।"

কথক : বেরোনোর সময় অস্ফুট স্বরে কানে এল

অফিসার : আপনি কি করে.....?

কথক : হঠাৎ করে জীবনের এই অদ্ভুত আয়তনে নিজেকে খুঁজে পেতে কিছুটা যেনো দুঃখ পায় শঙ্কু- কিন্তু ওই যে জীবন তাকে পাগল বানালেও হতাশ হতে শেখায় নি। বর্তমান এর নীলা যতোই অন্য কারোর হোক, কিন্তু অতীতকে কেউ তার থেকে কেড়ে নিতে পারবে না। নিজের মনেই হেসে ওঠে শঙ্কু, কপাল থেকে নেমে আসা ঘামের রেখা পকেট থেকে রুমাল টা বের করে মুছে ফেলে।

হারানো প্রাপ্তি নিরুদ্দেশ

শ্রেয়ান ঘোষ
সেমিস্টার ১
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

বাংলার নদী মাঠ প্রান্তরে, আকাশের মেঘ রৌদ্রের লুকোচুরি খেলায়, ফুলে ফুলে ছেয়ে যাওয়া গাছে, পাখির কলকাকলিতে প্রকৃতির অপূর্ব প্রকাশ বিভিন্ন ঋতুতে । ঋতুচক্রের পরিবর্তন জীবনের এক অপূর্ব অনুষঙ্গ । কিন্তু বর্তমান সময়ে অপরিকল্পিত নগরায়নের কারণে যন্ত্রদানবের হাতে পদদলিত প্রকৃতি দেবী মুখ লুকিয়েছেন ইঁট-কাঠ-পাথরের জঙ্গলে। আজ বাংলার আড়াই খানা ঋতু - গ্রীষ্ম ,বর্ষা , ও হালকা শীত।

যে মোহময় বসন্ত দক্ষিণ দুয়ার খুলে দ্বারের কাছে জাগ্রত হত তা আজ বিলুপ্ত, যে শরৎ হিমের পরশ ও দোয়েল কোয়েলের মধুময় কলতান নিয়ে বিরাজ করতো তার দেখা পাওয়া ভার , যে হেমন্ত হিমের রাতে আকাশ প্রদীপের আলোয় পথ চিনে নিতো তা আজ সকলের অচেনা । এমন কি যে শীতের হাওয়া আমলকির ডালে ডালে নাচন তুলত সেই হাওয়ার রেশ আজ স্তব্ধ।

গ্রীষ্ম বর্ষার দোলায় চড়ে এগিয়ে চলে বঙ্গ প্রকৃতি ; কিন্তু সত্যিই কি হারিয়েছে সেইসব ঋতু ,নাকি কোথাও লুকিয়ে আছে তারা ? এখন ফাল্গুনের কোন সকালে কোকিলের কুহুতানে মুখরিত হয় শহরের গলিপথ ,হঠাৎ কোন আম গাছের তলা আমোদিত হয় মুকুলের গন্ধে, দোল পূর্ণিমার রাতে চন্দ্রালোকে প্লাবিত হয়ে যায় ফ্ল্যাট বাড়ির একফালি বারান্দা - তখনই খবর পাই বসন্ত এসে গেছে। আবার যখন আশ্বিন মাসের কোন সকালে ঘুম ভেঙে উঠে দেখি শরত তপন প্রভাত স্বপন বয়ে আনছে , হঠাৎ কখন কাজের তাড়ায় ছুটতে ছুটতে মাড়িয়ে ফেলি একরাশ শিউলি,নীল আকাশে দেখি সাদা মেঘের ভেলা - তখন খবর পাই আনন্দময়ীর আগমনের সাথে শরৎ এসেছে। হেমন্ত আজ সত্যিই বড় কৃপণ - তাকে খুঁজে নিতে হয় কোন এক পুরনো ভাঙ্গা বাড়ির উপর আকাশপ্রদীপ দেখে।

সেই আকাশপ্রদীপ দেখে হয়তো পূর্বপুরুষেরা পথ চিনে আসবেন। হয়তো বয়ে আনবেন সেই পুরাতন চিরাচরিত ঋতুচক্র পরিবর্তনের অপরূপ বর্ণচ্ছটাকে । তাই মনে হয় ঋতু গুলি হারিয়েও হারায়নি, লুকিয়ে রয়েছে যান্ত্রিক নগর সভ্যতার কোন এক অজানা গোপন কোনে বঙ্গদেশকে আলিঙ্গন করে।

মন্দবাসার গল্প

দেবাশ্রিতা মজুমদার
সেমিস্টার ৯
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

আমার একটা পাহাড় কেনার শখ
তোমার চাহিদা স্রোতস্বিনী নদী
আমি যত বলি ডুব দিতে চাই আমি
তুমি তত বলো পাখি হতেম যদি।

আমি চাই শুধু এক টুকরো ঘর
তুমি পেতে চাও সাতমহলা বাড়ি
তোমার আমার পছন্দ মেলা ভার
আমাদের যেন সাতজন্মের আড়ি।

তবুও কী করে ভাব হয়ে যায় যেন,
না কষা অঙ্ক মিলে যায় বারেবারে
এমন করেই থেকে যাওয়াটুকু থাক,
মন্দবাসার গল্পের অভিসারে!

আর কী আসিবে ফিরে ?

শ্বেতা মল্লিক
সেমিস্টার ৩
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

তাকে তুমি সহিষ্ণুতা পারো না শেখাতে,
যে চিনেছে রক্তের স্বাদ, বারুদের গন্ধ,
তুমি ব্যর্থ তাকে ভালোবাসার রক্ত {রঙ }চেনাতে!

সততার রং যেখানে হয়েছে ফ্যাকাশে,
ঠখ {ছলনা} প্রবঞ্চনারা প্রবঞ্চনা প্রবাহিত যেই চোরা স্রোতে,
কেদার'এর কেদার এর সুর কীভাবে বাজে সে বাতাসে!

যে হাত কলমের বদলে রক্তে রেঙ্গেছে,
কত কিশোরীর পা লাল হয়েছে ঘুঙ্গুরের ক্ষতে,
আর শৈশব পাচার হতে হতেই সরেছে কেটেছে!

পাঠশালায় গুলির বর্ষণ,
কিংবা বিধর্মী শিশুর ধর্ষিত দেহ,
অসহায় মা সবই তো দেখছেন দেখেছেন।

তোমার নাম আমরাই দিয়েছি সমাজ ,
এখানে তো মানুষ মানুষকেই বেচেছে!

সন্ধ্যে নামার বেলায়

সম্পূর্ণা দে
সেমিস্টার ৩
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

সন্ধ্যে নামার বেলায়
গোধূলির আলো খেলে যায়।
ক্লান্ত পথিক, আঁকাবাঁকা পিচ পথে
নীরান্তে হেঁটে চলে সূর্যাস্তের সাথে।
মাঝদরিয়ায় পাল তুলেছে মাঝি
ভাটিয়ালি গানে বরণ করবে সাঁঝি।
দূরের ওই গাছে বউ কথা কও
তার মনের কথা শুনতে কি পাও?
নদীর ঢেউ গুলো আজ উতলা
বাঁশির সুর আজ এলোমেলো
লাল পাড় সাদা শাড়ি
এলোকেশী যুবতীর চুলের রঙ কালো।
বিকেলের শেষ ট্রেন পারি দিয়েছে গন্তব্যে
সন্ধ্যে নামছে,স্টেশনমাস্টার এর বাঁশি
আর যাত্রীদের মন্তব্যে।
রেললাইনের দুধারে সবুজ ক্ষেত
রাখাল বালক তার গরু চরাচ্ছে এখনো
“খোকা ফিরে আয়” - এক মা এর ডাক
এপার থেকে শোনা যায় তখনও।
শঙ্খধ্বনির পড়েছে রাশ
তুলসিমঞ্চে জ্বলেছে মঙ্গলপ্রদীপ
পুড়েছে অশুভর আশ।
তানপুরায় উঠেছে সুর, ক্যানভাসে পড়েছে তুলির টান

লেখকের কলম আজ বোধহয় করেছে অভিমান
জমিদার বাড়িতে আফিমের ধোঁয়া আর কাওয়ালি গান।
লম্ফবাতির আঙিনায়,
সবাই ঘরে ফিরে যায়
সন্ধ্যে নামার বেলায়।

যে অতিথি আমার দ্বারে স্থিত

অর্কপ্রভ মজুমদার
সেমিস্টার ১
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

যে অতিথি আমার দ্বারে স্থিত, তাকে উপহার দাও,
তাকে উপহার দাও ভরা জোয়ারের স্রোতস্বিনী।
আমি মন্থর, শ্রান্ত; তার হিমেল আনুগত্যে লুকিয়ে আছে,
লুকিয়ে আছে নক্ষত্রবিহীন অমাবস্যার কালো ক্ষত।
একটু দক্ষিণের বাতাস চায় সে; হাতে বোনা সবুজ
সোয়েটারে ঘাপটি মেরে বসে আছে ক্ষুধার্ত শ্বাপদের মতো।

যে অতিথি আমার দ্বারে স্থিত, তাকে উপহার দাও,
তাকে উপহার দাও নোঙরহীন বন্দর।
বারবার নিজেকে বাঁধতে চায় সে অপার্থিব অনুরাগে,
তার মধ্যে শূন্যতায় ভরপুর হয়ে গেছে অহংকারের থলি।
স্মৃতি রোমন্থন আর খালি স্মৃতি রোমন্থন; অভিজ্ঞতার
পুঁজি খুলে দেখি স্যাঁতস্যাঁতে ছত্রাকের গলি।

যে অতিথি আমার দ্বারে স্থিত, তাকে তিক্ততা দাও,
তাকে তিক্ততা দাও কোনো ভর দুপুরে শায়িত এক বাউন্ডুলের।
যে অতিথি আমার দ্বারে স্থিত, তাকে অস্তিত্ব দাও,
অস্তিত্ব দাও দস্তোভস্কির বইয়ের মাঝে।
শেষে যখন রইলো না আপ্যায়নের ত্রুটি,
স্বাধীনতার হাসি ফিরে পেল দুই দশকের খুঁটি।

টাপুর টুপুর বৃস্টি

পল্লবী চক্রবর্তী
সেমিস্টার ১
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

মেঘলা আকাশ। ভিজে মাটির গন্ধ।
বর্ষাকাল এর আগমন। হ্যাঁ, সেই বর্ষাকাল এর আগমন।
মনে আছে ওই আগের বছররের ফুটবল খেলার কথা, এই সময় ?
মনে আছে সেই বৃষ্টিতে ভেজা ?
আর সেই হালকা জ্বর আসা? আর মায়ের থেকে বকুনি খাওয়া ?
সেই টাপুর টুপুর বৃষ্টির শব্দ ?
সেই স্কুল কামাই এর বায়না ?
আর ওই স্কুলে বন্ধুদের সাথে বৃষ্টির জন্য আটকে পড়া ?
আচ্ছা বেশ, তাহলে ভোলোনি দেখছি ?
এই বছর তেমনটাই কি হবে ?
না এই লকডাউন-এর জন্য আমাদের এই বর্ষাকালের আনন্দটাও নষ্ট হয়ে যাবে ?

কায়াজমা

অভীরুপ চক্রবর্ত্তী
সেমিস্টার ৯
জৈবপ্রযুক্তি স্নাতকোত্তর বিভাগ
সেন্ট জেভিয়ার্স কলেজ (স্বশাসিত), কলকাতা

হাঁটুটা এখনও ঠিক আছে, এটাই বড় কথা,
পাঁচ বছর যে কি করে কেটে গেলো, সেটাই খালি বুঝতে পারিনা।

প্রথম বছরে মনে হতো, এই তো জীবন শুরু!
গলায় আই.ডি, কলার শার্ট পরে নিজেই নিজেকে বলতাম "এনজয় গুরু"।
জাভোৎসব থেকে এফ.আই.বি বেশ সেজেগুজেই ঘুরলাম,
কেউ তো নোটিশ করুক, এই আশাটুকুই রেখেছিলাম।
সেসব কথা এখন বাদ দে, খাতা পেনে এবার হাত দে।
মনের কথাটা তখন শুনে নেওয়া উচিত ছিল, এখন যাকগে...

দ্বিতীয় বর্ষে যখন উঠলাম, একটু ভারিক্কি এলো,
আই.ডি টা তখন পকেটে পুরে সিনিয়র হওয়া হল।
না না ওরম ভেবোনা, ভুল কাজকর্ম কিছু করিনি,
শুধু জুনিয়র গুলোকে একটু আধটু কলেজের সাধটুকু দিয়েছি।

তবে সে সাধটা পেট অবধি পৌঁছানোর আগেই,
নাক দিয়ে আর এক ভদ্রলোক প্রবেশ করলেন,
তার সাত খুন মাফ করেই,
বেশ ভালোবেসেই ডাকলাম তাকে, কোভিড নাইনটিন।

ব্যাস, তারপর আর কি,
জি.পি.এ ও ভুঁড়ি দুটোই দুর্বার গতিতে বেড়ে চললো,
কুড়ি থেকে বাইশ চোখের নিমেষে কেটে গেলো।

এখানে একটা জরুরি কথা বলে রাখা দরকার,
কারণ কলেজ জীবন ও কবিতাটা অলমোস্ট ওভার,
মনে রাখবেন, সব সম্পর্ক কিন্তু দূরত্বের জন্য ভাঙেনা,
আর কিছু দিনের জন্য হলেও, তিরিশ মাদার টেরেসা সরণিই আমার ঠিকানা।

সময়টা এখানে একই সাথে বেশি আবার কম,
সেটাই বুঝতে বুঝতে বছরটা হয়ে গেল পঞ্চম।
তাই এখানে এসে আজ এই উপলব্ধি করতে পারি,
চার তলা ওঠার থেকে ওই ফ্রন্ট গেট দিয়ে বেরনো এ কষ্ট ভারি।

হ্যাঁ জানি, ভালোবাসা উথলে পড়ে, যখন শেষটার দেখা মেলে।
জীবনের কায়াজ্‌মায় তাই, এই কবিতাটাই রেখে গেলেম।

Enhancing Career Opportunities in Life Sciences with statistics and programming.

Poulami Dey, Co-founder, EduBio India Pvt. Ltd.

Introduction

The fields of life sciences are very fertile source of big, complex and high dimensional data. Computing innovations have empowered today's world with efficient production, collection, and processing of the data. Advanced computational techniques and programming languages such as Python and R facilitate the application of statistical concepts on data to solve real-world problems by formulating data-driven predictive analytics. The life sciences industry has incorporated data analytics as an indispensable tool as it has proved to overcome its various challenges and enhance the operational efficiency. A recent business review has indicated a 12.75% compound annual growth rate of global life science data analytics market size during the period of 2022 to 2030[1]. This tremendous growth rate has obviously created an increased demand for data analysts and data scientists in the industry. Interestingly, it is reported that the data analyst job was one of the most sought-after jobs in India in 2021[2]. Further in countries like USA, job opportunities for data analysts are expected to grow by 23% from 2021 to 2031 (based on The U.S. Bureau of Labor statistics)3. Undoubtedly, US and India are the two most prominent hubs for data analytics jobs[2].

How data-driven analytics are transforming the life sciences industry

The pharmaceutical and the biotechnology companies are witnessing the most benefits of analytics and are also rightfully the key players in creating more demand for data analysts and data

scientists for the life sciences industry[4]. A review has reported that the pharmaceutical companies actively leverage real-world data and the associated analytics to strategize and accelerate the process of drug development[5]. The application areas such as adverse event predictions, clinical trial recruitment, drug repurposing etc. make use of the data and machine learning (ML) algorithms or natural language processing methods to improve the drug-discovery process. The type of data that are commonly processed for the purpose are electronic health records, clinical notes, claims etc[5]. Additionally, big data generated from next generation sequencing (NGS) technologies are applied to biomedical study that pave the way for advancements in personalized medicine or personalized nutrition research efforts. The increased production of similar big data from a variety of NGS technologies in biotech companies are also fueling data-driven analytics to address the various challenges including alternative energy sources, climate change, hunger issues etc.

Typical responsibilities of data analysts or data scientists in life sciences

The most important tasks that data scientists or data analysts mainly perform can be broadly binned into the following three categories:

1. **Data preparation:** This consists of data collection, organiza tion and cleansing. Data collection and systematic organization: Gathering and archiving data in an established scientific manner is very essential for its further processing. Data cleansing: Detecting anomalies and cleaning them (for e.g., removing, replacing or modifying corrupted, inaccurate, missing, or irrelevant parts of gathered data) are mandatory tasks performed by the professionals in the work space.
2. **Data visualization:** Powerful data visualization to identify trends or patterns in data is very vital for interpretations. Plots, charts, images, maps, often animations are very useful to visualize the dynamics or to present the findings from an analysis.
3. **Creating data models:** Machine learning algorithms are routinely used to build and train models to predict outcomes on larger

data and find patterns in them. Various tools are frequently used for this purpose.

The tasks described above are common to data analyst or data scientist job in any field such as finance, media, entertainment, telecommunications etc. However, when the input data belongs to the life sciences industry, it makes sense for an individual with life science background to acquire required skills and utilize the golden opportunity to widen the career horizon.

Skills required by individuals trained in life sciences to build a career in data science

The burst in the demand for data analysts or data scientists is met with a dearth of suitable talent as elucidated in a very recent detailed report based on a global survey of thousands of working individuals[6]. It is evident from the report that RStudio is one of the most popular tools used by organizations for data analytics. It is emphasized that knowledge of statistics, understanding of machine learning algorithms, expertise in data visualization and data management techniques and handling of RStudio and its libraries are among the very important skill gaps faced by the organizations today[2, 6].

Massive open online course (MOOC) providers offer excellent courses to meet the training needs required for the essential skills. However, there's an excessive shortage of live interactive training programs for aspirants who are eager to build a career as data analyst or data scientists in the life sciences work space. A conspicuous void exists in terms of availability of hands-on-training/ internship projects to learn and develop skills for securing a job in this space.

A start-up, Edu Bio India Pvt. Ltd. (https://theedubio.com) is committed to bridge the stated gap for the skills required by the life sciences industry. The company provides live interactive workshops and training programs related to statistics, ML, data management, and data visualization. Further, the company also hosts training programs on usage of RStudio and Bioconductor libraries to apply the statistical methods in data analytics which includes data

preparing, processing, visualizing, building models, predicting trends and interpreting results. Additionally, the company offers relevant projects and provides the aspirants with suitable resources to learn and develop skills required to make them industry-ready.

Conclusion

To summarize, there is a growing demand for data analysts and data scientists in the life sciences industry. In the article it is discussed in details that there are conspicuous skill gaps that make it difficult for individuals trained in life sciences to opt for such jobs as career options. However, MOOC providers have suitable courses for the individuals eager to build a data analyst or a data scientist career. The start-up EduBio India Pvt. Ltd. (https://theedubio.com) offers live interactive training programs and relevant projects that can enable the individuals with life science background to acquire skills to be ready for a data analyst or a data scientist job.

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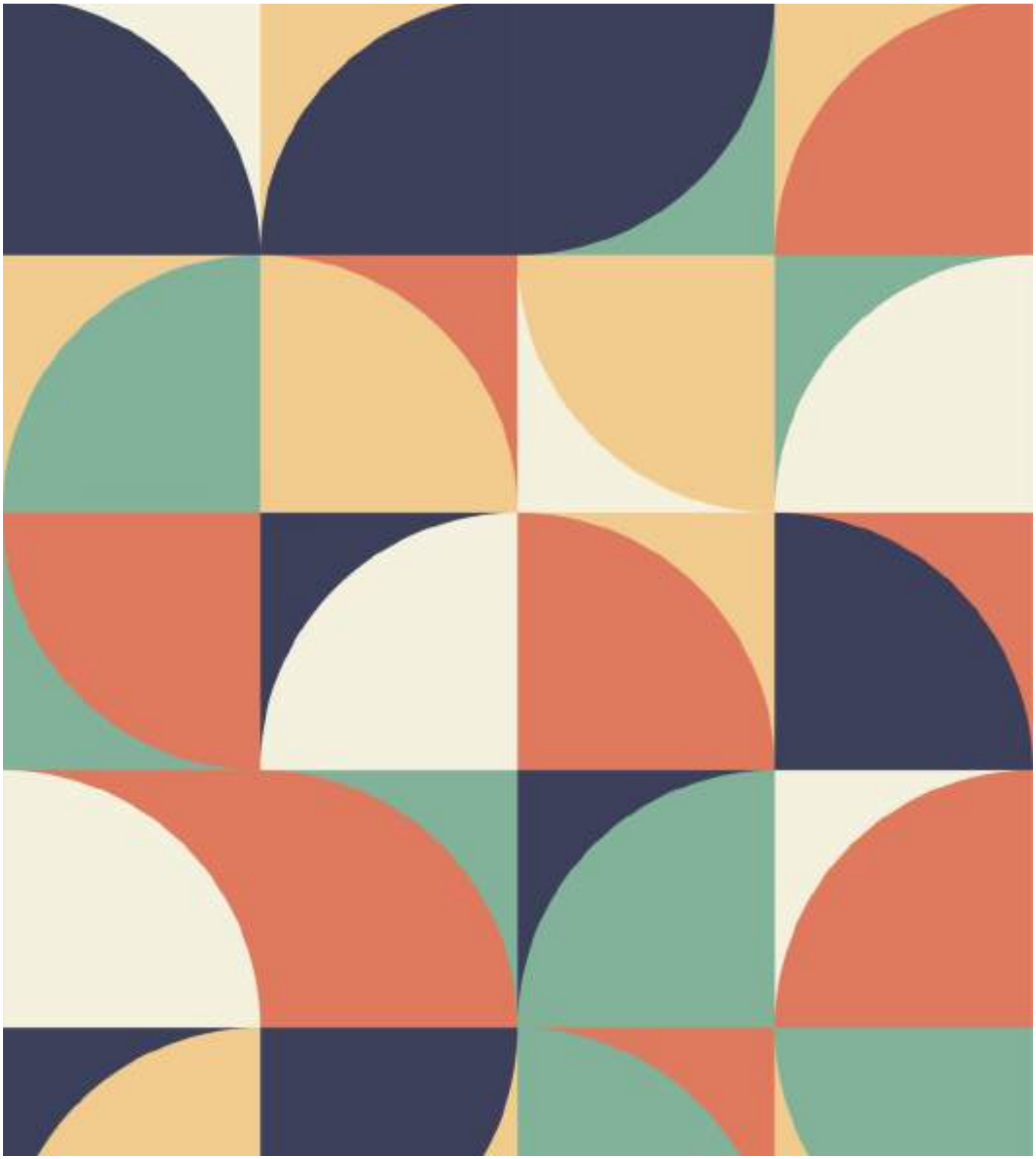

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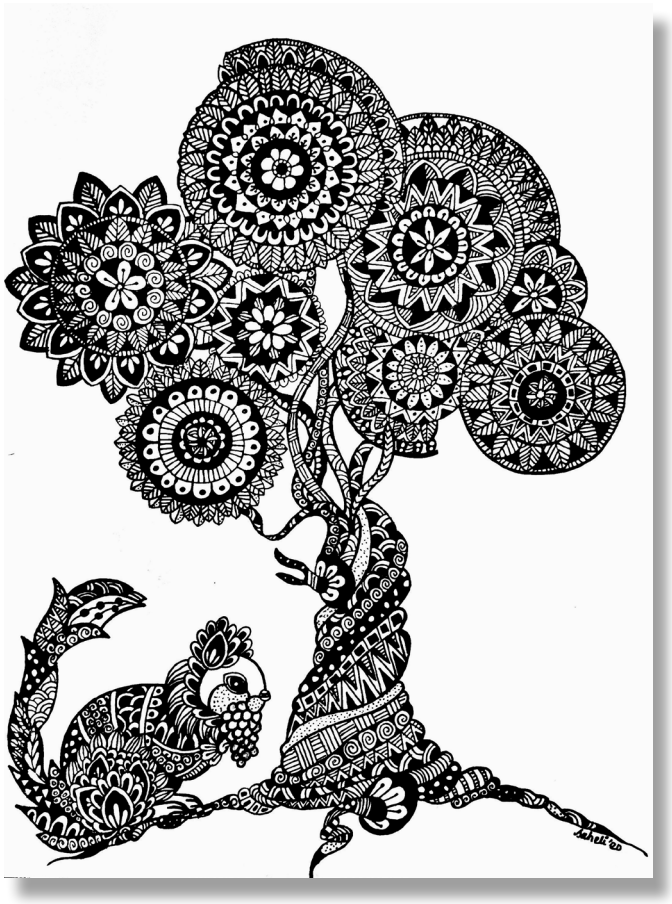
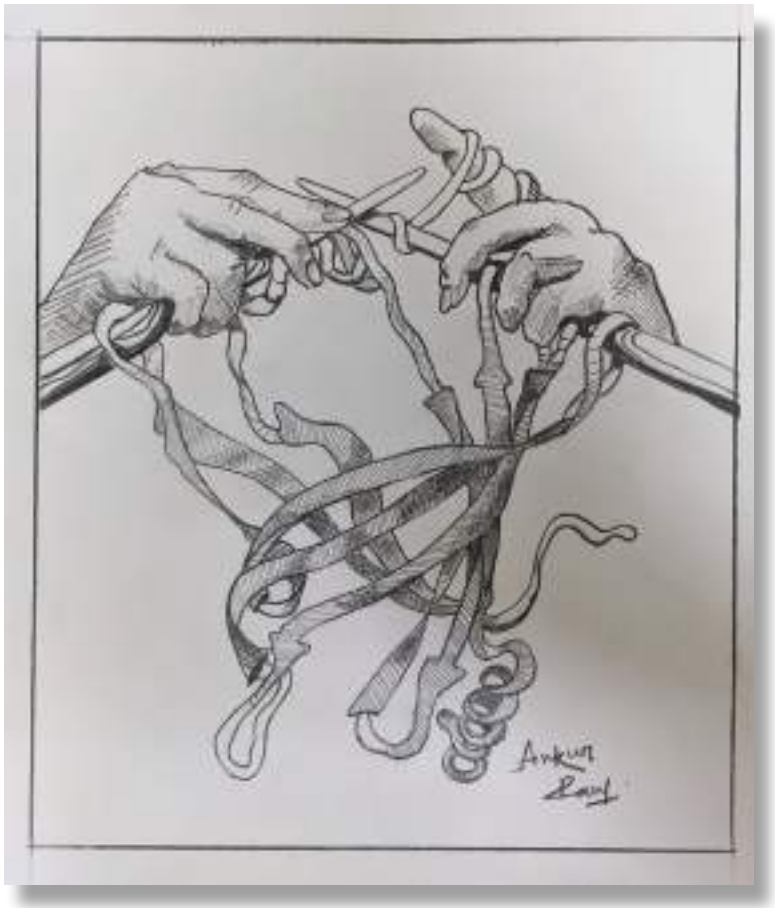


Saheli Majumder
Semester VII



Ankur Paul
Semester VII

Soham Pal
Semester III

Supreeti Poddar
Semester III

Konkona Lahiri
Semester III

Rupangi Biswas
Semester III

Madhushree Pramanik
Semester I

Swastik Khan
Semester I

Spandan Dutta
Semester I

Photograph by Dr. Aniruddha Banerji
Assistant Professor
Postgraduate Department of Biotechnology
St. Xavier's College (Autonomous), Kolkata

Indian Royal Bengal Tiger (*Panthera tigris tigris*)
Navaneel Sarangi
Semester IX

Blue-eared Kingfisher *(Alcedo meninting)*
Leena Bhadra
Semester IX

Saltwater Crocodile *(Crocodylus porosus)*
Abhijit Saha
Semester V

The Great Cormorant *(Phalacrocorax carbo)*
Shaiq Ahmed
Semester V

Rhesus Monkey *(Macaca mulatta)*
Subhrasobhan Biswas
Semester III

Transverse Ladybug *(Coccinella transversalis)*
Baibhab Chakraborty
Semester III

Black Garden Ant *(Lasius niger)*
Pratyusha Saha
Semester III

Photograph by Dr. Aniruddha Banerji
Assistant Professor
Postgraduate Department of Biotechnology
St. Xavier's College (Autonomous), Kolkata

Taken at **Tso Moriri Lake,Changthang Plateau, Ladakh**
Leena Bhadra
Semester IX

Red Wings *(Thunbergia coccinea)*
Krittika Dey
Semester IX

Taken at **Lion's Point, Lonavala**
Sampreet Manna
Semester V

Neuronal Tree, Maidan, Kolkata
Souvik Ghosh
Semester III

The Common Daisy *(Bellis perennis)*
Reetwan Sarkar
Semester III

Taken at **Gurudongmar Lake, North Sikkim**
Srijani Roychowdhury
Semester III

Lentinus sp.
Swastik Kundu
Semester I

Sunset at the Desert
Shehala Dhar
Semester I

PODCASTS

Series 1 : Scientific

Future of Antibiotic Resistance - What is it and where is it leading us?

This year's podcast provides a general introduction into the theme of this year's Chiasma, beginning with the causes of increasing resistance against conventional antibiotics among bacteria, going into depth about the various mechanisms such as antibiotic efflux, target modification, chemical alterations, etc by which bacteria acquire resistance against commonly used antibiotics. In addition, it also looks into the dangers that we face as a result of such antibiotic resistance and possible therapeutic strategies that could help us circumvent the problems posed by antibiotic resistance: alternative strategies such as nanotechnology, recombinant protein expression and quorum quenching have been discussed in detail and provide the readers with in-depth knowledge on how the threats of antibiotic resistance can be dealt with.

Recitation by:
1. Roopkatha Sen (Second Year)
2. Agnish Roy (Second Year)
3. Souvik Ghosh (Second Year)
4. Sakshi John (Third Year)
5. Uttirno Nath (Fourth Year)
6. Surya Sarathi Das (Fourth Year)

Conceptualized by: Abhinanda Adak & Krittika Dey

Series 2 : Literary

- যে অতিথি আমার দ্বারে স্থিত
  - অর্কপ্রভ মজুমদার (প্রথম বর্ষ)
  আবৃত্তি: অভিরূপ (পঞ্চম বর্ষ)
  শ্রেয়ান (প্রথম বর্ষ)
- কায়জমা
  - অভিরূপ চক্রবর্তী (পঞ্চম বর্ষ)
  আবৃত্তি: দেবাশ্রিতা ও অভিরূপ (পঞ্চম বর্ষ)
- মন্দবাসার গল্প
  - দেবাশ্রিতা মজুমদার (পঞ্চম বর্ষ)
  আবৃত্তি: দেবাশ্রিতা মজুমদার (পঞ্চম বর্ষ)
- The Night on the Street
  - Swastik Khan

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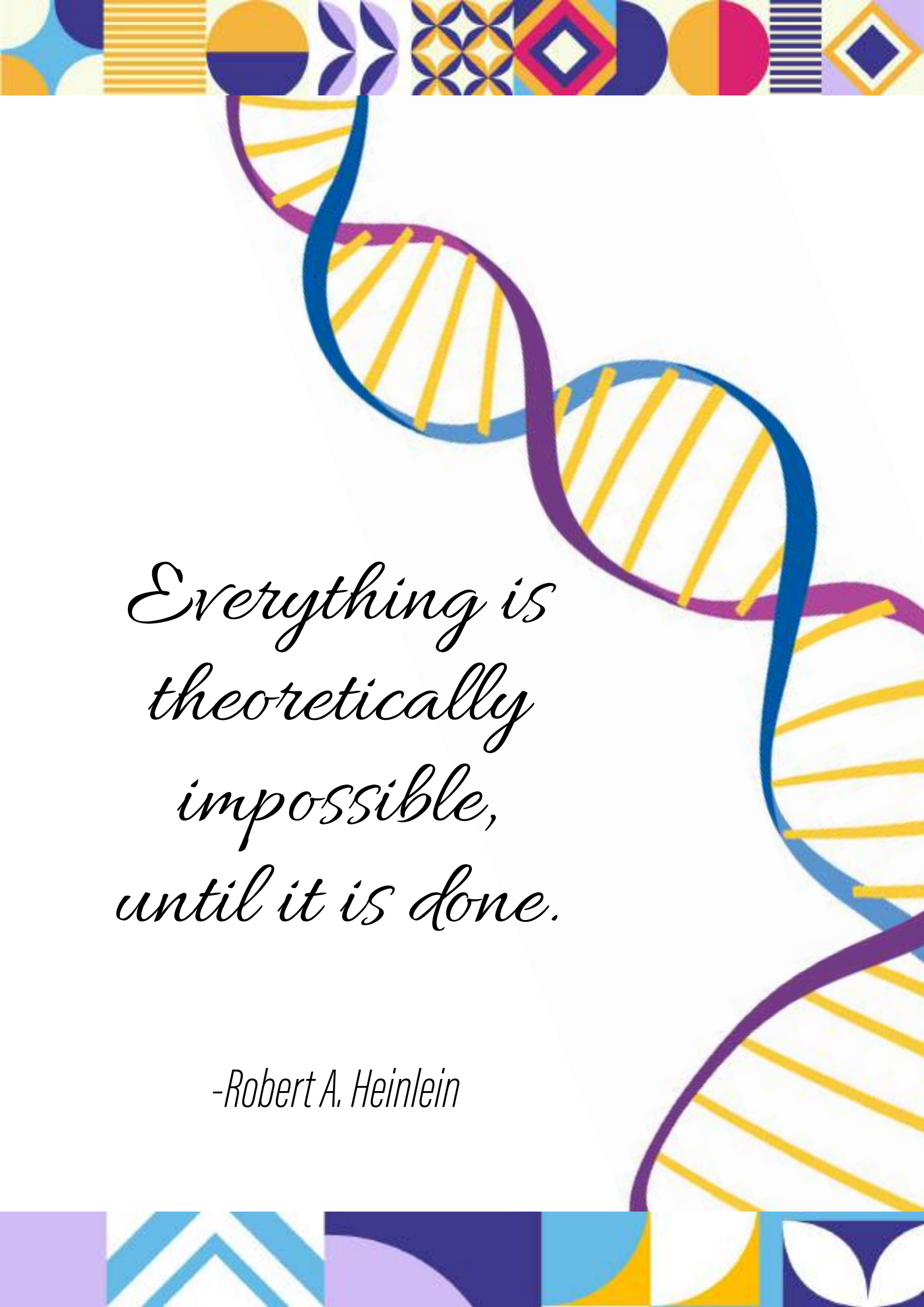
Everything is
theoretically
impossible,
until it is done.
-Robert A. Heinlein