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Foreword by The Staff Advisor

"Smooth seas do not make skillful sailors" – Chinese Proverb

The significance of oxygen in our daily lives has probably never been felt as acutely as in recent times. For the Chemistry Department of St. Stephen's College, its annual journal 'OXYGEN' has, for the past many years, been infusing fresh life into the routine teaching-learning activities. This year too, despite the odds, our OXYGEN team has worked tirelessly – as has the entire Chemistry Society Executive – to come out not only with this publication, but also with a couple of Newsletters over the course of the year, thereby providing students multiple platforms to

document scientific developments, whilst also allowing the sharing of ideas, experiences and creativity. Congratulations to Editor-in-Chief Sakshi and Sub-Editors Karen & Rhea, and to all those who volunteered to help in any way!

I would like to place on record how proud I am of the entire Chemistry Society Executive Council who have, under the superb guidance of President Ridhima and Vice-President Diksha, managed to organize successfully a plethora of activities in difficult times – even while having to readjust to the rather abrupt recommencement of regular classes and labs after a nearly two-year pandemic-induced gap. Talks by eminent scientists, scientific debates, photography competitions and other activities organized as part of the annual festival Resonance, Inter-College Paper Reading and Article Writing competitions, Workshops, Instagram-post series on Thermodynamics, Medicinal, Nuclear and Quantum Chemistry, etc.... all these events contributed to make the academic year 2021-22 fulfilling and everyone, especially our very deserving outgoing council members Ridhima, Diksha, Namrata, Jay Deepti and Sakshi, even greater achievements in the future!

Finally, a special thank you to all who contributed articles for OXYGEN, without which this publication would not have seen the light of the day. Happy reading!

"Live as if you were to die tomorrow, learn as if you were to live forever" – Mahatma Gandhi

Dr. Rene Saksena

Obstacles and challenges strengthen us consciously and subconsciously. The key to growth during tough times lies in observing and managing your emotions in a positive yet detached fashion.

My heartfelt gratitude and thanks to our Chemistry Department for their constant support. Wish you all my dear junior members best of luck for your exams and for their future endeavours.

“There Are No Limits To What You Can Accomplish, Except The Limits You Place On Your Own Thinking.” – Brian Tracy

I would like to congratulate the editorial team and to all those who made serious efforts to make this possible. I appreciate your competence in taking time out from your tight schedule and making this Journal a success.

Heartiest felicitations to Dr. Rene Saksena and Dr. Violet R. Macwan, the Advisors Chemistry Society during 2021-22 and 2020-21 respectively, ‘Oxygen’ Journal Head, Sakshi Sharma and the entire team of editorial board on ensuring the quality and timely publication of the Journal.

I wish ‘Oxygen’ all the success!

Dr. Vibha Sharma

A Message from The Head of Department





Foreword by The Editor-in-Chief

Chemistry! I still remember the first time I chanced upon this word as my school teacher initiated me into the world of 'reactions', 'bonds', 'elements', and 'compounds'. I transcended into a world that was replete with inexplicable, yet synergistic occurrences, and most importantly, 'synthesis'. My appetite to discover new developments in science and the joy I derived from innovating new ideas made me realize that science is the path for me, a path that would allow me to create a tangible impact on the world around me. With the same inherent belief, my academic career has solely been focused on making a change for the better. Getting admission to the prestigious St. Stephen's College

took me closer to my future ambition, and despite certain hurdles in terms of adjusting to uncharted territory, I emerged successful, both as a student and a valuable member of my college community.

My experiences as part of the Chemistry Society are very dear to my heart. The Chemistry Society of St. Stephen's College has made me realize my strengths and molded me into a person who can handle responsibilities and manage things well. The first time I was introduced to the Society was through the Orientation Program, where our enthusiastic seniors introduced us to the various verticals and posts of the Society. At that time, however, I had never thought that one day I would be the Editor-in-Chief of the Society's Annual Journal.

In my first year of college, the Chemistry Society was the first society where I volunteered for tasks without any fear. This, I can credit to the very friendly nature of our seniors. From distributing the refreshments after offline lectures to editing articles for our Annual Journal to giving the Vote of Thanks for various events, I did every task given to me with great enthusiasm, and it took me even closer to the Society. I applied for a post in the Society's Executive Council in my second year and was selected for the same. I was thoroughly aware of the responsibility that came with the position. So I started treating tasks related to the Society as if they were mine. Making posters and presentations for the Orientation late at night, managing glitches in events, getting scolded for mistakes - even stressful memories with ChemSoc, all turned sweet in my mind.

I was selected as the Editor-in-Chief of the Annual Journal of the Chemistry Society, and I found a medium to channel my voice. This provided me with the opportunity to expand my knowledge base and make myself acquainted with the latest developments in the field of Chemistry. During the academic year 2021-22, Team Oxygen has also launched its first-ever Newsletter, "Megaphone", whose first edition was released in October'21 and the second in April'22. The Chemistry Society is the heart of our Chemistry Department. Working with this society taught me the qualities of patience and diligence and has helped me to develop my leadership and interpersonal skills. The most important thing it showed me is how to maintain an equilibrium between my responsibilities and my aspirations, between my ideas and their execution, and lastly, between my physical disposition and its psychological impression.

In the end, I would like to thank our Head of Department Dr. Vibha Sharma, Staff Advisor Dr. Rene Saksena, Former Staff Advisor Dr. Violet R Macwan, and all my seniors for showing faith in me and giving me this opportunity to serve as Editor-in-Chief of the Chemistry Society. I would also like to thank my fellow council members for being so helpful and friendly throughout my journey. A special thanks to my Sub-Editors, Rhea and Karen, who have worked selflessly and sincerely for the Newsletter, "Megaphone" and the Annual Journal, "Oxygen" and other second-year council members who have contributed to the journal. I have full faith in our juniors that they'll give their best for taking the Society to great heights. I wish them all the best in all their future endeavors.

Sakshi Sharma
Editor-in-Chief
The Chemistry Society
2021-2022

*"Failure is often that early morning hour of darkness which precedes the dawning of the day of the success"-
Leigh Mitchell Hodges*

The journey from being, in our Principal's words, 'The Chosen One' to the 'President' of the Chemistry Society has been a whirlwind in itself. Rising from the torments of a budding first year to ranting the juniors for improper work, when I grew up, I didn't even realize. I came to college with a dream and a vision, little did I know that those red bricks would open up an endless realm of opportunities for me. I let those ambitious prospects grow in me organically as I journeyed through my course of Chemistry and probably that led me to come forward to present a Vote of Thanks at the Borosil Workshop. It took a lot of courage in me to speak up in front of a bunch of unknown faces in a new environment, but once it was over, I was filled with a sense of sheer enthusiasm which never saw the dim light thereafter. From running across the college to get tea cups, souvenirs etc., to managing Gmeet attendance, checking for technical glitches and taking screenshots, we all have come a long way and there are still miles to go.

Nelson Mandela once said-'It always seems impossible until it is done' and that has been 100% true. We have faced so many hiccups throughout that at times hosting an event the next day felt futile but as it is said 'Problems are not stop signs, they are guidelines' (Robert H.Schuller), we used to muster up the courage, only to end up making the event a huge success. Chemsoc has taught me

Foreword from The President



in life. The lesson of patience, the lesson of perseverance, the lesson of hard work, the lesson of team spirit, and the lesson of 'true friendships'. It has been the most wonderful place to be during times of happiness and the source of greatest learning during testing times, but through thick and thin, it has been there as a home away from home. Chemsoc has grown in me a more mature version of myself, both mentally and emotionally. It has taught me the significance of serenity and the necessity of being stringent. It has helped me learn the importance of planning and time management and value the momentum of life skills. There have been times of self-doubt, breakdowns, and situations where everything felt like breaking apart but my entire team in the executive council has come up to the rescue.

The third-year council has been the life support system throughout; without them, I cannot envision rowing past this year and it goes without saying the relentless efforts of the second-year council that has helped us pull through all our initiatives in the best way possible. Despite the differences we all carry, despite the difficulties we face, together we have managed to swim across the ocean to the best of our limits. I am thoroughly grateful to the Head of the Chemistry Department, Dr. Vibha Sharma for supporting our society's endeavors throughout and highly obliged to Dr. Violet R. Macwan to entrust me with this eminent responsibility. I consider it a blessing to have Dr. Rene Saksena as our mentor and guide, who has been so considerate and understanding throughout that made us sail through this journey in the most subtle way possible. Her advice and guidance

have always given an impetus to all of us to grow forward and push beyond push limits.

Today as we bring this academic year to a humble culmination with a piece of our hearts out as the 'Oxygen 2022', we are filled with a sense of pride and gratitude. I'm beyond words to thank all those who have been my anchors, all those who have silently worked for society, and all those who have been a constant source of motivation. As I pen down my foreword as the President of the Chemistry Society, filled with happy tears, I sign off with content and confidence and wish the forthcoming council and the future batches all the very best and a blissful Chemsoc journey.

Ridhima Raina
President of the Chemistry Society
2021-2022

Foreword from The Vice President



As an aspiring chemist, I recognize the value of deeply examining everything that is visible and manifest, to have a better scientific understanding. Applying what I have learned in academia to my personal life, I realize that introspection is just as important for understanding ourselves! Looking keenly, I see my ChemSoc journey as a beautiful fabric, knitted by three interwoven strands – growth, satisfaction, and most importantly gratitude! And as far as I can recall, every major event of my ChemSoc journey has revolved around these cornerstones, providing me with a meaningful and enriching odyssey!

All this started off with me excitedly volunteering to be the anchor for the society's very first event for the academic year 2019-20 - 'The Career Talk'. I must say that the experience was so liberating in itself, that it introduced me to a hitherto unfamiliar yet fascinating professional world and exposed me to different areas of growth and development. I still remember earnestly texting one of my seniors who provided me with this opportunity, saying, "thank you for showing *disha* to *diksha*"! And since then, there has been no looking back! The journey from being a volunteer, to the Treasurer, and to now being the Vice-President, has been a roller-coaster ride, with multiple twists and turns along the way. While handling hiccups during events' execution, while having fruitful discussions with our Staff Advisor both in person and on calls, while getting in touch with eminent Professors worldwide, or while just spending time with people from other societies for collaborations and growth, I grew up intellectually and emotionally alike!

From being with each other in all shades of circumstances, to crying together over things that couldn't work out, and to also rejoicing with each other and celebrating for even the smallest of the victories, we the council members have come a long way, fostering beautiful friendships that will last very long, for sure! To put it simply, ChemSoc journey has been a whirlwind of emotions for me, which now make me feel so satisfied, for if that was not the case, today the strength to handle the unexpected would not have been the same! In fact, building on the maturity I have

gained over these three years, I believe that all my ups and downs were there for a bigger reason - steering me towards a stronger version of myself. All this has reinforced my faith in the adage like never before, *"whatever pleases the God, O Nanak, that alone is good"*!

Throughout this beautiful journey of self-discovery, self-realization, growth, and establishment, I have been fortunate to have some of the best mentors to look up to, without whose support, nothing would have been possible. I am eternally grateful to Dr. Vibha Sharma for her unwavering support, as well as Dr. Violet R. Macwan for her faith in us. I have no words to express how grateful I am to Dr. Rene Saksena, the Chemistry Society's Staff Advisor for her invaluable advice and timeless suggestions. I am extremely thankful to the faculty members of the Chemistry Department, who have been with each one of us through thick and thin, being our biggest support systems throughout. Concurrently I am sincerely humbled

by the unwavering support of our lab staff, whose help and guidance has always been the society's strength!

In all, it is my firm belief that the Chemistry Society, in some of the most beautiful ways, has blazed my trail for a more meaningful life. I am truly thankful for the experiences which have been enlightening, bringing me back to my roots – the three strands that strengthen the fabric of my life! And today, as I and the entire ChemSoc family introduce you to the 2022 edition of Annual Journal, Oxygen, we are sure that you too will be able to experience our emotions and connect to the society through our experiences, setbacks, victories, moments of despair and joy!

Wishing you all the very best and hope you have a good time flipping through the pages of the 'Oxygen 2022'!

Earnestly yours,
Diksha Dewan
Vice-President, 2021-22
The Chemistry Society

**ARTICLES ON
CHEMISTRY AND
GENERAL SCIENCE**

Targeted drug delivery is an emerging field of medical sciences that involves the delivering of drugs to the patients in a target-oriented manner so as to increase the concentration of the drug molecule at the target of interest. The target can be organs/tissues/cells/proteins/enzymes etc. The basic aim of targeted drug delivery is to ensure a target-specific delivery of the drug molecules in order to decrease the administration dose and off-target side effects. During the preparations of targeted drug delivery systems, there are some basic requisites to be ensured:

- They should be non-toxic and non-immunogenic
- They should be stable (both physically and chemically) in vivo and in vitro conditions
- They should have uniform capillary distribution and restricted drug distribution
- They should be capable of delivering a drug at a controlled rate
- They should be associated with low off target effects and deliver adequate quantity of drug molecule.

A drug delivery system consists of two main parts- a target and drug carriers.

Target: it is molecule that is under consideration for treatment and the site of drug deliver

Drug carrier: It involves the different moieties that could be employed as agents for drug delivery at the targeted site. There are different types of entities that carry the potential to deliver the drug molecule to its site of action. Some of these have been described below as under:

1. **Liposomes:** The liposome delivery is primarily of four types: Conventional liposomes, sterically-stabilized liposomes, ligand-targeted liposomes, and a combination of the aforementioned delivery systems. By stabilizing therapeutic chemicals, overcoming barriers to cellular and tissue absorption, and enhancing biodistribution of drugs to target areas in vivo, they have enhanced medicines for a variety of biomedical applications. They've been

Targeted Drug Delivery

Ridhima Raina
B.Sc. Chemistry(Hons.) - III Year

demonstrated to help stabilize therapeutic compounds overcome barriers to cellular and tissue absorption, and improve drug biodistribution to target areas in vivo. This allows for the efficient distribution of encapsulated chemicals to target areas while reducing systemic toxicity.

2. **Modified proteins:**

Because of their solubility and low molecular weight, modified plasma proteins can be an intelligent drug vehicle for drug delivery. They are a suitable mechanism of drug delivery because they can readily be changed by attaching other molecules such as peptides, sugars and other ligands to transport the pharmaceuticals of interest. As adaptable drug carrier systems, soluble synthetic polymers have been extensively studied. Polymer chemistry enables the creation of custom conjugates in which target moieties and pharmaceuticals can be encapsulated within the carrier molecule. The well-known N (2- hydroxypropyl) methacrylamide (HMPA) polymers have been widely explored for cancer therapy. It also offers a method for selective and targeted chemotherapy.

3. **Nano particles:**

Non-metallic nanoparticles: Silicon and carbon are two of the most important nonmetallic materials used in the manufacture of nanocarriers. They are effective nanocarrier materials because of their inherent physical/chemical qualities, low cost, and great biocompatibility.

Nonmetallic NPs, such as silicon NPs (SiNPs), porous SiNPs (PSiNPs), graphene, and graphene oxide (GO), have risen to prominence in recent years, particularly for the development of cancer medication delivery systems. Biocompatibility, biodegrad-

ability, minimal cytotoxicity, and genotoxicity are all advantages of SiNPs in cancer treatment, and they can be totally eliminated by cells and tissues. Due to the features of room temperature photoluminescence, singlet oxygen formation under photoexcitation, and infrared radiation-induced and ultrasound-induced hyperthermia, SiNPs can also provide photodynamic treatment and radiofrequency hyperthermia for cancer therapy. PSiNPs are biocompatible, biodegradable, have a high drug loading capacity, and can be surface modified in a variety of ways. They can be employed as dissolved nano-containers that provide a platform for high-volume vectorization of hydrophobic medicines into pores while permitting the targeting molecule to be immobilised on the nanoparticles' surface (NPs). Graphene and graphene oxide have been widely touted as promising biomaterials for biomedical applications, including biosensing, bioimaging, drug and gene delivery, and photothermal therapy (PTT) in cancer treatment, due to their unique properties, such as 2-D planar structure, large surface area, chemical and mechanical stability, superb conductivity, and good biocompatibility. They've been explored extensively as drug delivery systems for loading anticancer medicines, in particular.

Metallic nanoparticles:

Metal NPs (MtNPs) like AgNPs, AuNPs, ZnO NPs, Fe₂O₃ NPs, CuO NPs, and Al₂O₃ NPs are some of the most common choices of for drug carriers. They are synthesized via techniques like mechanical attrition, chemical electrolysis, laser ablation, and synthesis by organisms such as bacteria and plants. MtNPs, not only have their own characteristic physicochemical properties but also contain antimicrobial, anticancer, catalyzing, optical, electronic, and magnetic properties; have been widely applied in different areas, such as biology, food, agriculture, engineering, electronics, cosmetics, and medicine; and have also been used in food and biomedical devices.

AgNPs, AuNPs, ZnO NPs, Fe₂O₃ NPs, CuO NPs, and Al₂O₃ NPs are some of the most frequent metal NPs (MtNPs) used as drug

carriers. They are made using procedures such as mechanical attrition, chemical electrolysis, laser ablation, and bacterial and plant synthesis. MtNPs, which exhibit antibacterial, anticancer, catalytic, optical, electrical, and magnetic capabilities, have been widely used in fields such as biology, food, agriculture, engineering, electronics, cosmetics, and medicine, as well as in food and biomedical devices.

Natural polymer nanoparticles:

Natural molecular materials such as chitosan or protein (albumin and ferritin) have been employed to make delivery carriers. Chitosan (CS), a chitin derivative having biocompatibility, biodegradability, nontoxicity, antibacterial activity, wound healing ability, and anticancer capabilities, is a natural biopolymer. CS and CS compounds produce NPs with a positive surface charge and mucoadhesive characteristics, allowing them to stick to mucus membranes and release the therapeutic payload over time. Nonparenteral medication administration for cancer treatment uses CS-based NPs in a variety of ways. Because of the solubility of CS, CS NPs also have pH-dependent drug release.

4. Monoclonal Antibodies

When monoclonal antibodies are conjugated to cytotoxic medications, they can selectively deliver therapeutics to cancer cells while reducing damage to healthy cells. Monoclonal antibodies are becoming more popular among carrier systems due to their excellent specificity.

Monoclonal antibodies are antibodies that detect and bind to a specific antigen and are produced by clones of a single cell. Theoretically, a highly specific antibody against an antigen on a single cell type can be produced. As a result, therapeutic substances conjugated to such specialised antibodies should reach the intended cell type in high concentrations, resulting in improved therapeutic efficacy at considerably lower concentrations than if the medication was given free. Monoclonal antibodies specific for cancer cells have been successfully generated. Monoclonal antibodies and immunoconjugates (containing tox-

ins, cytotoxic drugs, and radioisotopes) have been extensively studied in cancer chemotherapy due to their high affinity, and some of these conjugates have progressed to preclinical and clinical trial stages in the treatment of colon, breast, skin, and bone cancers.

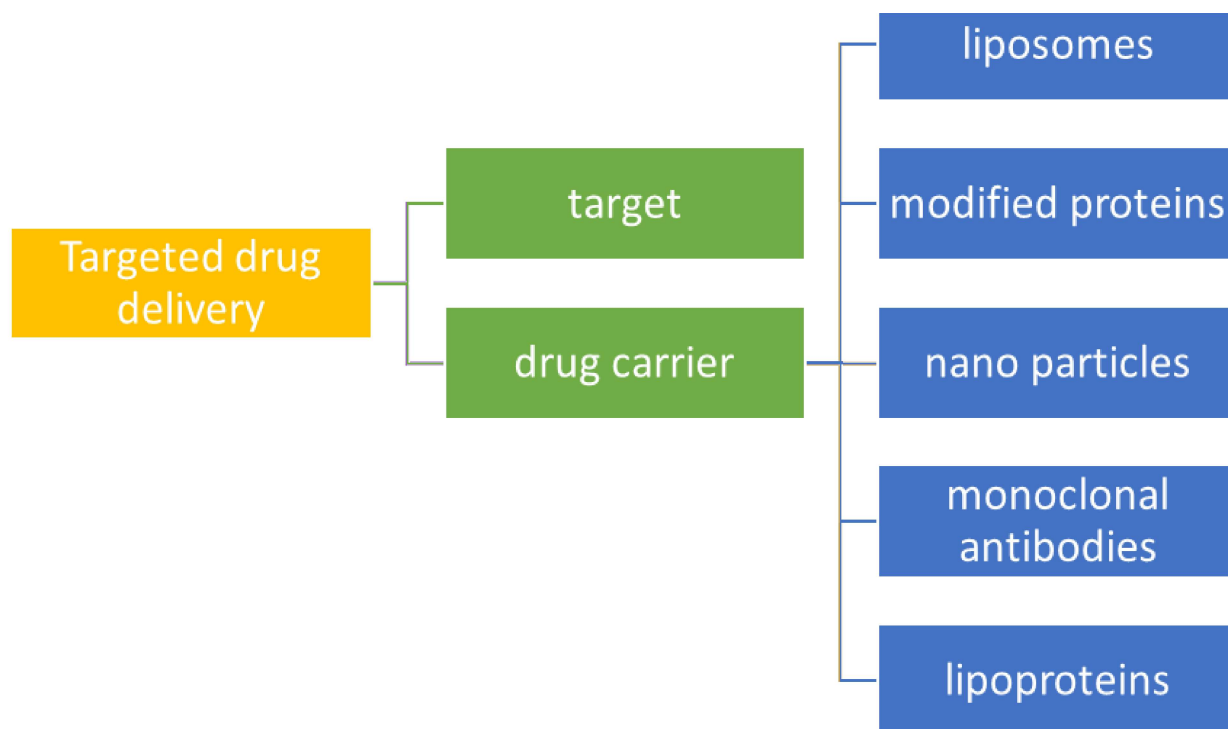
To create antibody drug conjugates, many cytotoxic medicines have been coupled with monoclonal antibodies. These conjugates have been utilized to investigate drug localization in tumors as well as drug toxicity modulation. They've been reported to be effective in the treatment of colorectal, gastric, ovarian, epidermal, endometrial, breast, lung, and pancreatic carcinomas, among others.

5.Lipo proteins

Lipoproteins are biological lipid carriers that aid in the transportation of fats throughout the body. Due to their small size and prolonged residence duration in the circulation, they are natural nanoparticles that function as drug delivery vehicles. Low-density lipoprotein (LDL) transports cholesterol in the blood stream and is involved in its metabo-

lism in both normal and malignant cells. Lipoproteins are used as delivery vehicles for chemotherapeutic drugs and carry substantial drug payloads. Because of their ease of delivery to cancer and tumor locations, they have unique targeting capabilities. Cancer cells are treated with LDL that has been loaded with ^{111}In -DOX. LDL is utilized to deliver radio-nucleotides for the treatment of neoplasms and malignancies via the receptor route.

Water-insoluble photosensitizers are also carried by liposomes and oil emulsions for tumor treatment.



The 2021 Nobel Prize in Chemistry

Diksha Dewan

B.Sc. Chemistry(Hons.) - III Year

Catalysts are powerful, and in the words of Benjamin List, one of the 2021 Nobel Laureates in Chemistry, a catalyst is “just one molecule away from magic!” Developing sustainable ways to catalyze and objectively drive chemical reactions has been the area of extensive research from a long time. The need to bring a sea-shift from conventional metallic and enzymatic catalysts, owing to the toxic nature of heavy metals and inefficient ways to steer production towards only the required enantiomer, was a matter of great concern, until the inception of the Nobel work on ‘Asymmetric Organocatalysis’ by Benjamin List of the Max-Planck-Institut für Kohlenforschung in Mülheim a der Ruhr, Germany, and David W.C. MacMillan of Princeton University in the United States, who together have been felicitated with the 2021 Nobel Prize in Chemistry for the development of asymmetric organocatalysis.

The field of asymmetric organocatalysis came up near the turn of the millennium, when Benjamin List and David MacMillan worked individually, and published their landmark papers, igniting explosive growth in this sector. In the year 2000, List, Lerner, and Barbas III demonstrated that the naturally occurring amino acid L-proline catalyzes an intermolecular aldol reaction, which forms carbon-carbon bonds between acetone and a series of aromatic aldehydes (reaction 1(a)). They proposed that the reaction proceeds through an enamine intermediate, resulting in a higher HOMO and increased nucleophilicity compared to the corresponding enol

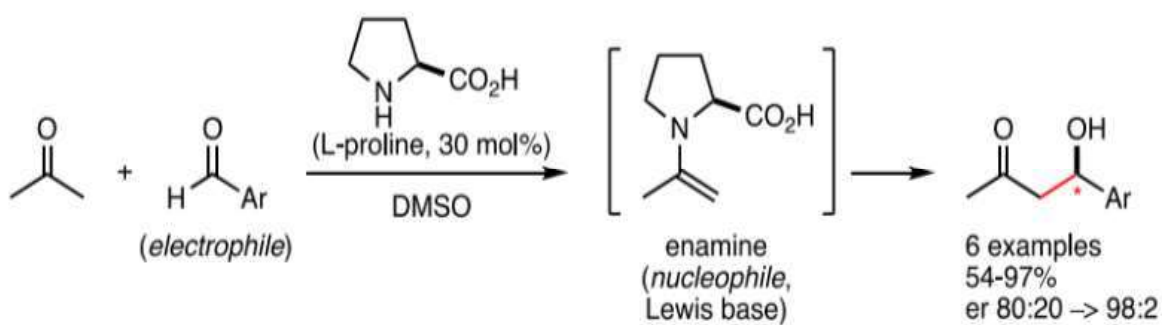
ether, and that the carboxylic acid functionality in the catalyst aids in the stabilisation of the metal-free Zimmerman-Traxler transition state through hydrogen bonding. As a result, the catalyst is covalently attached to the substrate and regulates the stereochemical pathway of the intermolecular aldol reaction. Similarly, in the same year, Ahrendt, Borths, and MacMillan demonstrated that chiral imidazolidinone can catalyse the Diels-Alder reaction between, unsaturated aldehydes and dienes (reaction 1 (b)). The key insight in MacMillan and colleagues’ work is the idea that lowering LUMO via catalytically generated iminium ion intermediates provides a general platform for designing and developing other asymmetric reactions. Putting it lucidly, the work by List and MacMillan indeed resulted in a turning point, opening up new avenues to perform chemical reactions, such as organocatalysis, expanding the toolbox that is available to chemists and allowing for designing new reaction pathways for organic molecules.

The indispensability of the 2021 Nobel Laureates’ work is tough to be described in a handful of words, for organocatalysis has touched almost all budding areas of research, playing important roles. It would not be an exaggeration to state that their work has fascinatingly conceptualized the field of organocatalysis, with a special focus on asymmetric catalysis, and indicated principles for designing new organocatalytic reactions based on modern concepts like LUMO lowering and HOMO raising. This research area has flourished in the years following these Laureates’ initial publications in 2000, with an impressive number of new reactions, catalysts, and applications described in the literature—this period has been referred to as the ‘organocatalysis gold rush’. To cite an example, in preclinical phar-

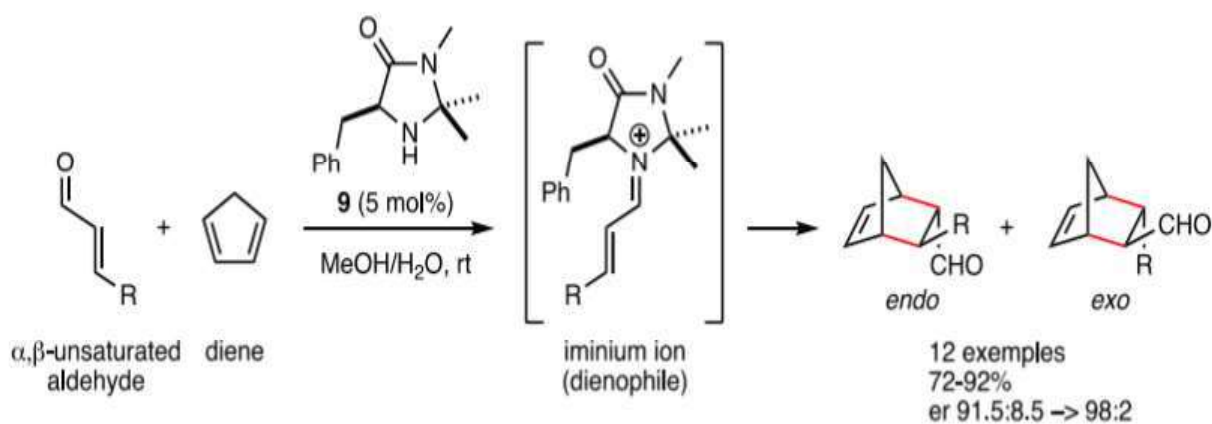
maceutical research where there is a great demand for new organic molecules to be tested in different disease models, organocatalytic methods have been applied eloquently. According to a recent study, Renin, a protease protein secreted by the kidneys, plays an important role in the treatment of hypertension by hydrolyzing the protein angiotensinogen in the bloodstream into the peptide angiotensin I. Angiotensin I hydrolysis results in the formation of angiotensin II, a vasoactive peptide involved in hypertension. One treatment option for hypertension is to inhibit renin and prevent the formation of angiotensin II. By following the asymmetric organocatalytic methodology, researchers at Novartis have come up with a novel renin inhibitor- Aliskiren(Rasilez).

Although organocatalysis has witnessed enormous growth over the years in the area of homogeneous catalysis, where enantioselectivity and rate together justify the proficiency of the catalyst being used, organocatalysts still have to bridge a long gap to emulate the standards of conventional metallic or bio-based catalysts. In this regard, the general catalyst loading is still in the 5–20 mol percent range, with only a few exceptions being lower. As a result, metal catalysts and enzymes possess extremely high catalytic activity and turnover numbers when compared to organocatalysts. These issues are exacerbated when the reaction rate decreases at lower temperatures and a greater amount of organocatalyst is required to compare its activity to the same reaction at room temperature. Although organocatalysts have often been envisaged as ‘artificial enzymes’ or small enzyme mimics, there are many differences and a long way to go before we get there. They are still inferior to natural enzymes in terms of catalytic activity and turnover, among other things.

One solution to this problem has been to create more acidic organocatalysts. Following the prevalence of multifunctional catalysis in enzyme catalysis, another strategy has been to design plausible bifunctional organocatalysts. In other words, there is still a lot of room for improvement in establishing new benchmarks in this field. Without a doubt, new avenues with all of the aforementioned characteristics and new sustainable aspects convergent in the processes (sustainable methodology, solvent, energy source, structural complexity, and final application) will emerge in the near future, and will surely revolutionize the pharmaceutical industry, among other sectors.



Reaction 1 (a): Catalysis of inter-molecular aldol reaction by L-Proline



Reaction 1 (b): Catalysis of Diels-Alder reaction by chiral imidazolidinone

The Impact of the Pandemic on Learning and Teaching: A Perspective

Dr. Vibha Sharma

The COVID 19 Pandemic has changed the world and transformed life and work in more ways than we can imagine. The threat to human life and existence is serious. Hygiene, social distancing and timely vaccinations are becoming as important as air, water and food. Lockdowns and curfews though inconvenient have become necessary. Travel whether for work or leisure within the country and abroad has become very unpredictable and to some extent dangerous.

Scientifically speaking (my simplistic non-medical science view is that) a virus by its nature has a limited shelf life and it looks like a bell curve. The reason why COVID 19 is dangerous is because of what it does to the human body while it is live in it. The degree of danger and the impact it can have on a human is multifactorial. Immunity of a person to fight the virus is based on age, genetics, lifestyle (food habits, sleep habits, sedentary/non sedentary etc.) and stress. The virus spreads because people lower their guard and stop following prevention norms like social distancing and hygiene. The vaccines can never be all encompassing. Having said that, vaccines are still very necessary to prevent serious impact of COVID, hospitalization and death. COVID 19 virus has also been mutating, we now have a new Chinese strain and UK strain which are different from the earlier Brazilian strain, UK strain, South African

strain and an Indian double mutant strain which further makes the situation more complex.

The topic of pandemic is vast and perspectives are endless. I would like to give my view of the impact the pandemic has had on the lives of students, laboratory staff and professors of Chemistry Department. Junior first year members who joined college during lockdown period had a certain view of what their life would be in college. Clearly college life has not turned out to be like they expected. Meeting fellow students, forming bonds and friendships, getting involved in team events seemed impossible especially during the initial part of the pandemic. Senior members and laboratory staff too were finding it difficult to do their duties in the absence of normal classes and laboratory time. The pandemic forced an accelerated creative and innovative thought process. All stakeholders had to shift gears really quickly and get used to the online mode of studying, working and socializing. It opened up a plethora of possibilities – with online webinars, workshops and add-on online courses etc. When we look back over the last 14-15 months and the way we adopted new teaching methods, it reinforces our belief in the cliched saying that “Change is the only constant”. Learning is purely a function of your focus and dedication.

We are privileged to have well equipped

labs. More instruments have been acquired over last few years under the esteemed headship of Dr. Shabnam Johry. As a Chemist, the biggest loss due to the prevalent pandemic situation is the lack of chance to work in the laboratory. Students have missed out on the opportunity to explore time tested experiments as well as newer methods, and processes. Immense growth could have been possible through summer internship programs as well. It is great to be back in our laboratories and explore the world of Chemicals in true sense.

The lockdown which initially started as a period of break, eventually became a burden. From a psychological impact perspective, we all have gone through a flurry of emotions like excitement, sadness, anxiety, anger, helplessness and fear etc. to name a few. I feel that it is human and perfectly fine to go through these emotions but it is of utmost importance to practice and observe individual detachment and balance in order to come out of the situation safely and become positive so that you do not just exist but live and flourish. The only option to remain positive through this testing time is to enjoy every moment, work conscientiously and concentrate on the opportunities that we have in hand rather than focusing on negative thoughts. The mind is very powerful and if you fill it with positive thoughts, it can and will change your life. I believe that

even we cannot control a situation, we can control our perception of it and thereby alter our outlook on stress and ensure it does not affect us. As rightly said by Robert H. Schuller, "Tough times don't last but tough people do" so we should buckle up, stay strong, and take things in our stride.

Despite the hurdles and hard times, many of our students appeared for competitive examinations like JAM etc. and are waiting to join in Master's programme at IITs, NITs, TIFR and several prestigious foreign Universities/Institutes such as Oxford, Cambridge, Ecole Polytechnique, Wageningen University etc. Congratulations to all the senior and junior members of the Chemistry department in keeping their morale high and achieving great things.

The situation seems to be normalizing in India. I am not sure whether it is herd immunity or mass vaccinations that has led to it. The result seems quite positive and encouraging. We are very happy to welcome the students back to college to attend classes and laboratory sessions in person. While I would still encourage you to be cautious and preemptive by maintaining good habits like social distancing, wearing masks and maintaining hygiene. The COVID 19 Pandemic has changed the world and transformed life and work in more ways than we can imagine.

Caffeine is a methylxanthine alkaloid which stimulates the central nervous system. It is a bitter, white crystalline purine and is chemically related to adenine and guanine bases of DNA and RNA. The best source of caffeine is the coffee bean. Caffeine is the world's most consumed psychoactive drug. It can have both beneficial and detrimental effects on one's health. It can treat and prevent the premature infant breathing disorders bronchopulmonary dysplasia and apnea of prematurity. Caffeine citrate shows a protective effect against some diseases like Parkinson's. It is recognised as safe by the US FDA.

Caffeine resembles purines adenine and guanine in structure. The carbon atoms in the second and sixth positions of the purine ring are doubly connected to oxygen atoms, while the nitrogen atoms in the first, third, and ninth positions are bound to methyl groups.

Caffeine Derivatives

Theophylline

Theophylline is a caffeine derivative which is found in tea. It is also known as 1,3-dimethyl xanthine and it is a phosphodiesterase inhibiting drug used in therapy for respiratory diseases like chronic pulmonary disease and asthma. It is a nonselective adenosine receptor antagonist. It has a structure similar to theobromine and caffeine.



Caffeine

Medical effects and its derivatives

Akansha Shahi

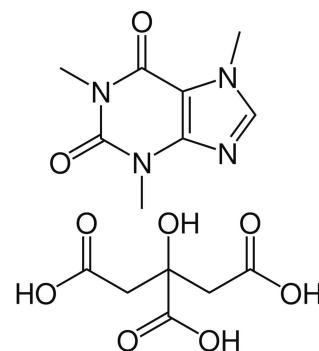
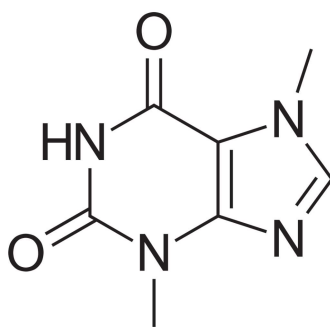
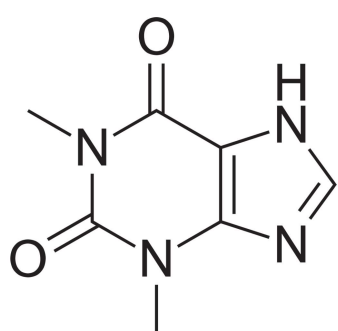
B.Sc (Hons) Chemistry - IInd year

It is also pharmacologically similar to caffeine and is found widely in tea. Main actions of theophylline involve relaxing bronchial smooth muscle, curing lung disease like emphysema, wheezing, chronic bronchitis increasing heart rate, increasing blood pressure, renal blood flow and stimulating central nervous system. It can be used to improve sense of smell in subjects with anosmia. It has many medical uses but a narrow therapeutic window. Serum theophylline levels must be monitored to avoid toxicity. It can also cause nausea, diarrhea, increase in heart rate and insomnia. Seizures can occur in severe cases of toxicity. Theophylline toxicity can be treated with beta blockers.

It is metabolized extensively in the liver and hence those suffering from cirrhosis or malnutrition may have increased amount of theophylline in their blood. When administered intravenously, its bioavailability is 100%.

Theobromine

Theobromine, also known as xantheose, is an alkaloid. It is found in Theobroma cacao (cacao plant) and it tastes bitter. It has a similar but lesser neurological effect than caffeine. It is categorised as dimethyl xanthine. Currently, theobromine is not used as a prescription drug. It is weaker in both its inhibition of cyclic nucleotide phosphodiesterases and its antagonism of adenosine receptors.



Theophylline, Theobromine, Caffeine citrate

The actual effect of theobromine on phosphodiesterase inhibition is seen at amounts which are way higher than what people would normally consume in a normal diet including chocolate. It may cause heartburn in some people which could be due to the effect on oesophageal sphincter muscle in a way that permits stomach acids to enter the oesophagus.

Theobromine is poisonous for animals as it metabolizes more slowly. Theobromine poisoning from as low as 50 grams of milk chocolate can kill dogs. Complications in cats due theobromine poisoning include digestive issues, dehydration and a slow heart rate. Later stages of poisoning include epileptic like seizures and death. If caught in the beginning, theobromine poisoning is treatable.

Short term effect of lowering of blood pressure by consuming cocoa products is observed in reviews but there is no evidence of long-term benefits on cardiovascular health. Daily consumption of cocoa appears to benefit platelet and vascular function.

Caffeine Citrate

Sold as Cafcit, it is a medication used to treat lack of breathing in premature babies. It is manufactured by preparing

combined anhydrous caffeine with citric acid monohydrate and sodium citrate dihydrate. It takes a larger dose of caffeine citrate to get the same amount of caffeine due to the added weight of citrate moiety. The preparation is similar to that of caffeine base since the citrate ion dissolves in water. Caffeine citrate has fewer side effects as compared to theophylline and it improves airway function in asthma, increasing forced expiratory volume by 5-18%, which makes the effect last up to four hours.

Medical uses of caffeine

Caffeine is used to treat mental alertness, headache, migraine, athletic performance, memory and obesity. It can be used for asthma, gallbladder disease, ADHD, low blood pressure, depression and other mental conditions. Caffeine works well only when taken in low doses. In concentrated doses, it is a cause of concern. Concentrations over 15 mcg/mL in urine are prohibited.

1. Effects of caffeine therapy for apnea

Barbara Schmidt et al. investigated the effects of caffeine on preterm apnea in newborns and discovered that the treatment enhances the rate of survival without neurodevelopmental damage at 18 to 21 months in infants with very low birth weight. Caffeine was also found to lessen the occurrence of severe

retinopathy of prematurity. Caffeine was originally used to treat prematurity apnea by Aranda et al in 1977.

Present studies show how caffeine significantly improved survival without neurodevelopmental disability at an age of 18 to 21 months, showing that overall benefits of methylxanthine therapy outweigh any potential risks up to 2 years after preterm birth.

2. Anxiogenic effects of caffeine on panic disorders

Dennis S. Charney et alii studies the effects of oral administration of caffeine on behavioural ratings. Caffeine produced a greater increase in the subjects' anxiety, nervousness, fear, nausea, palpitations, restlessness and tremors compared with healthy subjects. 71% of the patients reported that symptoms of caffeine were similar to those experienced during panic attacks. Since caffeine is an adenosine receptor antagonist, results suggest that panic disorder patients may have abnormalities in neuronal systems involving adenosine. In general, patients having anxiety disorders may benefit by avoiding caffeine-containing foods and beverages.

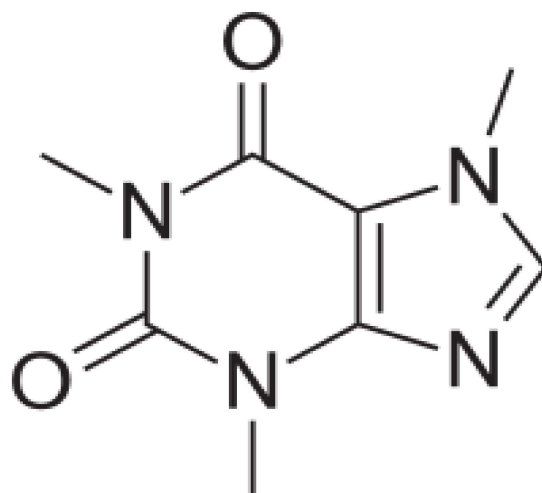
3. Antiproliferative activity of novel caffeine derivatives

It has been found that inhibition of ATM and ATR kinases by caffeine can affect the cell cycle and DNA repair. Studies performed by Martin Andrs et aliii have developed a series of caffeine derivatives which been compared to standard ATR inhibitor VE-821. The caffeine derivatives did not match the overall potency of VE-821 but several compounds exhibited enhanced antiproliferative activity when compared to caffeine and some were comparable to VE-821.

4. Effects of theophylline and theobromine on exercise performance

Theophylline was shown to have adverse effects in six participants of study conducted with 7-15 subjects to study the effects of theophylline and theobromine on exercise performance. Theobromine investigation showed no adverse effects. Though studies showed contradictory results or insufficient data, both drugs have potential to enhance performance and can be considered to be included in the banned list of drugs for enhanced performance.

Caffeine and its derivatives have had proven positive effects on pulmonary problems in infants and show decent antiproliferative activity. Negative effects have been shown on panic disorders and anxiety. High doses of caffeine or its derivatives in pregnant women can cause increased heart rate in babies. In addition to being a psychoactive substance, caffeine has certain health benefits which can be explored further, especially its antiproliferative activity in the context of cancer therapy.



Structure of Caffeine

Antibiotic Resistance

Sakshi Sharma

B.Sc (Hons) Chemistry - IIIrd year

Antibiotics are the drugs which are taken to kill or stop the growth of bacteria, viruses and other harmful microorganisms. Antibiotic resistance develops when bacteria gain the capacity to tolerate antibiotics that were supposed to kill them or halt their development. Antibiotic resistance has the potential to harm people at any age, as well as the healthcare, agricultural and veterinary industries. As a result, it is one of the world's most pressing public health issues.

India has one of the highest incidences of antibiotic resistance in both people and food animals. The existence of resistant organisms or their genes has also been recorded in the environment, particularly in bodies of water. India has been referred to as 'the antibiotic resistant capital of the world'. Increased intake of antimicrobial medications, both by humans and animals, and improper prescribing of antimicrobial treatment are two factors that have contributed to the developing resistance problem.

There are two types of resistance: Natural and Acquired. Natural resistance is intrinsic - it is expressed in the species or induced means the genes are naturally occurring in the bacteria, but are only expressed to resistance levels after exposure to an antibiotic. Acquired resistance means that resistance is possible through all of the main routes by which bacteria acquire any

genetic material: transformation, transposition, and conjugation. the bacteria may experience mutations to its own chromosomal DNA. Antibiotic resistance is caused due to mutations in the DNA or acquisition of antibiotic resistance genes from other species through horizontal gene transfer.

The four main mechanisms leading to antibiotic resistance are limiting uptake of a drug, modifying a drug target, inactivating a drug, active drug efflux.

Since bacteria have different structures, gram positive and negative bacteria show different mechanisms. Gram positive bacteria make use of all the four main mechanisms for showing resistance but gram negative use limiting the uptake of a drug less commonly and they don't have the capacity for certain types of drug efflux mechanisms.

Limiting Drug intake - Due to the structure and functions of the LPS layer in gram negative bacteria, a barrier is provided to certain types of molecules which give those bacteria innate resistance to certain groups of large antimicrobial agents. For example, the mycobacteria have an outer membrane with high lipid content, and so hydrophobic drugs have an easier access to the cell, but hydrophilic drugs have limited access. Hence the bacteria that lack a cell wall are intrinsically resistant to all drugs targeting cell wall. On the other hand, the gram positive bacteria don't possess an outer membrane so the drug resistant via this mechanism is not prevalent.

Modification of drug targets: Antimicrobial agents target multiple components in the bacterial cells. These targets may be modified by the bacteria

in order to get resistance from a particular type of drug. β -lactam drugs get resistance from gram positive bacteria via alternation in the structure and number of PBPs (penicillin-binding proteins).

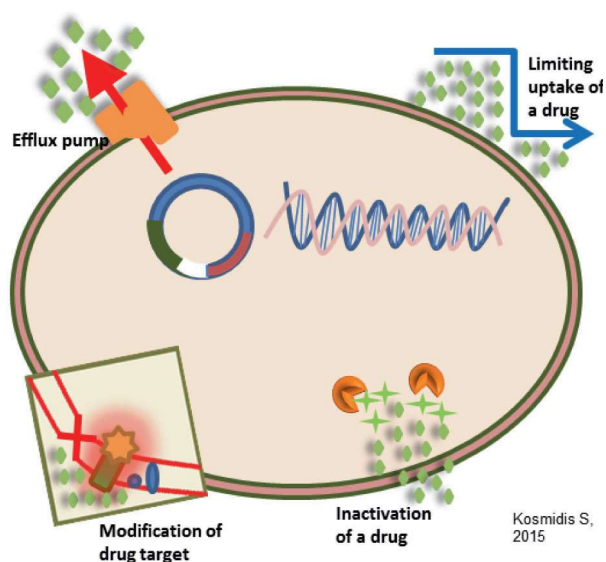
PBPs are transpeptidases which are involved in the construction of peptidoglycan in the cell wall. If there is a change in the number of PBPs then the amount of drug that can bind to that target also changes. Any change in the structure of PBP's may lead to a decrease in the ability of the drug to bind, or totally inhibit drug binding.

Drug inactivation:- Drug inactivation can be achieved by either actual degradation of the drugs or by transfer of a chemical group to the drug. The β -lactamases are very large group of drug hydrolyzing enzymes. Another drug that can be inactivated by hydrolyzation is tetracycline, via the tetX gene. Acetylation is the most adversely used mechanism of drug inactivation using the mechanism of transfer of the chemical group to the drug. Other groups that can be transferred includes phosphoryl, and

and adenylyl groups. Acetylation is used against the aminoglycosides, chloramphenicol, the streptogramins, and the fluoroquinolones whereas the phosphorylation and adenylation are known to be used primarily against the aminoglycosides.

Drug efflux:- Bacteria have chromosomally encoded genes for efflux pumps. Some are expressed constitutively, and others are induced or overexpressed (high-level resistance is usually via a mutation that modifies the transport channel) under certain environmental stimuli or when a suitable substrate is present. These efflux pumps function primarily to rid the bacterial cell of toxic substances, and many of these pumps will transport a large variety of compounds. The resistance capability of many of these pumps is dependent on the carbon source which is available.

β -lactamases:- β -lactam drugs are the most commonly used antimicrobial agents. Resistance to these type of drugs occurs through three general mechanisms which involve - preventing the interaction between the target PBP and the drug, usually brought about by modifying the ability of the drug to bind to the PBP (mediated by alterations to existing PBPs or acquisition of other PBPs), second is the presence of efflux pumps that can extrude β -lactam drugs; and third is the hydrolysis of the drug by β -lactamase enzymes. The β -lactamases enzymes (also called penicillinases and cephalosporinases) cause the inactivation of β -lactam drugs by hydrolyzing a specific site in the β -lactam ring structure, causing the ring to open. These open-ring drugs are not able to bind to their target PBP proteins. The production of β -lactamases is the most



common resistance mechanism used by gram negative bacteria against β -lactam drugs, and against penicillin and cephalosporin drugs.

Antibiotics are becoming less and less effective due to over-prescription and their inappropriate use. The reality that we need to accept is that bacteria are very versatile and adaptive. They need to be capable of dealing with toxic substances, in order to survive. Bacteria need to be able to survive toxic attacks and waste products from other organisms. There should

be no surprise that the bacteria that infect humans are able to defend themselves against antimicrobial agents. But we need to combat the increase in antibiotic resistance. The development of new antibiotics has also slowed due to market failure and regulatory disincentives. These problems have made it far too difficult for companies to continue developing new antibiotics. Moreover, when new antibiotics comes into the market, physicians hold it on reserve for only the worst cases rather than rushing to use it on all their patients due to the fear of drug resistance.

Silymarin is the common name given to a mixture of flavonolignans, found in the fruit of the plant *Silybum marianum* (L.) Gaertn (Asteraceae). It is commercially extracted using a pressurized liquid extraction technique (AbouZid & Ahmed, 2013). This herb is native to areas near the Mediterranean Sea. The research and applications on Silymarin are mostly focused on its hepatoprotective nature (Agarwal et al., 1994; Saller et al., 2001). Silymarin mixture can be resolved into seven flavonolignans, namely, Silybin A, Silybin B, Isosilybin A, Isosilybin B, Silychristin, Isosilychristin, and Silydianin. Silybin A, Silybin B and Isosilybin A and Isosilybin B are enantiomers (AbouZid & Ahmed, 2013). Biologically, flavonolignans are synthesized by oxidative coupling between a phenylpropanoid, and a flavonoid. As per the reaction shown, taxifolin radically couples with Coniferyl alcohol yielding Silybin A and Silybin B. This coupling reaction is mediated by the formation of free radicals and is catalysed by radical generator peroxidase enzyme (Saller et al., 2001). Silymarin is well known for possessing hepatoprotective, antioxidant and anti-inflammatory properties.

Silymarin can remove oxidizing ability of a body (Reina & Martínez, 2016), which



Silymarin

Humanity's new bid against diabetes

Tushar Redhu

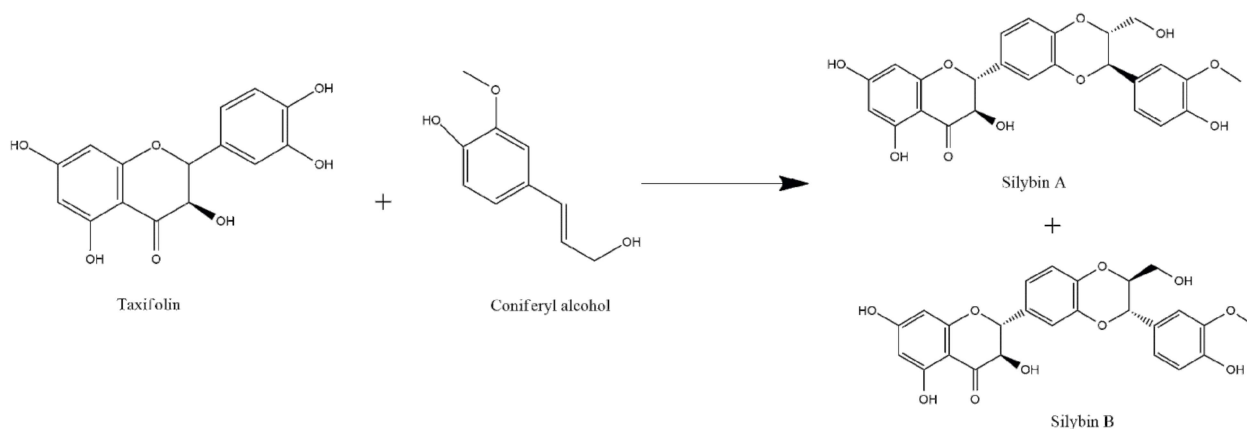
B.Sc (Hons) Chemistry - IIIrd year

otherwise can potentially cause insulin resistance, glucose oxidation in blood and lipid peroxidation leading to diabetes and its complications (Asmat et al., 2016). Research trials have demonstrated that silybin (major component of Silymarin) can undergo single electron transfer, hydrogen atom transfer and radical adduct formation for countering the radical species in the body (Reina & Martínez, 2016). Most of the properties of Silybin are due to its radical scavenging activity (Gazák et al., 2009).

Studies have shown that silybin doesn't have superoxide anion eliminating capability but it can significantly decrease (at 20 μ M) oxidation of heme-mediated low-density lipoprotein and showed mild inhibition of hydroxyl radical formation mechanism (Varga et al., 2006), proving that direct scavenging in biological systems does not contribute to its antioxidant properties. Silymarin has also shown the ability to protect the mitochondrial structure. It optimizes the electron transport chains, decreasing the electron leakage and formation of ROS and reducing the activity of enzymes responsible for ROS generation (Rolo et al., 2003). It interacts with ROS generating enzymes like xanthine oxidase and NADPH oxidase directly. Although mechanisms of these interactions are not clear, studies suggest that the activity of

that the activity of these enzymes reduces drastically in the presence of silymarin (Surai, 2015). Co-administration of Silymarin with arsenic has shown an increase in the level of the renal antioxidant defense system. It decreased the NADPH oxidase, iNOS and NF- κ B overexpression by arsenic and upregulated the Nrf2 expression in the renal tissue (Prabu & Muthumani, 2012). Silymarin being a polyphenol also interacts with transcription factors (signalling pathways) which are responsible for regulating antioxidant defence systems. Silymarin's ability to up-regulate master antioxidant coordinator Nrf2 has been shown in various in vivo and in vitro systems. Silymarin also tends to activate the Nrf2-antioxidant

responsive element signalling and induce various antioxidant molecules (Surai, 2015). Silymarin also has anti-inflammatory properties as it can act as a modulator, like other polyphenols of inflammatory redox signalling pathways (Morales-González et al., 2013). It can control pro-inflammatory genes like lipoxygenase, nitric oxide synthases, cyclooxygenase and some important cytokines. Both in vivo and in vitro studies suggest that silymarin can inhibit pathways associated with NF- κ B inflammation and TNF- α activation (Morales-González et al., 2013). Silymarin has another plus point of being free of any sort of toxicity, whether consumed orally or injected in the blood directly (Desplaces et al., 1975)



Chemical Synthesis of Silybin A and Silybin B by Radical coupling between Taxifolin and Coniferyl alcohol

(Z)-9-Tricosene

Sexual attractant in flies

Aravind Ravi

B.Sc (Hons) Chemistry - IInd year

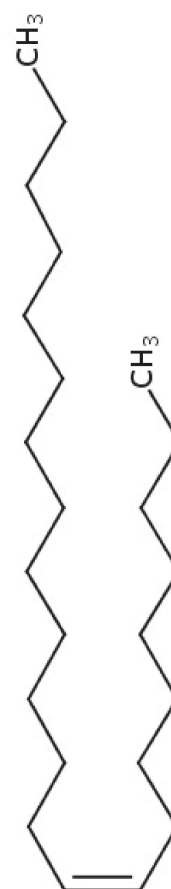
Chemical signals play an important role in sexual communication among insects, yet the chemistry of sex pheromones remains poorly understood. Yong-Hong Xiao et. al. studied the chemically modified strategies employed by the males of the spider *Pholcus beijingensis* for increasing the probability of copulation. They noticed that Tricosene was inevitably a part of the mechanism.

The presence of a sex pheromone in the house fly, *Musca domestica* L., was first reported by Rogoff et al. (1964), and confirmed by Murvosh et al. (1965). In 1971, Carlson and co-workers isolated a pheromone from female flies by using the olfactometer bioassay of Mayer and Thaggard (1966) to monitor purification, and identified it as (Z)-9-tricosene (muscalure). This compound was found to attract (Carlson and Beroza 1973, Morgan et al. 1974) and sexually stimulate (Rogoff et al. 1973) male flies.

Bactrocera oleae (Rossi) (Diptera: Tephritidae), the olive fruit fly, is a pest of great economic importance. Gas Chromatography analyses of the bioactive 15-day-old male extracts showed the presence of several unknown compounds. Some of these were not found in 15-day-old female extracts and could potentially be part of an attractant blend; however, the scientists focused on one of them because it was the most

t volatile, in general it was less variable than the other compounds, its presence was clearly age dependent, it increased significantly when males were sexually mature (8-day-old). This compound was unambiguously identified as (Z)-9-tricosene. The electron ionization (EI) mass spectrum of the compound was almost identical to that of authentic tricosene molecule. This went down as the first identification of a male-produced female attractant in the olive fruit fly.

Applications of this interesting aspect include fruit fly traps in farms and agricultural lands throughout the world, where (Z)-9-tricosene is used to catch fruit flies that may cause potential harm to the yield.



It's not an overstatement when one says 'The Earth is the mother of all living beings.' Soil is not 'just dirt' but is a complex mixture of rock-derived minerals, organic matter, nutrients, and a well interactive food web. No one could ever imagine life without this component of nature. Especially in a world where agricultural land use occupies 36.5% of the earth's landmass and is being taken over by the growing world population. Now, this large area is viewed as a global environmental goods and services provider. However, the conventional agricultural practices like plowing and tilling land, as well as the unmanaged use of fertilizers and noxious pesticides are shown to be highly destructive to the soil, which resulted in the degradation of about 24% of global agricultural land. This article is to give the significance of soil microbes, as today the science community is raising a voice for soil management.

Topsoil being rich in soil organic matter (dark spongy material formed from decomposed plant and animal tissue. Soil organic matter critically helps soils hold water and nutrients, and assist soil microbes to recycle nutrients . By losing soil organic matter we may have cut our own throat, facing consequences now farms are increasingly reliant on fertilizers, pesticides, and herbicides. We'll need to know how the microbes help, an interesting study by Kristen M. DeAngelis suggests that all organisms in microbiomes interact with each other in several ways within, across species, and domains of life. This interaction helps them break down complex organic matter, forming organic matter from the simple molecules for the plants and nitrogen fixation. Healthy soil needs the organic matter reserves. However, tilling

Need for Soil Revitalization

Mridul krishna Sharma
B.Sc (Hons) Chemistry - IIIrd year

unlocks the carbon content and organic matter allowing the upper soil microbes to consume organic matter which depletes their healthy food supply and eventually dies off. The huge amount of carbon content (over 50%, i.e., even more than plants and animals) indicates its importance in the soil. The loss of this carbon-rich organic matter causes the greenhouse effect accelerating climate changes . Fostering the use of cover crops which takes the carbon out of the atmosphere channel into the soil, unlike the cash crops. Recently our knowledge about humus got modified by the strong evidence that the soil carbon is predominantly from dead microbial bodies rather than plant leftovers. While the original source of carbon is from plants only, therefore it is vivid that microbes decide the fate of the plant and animal residues by feeding on them and ensuring their availability in soil.

In the Indian context, the green revolution was indeed a need of the time and became a massive hit in India for being self-reliant on food production, which was achieved by modern technologies such as HYVs of rice and wheat, and tractors, fertilizers, and pesticides dependency. As time passes by these costs the soil's health. The fact that the vast Indian population is still malnourished, even though having bumper crop production every year, is disappointing and is

indicates the poor nutritional level of the crops. The current situation on Indian soil is devastating and going worse. The need to encourage, and educate the farmers about soil rejuvenation through the microorganisms' biomes is of paramount importance.

The solutions include age-old practices as well as simple innovative ideas, involving increasing soil's hold capacity through crop rotation of diverse crops, increasing the organic matter as well as microbes in the soil, and reducing the soil erosion with no or very little tillage or reshaping the land. Microbes feeding - the microbes break down plant matter to produce new biomass, during which they consume some of the organic materials and exhale the rest as carbon dioxide. Every microbe has different efficiencies for this conversion. Some are fast-growing, but slow eaters and waste more of what they consume, while others are slow-growing, but effective, and waste little but higher retention to climate. What we need is the quick conversion of the dead plant materials to the soil organic matter, also a healthy soil always needs microbiomes which makes the plant tolerant and also cycles nutrients. Also, the No-Tillage method is a good way but, there are not many convincing studies done in this regard for Indian subcontinent conditions. However, several studies in US and Australia showed it to be good for enhancing water-logging of soil. For instance, as a case study, in the rural part of Bengal (India) a common wetland plant, *Phragmites karka*, is traditionally

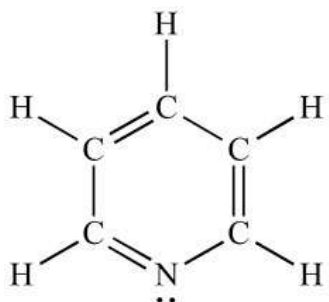
used, which makes wastewater suitable for fish culture. Recently, studies show detoxification done by this plant due to biodegradation of some harmful elements by microbes associated with the roots of this plant. This led to the worldwide application of these plants to recycle sewage, paper mill, distillery effluents, etc. This widely used method is now known as the 'root zone method' as being used to treat effluents containing sulfur compounds, chlorinated hydrocarbons, reactive dyes, ammonia, phosphates, and heavy metals. The use of legumes with non-legume crops is also found to improve soil fertility by introducing *Rhizobium*. Nitrogen-fixing algae-like *Tolypothrix tenuis* and *Scytonema cinnatum* in waterlogged areas and Blue-green algae (BGA), bio-fertilizer can be used to bring down pH and sodium content. These are only a few microbes to be named, there are various types unexplored, therefore there is more research to be done in this field and the intent for the soil conservation must be. Ever wondered, besides knowing that our soil is deteriorating and there are several solutions available to the farmers, they still stick to the conventional methods, the answer lies in the shackles of global capitalism. Because of the narrow profit margins available for farmers, they are not left with any solutions. This is the hot topic whether to cut the farmer's livings or ours. We'll need to directly invest in the farmers for the holistic conservation of the soil. The world will have to answer this as early as possible; any delay is now a step toward ghastly consequences.

Pyridine

Medical uses of its Derivatives

Rhea Mathew

B.Sc (Hons) Chemistry - IInd year



Pyridine is a heterocyclic organic compound with the chemical formula C_5H_5N . It was first synthesized in 1876 from acetylene and hydrogen cyanide. Pyridine is an azaarene comprising a benzene ring as its core in which one -CH group is replaced by a nitrogen atom. It is the parent compound of the class of important organic compounds pyridines. It is a colourless, flammable, weakly alkaline, water-soluble liquid with an unpleasant fishy odour. It was the market need during World War II that motivated the development of synthetic processes for pyridines during the 1940s, in preference to their isolation from coal-tar sources. In nature, it is found in the leaves and roots of belladonna and in marshmallow. Pyridine derivatives are often part of biomolecules such as alkaloids.

Pyridine became an interesting target in 1930 with the importance of niacin for the treatment of dermatitis and dementia. Pyridine is used as a solvent in organic chemistry. It is added to ethyl alcohol to make it unfit for drinking. It is converted to such products as sulfapyridine, a drug

active against bacterial and viral infections; pyribenzamine and pyrilamine, used as antihistaminic drugs; piperidine, used in rubber processing and as a chemical raw material; and water repellents, bactericides, and herbicides. Compounds containing the ring structure of pyridine include niacin and pyridoxal, both B vitamins; isoniazid, an antitubercular drug; and nicotine and several other nitrogenous plant products.

1. Anti-Microbial Action - Thienopyridine

The thienopyridine compounds of type 6-14 possess antibacterial activity against gram positive bacteria *S. aureus* and are also efficient against gram negative like *E. coli*, *P. aeruginosa* and *P. vulgaris*. Drugs in this class include: clopidogrel, prasugrel and ticlopidine.

2. Anti-Viral Action - Oxime Derivatives of Pyridine

Oximes-Pyridine derivatives are useful against many viral agents and are used as antidotes against organophosphorus poisons. The Oxime derivatives of thiazolo [5,4-b]pyridine are used against influenza B virus. The oxime derivatives of pyridine and naphthiridine are effective against HIV.

3. Anti-oxidant properties - Thiopyridine

Thiopyridine derivatives are antioxidant in addition to their cytotoxic activities. QSAR studies showed they have high dipole moment and electrophilic index values also had high SOD activity. (SOD - Superoxide dismutase is an enzyme that alternately catalyzes the dismutation of the superoxide radical into ordinary molecular oxygen and hydrogen peroxide)

4. Anti-diabetic properties - Thiazolidinones Derivatives of Pyridine

The pyridine derivatives containing thiazolidinones exhibit antidiabetic activities using GOD-POD method. They are oral agents for treatment of type-2 diabetes, improving insulin sensitivity and lowering blood glucose, free fatty acid, and triglyceride levels.

5. Anti-Cancer Activities – 2-Acetyl Pyridine

It has anti-tumor activity and is an excellent inhibitor of leukemia, colon and ovarian cancer cell line, especially if acetyl groups are replaced with acyl groups. Palladium and zinc complexes of 2-acetyl pyridine thiosemicarbazone have good anti-tumor activity against human cell with less cytotoxicity and are potential candidates as anti-tumor agents.

6. Anti-Malarial Agents - Pyridine quinoline

While they are poor anti-malarial agents by themselves, can be used as templates for designing new anti-malarial drugs and their haem polymerization inhibition

activities (HPIA) can be improved.

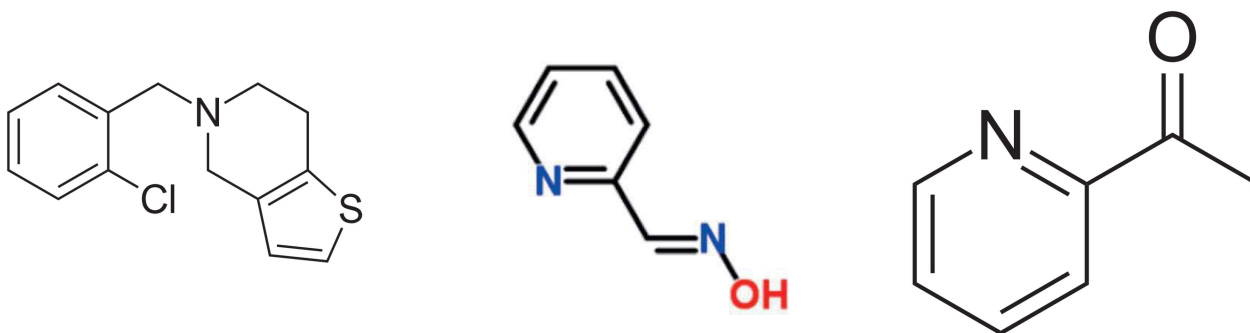
7. Anti-Inflammatory Agents – Imidazo Pyrrdine

Imidazo [1,2-a] pyridine derivatives have been synthesized that exhibit anti-inflammatory activities.

8. Anti-Amoebic Agents – Ruthenium Complex of Acetyl Pyridine

Acetyl pyridine acts as a ligand with Ruthenium as a central metal atom, the resultant complex shows high anti amoebic activity compared with commercially available standard drug, metronidazole especially against Clostridium difficile.

Pyridine is an extremely essential group present across organo-biological compounds in nature and in synthesis processes. Pyridine derivatives, produced by changing substituents on the pyridine nucleus, have moderate to excellent activities against number of biological targets. It is important to understand its properties and heterocyclic reaction mechanisms to unlock its full potential to be used for the betterment of human life.



Thienopyridine, Oxime Derivative of Pyridine and 2-Acetyl Pyridine

Rekindling Labs and our Lives

Judith L. Pulamte, Manav Jaison, Samarth Bhatnagar and Vidushi Gupta
B.Sc (Hons) Chemistry - 1st year

Tuesday morning comes with the eternal struggle of forcing ourselves out of bed and convincing ourselves to be productive. All of us were going to step out of our houses after months of isolation, to a place that we are going to spend the next three years of our lives in.

We entered the college with many new faces and were greeted cheerfully by Dr Sharma in the morning. It was such a nice feeling to be physically present in a class again, sitting on a desk with an open notebook and a blackboard in view, that was something we had been craving for a very long time. We met our classmates in person for the first time and couldn't recognize half of them by their faces, but only through their voices. We entered the chemistry lab at around noon. After carefully organizing the apparatus in our individual lockers, we proudly unfolded and donned the shining white lab coat that we had brought with us. At first, all of us were very skeptical about performing an experiment on the very first day since this switch, from virtual mode to actually performing an experiment and observing the changes right in front of us, was too quick to adapt but we soon found ourselves in a place with many curious minds and a teacher to be with us physically, and guide us. Some of us made mistakes on the first day itself while performing our experiment but that's the thing with an offline lab, you make mistakes, correct them, and then learn from them.

On the following Friday, we met

again for our physical chemistry practical, the aim being to find viscosity using a viscometer. As we began our class, Dr Thareja filmed us while doing our experiments so our fellow classmates who had joined online could watch and get familiar with the apparatus like viscometer and specific gravity bottle. The most challenging aspect of the viscometer was filling the viscometers with liquid and then sucking it upwards through a rubber tube from the other end. It was difficult for two reasons: first, it was difficult to suck the liquid up, and it frequently left most of us breathless and drained all of the air from our lungs; and second, when it did come up, it was either too low or too high, and the taste was disgusting because it was distilled water fused with what the rubber tube was made of. To the amusement of our classmates, many of us accidentally ingested a small amount of sugar solution and distilled water while attempting to pipette it but we were ultimately able to collect three readings for each of our liquids and complete our practical.





With hopes and excitement, we met again the following week for an inorganic practical. Who'd have guessed it'd be our last meeting of the year? There were fresh things to learn and a new experiment to perform. We were in a race against the clock to complete two experiments by the end of the day. The experiment lasted over 4-5 hours, and while we were all exhausted at the end, there was a sense of satisfaction in all of us that we were able to efficiently use our time and genuinely grasp much of what we did, which would not have been possible if we had done the same things virtually. One would expect that time management would be the largest challenge of the day, but for many of us, it turned out to be color identification! Confronted with so many shades, after a point of time, we couldn't distinguish between red and orange.

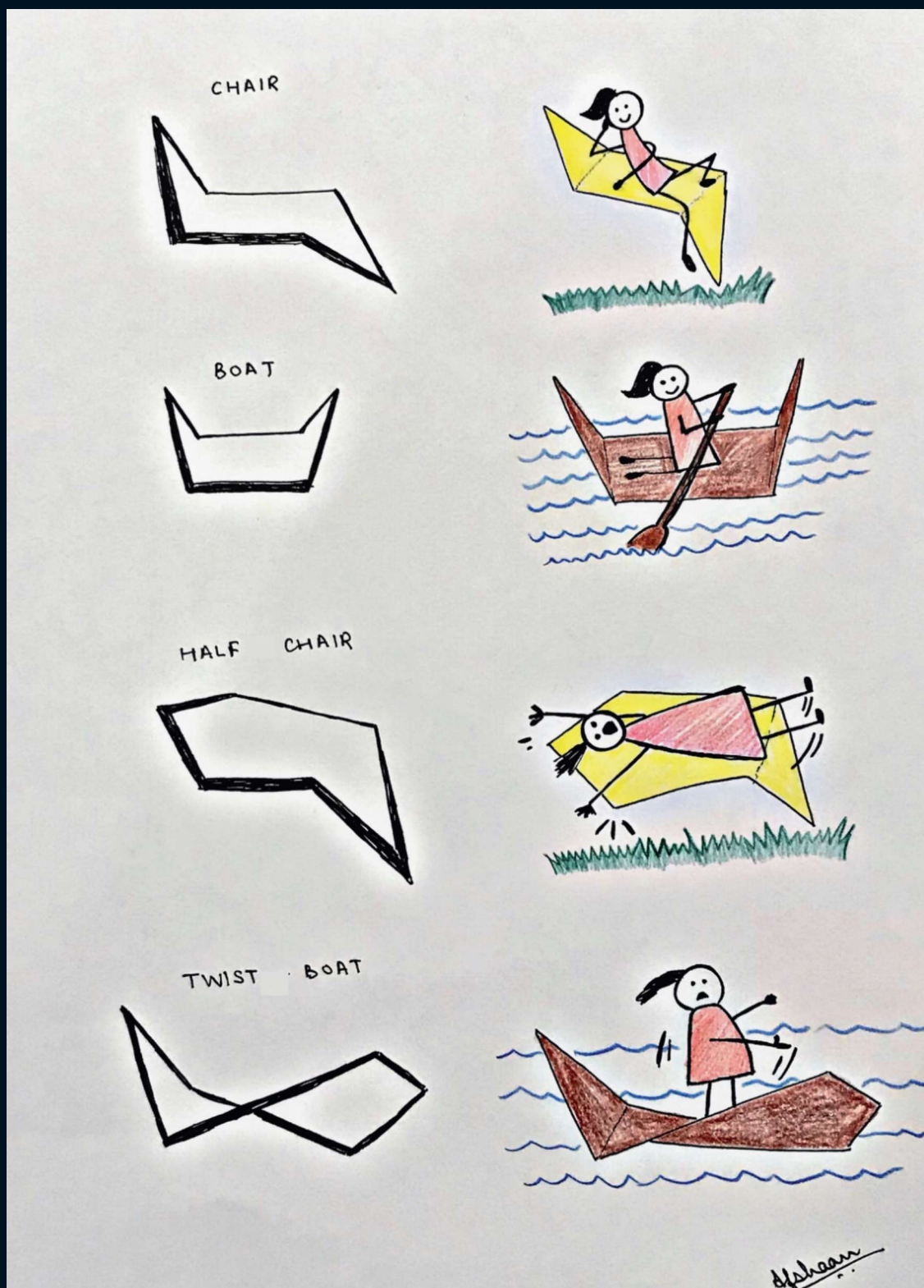
Sharing her experience of juggling offline college with residence for the first time, Judith says, 'I have to rely on mess food for the most part. So, I had to halt my experiment in the middle and go to the mess hall to eat rajma and chapati, which, of course, provided me with

energy. Rushing back to NCL after lunch, I saw my classmates about to finish their practicals and pushed myself to finish mine as quickly and accurately as possible. It was thrilling since I enjoy the rush of having to finish a task while under time constraints, that is, I find calm in the chaos. Working on a strict schedule, performing double titrations for two experiments, negotiating with teachers to change the timetable in order to give everyone enough time to have lunch - doing all of this was exactly the 'chaotic' experience that our friend Judith described to Dr Macwan as our feedback on our offline practical experience. Our professor, Dr Macwan also shared her experience when she used to attend theory and practical classes on campus and how, as a Residence student herself, she managed to work around the mess timings for lunch. To sum it up, what ma'am wanted us to do was to get used to this "chaotic nature" and to embrace the chaos. After all, she said that it was just the beginning.

We sincerely hope that our stories about our experience in the lab don't just end with these 3 days, but that we get many more days to create and share our disasters in the lab!



Cyclohexane Conformations



ARTICLE WRITING

The award-winning articles of the article writing competition conducted as part of Azadi ka Amrit Mahotsav on the topic “Science in Indian Traditions”

Have you ever wondered why after marriage beautiful bangles adorn the hands of Indian women? Or why most of the Indian children go through this painful process of ear piercing as a part of tradition? Or you might have wondered why people apply chandan tilak on their foreheads during religious traditions? And why certain days like Thursdays, Saturdays are meat forbidden days as a part of custom? Just like these, there are a plethora of Indian traditions that are practiced strictly till date without any restriction or obstacle. While following these customs the traditional aspect is very well comprehended but somewhere the scientific aspect is either not recognized or known owing to the utmost faith in one's culture and origin.

Science is the study of natural world around us through various meticulous experiments and observations. It's the process of unravelling the mysteries of universe through practical applications. The modern science which we know and study today has its origin from historical civilizations and practices. In India, religion played a key role in molding the traditions and cultures. The origin of these religion dates back to 5000 years. If we look back all Hindu scriptures are written in Sanskrit language due to their origination from Vedas. The teachings of Gautam Buddha in the country developed the religion Buddhism. Jainism is believed to be originated from the Indus valley. Different scriptures of different religions were worked upon by proficient gurus and preachers who had an extensive knowledge about science and have dictated the way of life in India for thousands of years. It is true that people follow these traditions and the influence of real culture is still on because of which even younger generations unknowingly through traditions live a healthy or scientifically follow the right way of life.

There are many common traditions which we follow blindly without realizing its positive effects in our life. Let's give a chance to understand their scientific significance. It always sounded unintelligent when elders told sleeping in a particular direction is bad omen,

Science In Indian Traditions *(first prize)*

*Mariet Sibi Puthenagady
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however, what we missed to understand was that sleeping with head in the north direction creates blood pressure problems as our blood have to work harder to maintain our body's magnetic field with respect to the earth's magnetic field. While leaving for exams, we all might have experienced the scenario where parents come running with a bowl of "dahisha-kar" (curd and sugar), this helps to keep the tropical Indian stomach cool and acts as an instant source of glucose. Even the henna used during Indian weddings have a function of acting as coolant and stress reliever by preventing the nerves from getting tense along with decorating hands and legs. The most common greeting custom followed by Indians also known as 'Namaste' which includes joining hands along with fingertips activates pressure points relating to eyes, ears, and mind, which enables us to remember a person for long. Also, it saves us from transfer of germs. Understanding the practical purposes of these traditions allows their easy acceptance in our day-to-day busy lives.

Certain traditions are even gender specific and are specifically followed by women, like, the red round 'bindi' applied by women on forehead also called 'kumkum' is a mixture of turmeric and slaked lime. It's mixed with little water and applied daily. Scientifically, it gets absorbed on the skin and on that position of the forehead is located the acupressure of pituitary gland. On being applied, the kumkum reaches the pituitary gland and improves its functionality and balances hormonal secretion thereby regularising menstrual cycle. The 'sindoor' worn by married women along the parting hairline keeps the blood pressure under control. The mercury content in the sindoor

assists in relieving stress, strain and providing mental peace to the newly-wed bride to adapt in a new environment. A silver toe ring worn on second toe by married women helps in strengthening the uterus and maintaining healthy blood flow. It also helps pregnant mother to carry more weight of the baby by activating weird acupressure points as it helps to connect to the uterus through a nerve that reaches heart. We all have seen how beautifully coloured and shiny bangles are worn by most of the Indian women. Along with adding to beauty, these act as a cure for menstrual pain and for pain in heels that occurs after forties. These bangles activate the acupressure points for uterus and ovaries which lie below our thumb and underneath the little finger respectively. This probably tells us why men don't wear bangles at all or more accurately don't need them except for decorative purpose. Thus, surprisingly most of the traditions was developed for a specific purpose and for a specific group of people!

Most of the Indian traditions originated on account of their scientific significances itself,

followed by the beliefs. We have come across certain experiences wherein elders tell us to avoid doing certain things or to follow certain way of doing things just because they learnt from their ancestors and have experienced the benefits of those practices. However, overtime due to the continuous use of these traditions along with the rituals their scientific relevance was somewhere left out and was not passed on meticulously which adds to the ignorant and mocking attitude of younger generations towards these ancient Indian traditions. However, following Indian traditions knowingly or unknowingly helps to live a life "free of unannounced risks" and "full of mental and spiritual serenity". Thus, science has its way in every sphere of our life; be it in the practical experiments we conduct in lab or the customary/religious traditions we perform. Hence, following the Indian traditions should not make one feel slow-witted or dull because now we know that even our 'Namaste' has a purpose.

Thank you.

Have we ever wondered, especially being Indians, that the rituals we follow, why we do so? Why do we exchange greetings by doing a namaskara, why do we touch the feet of our elders, or why does the bride apply henna on her hands and feet before her marriage? These are all traditional practices which we have always followed, and all of these have a scientific reason behind the “why we do so?” In this article the main focus is on the science in our kitchens. Indian cooking traditions have been influenced largely by Ayurveda. Historians have found many ancient texts such as Bhojanakutahalam, Kshema Kutuhalam and Nalapaka Darpana which give an account of traditional food science and technology as developed by our ancestors and describes food as being medicinal. These texts outline the entire process right from the growing of the crops, emphasizing on the local and seasonal ones, the use of certain utensils as well as the nature and mood of the person who cooks the food.

In the ancient days, the kitchen was built a little away from the house, towards the south-east direction, with the stove running from east to west. This was because it is believed that the Agni Devata (god of fire) resides in the south-east. Not only the location of the kitchen, but also the utensils in which we cook and store food is very crucial to keep the nutritional values of the food intact. Certain materials confer medicinal properties to the food that when consumed is beneficial in curing various maladies. The first utensil material which comes to our mind when we think of the older days is definitely clay. Clay was extensively used to cook food, because it is a bad conductor of heat and so it takes a lot of time to get the meal ready, making sure that the nutrients and minerals in the food were retained properly, and also the taste and aroma was enhanced in this way. Although everyone used clay to cook food, nobody dared to serve the same food in a clay pot, because it is believed to bring misfortune. Well, we do know about the superstitious nature of our people as well! Even today we hear from a lot of doctors that we must try and drink “ghade ka paani” (water

Science In Indian Traditions *(second prize)*

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kept in clay pot), because till date it is considered as the best way to drink water. This water is naturally enriched with a lot of minerals, and improves one's metabolism. The clay vessels also help in keeping the water cool, and this cool water can never cause a sore throat or cough. Not only water, but also many dairy products like milk, buttermilk and curd were stored in these clay pots. Curd was allowed to settle in these pots, having a very unique taste, and proving to be very healthy for the stomach. People also used utensils made out of metals like copper, gold and silver. Food cooked in these utensils improved the mineral content of the body and also the eye sight, and is also known to bring in enthusiasm and improve one's intellect. Then after that came iron which became every one's favourite when it came to cooking utensils. Life became a bit faster, and people preferred if it took lesser time to prepare the meal. Iron served this purpose the best, being a good conductor of heat, food cooked faster in it. Food that is cooked in iron vessels helps to increase the haemoglobin content in the body and helps to cure infections of the eye and piles. It also treats inflammation, imparts strength to the body and is known to be an excellent treatment for severe anorexia or malaise. Now if we again go back, Ayurveda gives us an account of utensils made out of leaves as well. Leaf vessels stimulate the Agni and act as a detoxifier. The plantain leaf is an aphrodisiac. It improves the taste and treats any toxicity in the body.

Lastly, it is also very important to consume the food in the right manner, which means eating the right food at the right time. There is an old saying in Sanskrit which means: “Food partaken of with reverence results in strength and longevity, and the destruction of both, when partaken of irreverently.”

PAPER PRESENTATION

Some of the award-winning presentations from the recently concluded Inter College Paper Presentation competition on the topic “Scientific Endeavours and Amelioration in the field of Medicine in Independent India.”

Development Of Maternal and Child Healthcare Services in Independent India

*Yogita
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Abstract

India has been independent for 72 years. However, when the British left, the country's 5,000-year history of medical sciences was in ruins. Since then, India has concentrated on growing its economy and developing its health care system, which has progressed at a rapid pace. In terms of enhancing justice and lowering poverty, maternal health is an important part of every country's growth. Mothers' survival and well-being are critical not only in and of themselves, but also in addressing larger economic, social, and developmental issues. India, through its plethora of schemes under various governments, has endeavoured to bring quality maternal and child health care (MCH) services to rural India. MCH began in the early 1900s when rural midwives and birth attendants were trained and maternity services were enhanced. MCH was a voluntary effort administered by the Indian Red Cross Society's Maternal and Child Welfare Bureau. In 1931, the state of Madras was the first to create a dedicated separate Maternal Welfare section inside the Office of the Director of Health Services.

The Bhore Committee suggested integrating MCH into General Health Services in 1946, but it wasn't implemented until 1955. Prior to 1953, MCH was distributed inequitably and delivered by maternity homes and midwives. The spread of MCH services was aided by WHO and UNICEF funding. In 1962, the Mudaliar Committee suggested that MCH centres be expanded to include one ANM per 10,000 people. In 1960, the Child Care Committee issued its first report on preschool child care, outlining many forms of comprehensive child welfare services. The Committee on Child Welfare Programs linked effective family planning (FP) to good MCH services in 1968. The 1969-74 5-year plan was the first to combine FP and MCH. 1974 was a watershed moment in

history.

Why look at the historical aspect?

India's ongoing efforts under the National Rural Health Mission (NRHM) to preserve advancements in institutional maternity and neo natal care utilisation are focused on treatment quality. For effective planning around institutionalising quality improvement approaches, it is necessary to critically analyse India's maternal health policies and services in a historical context. With more than two decades of devoted safe motherhood training, India has a long history of maternal health initiatives. Despite this, an estimated 56,000 maternal fatalities occur in the country each year, accounting for 19% of all maternal deaths worldwide. The progress India makes toward its maternal and child health goals is expected to have a big impact on global outcomes. As a result, it's critical to comprehend her story. I attempted to investigate maternal health care quality in India with two specific goals:

- (i) to trace the evolution of maternal health concerns in the context of India's health system development from independence (1947) to the present
- (ii) to identify quality-related issues and areas for further action to improve maternal and infant survival outcomes.

In recent years, initiatives under the National Rural Health Mission to extend access to emergency obstetric and newborn care have resulted in greater utilisation and positive outcomes, but such efforts can only be sustained if quality treatments are provided. Over time, India's health policies and programmes have increased service coverage and improved health outcomes. The infant mortality rate (IMR) has decreased from 148 per thousand live births in 1951 to 44 per thousand live births in 2012. In British India, maternal mortality was predicted to be 2000 per 100,000 live births in

2007-09 [Figure 1]. In 1981, only 18.5 percent of babies had a skilled attendant, but that number has recently risen to 52.7 percent in 2007-2008.

These accomplishments must be examined in light of the quality of care provided, since this information could be useful in planning for institutionalising quality improvement in services. The technical competence of service providers as well as patient satisfaction with the treatment obtained are both considered when determining quality of care. Six main elements of health system functioning have been highlighted as critical priorities for quality improvement: safety, efficacy, responsiveness or patient-centered care, timeliness, efficiency, and equity.

Policy trends in maternal health development and concern with quality

Focus on improving equity and coverage (1947-77).

India inherited a health system riddled with inequities and inadequate coverage when it gained independence from colonial rule in 1947. As a result, in the early years after independence, India's health system was led by principles of justice and extending coverage; but, due to limited resources, efforts were severely limited. Several vertical disease eradication programmes for various infectious diseases affecting the country were launched under the First Five Year Plan (1951-56). Doctors, nurses, and midwives were to be trained in order to expand MCH services. However, little progress was made in practice, and infrastructure and human resources quality became a subject of worry. Concerns about population control prompted the third five-year plan (1961-66) to introduce the extension strategy to family planning, in which extension workers were set contraception targets. The pressure to fulfil these standards overshadowed community-based MCH services, especially during the Emergency (1975-77), when civil freedoms were suspended and forced sterilisations were used to meet targets. Following the Emergency, a reaction against the

target method led to its replacement in the late 1970s with a broader family welfare approach. The Alma Ata Declaration of 1978 refocused attention on primary health care based on universality, comprehensiveness, and fairness principles. During this time, policy concerns and quality-related suggestions were mostly limited to health-care human resources. Several health committees gave recommendations on how to improve the physical and human resource quality. However, the health sector's effectiveness in this area has been hampered by poor implementation and funding.

Primary health approach (1978-1990)

Based on the 'health for all' idea arising from the primary health approach, the first national health strategy in 1983 focused on primary level MCH care with concrete goals of reducing IMR from 125 (1978) to below 60 by 2000 and MMR from 4-5 to below two by 2000. It emphasised the importance of boosting coverage and strengthening referrals through India's three-tiered rural health centre system (Sub-Centre, Primary Health Centre and Community Health Centre). Maternal health was prioritised in the Seventh Plan (1985-1990), with an emphasis on preventive, promotion, and educational components. Later, primary healthcare evolved into vertically operating programmes focusing on specific components such as immunisation, oral rehydration, breastfeeding, and anti-malarial medications. For the first time, quality of care was expressly highlighted as a concern in the health sector in the Seventh Plan document, particularly in terms of supplies, training, management, and supervision. However, no real strategy was proposed to address these problems.

Economic liberalization and global development priorities (1990-2000)

Economic liberalisation under the Strategic Adjustment Programme in the 1990s resulted in increased private investment in secondary and tertiary care, increasing access inequity at this time. At the same time, global women's movements for reproductive rights prompted a shift

in family welfare programmes to a target-free approach with an emphasis on overall reproductive health. MCH programming grew as a result of the change to the RCH approach. In 1992, the World Bank-funded Child Survival and Safe Motherhood initiative was created, expanding MCH services to include vitamin A supplementation, traditional birth attendant training, disposable delivery kits, and First Referral Units (FRU) for emergency obstetric care (EmOC). The RCH Programme (RCH-I) was established in 1997 with the goal of integrating reproductive, maternal, child, adolescent, and family planning services through a decentralised “bottom-up” approach. The development of private sector operations in the health sector in the late 1990s led to the rise and extension of public-private partnerships (PPPs), which have since become a well-established method of financing and delivering healthcare. Under the influence of primary health advocacy and reproductive rights, quality awareness rose significantly, with stronger articulation in the five-year plans. The scope of the project expanded to encompass efficiency and quality assurance, particularly as the necessity for service norms and standards for the growing private sector became apparent. Several states benefited from the World Bank’s efforts to implement quality improvement measures through its India Population Project and Health System Development Project projects.

Focus on quality improvement (2000 onwards)

Over time, advocates for health-care quality improvement have been more vocal. The tenth and eleventh five-year plans’ quality concerns were backed up with quality assurance and appraisal procedures. Quality improvement strategies finally emerged with India’s flagship health programme, the National Rural Health Mission (NRHM), which was launched in 2005 to carry out fundamental reforms in the country’s basic healthcare delivery system, integrating all existing programmes, including the RCH programme phase II (RCH II). The Indian Public Health Standards (IPHS) set out guidelines for improving primary health care facilities and services in India. The RCH-II

quality assurance guidelines called for the formation of Quality Assurance Committees at the district and state levels to provide ongoing quality monitoring and corrective action through frequent facility visits and feedback. Technical assistance and capacity building institutions, such as the National Health Systems Resource Centre, were established to improve service quality. To address significant gaps in skill sets, such as skilled birth attendance, emergency obstetric care, integrated management of neonatal and childhood diseases, and home-based newborn care for community health workers, standard treatment protocols and training modules were designed. For increased openness and accountability, monitoring and evaluation systems were expanded, including community-based monitoring. These included the mandatory formation of patient welfare committees at the facility level, which were also given untied monies to remedy gaps in care quality. The program’s standards included specific guidelines for quality control, certification, and improvement. Guidelines for executing maternal death reviews, a technique outlined in RCH-II to improve obstetric care quality and minimise maternal morbidity and mortality, have also been released. The National Accreditation Board for Hospitals and Healthcare Providers (NABH) was established under the Eleventh Five Year Plan (2007-12) to accredit commercial and public health centres at secondary and tertiary levels. In addition, the Bureau of Indian Standards (BIS) produced ISO accreditation for hospital quality management systems.

Impact of quality improvement in health on MCH care and services.

Review of Literature also identified a number of critical issues relating to quality of MCH services and care in India. These are summarized below.

Research evidence on quality related issues in MCH care in India

To begin, we might discuss research findings on quality-related difficulties in Indian MCH care. Poor access, infrastructure constraints,

high expenses, inefficient treatment, and insensitive behaviour were highlighted as important factors for limited utilisation of public facilities in a study on MCH care in India. Lack of educated human resources, poor communication, and poor referral and blood bank linkages harmed maternal care the most. Staff absenteeism, a lack of drugs, and a long wait time have all been identified as major issues with public health centres in rural areas in studies on maternal satisfaction with care. The Janani Suraksha Yojana was evaluated, and it was discovered that good staff behaviour, cleanliness, and counselling about many elements of newborn care all contributed to increased satisfaction with the programme. Lack of cleanliness and hygiene, privacy, promptness of treatment, and bad staff behaviour were found as some recurrent quality-related problems in institutional delivery care in a comparable study. Improved utilisation and outcomes were also connected to quality improvement measures, according to research. Staff morale has improved as a result of the refurbishment, as has patient flow. Increased use and patient satisfaction were also a result of improved clinical and public health service quality, particularly in primary and secondary level facilities.

Issues in implementation of quality improvement measures.

Implementation issues with quality improvement measures Several concerns have emerged as a result of the rapid expansion of services and implementation of quality improvement initiatives since 2005, according to NRHM/RCH-concurrent II's monitoring and evaluation reports. The use of additional NRHM funds has been influenced by regional health sector inequities. States with higher baselines, like as Kerala and Tamil Nadu, have been able to employ decentralised finances and planning procedures to improve their services more quickly. Weaker states, on the other hand, are reporting enormous sums of unspent monies, indicating that they have been unable to use them. [39] The IPHS recommendations are extensively utilised as a benchmark for improving facilities, and the results are obvious.

However, development is delayed in other areas, probably due to the legacy of poor health systems. Interrupted and inappropriate supplies, poor logistics, claims of significant out-of-pocket costs by the poor, poor infection control, lack of privacy, and insensitive clinicians are all persistent flaws. [40-42] Quality assurance committees do exist, but their efficacy is restricted, and periodic quality evaluation is not performed uniformly. [40] Another significant concern is demand outstripping supply. Marginal infrastructure upgrades and incentive schemes for institutional deliveries have all led to a boom in demand, with facility improvements being surpassed by the quick increase in utilisation, particularly the burden of institutional deliveries. Where primary level facilities are inadequate, births reach secondary and higher levels, which are frequently forced to compromise quality of treatment due to acute overcrowding and bed shortages. [40,43,44] Quality-control mechanisms are not yet fully operational in all states, and institutions such as Hospital Development Societies, which were established for participatory management of facilities, require more training on their role in ensuring equity, as well as the quality of services, among other things.

Discussion

Since independence, mother and child health has been one of the most important components of public health programming in India. Concerns about expanding access and infrastructure, on the other hand, usually led to a lack of focus on quality. In summary, quality remained an underlying concept with no clear method for achieving it. Growing public concern about healthcare quality in the 1980s and 1990s, influenced by primary health and reproductive rights movements, brought it back into spotlight. One of the first quality criteria addressed was equity of access, which was addressed through expanding facilities, particularly in underserved areas. Strengthening physical and human resources addressed effectiveness and safety in a subtle way. NRHM was groundbreaking in the last decade since it tackled all aspects of quality directly. It established public health standards and emphasised

infrastructure, referral networks, and health-management systems. The IPHS also includes recommendations for protecting patient privacy, while physician behaviour is still a problem that has to be addressed. There is a strong focus on improving the quality of maternity care services, which is reflected in a faster improvement in maternal outcomes, such as lower maternal mortality [Figure 2]. However, in India, the road to good maternal care is still long and twisting. Decades of neglect have created a huge chasm that needs to be bridged in terms of quality improvement in accordance with industry standards. Quality inadequacies have been frequently recognised in programme assessments, which have been exacerbated by rising patient loads as a result of demand stimulation through incentive schemes and infrastructure upgrades. Furthermore, there is a major regional mismatch in the development of health systems across states. Within the country, maternal mortality rates range from 81 in Kerala to 359 in Uttar Pradesh. Less developed states such as Uttar Pradesh, Bihar, and Orissa are hampered by a lack of basic infrastructure and human resources, all of which must be addressed before quality improvement programmes can be implemented. Progressive states, on the other hand, such as Kerala and Tamil Nadu, have been able to take use of the NRHM chance to significantly increase service quality.

Areas for future action — strengthening management for improved outcomes

The experience of India with NRHM has shown us that more funding and better fund use are critical for improving the quality of treatment at the facilities. Though public health spending has increased under the NRHM, it is still insufficient, accounting for only 1.3 percent of GDP.[46] There is consequently a huge opportunity to raise healthcare funding in order to significantly enhance the system's quality. Another crucial takeaway is that, despite increased efforts, the system's inability to expand supply quickly enough to meet rising demand has necessarily harmed existing quality. Overcrowding and insufficient services, particularly in institutional settings, suggest this. While at-

tempts are being made to address this, it is important to ensure that they do not become lax. Another conclusion is that putting in place quality assurance systems is only half the battle; they will not be effective in ensuring quality unless they are functional. The RCH-II quality assurance system has flaws in multiple areas, including non-functional QACs and a scope and membership that isn't broad enough to cover all components of the programme. Clear directives must be issued in order to prioritise their functionalization in accordance with programme parameters. The lessons learned under the NRHM programme include the importance of community awareness in promoting a culture of high-quality care. As a result, initiatives to raise community awareness of quality of care and channels for community input will be needed in the future to improve facilities and assure openness and accountability of services. According to research findings, enhancing infrastructure alone may not be enough to increase use unless patient dignity and staff behaviour are also addressed. This is likely one of the most important lessons learned from quality improvement initiatives under the NRHM and RCH-II programmes, which place a higher emphasis on supply-side concerns. In the future, it will be vital to guarantee that behavioural issues such as staff sensitivity and enhanced communication with patients are adequately addressed, or public facility utilisation will continue to be unsatisfactory.

Conclusion

To sum up, the review demonstrates that in India, quality of care has progressed from an underlying implicit theme in the early decades after independence to a well-articulated strategy under NRHM. Years of neglect resulted in modest development until the last decade, when increased focus on quality helped speed favourable mother outcomes. India's experience has also taught many important lessons about the future path of quality improvement in the Indian health system, particularly in terms of higher funding, enhanced services, and functional quality assurance systems. For the improvements to last beyond the Mission time, consistent efforts to institution-

alise quality assurance methods would be required.

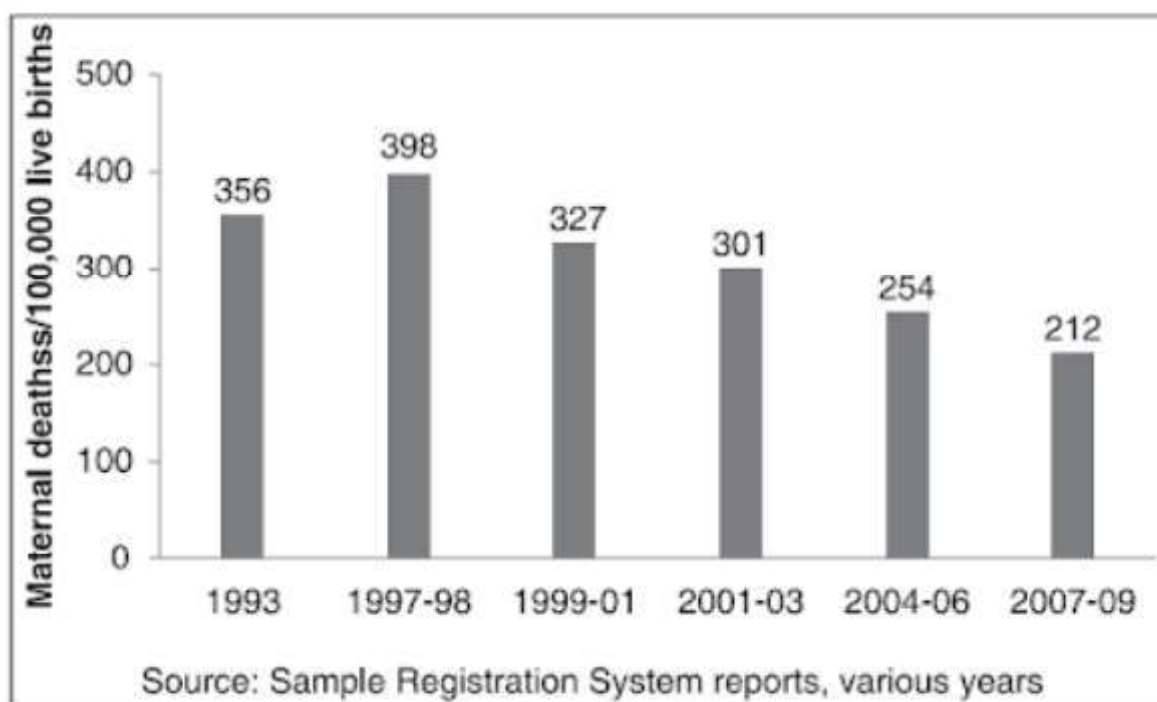


Figure 1: Maternal Mortality Ratio in India, 1990-2009

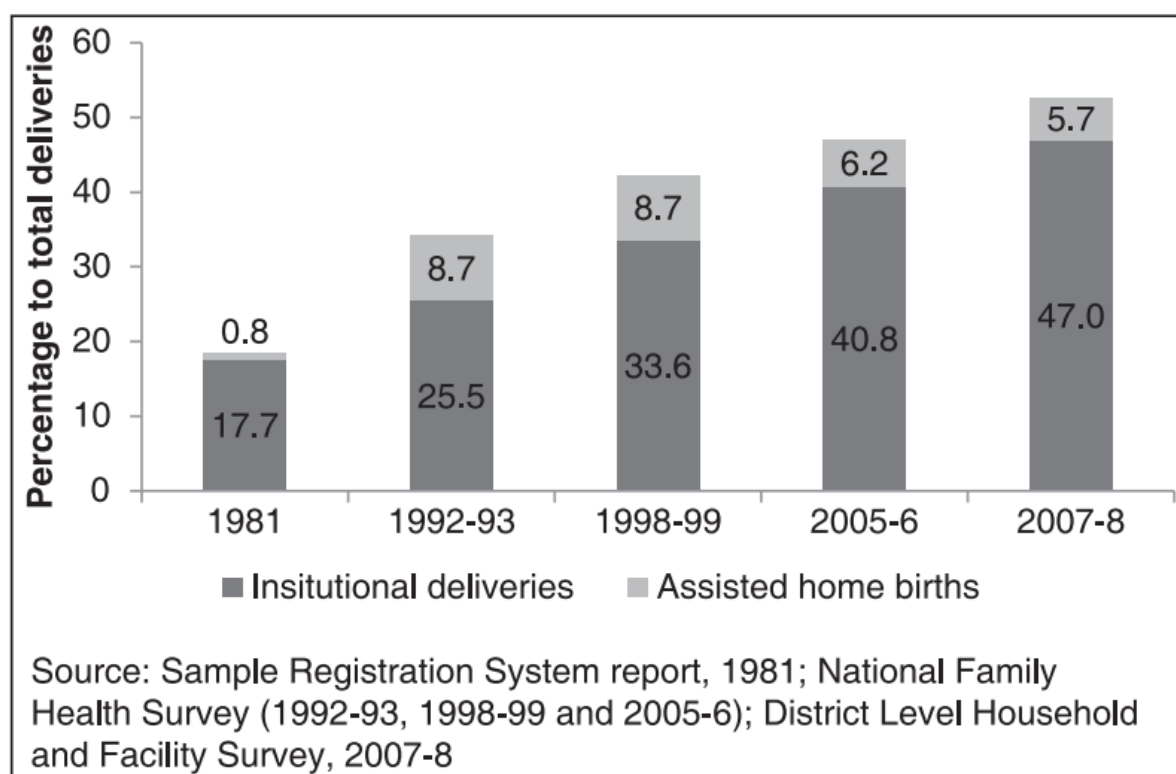


Figure 2: Growth in skilled attendance at birth in India

How India was able to Produce Large Quantity of Hydroxylchloroquine and helped other countries- during Covid-19 Pandemic?

*Devanshu Lalwani
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India has been growing post its independence incessantly in the field of technology and medicine. It is very evident from the fact that when the covid 19 pandemic hit the world, India was one of the countries who was improving upon providing healthcare facilities and ensuring as less deaths due to pandemic as possible. Hydroxychloroquine, had been identified by the US Food and Drug Administration as a possible treatment for the Covid 19 and was being tested on more than 1,500 coronavirus patients in New York for its approval.

So what is hydroxychloroquine?

It is a medication that causes reversible skin whitening by interfering with the formation of melanin by melanocytes. The chemical decrease of pigment is achieved by inhibiting the enzymatic conversion of tyrosine to DOPA (dihydroxyphenylalanine). It's used to lighten darkish skin spots like freckles, age spots, chloasma, and melisma that are caused by pregnancy, birth control pills, hormone therapy, or skin injury. And how India was able to produce this drug? With the help of GLOBAL CALCIUM. Global Calcium is one of the most well-known manufacturers of this medication. It produces this medicinal medicine and distributes it to both domestic and international markets. Global Calcium's manufacturing sites are fully cGMP certified and feature state-of-the-art manufacturing facilities, according to EU standards.

There were many factors which enabled them to produce large quantities of this drug. These include

1. Have multi-facilities with SS electrochemical reactors,
2. SS filters & sparklers
3. Chilling and evaporation crystallizes
4. Centrifuging facilities, crushing facilities,
5. Granulation & blending facilities
6. Calcium spray dryer technology: Large Scale

7. Integrated water system, waste treatment and auto packaging.

The 5 independent manufacturing plants have a capacity to produce over 2000 MT of various Calcium and Mineral Gluconates salts the year around, making it one of the world's largest producers in the world. It has a dedicated Spray-Drying Unit that is designed to meet the highest quality standards and optimize product-drying yields with improved density control. The plant is fully automated and has a processing capacity of 750 MT per year. This is now being increased 1500 MT per annum. Global Calcium has multi feeder and storage tanks, hot air generators, alcohol storage tanks, cooling towers and complete generator power back up to support power fluctuations and low voltage power conditions. Research and Development at Global Calcium ensures a complete focus program that covers chemical analysis, stability studies, physical analysis, safety assurance, formulation and new product development and quality assurance. Global Calcium's multidisciplinary R&D strategy ensures improved efficacy and superior safety profiles for our products, which are examined using cutting-edge technology such as HPLC, HPTLC, UV-Spectrophotometer, GC, BOD incubators, and more. Their team of focused PhDs, MScs and focused specialists conduct extensive testing and development pilot trials using optimized process upgrades towards improved yields. The R&D team drives these initiatives towards offering cost advantages to our customers. The routine R&D activities cover chemical analysis and certification according to USP, BP, EP and JP; Physical tests for assay, bulk density, pH, etc.

With so much potential of production of this drug, India showed its supremacy and kindness to other countries of the world by exporting it in large quantities when it was required during

the pandemic. India supplied anti-malarial drug hydroxychloroquine to 55 coronavirus-hit countries as grants as well as on commercial basis. The medicine has already been sent to a number of countries, including the United States, Mauritius, and the Seychelles. Hydroxychloroquine has been identified by the US Food and Drug Administration as a possible treatment for the COVID-19 and it was being tested on more than 1,500 patients in New York. In the neighborhood, India is sending the drug to Afghanistan, Bhutan, Bangladesh, Nepal, Maldives, Mauritius, Sri Lanka and Myanmar. India is also supplying hydroxychloroquine to Zambia, Dominican Republic, Madagascar, Uganda, Burkina Faso, Niger, Mali, Congo,

Egypt, Armenia, Kazakhstan, Ecuador, Jamaica, Syria, Ukraine, Chad, Zimbabwe, France, Jordan, Kenya, Netherlands, Nigeria, Oman and Peru. It was also sent to the Philippines, Russia, Slovenia, South Africa, Sri Lanka, Tanzania, the United Arab Emirates, Uzbekistan, Uruguay, Colombia, Algeria, Bahamas, Mauritius and the United Kingdom. The drug was sent to several countries on a commercial basis while many others are getting it as India's grants.

This indeed is sufficient to prove that India is and continues to perform scientific endeavors and amelioration in the field of medicine.

Chemistry Between Us

I am attracted to you
Like an electron to a proton
Together we form an ionic bond
Though we are oppositely charged
I am drawn towards you

Our love is unique as an orbital
A space only two electrons can fill
As my love for you increases
My energy level rises
I am forever in this excited state

Increasing the tendency to form a chemical bond
I was an element
You helped make me a compound substance
Falling in love with you was a chemical reaction
Which caused my love for you to grow
Ours is an exothermic love
Each for giving off the love not just absorbing it

Sometimes you do something especially (Ni-Ce)
Which speeds up the chemical process
Like a catalyst is my increasing love for you

I realise we have our inhibition periods
And sometimes I am selfish enough
To be an endothermic reaction
Only absorbing your love
The feelings I have for you are so ardent
It cannot be measured in Kilojoules
Often I have to analyze quantitatively
To understand and love you more

I don't expect to know your molecular formula
You are too complex a person for that
When you are gone
I am a noble gas
An inert substance
When I am without you
The world seems still
And I am at equilibrium.

EVENTS

On the 20th of August, the Chemistry Society organized its first event of the year: the online workshop titled 'How to build your Resume and SoP: Insights into Higher Education .' The goal was to help students understand the application process better and ease the anxiety of admissions . The panelists included alumni of St. Stephen's College - Vidhi Sehrawat, Chaitanya Verma, and Navoneel Sen. The event began at 2 pm with Aravind Ravi, Publicity Head of the Chemistry Society, introducing the speakers. Sixty-four people participated in the workshop, and it was two hours long. The audience gained many insights into the foreign application process. I. Chaitanya Verma Erasmus Scholar for LASCALA Masters Chaitanya explained the difference between a Curriculum Vitae and a Resume. He also demonstrated ways to improve their presentation through examples. A CV is more detailed than a Resume. In the USA, a Resume and CV are different types of documents. The terms CV and Resume are used interchangeably in places like India, South Africa, the UK, New Zealand, Australia and most parts of Europe. He discussed various software and applications that provide templates to create these documents like Overlead, NovoResume, Canva and Microsoft Publisher . He advised the participants to choose a layout that is easy to read and keep the content precise. One must always be honest while reporting one's skills. He told them that improving one's expertise is a continuous process and advised the audience to always be perseverent. II. Navoneel Sen University of Oxford Navoneel spent his masters studying the coarse-grained modelling of DNA Origami force sensors and plans to research structural heterogeneity in proteins. After giving us a brief background about himself and Oxford University, he described its various postgraduate programmes. Different departments at Oxford offer Taught Master's programmes which last ten months to one year in fields like Theoretical Chemistry, Computation, Energy Systems and Mathematical Modelling. Masters by Research and Doctoral Training last 3-4 years in various fields. He encouraged the audience to look at courses outside merely their undergraduate subject as most specializations are interdisciplinary in nature. For example, a chemistry student might

Resume and SOP Building Workshop

*Rhea Benny Matthew
B.Sc. Chemistry/HonsJ -If Year*

be interested in neuroscience offered by the Department of Psychiatry or environmental courses by the School of Geography and Environment. He said that interested students must email the supervisor of research programs before applying to them . It is helpful to build your soft skills outside the classroom by applying to internships and doing online courses. As internships are hard to find online and offline options are limited during the COVID-19 pandemic, learning programming like Python or Mathematica is beneficial. Computational methods are gaining popularity across different fields of research . His parting words to the audience were to find subjects that inspire them and to learn how to showcase all their skills. While being knowledgeable is important, knowing how to communicate ideas and demonstrate capability is what opens up opportunities. 3. Vidhi Sehrawat SSERP+ Erasmus scholar at Universite Paris-Saclay Her presentation emphasised the importance of gaining work experience during our education and guided the listeners on how to approach it. The first step of gaining research experience is to find a topic that interests you and read related scientific literature. While emailing professors, including why their subject interests you and why you would be a good fit in their lab. She spoke about the importance of writing personalised emails to professors and arranging a video call before starting your tenure. Attaching your CV and Marksheet with the email is a must. Internships are beneficial experiences to learn practical research skills. Vidhi instructed the audience to take extensive lab notes and keep a copy of them during an internship. One must talk to other participants about their experiences and learnings. In the end, one must ask for a completion letter and a letter of recommendation. It is also useful to ask whether the supervisor can function as a as a point

of reference. She also spoke about how to write an engaging Statement of Purpose. She advised the audience to answer the question 'Why?' to not bore the reader. A good Statement of Purpose uses simple and concise language, demonstrates an honest and realistic approach to research, and shows that the author has set achievable goals for themselves. The workshop ended with a question-and-answer session moderated by Akanksha Shahi, Logistics Head of the Chemistry Society. The panel of speakers enthusiastically answered all the questions posed by the students present in the meeting. They shared what mistakes they made along the way and elaborated on their personal experiences. All in all, the workshop was a success. It enlightened all the participants and offered clarity on the confusing process of admissions and applications. The speakers inspired the participants to experiment, always do their research, persevere and never stop learning. Scientific research is not about the brand name of a university but pursuing a field that you care about. As scientists, we have to find solutions to make an impact in the world. The easiest way to ease the application process is to have a personal vision.

of reference. She also spoke about how to write an engaging Statement of Purpose. She advised the audience to answer the question 'Why?' to not bore the reader. A good Statement of Purpose uses simple and concise language, demonstrates an honest and realistic approach to research, and shows that the author has set achievable goals for themselves. The workshop ended with a question-and-answer session moderated by Akanksha Shahi, Logistics Head of the Chemistry Society. The panel of speakers enthusiastically answered all the questions posed by the students present in the meeting. They shared what mistakes they made along the way and elaborated on their personal experiences. All in all, the workshop was a success. It enlightened all the participants and offered clarity on the confusing process of admissions and applications. The speakers inspired the participants to experiment, always do their research, persevere and never stop learning. Scientific research is not about the brand name of a university but pursuing a field that you care about. As scientists,

The Chemistry Society organized its Inaugural Lecture for the academic year 2021-22 on 14th October, 2021 online via Google Meet. Dr. Amit Kumar Mandal, Associate Professor, IISER Kolkata and Honorary Adjunct Faculty, Ramakrishna Mission Vivekananda Educational and Research Institute was invited as the Guest Lecturer for the event. It was a pleasure to listen to Dr. Mandal as he shared his vast knowledge on the topic "Mass Spectrometry A Platform to Analyze Molecular Constraints to Functionality Active Conformations". The purpose of the event was to provide the students with an opportunity to learn beyond the curriculum and

Inaugural Lecture

Sakshi Sharma
B.Sc. Chemistry{HonsJ -II/Year

introduce them to the intricacies of the research going on in the field of chemistry. It was a wholesome and enriching session where the audience participated enthusiastically, putting up interesting questions and queries, and everyone left with a greater knowledge of the subject.

The Chemistry Society orientation was held on the 15th of January at 4:00 PM. Its main aim was to educate and show the First Years what the Chemistry Society's functions as well as their annual events.

We were first introduced to the Executive Council led by the Third Year, Ridhima Raina. The First Years were then told about the society's monthly Newsletter, Megaphone, as well as their annual Journal, Oxygen. We were told about the process behind article selection as well as how First Years could volunteer to write articles as well how to edit these articles.

We were then made aware of the Chemistry Society's Annual Fest, Resonance, one of the flagship events of the society as well as the most diverse. We were told about how the Fest was a combina-

Orientation

Timothy Gladston
B.Sc. Chemistry{HonsJ-IYear}

tion of multiple events, all related to Chemistry and is intended to expand our horizons.

The orientation was light-hearted, peppered with friendly banter between the First Years and their newly acquainted seniors. Not only did it inform us of the Society's functions and events but it also served as an important ice-breaker between the First Years, Second Years and the Third Years.

Fresher's welcome for the Chemistry Department St. Stephen's College was organized virtually on the 2nd of February, 2022 by the second and third-year junior members of the Chemistry Department, together with the Chemistry Society. The event started with a heart-warming welcome by Dr. Shabnam Johry, former Head of the Chemistry Department. Her motivating words moved everyone present. This was followed by an enriching celebration with group dances, music performances, exciting games, and other fun events. The first years actively participated throughout the session and showcased their plethora of talents ranging from singing, dancing, process.

Freshers '22

Sakshi Sharma
B.Sc. Chemistry{HonsJ -II/Year}

poetry writing, etc. Later, Dr. Vibha Sharma, the Head of the Chemistry Department welcomed the freshers with her enlightening words. The event

offered a platform for the first years to interact with their seniors, peers and faculty members, which helped them build their relationship, despite the boundaries set by the online teaching-learning process.

Resonance is the annual flagship event of The Chemistry Society of St. Stephen's College. It comprises of the Opening Lecture along with many intra- and inter-college competitions. This year's edition was held online, with all the events conducted virtually. Resonance 2022 was conducted over a span of 5 eventful days, which had activities that spanned various disciplines of science and helped students (and participants) gain knowledge. The first event of Resonance'22 was the 'Opening Lecture' which this year was delivered by a renowned Professor from the University of Cork, Ireland on 23rd February, 2022 (Wednesday). Prof. Alan Kelly addressed the participants, and he talked about "Nature of Modern Science Communication". His talk was very detailed, simple to understand and highly interactive. After this we had a series of events that started with the 'Pic tinary' on 24th February, 2022, followed by the 'Debate ' which was organized on 25th February, 2022 (day 1) and 27th February, 2022 (day 2). On 26th February, 2022 we conduct

Resonance '22

Jay Ingle
B.Sc. Chemistry{HonsJ -III Year

ed the very famous inter-college science quiz, 'Chemathon' followed by the 'Treasure Hunt' in the evening. The last day of Resonance '22 was 27th February, 2022 (Sunday), a day which witnessed a lot of activities. Starting with the finals of the Debate, an interactive 'Career Counselling' webinar by ChemAcademy followed. Resonance '22 concluded with the 'Photography Competition' along with announcement of the winners of the various competitions. The final ceremony was addressed by our highly supportive Dr. Vibha Sharma, Head of the Chemistry Department, St. Stephen's College. All in all, Resonance '22 was a huge success due to the beautiful teamwork of the entire Executive Council and members of the Chemistry Society.

Prof. Charusita Chakravarty, a famous scientist and researcher who made substantial contributions to the fields of Theoretical and Computational Chemistry as well as Chemical Physics, embodies this remark perfectly. Prof. Charusita Chakravarty made it her ambition to excel in the field of Chemistry at a time when it was difficult to be taken seriously as a woman in the sciences. As a social crusader, she spoke out against the hostile atmosphere that women face in scientific fields and inspired many women to pursue the field despite the numerous challenges. Through her love for poetry and music, she broke the unwritten barrier between the arts and sciences, demonstrating that one's interests do not have to be limited to the fields in which they work. She accepted a position in the Chemistry Department at IIT Delhi, where she rose through the positions from Assistant Professor to Professor in 2006, and continued to teach there until her untimely death. Her initial work focused on Atomic and Molecular Clusters, and she became known for her specialised application of path integral Monte Carlo simulation to unravel Quantum Mechanical influences in the properties of Atomic and Molecular Clusters during the course of her career. Her work was much appreciated, and she got numerous awards and prizes for it. Prof. Charusita Chakravarty won her first award from the Indian National Science Academy (INSA), a premier society for Science and Technology in India, in 1996, when she received the Medal for Young Scientists. She served as a member of the Abdus Salam International Center for Theoretical Physics in Trieste, Italy, from 1996 to 2003, an institute dedicated to scientific research and excellence. The Indian National Science Academy presented her with two prizes in 1999: the B.M. Birla Science Award and the Anil Kumar Bose Memorial Award. She was awarded the Swarnajayanti Fellowship by the Department of Science and Technology in 2003, and an Indian Academy of Sciences Fellowship in 2006. She was also an Associate Member of the Centre for Computational Material Science, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, and earned the renowned Shanti Swarup Bhatnagar Award in 2009. She passed away on March

The Charusita Memorial Lecture

*Deepti Nehra
B.Sc. Chemistry{Hons.} -III Year*

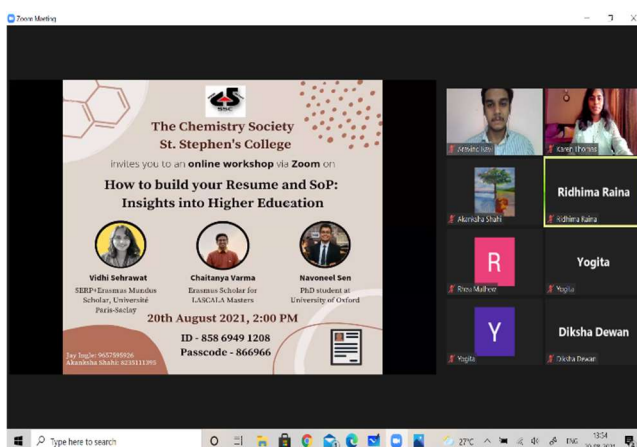
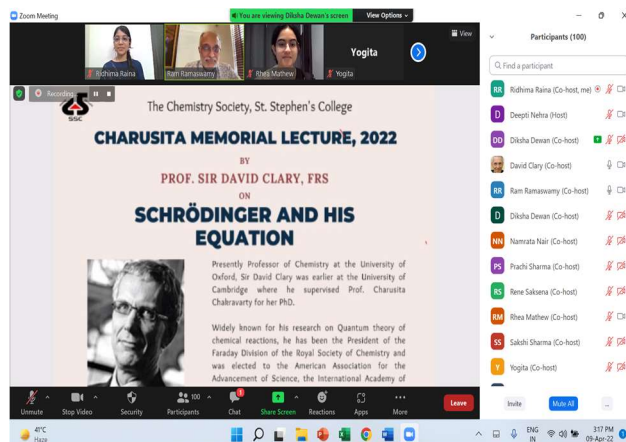
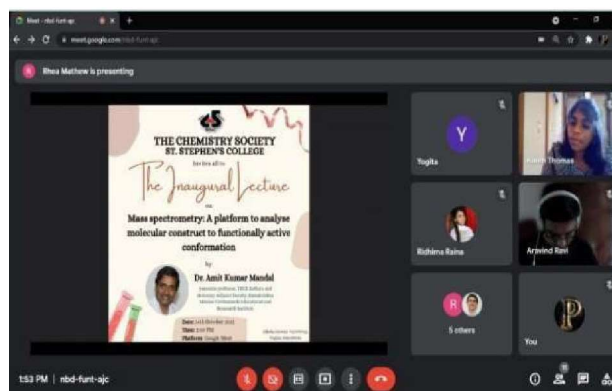
29, 2016, after succumbing to breast cancer. Prof. Ramakrishna Ramaswamy, the late Prof. Charusita Chakravarty's husband, established the Charusita Memorial Lecture series in her honour in 2017, drawing inspiration from her incredible life. The Charusita Memorial Lecture not only allows us to hear from renowned academics, but it also serves as a celebration of Prof. Charusita's life and the field she so passionately studied. One of the Chemistry Society's most anticipated events is the Charusita Memorial Lecture. So far, we've had six enlightening and informative lectures from the following honourable professors:

1. (2017) Prof. Dick Zare
2. (2018) Prof. Sanat Kumar
3. (2019) Prof. Marcia Barbosa
4. (2020) Prof. Pablo Debenedetti
5. (2021) Prof. Biman Bagchi
6. (2022) Prof. Sir David Clary, FRS

It was a true honour for me to organise this lecture on behalf of the Chemistry Society as the Charusita Memorial Lecture Head. This event was held on April 9, 2022. Prof. Sir David Clary, FRS, of the University of Oxford, was our distinguished Guest Lecturer. He is currently a Professor of Chemistry at the University of Oxford. Prof. Sir David Clary previously worked at the University of Cambridge, where he was Charusita Ma'am's Ph.D. supervisor. The Royal Society, the American Association for the Advancement of Science, the American Physical Society, the International Academy of Quantum Molecular Science, and the American Academy of Arts and Sciences are among the academies to which he has been elected. During the lecture, the background that he provided on the difficulties many eminent scientists faced while dealing with the hydrogen emission spectra was incredible, because this allowed us to truly appreciate the ingenuity

behind Schrodinger inventing the concept of orbitals. He also explained beauty of Schrodinger's work, and its applications . Through his lecture, we were also able to peek into Charusita ma'am's work on the Argon-OH spectrum, which gave us an avenue to feel more connected to her. It was an incredible lecture that left us all enthralled. We're privileged to have the opportunity to benefit from his experience and wisdom. We had more than 100 participants in the lecture including students and professors from all across the world. At the end of the lecture, we had an interactive session and a questionnaire round for students in which everyone took part actively. It was an astonishing lecture which helped all to enhance their knowledge and rejuvenate the memories of our honourable Charusita ma'am.





The Chemistry Society participated in the Alumni Meet held on 13th December, 2021

INTERNSHIP EXPERIENCES

The hardest part of college is finding an internship that suits your fancy. It is an even bigger challenge online. I didn't know when the right time to start was. Some third years I spoke had done multiple internships while others hadn't even done one. I decided not to stress about it until I heard that a couple of classmates started doing research under a professor of ours. There began the fury. Searching every online site available to see if they were open to interns. Speaking to seniors, classmates, and alumni about the internships they had done. All to no avail. I finally decided to reach out to my professors for help. Dr. Satish Kumar is the one who finally let me come and work in his lab. I wasn't expecting him to agree so easily but was glad he did. He gave me a lot of options for the work I would like to do, and I chose hands-on lab experience over the others.

The research work, in the beginning, was mostly washing the apparatus (first with water and then acetone) and drying them in the oven. I eventually learned how to take a TLC (Thin Layer Chromatography) and siphon acetone out of drums. I learned how to weigh compounds to the fourth decimal place, make a 10^{-4} M solution with it, and take its UV. Finally, I got to synthesize compounds by myself. This personally was the most exciting part for me. I wrote down the reactions in my lab notebook and calculated the amount of compound we would require. We reacted the reagents and kept them stirring for a day or two till the reaction was complete. We tested this using TLC. Once that was done, I did work-ups on the compound so that we could extract a purer form. [Work ups are done in separating funnels. We add an organic and an inorganic solvent (Dichloromethane and water respectively) to the compound in the separating funnel. Following the principle, "Like dissolves like", the organic impurities are dissolved by the organic solvent, and the inorganic impurities are dissolved by an inorganic solvent. They form layers (due to differences in densities) and we can extract the organic layer.] We then heated the organic layer and kept it for cooling for crystals to form. They were then reacted again with another reagent to give us the final product. This is as far as what I have done in the lab in the two months I was there. We repeated the

Internship Experience

Isabella Suzanne Koshy
B.Sc. Chemistry (Hons.) - II Year

experiments multiple times when the desired result wasn't obtained, which delayed the process.

But one of the things that fascinated me most when I was there was the beauty and power of acetone. This may seem trivial to most of you but seeing it dissolve almost every organic compound away, resulting in a clean apparatus, caught my attention. I would volunteer to wash to see the impurity dissolve away in its presence. What a heart-warming sight for a first-year like me! It reduced my workload so much that I was almost grateful to that inanimate solvent. The other thing that I had not expected was how friendly Sir's Ph.D. students were. As I did all my work under their guidance, I realized that they were there to learn and experience as much as I was. They didn't seem so scary after that. The final thing I learned was to not do something for the sake of doing it but with expectations of learning something from it. That has stayed with me and is something I hope will continue with me.

A virtual internship for Chemistry- a subject that is almost entirely based on practical work? How is this even possible? The idea intrigued and confused me. The first semester had ended and the second semester started with my teachers talking about the importance of internships. It was scary at first, because I was just a first-year student without any experience or much knowledge. I spoke to some of my seniors and they said start applying, even if you do not get accepted, it's always good to try. I mailed multiple professors and applied to many summer internship programmes. After the first few rejections, I presumed that I would not get any internships in my first year and enrolled for a couple of courses on Coursera. Then suddenly one day, after a lot of surfing, I found this summer internship programme by the Indian Institute of Information Technology, Allahabad and applied for this one as well. The very next day, I got a response from the research supervisor, Dr. Nidhi Mishra, who is also a DU alumni. I was elated! My work started on 24 th of May, 2021 and it was all I could talk about for the following few days. Dr. Mishra's field of research is synthetic medicinal chemistry and natural product chemistry. The internship was under the umbrella of biochemistry, mainly proteins and drug development. The idea of doing computational work for Chemistry was very exciting and new to me. The research was basically a docking study of multidrug resistance by a particular protein. Five interns, three of whom were first years including me, embarked on the journey of our first internship. We started off with a literature research on the topic and it opened vast vault of information. I made my very first report and did my first protein modeling. When I looked at the protein model, I was reminded of everything that made me fall in love with Chemistry, the elegance of the subject awed me. I could see how a medicine hits a protein at a particular spot and it made me see the world in a whole new light. Then, we were told to make a ligand library. This process was a little difficult as we did not know which ligands to select and how to work with them. Our supervisor was extremely helpful and showed us how to do it. After this, came docking. I got to learn the software

My Internship at IIT-Allahabad

Akanksha Shahi
B.Sc. Chemistry (Hons.) - II Year

AutoDock Vina and visualize the docking process. We were not required to know the docking process perfectly but were supposed to perform the docking around 12-13 times which was a tedious but fun process. On the basis of our docking results, we were asked to prepare individual reports for our work done. Even though it was a virtual internship, I had a lot of fun doing it because before this I was unaware of the amazing software that has been made to digitalize Chemistry and make it easier to visualize molecules and compounds that I never thought could be seen. Science has come a long way and I hope this internship has been my first step in contributing to the advancement of science.

What started as an excuse to distract myself from the uncertainty regarding college admissions turned into the most fulfilling experience of my life - The India Smart Protein Innovation Challenge (ISPIC) 2021 conducted by The Good Food Institute India. The competition was divided into 4 Phases namely Induction, Ideation, Inspiration and Initiation and into 2 Tracks namely Entrepreneurship and Innovation spread over 7 months (13 September 2021 to 11th March 2022).

The Induction phase involved an introduction to the alt protein sector with 40+ hours of content (videos + research papers + articles etc.) and biweekly quizzes (8 in total). In order to qualify for Phase 2, participants were required to score more than 60% marks in the quizzes. The Ideation phase began with choosing a Track (Entrepreneurship/Innovation) and forming a team of 3 (Match-making). I was fortunate enough to meet like-minded individuals that wanted to innovate in the whitespace I was most interested in. We had to choose 1 of 15 given whitespace areas to write a 5-page proposal. I ended up choosing the Innovation Track in Fermentation and our team - Protylum - ideated on "Screening Filamentous Fungi to Identify New Candidate Strains or Strain Improvements for Enhanced Protein and Organoleptic Properties".

Through our proposal, we hypothesised a strain improvement in two edible fungi using a genome modifying tool to produce a resultant strain whose mycelium has the taste, texture and aroma of crab meat. We believe it can be a great substitute in hybrid alt-seafood in the near future. This phase involved multiple webinars by industry experts under the Smart Protein Summit. The Inspiration phase again involved multiple webinars and mentoring sessions with industry experts and leaders. We had to expand our 5-page proposal into a 15-page detailed plan covering the environmental,

Research and Internship-ISPIC 2021

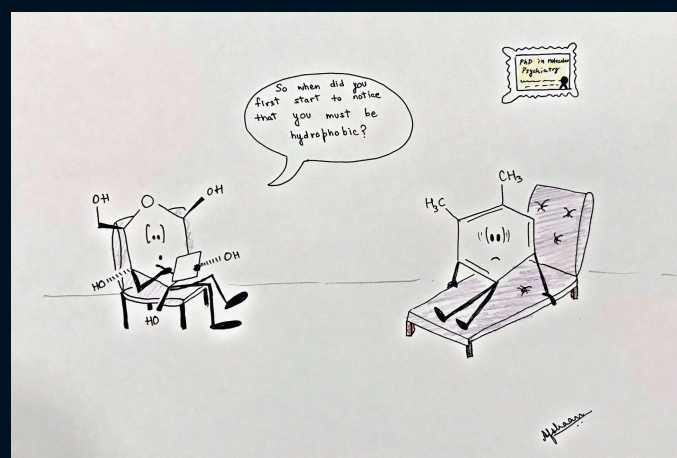
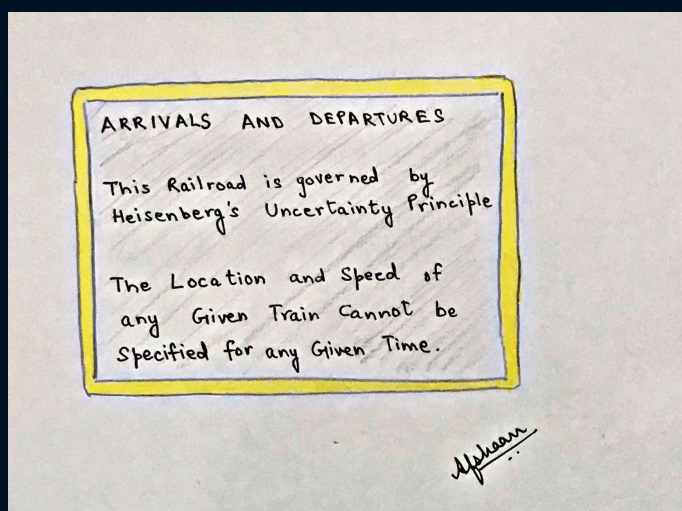
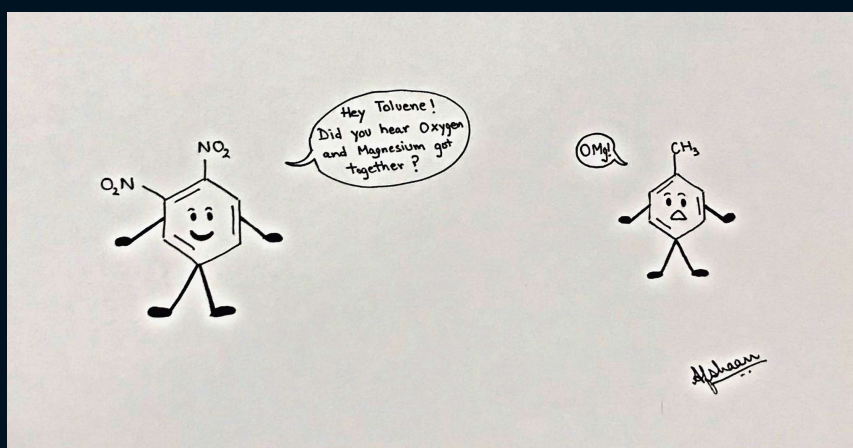
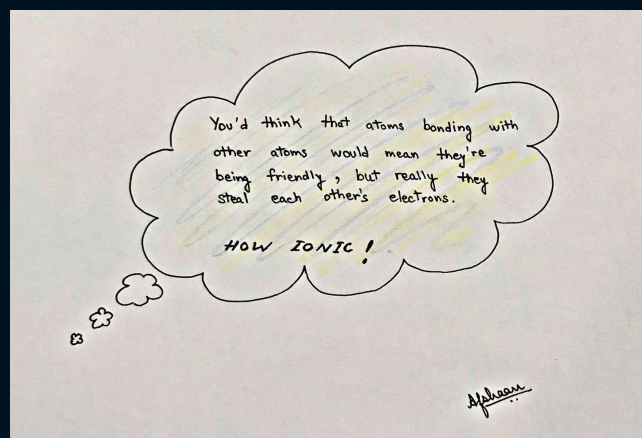
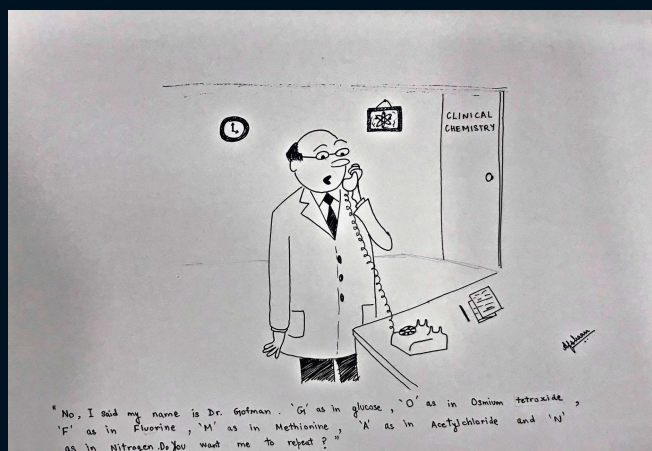
Armaan Dhandra
B.Sc. Chemistry (Hons.) - I Year

economic and socio-political impacts of our research.

We Qualified!

Phase 4 is still going on and will involve presenting our proposal and solutions to a panel of expert judges and challenge partners. We are expected to demonstrate an overall understanding of the sector, technological viability with clear milestones for developing a proof of concept, and marketability of our proposed solutions.

Demo Day is on 11th March 2022, World Protein Day. If possible, I'd request anybody reading this to tune in. There are 20 prizes, each worth 1 lac rupees, up for grabs in Phase 4! The competition started with 750 people which reduced to 320 in Phase 2, to 53 teams in Phase 3 and finally to 23 teams in Phase 4. The competition improved my communication skills, data representation skills and introduced me to trailblazers in the industry. I'll forever be grateful to GFI India for this opportunity. It has been an exhilarating experience to say the least!



**IN CASE YOU MISSED
THE NEWSLETTER
SERIES...**

CONTROVERSIES IN CHEMISTRY - A WAY OF SCIENTIFIC PROGRESS

- Karen Roanna Thomas

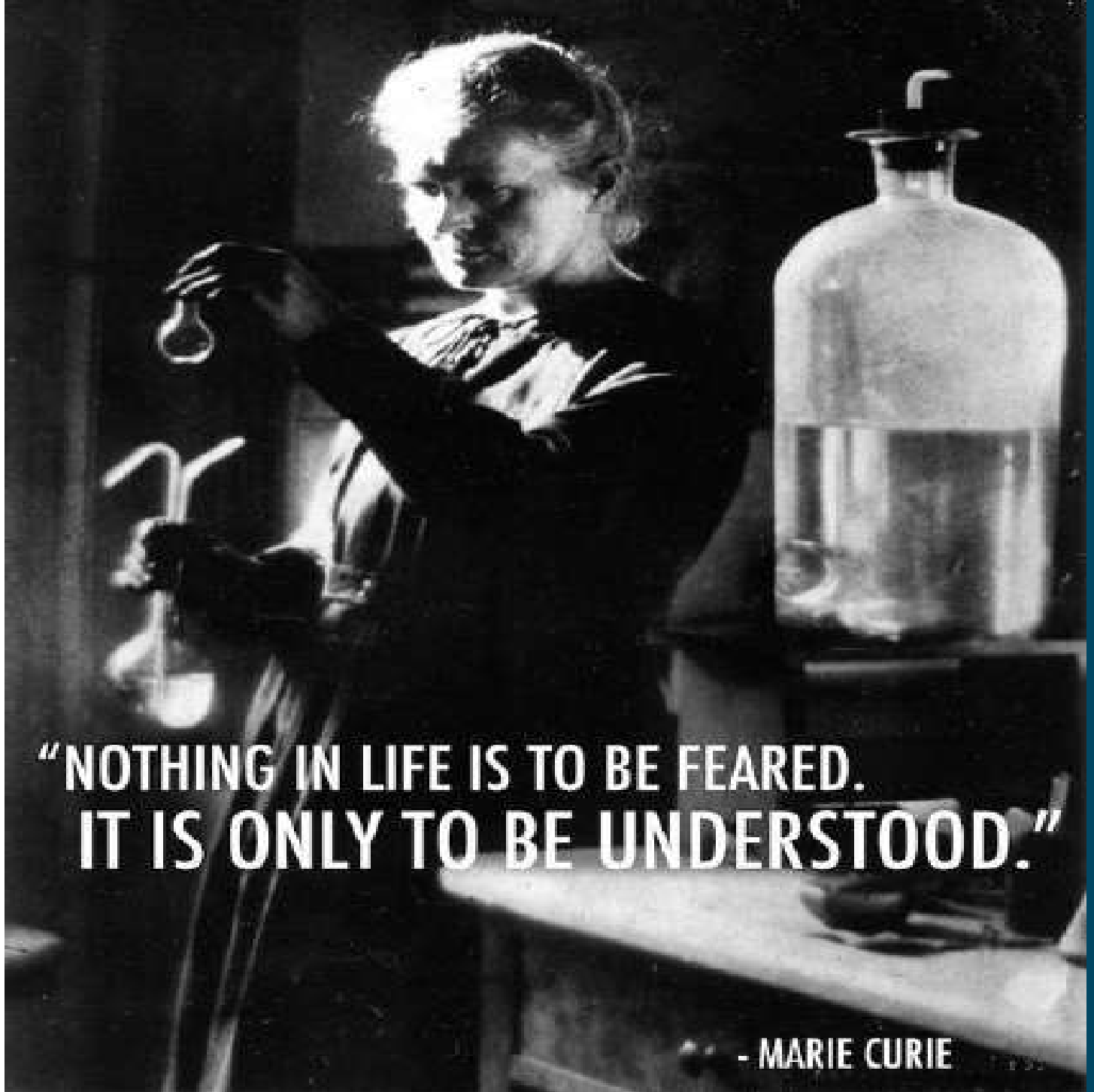
Science is a subject that is always changing. Over the years, as scientists review the experiments and theories of their contemporaries or former stalwarts of their field often discover some problems that weren't considered. For example, the discovery of the atom. Dalton's atomic theory gave the future scientists some foundation on which they could work on but his theory was challenged by scientists like Ernest Rutherford, and later on, Niels Bohr. The periodic table is another example of how science changes over the years with scientists bringing in different perspectives. Scientific progress is characterized by competition among rival theories.

There is no one way to do science and hence no universal step by step scientific method can be followed. Different scientists can interpret the same experimental data in more than one way. Joseph John Thomson's determination of the mass-to-charge ratio of the cathode rays helped him discover the electron, but he wasn't the first one to do so. Walter Kaufmann and Johann Emil

Wiechert also determined the mass-to-charge ratio of cathode rays in the same year and their values did agree. So how did Kaufmann and Wiechert not discover the electron? The discovery of the electron is owed to Thomson's tendency to speculation. He hypothesized that if this ratio varied in different gases, cathode rays could be considered as ions and alternatively, if the ratio is constant, cathode rays could be universally charged particles. This is actually based on the heuristic principles. While Kaufmann and Wiechert got the empirical data, Thomson interpreted the data he had to come up with his conclusion.

Heuristic principles are what sets apart many scientists from each other. Heuristic comes from the Greek word εὑρίσκω, which means I find or discover. It is a technique designed to solve a problem more quickly when classic methods are too slow, or for finding an approximate solution when classic methods fail to find any exact solution.

The development of the periodic table as a sequence of heuris-



**"NOTHING IN LIFE IS TO BE FEARED.
IT IS ONLY TO BE UNDERSTOOD."**

- MARIE CURIE

“I have read the Russian articles
carefully and I must say that I
cannot understand the
arguments”

- LINUS PAULING

principles in the form of a convincing argument has been ignored. The textbook approach of emphasizing that the development of the periodic table was an inductive generalization, and that Dmitri Mendeleev had no model or theory, does not facilitate the spirit of critical inquiry that led the scientists to grapple with alternative interpretations, conflicts, and controversies. It is concluded that the development of the periodic table went through a continual critical appraisal (conflict and controversy), in which scientists presented various tentative theoretical ideas to understand the observed phenomena.

The theory of resonance formed by Linus Pauling is another topic strewn with controversy. The Lysenko-era Russian researchers, intent on boosting the reputation of Russian achievements in structural chemistry, had for two years been tearing away at Pauling's 'reactionary, bourgeois' chemical ideas, especially his use of idealized resonance structures with no real independent existence. The following is an excerpt from a letter that Linus Pauling had written to his friend, Frank Aydelotte.

"As to the Russian scientists and the scientific controversies, I must say that I have great difficulty in understanding what is happening. The most likely explanation seems to be that some of the Russian scientists are taking advantage of the political situation to advance themselves at the expense of their colleagues. Others are then drawn into the controversy, and required by practical considerations to align themselves with those who say that they are supporting the correct Marxist position. I have read the Russian articles carefully, and I must say that I cannot understand the arguments."

In 1947, K.Syrkin and M.E. Diatkina, a chemist and a mathematician respectively came out with the Russian translation of Pauling's 'Nature of the Chemical Bond'. K. Syrkin and M.E. Diatkina were two of the Soviet Union's most prominent sympathizers and popularisers of Pauling's resonance theory of chemical bonds. Simon Shnol, a student of Syrkin and Diatkina's, remembers having attended their

lectures on resonance theory in 1950 before its fall from grace. Shnol attended the 1951 conference at which the official rejection of resonance theory was formulated. Syrkin and Diatkina were severely criticized resulting in their careers being effectively stifled. Both Syrkin and Diatkina were asked to leave Moscow State University.

Pauling, was not uninformed of the controversy, forming in the Soviet Union. Pauling was concerned by the ideological path that Soviet Chemistry was taking. The scientific community of the Soviet Union became increasingly closed after World War II. This was because all research, including natural sciences was to be founded on the philosophy of dialectical materialism.

Dialectical materialism was a concept based on the writings of Karl Marx and Friedrich Engels. This philosophy emphasizes the importance of real-world conditions and the presence of contradictions within things. This is in contrast to the idealist Hegelian dialectic, which emphasizes the observation that contradictions in material phenomena could be resolved by analysing them and synthesizing a solution whilst retaining their essence. These ideas affected the research in science taking place in the Soviet Union and prevented many scientists from cooperating with foreign researchers.

These are just a few examples of the many controversies that have come up over the years. Through all these controversies, science has progressed and given rise to new laws and theorems. As scientists debate on these topics, it gives them new perspectives and allows them to look at the same problem in a different way. In the end, it benefits all of us and makes us want to think about what is taught in the classroom.

The Chemistry Society



DR. ASIMA CHATTERJEE

- Tulip Roy

Dr. Asima Chatterjee was the first woman to be awarded a Doctor of Science by an Indian University in 1944. She was also the first woman to be elected as the General President of the Indian Science Congress. She has won several prestigious awards such as the S S Bhatnagar award, the C V Raman award, the P C Ray award; and is the recipient of the Padma Bhushan, the third-highest civilian award, in recognition of her contributions to the field of science. Her area of interest was natural products with special reference to medicinal chemistry.

I feel her life is truly inspiring for all the scientists of today's world. She broke stereotypes like 'working women can't be good mothers' or 'women are not intelligent enough to be scientist'. She proved that the hand that moves the cradle can indeed rock the world. She is the icon of many aspiring scientists. Women like Dr Asima Chatterjee has paved the way for all the female scientists in the years to come.

Dr. Asima Chatterjee (née Mukherjee) was born on September 23, 1917, in Calcutta to late Dr. Indranarayan Mukherjee and late Kamala Devi. In 1936, She graduated with Honours in Chemistry from Scottish Church College and received the Basanti Das Gold Medal. She obtained the M.Sc. degree in 1938 with Organic Chemistry as special paper and received the Calcutta University Silver Medal and Jogmaya Devi Gold Medal. She then started her research career under the guidance of Professor Prafulla Kumar Bose, one of the pioneer Natural Product Chemists. In 1940, Asima joined Lady Brabourne College, Calcutta, as the founder-Head of the Department of Chemistry. In 1944, she was awarded a Doctor of Science by University of Calcutta and was appointed an Honorary Lecturer in Chemistry, Calcutta University.

In 1945 she married Dr. Baradananda Chatterjee, D.Sc. F.N.A., a well-known physical chemist who became Professor and Head of the Department of Chemistry, Geology

and Metallurgy and went on to become the Vice-Principal of Bengal Engineering College, Howrah. They soon had their daughter, Julie, who was also a Chemistry enthusiast and later on became the Head of the Department of Chemistry at the University of Calcutta.

During that time doing research was not as easy as it is today. The laboratories were not that well equipped, lacking the sophisticated devices that we are familiar with today. They had limited chemicals and meagre financial assistance. Research guides had to often pay for chemicals, apparatus, the charges of even elementary and almost all spectral analyses had to be from abroad. Though things were tough, they could not stop Asima from achieving her dreams. She successfully developed the anti-epileptic drug, 'Ayush-56' from *Marsilia minuta* and the anti-malarial drug from *Alstonia scholaris*, *Swertia chirata*, *Picrorhiza kurroa* and *Ceasalpinna cristata*. The patented drugs have been marketed by several companies.

Among her many contributions, a few notable ones are:

- Initiated chemical investigation of alkaloids in *Rauwolfia canescens*.

- Investigated the chemistry of almost all principal types of indole alkaloids.

- Contributions with regard to elucidation of structure and stereochemistry of ajmalicine and sarpagine.

- First suggested stereo-configuration of sarpagine.

- Isolated and characterized geissoschizine, a key precursor in biogenesis of indole alkaloids from *Rhazya stricta*.

- Carried out synthetic studies on a number of complex indole alkaloids, quinoline and isoquinoline alkaloids.

- Developed simplified and normal procedure for preparation of required beta-phenylethanolamines in connection with alkaloid synthesis.

- Elucidated the structure of luvangetin isolated from *Luvanga scandens*.

- Studied the action of various Lewis acids on

“There is no force more powerful than a woman determined to rise.”

– Bosa Sebele

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prenylated coumarins and devised simple synthetic routes to a number of complex coumarin systems.

- Investigated the mechanism of acid-catalysed hydramine fission of beta phenylethanol amines.

- Introduced use of periodic acid as a reagent for detection and location of both terminal and exocyclic double bonds in organic compounds.

She published around 400 papers in national and international journals and more than a score of review articles in reputed serial volumes. Her publications have been extensively cited, and much of her work has been included in several textbooks.

On the request of the late Professor Satyendra Nath Bose, FRS, she wrote “Sarai Madhyamic Rasayan”, a book in Bengali on chemistry for secondary school students, published by Bangiya Bijnan Parishad, an Institute for the Popularisation of Science founded by SN Bose himself. She edited and rewrote “Bharater Bonousadhi” (originally compiled by the late Dr KP Biswas), a treatise in Bengali on Indian Medicinal Plants in six volumes (Volumes 1-5; 1973; Volume 6; 1977) which was published by the Calcutta University Press. As an author/principal-editor she compiled “The Treatise on Indian Medicinal Plants” published in six volumes in English, earlier by the Publication and Information Directorate, CSIR, then by the National Institute of Science Communication, CSIR and now by the National Institute of Communication and Information Resources, CSIR.

It is often believed that men of that era were not quite supportive of their wife’s work but Prof. Baradananda proved it wrong. He

was there for Asima through thick and thin and encouraged her to follow her passion. Dr. Indranarayan Mukherjee, (her father) and Prof. Baradananda Chatterjee (her husband) were her rock who made her the strong woman that the world talks about today. In 1967, Asima lost her father and within a period of four months she lost her husband too. Due to the sudden trauma, she suffered a massive heart attack and lingered for days between life and death. After about three months she recovered but had lost her happy self. It was through the influence and affection of Late Swami Abhayanandaji Maharaj of the Ramakrishna Math and Mission, Belur, that she regained her mental strength. Her love for Chemistry and her students brought her to life again.

Professor Chatterjee did have her own ups and downs, but her perseverance and insatiable thirst for knowledge made her a stalwart in her field. She was the epitome of humility and hard work and will always be cherished by the world.

TRANSFORMATION OF PURE WATER INTO METAL

- Jatin Kumar

For the first time, scientists have created metallic water. Through a very careful experimental setup, the team grew a thin layer of a gold-colored metallic water on the outside of a droplet of liquid metal.

Pure water is not a good conductor of electricity. Yes, the water we use every day, however, conducts electricity- but that is due to the salts and impurities it contains, which dissolve into free ions that conducts electricity. But making pure water metallic, or conductive, has long been a scientific challenge as it requires extreme high pressures which is beyond our current capabilities.

There's nothing new about the idea of utilizing huge pressure to make metal out of water. In theory, water molecules may be compressed to the point where their electron shells begin to overlap and form a conduction band, same as that is found in metallic materials. The required pressure of 50 Mbar (i.e. approximately 50 million times greater than on the Earth's surface) can be found in the cores of large planets, but we have yet to achieve it under terrestrial conditions.

But now, a team of researchers from 11 institutions around the world has pulled it off at the BESSY II facility in Berlin.

This metallicity can be induced not just by high pressures in pure water. Free-moving charged particles can be added to pure water by bringing it in contact with an electron-sharing alkali metal - in this case, a sodium-potassium alloy - turning it metallic.

The problem is that water and alkali metals don't mix well - when dropped into water, the metals can fizz, ignite, and even explode. Therefore for this experiment, the researchers reversed the usual mix by coating alkali metal in a thin layer of water.

A sodium-potassium (Na-K) alloy, which exists as a liquid at room temperature, was dripped from a nozzle inside a vacuum chamber. After that, the water vapor was piped into the chamber, forming an extremely thin skin on the metal droplet's outside. The Na-K then releases electrons and metal cations into the water, resulting in conductive metallic water.

"You can see the phase transition to metallic water with the naked eye!" says Dr. Robert Seidel, an author of the study. "The silvery sodium-potassium droplet covers itself with a golden glow, which is very impressive."

To investigate what was happening, the scientists examined the short-lived metallic water using optical

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reflection spectroscopy and synchrotron X-ray photoelectron spectroscopy. The metallic phase was confirmed.

"Our study not only shows that metallic water can indeed be produced on Earth, but also characterizes the spectroscopic properties associated with its beautiful golden metallic luster," says Seidel.



BENZENE AND ITS CARCINOGENICITY

- Alen Binu Abraham

Benzene is an aromatic hydrocarbon with the molecular formula C_6H_6 which was discovered by Michael Faraday in 1825. Benzene is a natural constituent of crude oil and is one of the elementary constituents of petrochemicals. The word benzene was derived from "gum benzoin" (benzoin resin). Benzene naturally occurs from forest fires and volcanoes.

Structure of benzene

The benzene molecule is composed of six carbon atoms joined in a planar ring with one hydrogen atom attached to each. The molecular orbital description involves the formation of three delocalized pi orbitals spanning all six carbon atoms, while the valence bond description involves a superposition of resonance structures.

Carcinogenicity of Benzene

Benzene and polynuclear hydrocarbons which have two or more benzene rings fused are toxic and possess carcinogenic (cancer-producing) properties. Incomplete combustion of organic materials like tobacco, coal, and petroleum leads to the formation of such polynuclear hydrocarbons. Cancer is caused when they enter the human body and undergo

biochemical reactions and damage DNA.

Some examples of these types of polynuclear hydrocarbons are

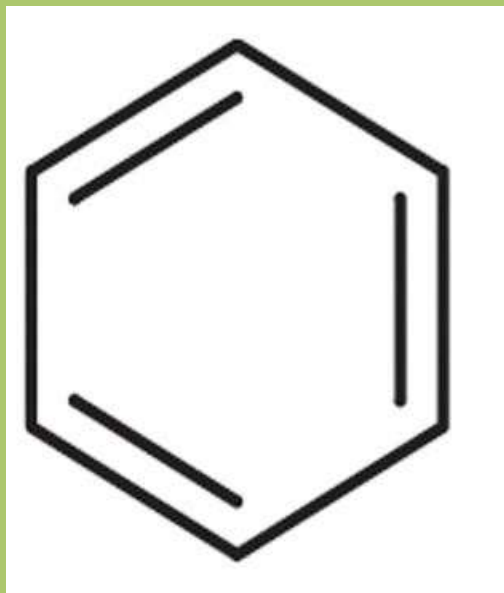
- 1,2-Benzanthracene
- 3-Methylcholanthrene
- 1,2-Benzpyrene
- 1,2,5,6-Dibenzanthracene
- 9,10-Dimethyl-1,2-benzanthracene

How does Benzene work on our body?

Benzene works by causing cells not to function properly. For eg; it can cause bone marrow to not produce enough blood cells, which can lead to anemia, and also, it can damage the immune system by changing blood levels of antibodies and causing the loss of white blood cells. The seriousness of poisoning caused by benzene depends on the amount, route, and length of time of exposure, as well as the age and pre-existing medical condition of the exposed person.

Long-term exposure to benzene mainly harms the bone marrow, the soft, inner parts of bones where new blood cells are made. This can result in:

- Anemia (a low red blood cell count), which can cause a person to feel weak and tired.



- A low white blood cell count, which can lower the body's ability to fight infections and might even be life-threatening.

- A low blood platelet count, which can lead to excess bruising and bleeding.

To protect yourself from benzene, the best way is to leave the area where the benzene is released so you can breathe some fresh air. If you feel like you are exposed to benzene then remove your clothes and wash the clothes properly. Also, take a bath as quickly as possible.

Other compounds which can be used in place of benzene :

pentane, cyclopentane, 1,4-dioxane, chloroform, and diethyl ether.

- ☒ Pentane is relatively inexpensive and is often used in the laboratory as a solvent that can be easily evaporated.

- ☒ Cyclopentane is employed in the manufacturing of synthetic resins

and rubber adhesives.

- ☒ Chloroform is used as a solvent because it is miscible with organic liquids and is highly volatile.

INTERESTING FACTS ABOUT CHEMISTRY

- Prachi Sharma

Unlike other substances, water expands as it freezes.

When something gets cold, it usually shrinks. Since temperature is a measure of atomic vibration, the more vibration there is, the more space it takes up, resulting in expansion. The exception is water, where ice occupies greater volume when it is frozen, although vibrating less. This is because of the peculiar structure of the water molecule. The water molecule is an open structure with a lot of room because of the interaction of oxygen and hydrogen. Also, many additional strong connections may be formed when water freezes, which releases energy. However, it does take up more room. As a result, when ice freezes, it expands.

The water level in a glass of water will drop if you put a handful of salt in it.

According to Archimedes' law, the water level in a bathtub will quickly rise as you enter it. However, when a volume of sodium chloride (salt) is added to a volume of water, the overall volume reduces by up to 2%. Solvent molecules

become more structured in the vicinity of dissolved ions, resulting in a net reduction in perceived volume.

What is the purpose of adding salt on icy roads?

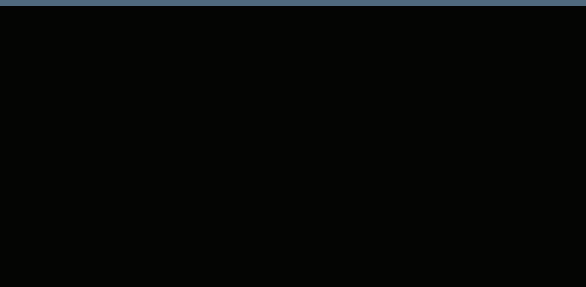
Colligative characteristics, especially depression of freezing point, is to be highlighted. We may reduce the melting point of water by adding NaCl, which reduces the freezing point from 0 °C to -20 °C or below. In this manner, even in sub-zero conditions, water will remain liquid, preventing ice from forming on the roadways.

Why is Mars red?

Iron oxide, or rust, Fe_2O_3 , gives the planet its name. This orange-red substance covers the surface of Mars. Due to iron oxide particles suspended in Mars' atmosphere, the sky appears bright orange as viewed from the planet.

DNA is a flame retardant.

DNA, often known as the life blueprint, includes all of the basic instructions that distinguish each species. Life's



molecule is also remarkably resilient, acting as a natural flame retardant and suppressor. The chemical structure of DNA is responsible for its flame retardant properties: when heated, the phosphate-containing backbone generates phosphoric acid, which chemically eliminates water and leaves a flame-resistant, carbon-rich residue. Nitrogen, for example, reacts with other bases to generate ammonia, which prevents combustion. Researchers hope to cover fabric with DNA in the future to create inflammable clothes.

Why do storms with lightning have a characteristic smell?

Lightning produces ozone, a triple oxygen molecule that functions as a protective stratospheric blanket against UV radiation. When lightning strikes, oxygen molecules in the atmosphere are split into radicals, which then re-form into ozone. The odour of ozone is quite strong, and it's often compared to that of chlorine. This is why, after a thunderstorm, you get that "clean" scent.

How did they come up with Coca-Cola?

An American Civil War soldier, John Pemberton, was injured at this time and dedicated the remainder of his life to the invention of a new painkiller. Except for a beverage made from the coca plant, which helped soothe nerves, most of his attempts were fruitless. Before he died, Pemberton sold the recipe to a businessman, who developed it into the drink we know today.

ALUMNI CONNECT

BATCH OF 2020-21

University of Oxford



Siddhant Dhingra
D.Phil. in
Organic Chemistry



Aditi Rajpal
M.Sc. in
Computational
Chemistry



Disha Kashyap
D.phil. Chemistry
in Cells

University of Cambridge



Yuthika Pillai
M.Phil. in Chemistry

TIFR, Mumbai



Urshita Gandhi
Integrated PhD



Charvi Singhvi
AIR-50 (JAM)
Integrated PhD

Indian Institute of Technology and IISER's



Karan Veer Singh
AIR-83 (JAM)



Shubh Jhavar
Under AIR 500



Laxman Banavath
Under AIR 1000



Shivam Singh
AIR-525 (JAM)



Mahima Rana
AIR-281 (JAM)



Pranjali Verma
AIR-339 (JAM)

Erasmus Mundus Scholars



Maris Minna
(MESc+)



Anita Jose
(BIOPHAM)



Shreyansh Mangal
(SERP+)



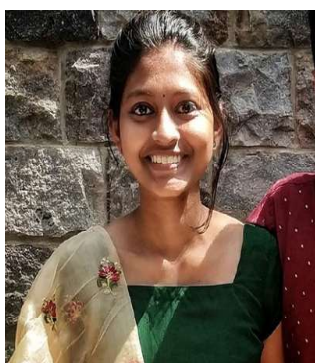
Arpita George
(MESC+)



Seerat Sekhon
(BIOPHAM)



Akshit Ahuja
(SuCat)



Esther Mathew
(MESC+)



Devanshi Gupta
AIR-18 (JAM)
IISc Bangalore



Yash Yadav
M.Sc. in Energy Environment:
Science, Technology and Man-
agement
Ecole Polytechnique Palaiseau



Merin Kennedy
Master's in France
(SERP+)
Paris Saclay



Pooja Sabu Thomas
M.Sc. in Chemistry
Leiden University

DG NCC COMMENDATION

SUO Ridhima Khanna and JUO Aartika Bhayana, from the batch of 2020-21, were awarded DG NCC commendation for their unmatched efforts and achievements in NCC and undying service during pandemic.



SUO RIDHIMA KHANNA



JUO AARTIKA BHAYANA

"When life gives you lemons, make lemonade."

I received the email about my selection to MESC+ while I was on a trip with the Chemistry Department as a Third-Year student of St. Stephen's College. Two days later, I received an acceptance letter from SERP+. Both programmes are funded by the Erasmus Mundus Scholarship. What followed was confusion due to Covid-19, lockdowns and an uncertain future. After deliberating, I accepted the SERP+ scholarship. I was unsure whether the programme would continue as many programmes were getting deferred or cancelled. Fortunately, mine was not. Despite submitting my visa application on time, I received my visa a month late. D-Day arrived. I left for France after attending a month of classes online. For someone who hasn't lived away from home her entire 21 years, suddenly I found myself alone in a country where people didn't even speak the same language as me. Thus began my series of 'miseries.'

There are two sides to every story. The beginning of my Master's degree was the difficult side. France has a very rigid system of education and I found the semester very short. Most of the classes were held online due to COVID. The French system of examination was very stressful. Within three months, I reached my saturation point. This 21-year-old was no longer yearning to see the Eiffel tower but rather wanted to run back to the Red Fort. I seized the opportunity to return home before my 2nd semester in Poland. I couldn't see much of Paris and also my mind wasn't in the right place to explore it yet.

I was scared to return, but I had to. I left for Poznan with a heavy heart. Contrary to my expectations, things were changing. Restrictions lifted. The days got longer and easier to bear, I met new people and had a daily routine. This semester worked wonders for me. I never knew that a day could last till 10 pm. I discovered how special weekends could be. I got to live like an "Erasmus" student. I got to see the most beautiful sunsets, the most beautiful landscapes and the most beautiful springtime. I finally felt that the purpose of my international master's was being fulfilled. I met people from

A Word from Cheshta Chopra

BATCH OF 2019-2020

B.Sc. (H) Chemistry - St. Stephen's College
Erasmus Mundus Joint Master's Degree - SERP+

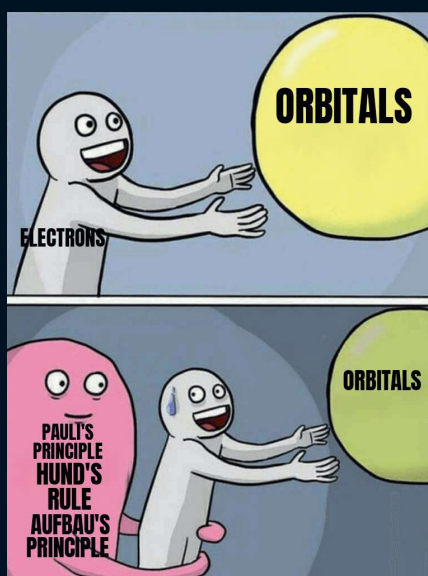
Turkey, Ukraine, Spain, Columbia, Brazil, Italy and all over the world. In the varying differences between the cultures, I found the most striking similarities. I never knew that the "language barrier" is secondary but understanding each other through feelings always remains primary.

On my journey, I got to travel few cities in Poland, the Czech Republic, Germany, Belgium and France. I learnt that, along with my academics, travelling is something that I enjoyed and I would continue. I spent my 3rd semester exploring hidden streets, libraries, riverbanks of Seine, and restaurants of Paris. The second chance France gave me was worth it. The best part was enjoying Christmas time with all the hustle-bustle in the city of Strasbourg. I am still a Master's student and will graduate in September 2022.

These past months have taught me a lot and helped me to move towards my betterment – emotionally, academically and in many other ways. Learning about so many different cultures instils in your heart a sense of curiosity to never stop exploring. Different laboratory techniques that a master's programme teaches you are the best part of it. The kind of exposure I got by meeting scientists who are doing such great research was overwhelming. I believe that a master's degree is just the beginning of a more exciting adventure. And like all spheres of life, it has its highs and lows.

Throughout my journey, I have been grateful for all that I have learnt - through my parents, my professors and my friends. Life in itself has been a great teacher for each one of us. We just need to tune it to the correct "wavelength"! (said as a true Physical Chemist would say)

it to the correct “wavelength” and thus our work will be done! (said as a true Physical Chemist would say)



Thomson's Model of an Atom

Rutherford's Model

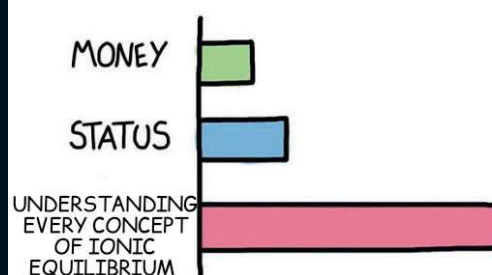
Bohr's Model of Atom



Electrons on absorbing light of different frequencies



WHAT GIVES PEOPLE FEELINGS OF POWER



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