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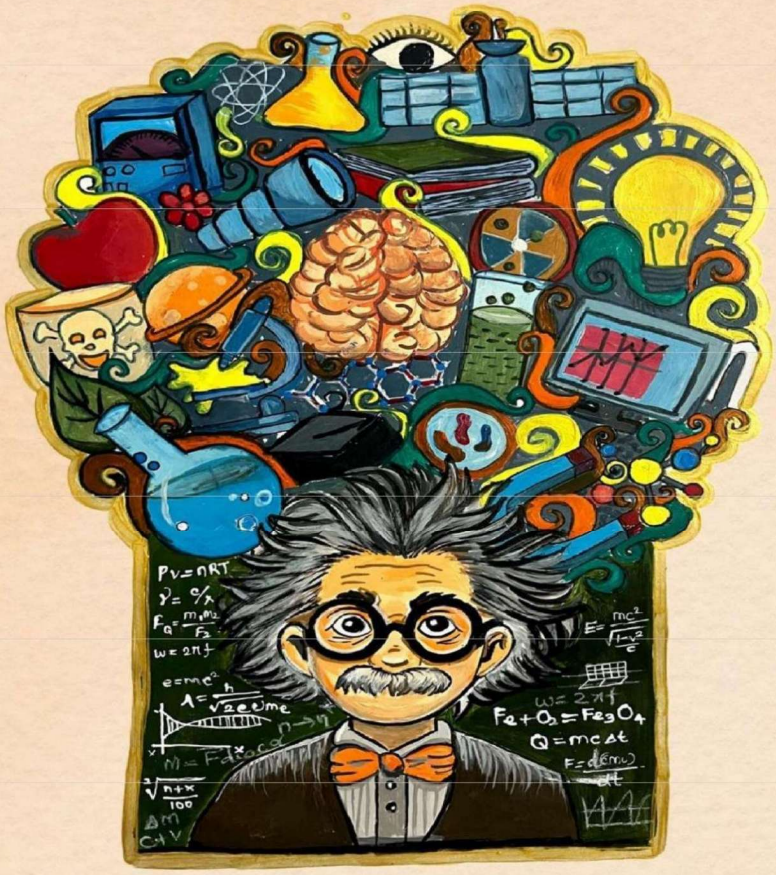
Joseph Chemical Letters



Published By

Mendeleev's Chemistry Club
Department of Chemistry
St. Joseph's College (Autonomous)
Tiruchirappalli-02

FOREWORD

It gives me immense pleasure to present the upcoming issue of Joseph Chemical Letter (JCL), a remarkable initiative by the Department of Chemistry at St. Joseph's College. This magazine stands as a testament to the dedication, enthusiasm, and intellectual curiosity of our students and faculty.

St. Joseph's College strives to nurture a spirit of inquiry and innovation, encouraging our students to explore the wonders of chemistry and its profound impact on society. This magazine serves as a platform for young minds to showcase their research, ideas, and scientific explorations, reflecting their commitment to academic excellence and creative thinking.

Science, and particularly chemistry, plays a pivotal role in shaping the future of humanity. As we advance into an era of rapid technological and environmental changes, it is essential that we equip ourselves with knowledge that is both theoretical and practical. The contributions in this issue highlight the importance of chemistry in addressing global challenges, fostering sustainable solutions, and inspiring future scientists.

I extend my heartfelt appreciation to the editorial team, faculty members, and students who have worked tirelessly to bring this magazine to life. May this edition of Joseph Chemical Letters continue to inspire curiosity, critical thinking, and a lifelong passion for learning.

May God bless all our endeavors.

Rev. Dr. S. Mariadoss SJ

Principal

St. Joseph's College (Autonomous)

Tiruchirappalli

Foreword

It is with great pride and enthusiasm that we present this edition of Joseph Chemical Letters, a platform dedicated to showcasing cutting-edge research and innovations in the field of chemistry. This magazine serves as a testament to the dedication, curiosity, and intellectual rigor of our students, researchers, and faculty members.

Chemistry plays a crucial role in addressing global challenges, from sustainable energy solutions to environmental preservation and advanced material development. The contributions in this issue reflect the depth and breadth of chemical sciences, offering fresh perspectives, novel methodologies, and ground-breaking discoveries that push the boundaries of our understanding.

We extend our sincere appreciation to all the authors, reviewers, and editorial team members whose commitment to excellence has made this publication possible. We also encourage readers to engage with the authors here, fostering a collaborative spirit that drives scientific progress forward.

As we continue to explore the endless possibilities within the realm of chemistry, we hope that Joseph Chemical Letters will inspire future researchers to pursue knowledge with passion and perseverance.

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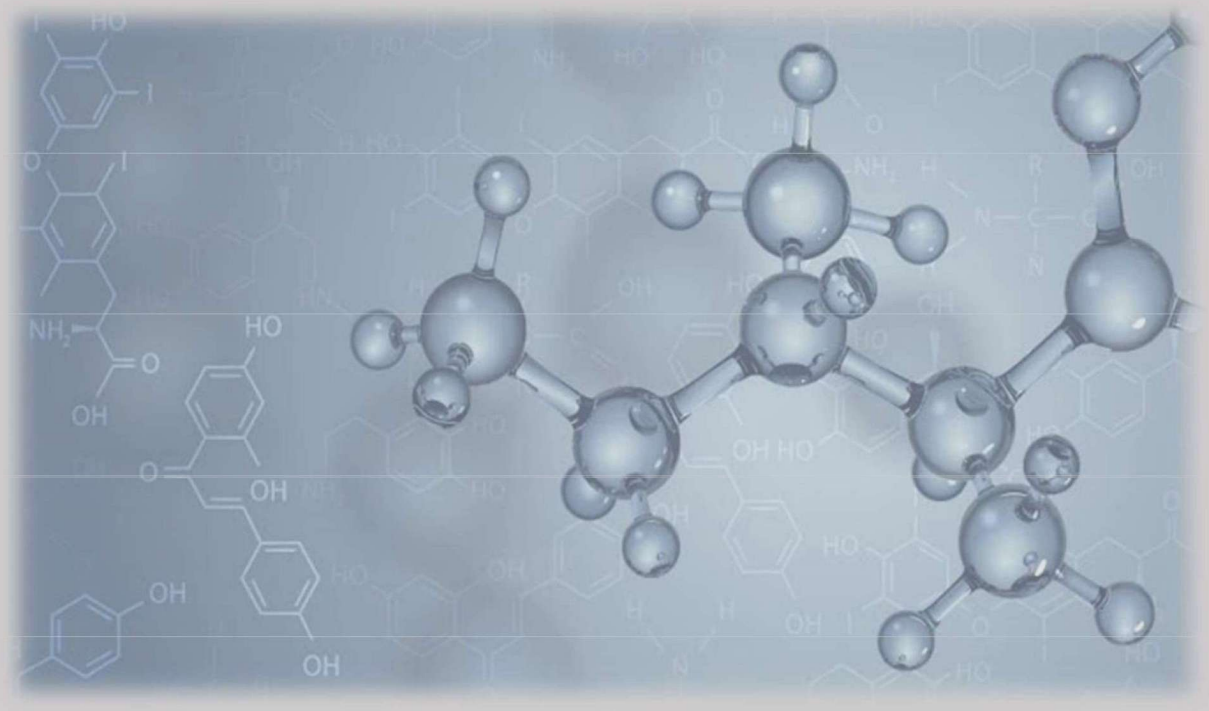

INSIDE THIS ISSUE

"Chemistry is the melodies you can play on vibrating strings"

-Michio Kaku

Toxic Communication

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We are making communication in two ways, verbal and non-verbal communication. But nowadays the young generation mixes toxicity in both the types, that will result in toxic communication.

You are penalized, if your vehicle emit smoke above the allowed limit. It is considered an offence, if factories emit toxic gases above the limit. We get terrified when chemical wastes are being mixed in rivers. But, most of us are spreading a powerful poison to the society through toxic words and non-verbal signals.



Nowadays, the term 'toxic communication' often takes place in media. And also we spread poison in communication through many ways like teasing the speech of the person, scolding others, body shaming, criticizing others in a bad manner etc. It will be highly dangerous to the society, if we don't feel these behaviors guilty.

Toxic communication will lead to many problems like increasing conflict, affecting trust, enhancing the feel of blaming and raising inferiority complex.

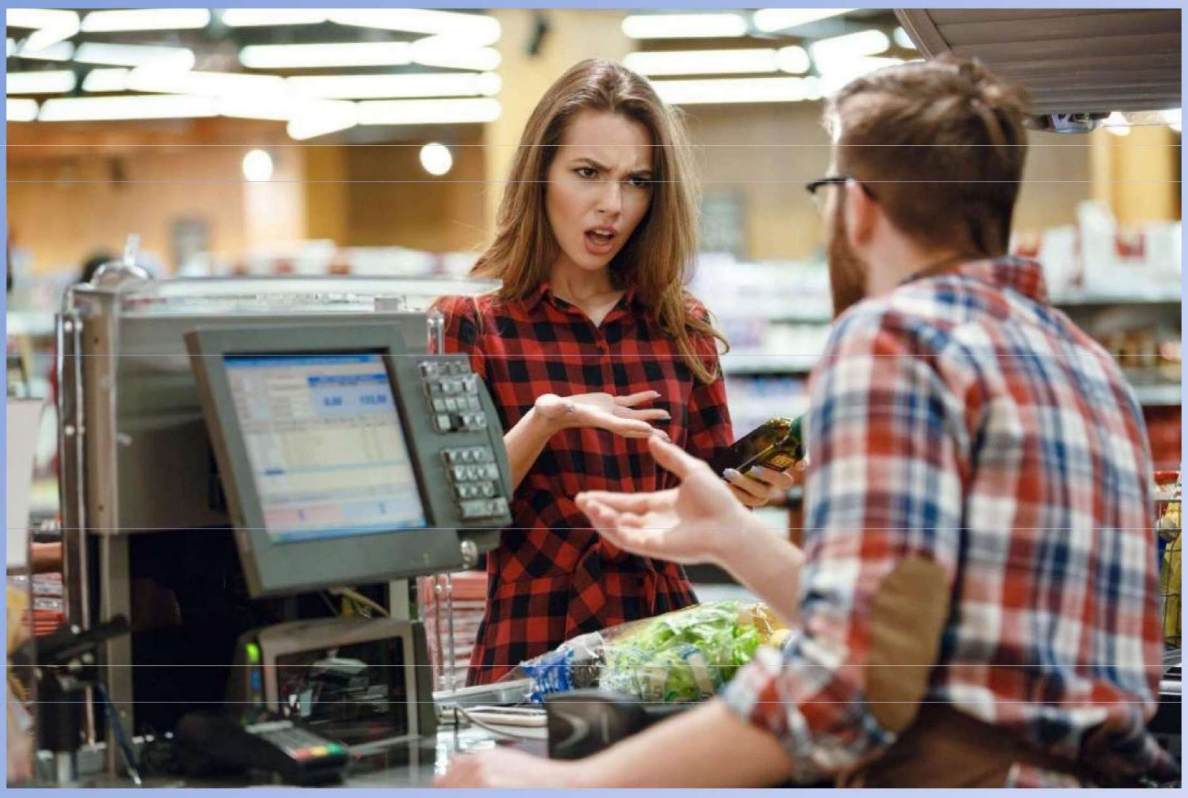
We need proper communication in several moments of our life. Some people who spread poison through their words, fail to utilize such moments positively.

It is sometimes usual, for the man and the woman who are committed to marry each other, to meet in a private place. Several marriages have been cancelled when they have conflict during such meeting.

We need to face an interview before joining in a job. There is a possibility to ask the higher officials for incentives. We will miss a chance of getting these things, if we fail to speak smoothly.

It may sometimes be our duty to correct either our relatives or friends who make mistakes, carefully through proper words. The society of young generation which went on wrong way, perhaps to be governed to the right direction. Here, each and every word should be utilized with much care.

It may sometimes become mandatory for the business man to pacify the annoyed customer. Sometimes he faces a situation to regret the delayed or incomplete service. We have to be careful as not to excite as the customer does.

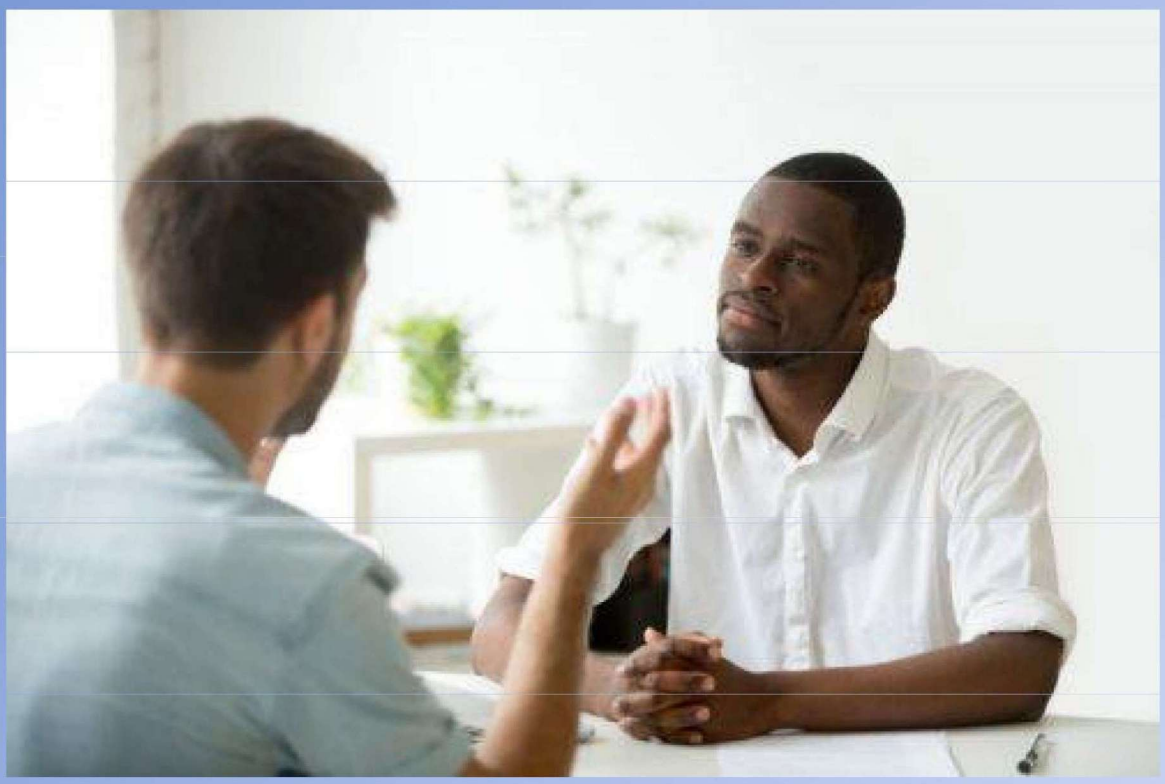


The toxic communication is made via blaming entirely others, generalizing other's character, criticizing other's emotions, mimicking others in a situation that he/she is in depression.

What could be the reason for toxic communication and how to rectify it?

Empathy is the ability to imagine oneself in the condition of another. Failing in empathetic behavior will lead to the arrogant way of communication. Though we are right, we cannot blame others who differ from our ideas. For instance, the numeral 6 could be visible as 9 to the person who is in front of us. That cannot be wrong also.

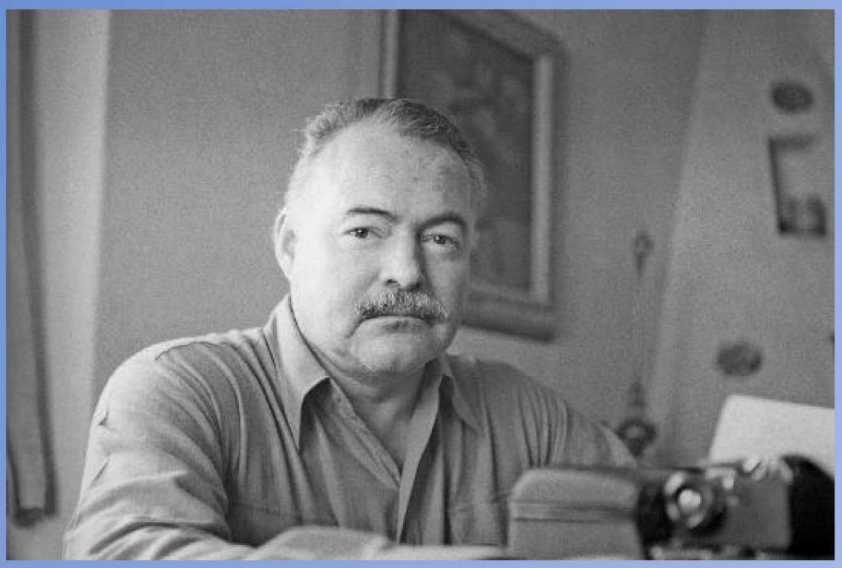
A dark comedy comes to mind, a man decided to quit from his life, by falling down from the eighth floor of a building. There a woman asks him a help to dispose the garbage while he jumps. It is completely against empathy. No one can find wrong in his act, if he takes her with him while he falls down.



Communication is not only sharing the message or talking, but listening too. Listening is an important angle of empathy to understand the mindset of the person speaking with us. Most of us fail to do this.

I like to listen. I have learned a great deal from listening carefully. Most people never listen.

Says Earnest Hemingway, a Nobel laureate in literature.



There are many reasons for passive listening: feeling to have many jobs to do rather than listening, feeling our self-more expert than the speaker and disliking the person who speaks. It severely hurts the communicator when we skip the speaker's points and make him/her hurry to conclude.

Many of us have a thought that the speakers are superior and listeners are inferior. Neverthless, we rehearse for our speech while others are performing. So that, we become a passive listener.

We like the people who understand our feelings. We hate the people who boast themselves as genius.

Discussion when it goes on wrong direction, may lead for toxic communication. There are several advantages in discussing the problem, like understanding the views of others. As the saying, 'face is the index of mind', the discussion reveals the true face of the arguer. Counter arguments may lead to make a good solution to the problem of concern.

But how would you feel, when you fail in an argument in the forum. Frustration or resentment, getting challenging mentality to defeat the debater. You can win an argument, but might lose a friend.

Therefore, discussion should be avoided? No. We can observe whether the argument goes on healthy, contains unparliamentary words and has a repetition of points. If these happen, stop the discussion. It is not mandatory to accept the points of arguer, but one should understand that the arguer has a right of expressing his/her views.

Tips for avoiding toxic communication

- Voice plays a major role in communication; commanding or mocking or hurting words should not mix in your voice when we find faults with others.
- Pointing out our need is more important than finding fault with others.
- How we speak is more important than what we speak.
- Praising the good things in others will reduce spreading the toxicity.
- Getting feedback on your arguments from your well-wishers will be helpful to correct yourself. You may wonder to receive a list of suggestions. Follow them up to reduce the toxicity in communication.

The art of communication is the language of leadership, says James Humes.

Images are taken from the following websites

1. www.spinny.com
2. www.istockphoto.com
3. www.shooksvensen.com
4. www.linkedin.com
5. https://online.maryville.edu
6. www.poetryfoundation.org
7. www.creativerealities.com

Evolution of Atmospheric Composition of Planets

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Many misconceptions with the study of science or any discipline of chemistry stems from providing absolute answers to questions. Giving absolute answers usually comes from inadequate understanding of the nature any scientific discipline. This article takes into account of the atmospheric composition of and other planets and its evolution. A familiar question faced by any student in high school or higher secondary education is atmospheric composition of earth. When this question is posed to students, they normally give you an instant answer as 78% nitrogen, 21% oxygen, 0.9% argon, and 0.1% other gases.

Though the answer appears right, it inherently misrepresents the nature of science which is evolutionary. Atmospheric composition of earth is not static, it has undergone many changes from the formation of earth. Decades of research by the geologists and atmospheric chemists, has revealed the formation earth dates back to 4.5 billion years.

Popular science writer Sam Kean narrates, the formation of earth in the book *Caeser's Last Breath* as

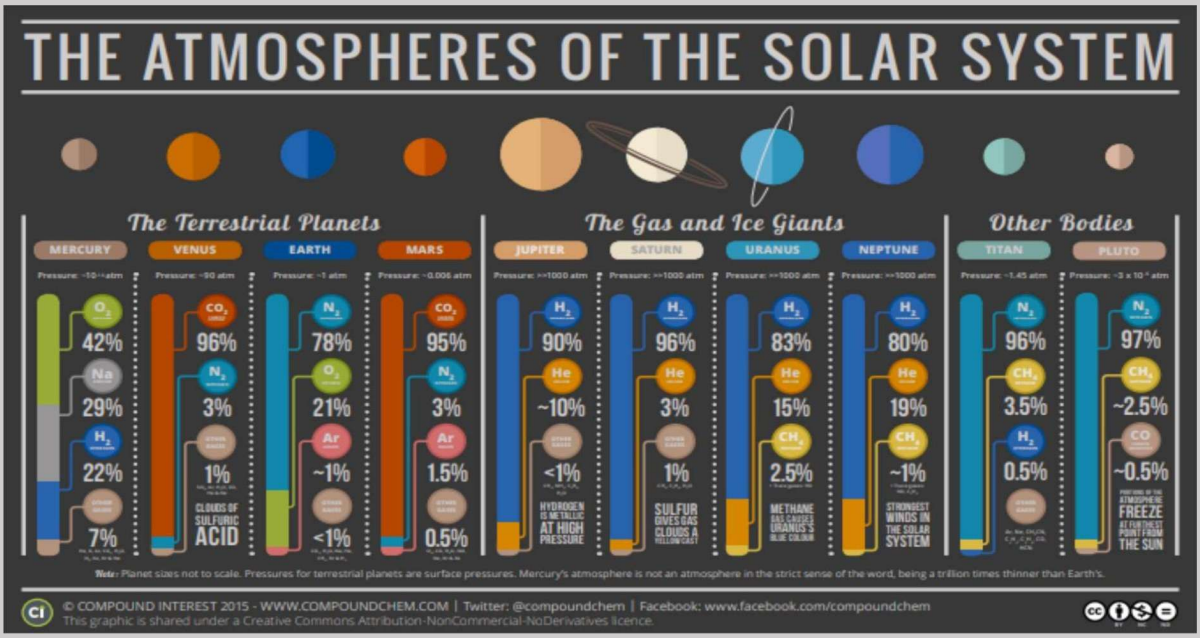
"*Around 4.5 billion years ago, a supernova detonated in our neck of the cosmos and sent a shock wave into space. This shock wave plowed into a sea of mostly hydrogen gas that happened to be nearby and stirred something inside it to life, causing the sea to grow choppy and swirl in a vortex about its center. Gravity eventually sucked together 99.9 percent of that gas to form a new star, our sun. The majority of the remaining gas got pushed to the edges of this incipient solar system, where it formed gas giant planets like Jupiter and Saturn*".

The early earths atmosphere had lighter gas like hydrogen and helium, earth is not a solid mass yet, gravity played a pivotal role in the attracting heavier atoms. Constant attraction of heavier gasses led to the formation of solid mass on a large geological time scale of billions of years. Earth's Surface remained as hostile with gusting gases; this could be the earliest composition of earth's atmosphere with just two gases (hydrogen and helium). As the temperature remained close to that stars the cooling process led to formation of heavier elements and molecules. During the formation of second atmosphere earth was filled with carbon dioxide, water vapor, hydrogen sulfide and oxides of sulphur. Earth second atmosphere played crucial role in depositing carbonates in the earth's crust as dissolved carbondioxide in water vapor reacted with other metals to form carbonates. Earth was not alone in its orbit but there was another planet named Theia sharing the same orbit. The collision of Theia and earth made earth's crust even more hostile than ever before with prolonged volcanic activity. The present atmosphere has large quantity of nitrogen, but why nitrogen alone is present in large quantity is an important question to be answered, is not? Nitrogen began to accumulate from volcanic activity that existed for four billion years. While other elements like sulpur, oxygen had better reactivity they formed minerals and different compounds but nitrogen being inert remained as nitrogen. Nitrogen plays a crucial role in supporting many life forms especially plants, thanks to some bacteria which can metabolize nitrogen and covert it into nitrates in the soil. Remember the nitrogen present in the breath came from volcanoes.

Atmospheric composition of other planets

Have you ever asked the question, why first four planets alone contain solid surfaces while rest of them from Jupiter are gas giants? The role of gravity played an important role in shaping the solar system. Sun is the largest and heaviest in the solar system and its gravity attracted heavier elements forming solid surfaces for first four planets while the rest of the planets has lighter elements such as

hydrogen and helium as the major constituents. The following infographics published by Andy Bruning and subsequent table published by NASA presents a clear picture of atmospheric composition of various planets.[1,2]



Object	Mass (kilograms)	Carbon Dioxide	Nitrogen	Oxygen	Argon	Methane	Sodium	Hydrogen	Helium	Other
Sun	$3.0x10^{30}$							71%	26%	3%
Mercury	1000			42%			22%	22%	6%	8%
Venus	$4.8x10^{20}$	96%	4%							
Earth	$1.4x10^{21}$		78%	21%	1%					<1%
Moon	100,000				70%		1%		29%	
Mars	$2.5x10^{16}$	95%	2.7%		1.6%					0.7%
Jupiter	$1.9x10^{27}$							89.8%	10.2%	
Saturn	$5.4x10^{26}$							96.3%	3.2%	0.5%
Titan	$9.1x10^{18}$		97%			2%				1%
Uranus	$8.6x10^{25}$					2.3%		82.5%	15.2%	
Neptune	$1.0x10^{26}$					1.0%		80%	19%	
Pluto	$1.3x10^{14}$	8%	90%			2%				

Concluding remarks

Beware! students of science while providing one absolute answer to questions, there could be more than one correct answer for the questions like atmospheric composition of planets on a geological timescale.

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1. https://www.compoundchem.com/2014/07/25/planetatmospheres/
2. https://www.nasa.gov/wp-content/uploads/2015/01/yoss_act_4.pdf

THE CHEMISTRY OF CHOCOLATES

-Mano Johswin J
24PCH101
I M. Sc. Chemistry

Chocolate is popular among people with a sweet tooth. cacao beans, the source of this complex food, contain over 300 chemical compounds that contribute to its unique taste, aromas, and texture. Many also claim it reacts with the human brain and alters their mood. It temporarily makes you happy. Every child knows what a birthday or festival is really all about. Yes, chocolates, yummy, delicious chocolates How do they get it to melt so perfectly in your mouth? Does it really give you a happy high? So, with that in mind, let's talk about the chemistry of chocolate.

DARK CHOCOLATE: COCOA SOLID:>35%

Theobromine+phenethylamine

Dark chocolate has the highest number of cocoa solids. The solids contain theobromine (toxic to dogs) and phenethylamine (linked to a feel-good effect).

MILK CHOCOLATE: COCOASOLIDS: 20-30%

Vanillin+butyricacid

Vanillin is used to add in milk chocolate to enhance their flavour. Butyric acid, which adds a sour note to the chocolate's taste.

WHITE CHOCOLATE: COCOA SOLID: 0%

Stearic acid + Palmitic acid

It uses only cocoa butter. It is composed of stearic acid and palmitic acid. Stearic acid has a neutral effect on blood cholesterol. Whereas palmitic acid plays a role in the texture and firmness.

HOW DOES THE CHOCOLATE MELTS SO PERFECTLY AT BODY TEMPERATURE?

30-40% of chocolate comprising fatty acid chains (oleic acid, stearic acid, palmitic acid) with the melting point around 105°F (40°C); on the other hand, sugar 40-60% of chocolates, primarily sucrose ($C_{12}H_{22}O_{11}$), which dissolves in saliva. Saliva's water and enzyme disrupt emulsifier bonds, merging cocoa butter droplets and facilitating melting. Saliva's water dissolves sucrose, reducing viscosity and promoting smother melting. Cocoa butter's fatty acid chain transitions from solid to liquid, releasing flavours, aromas, and texture.

DOES CHOCOLATE REALLY GIVE YOU A 'HAPPY HIGH'?

Theobromine and caffeine: Theobromine is an alkaloid usually produced by plants, including the cacao plant. Chocolate is the richest source of theobromine, which chemically resembles caffeine. The combination of theobromine and caffeine in chocolates helps to lift up the feel after eating it. Chocolate is filled with antioxidants, which help to prevent damage to cells. On the other hand, these compounds are toxic to dogs and cats. So, remember to keep them aside from your pets.

Phenethylamine: chocolates having a significant amount of a compound called phenethylamine that causes brain cells to release dopamine (Happy Harmone), a neurotransmitter with the feel-good effect.

Combining these compounds in chocolates would help to stimulate our brain; it temporarily makes you feel happy.

Eating too much chocolate can cause side effects. Caffeine and theobromine cause nervousness, increased urination, sleeplessness, and a fast heartbeat

.

CRAVING CULPRITS:

Chocolate is adored by people of all ages and backgrounds; it produces a strong effect on us. The combination of sugar with these compounds helps the reward centres in our brain and makes us crave, but it does not matter on chemical specifics. Chocolate is something we can enjoy in moderation.

CONCLUSION:

CHOCOLATE "THE FOOD OF GOD"

Because of its origin with the ancient Maya and Aztecs, who believed it was a gift from gods. Chocolate has so many health benefits when eaten in moderation. According to some research, chocolate intake helps to reduce cardiovascular diseases.

It improves the blood flow and has an impact on our cognitive abilities. It functions as an antibiotic and antiplatelet similar to aspirin, increases HDL (good cholesterol), decreases LDL (bad cholesterol), and contains polyphenols that prevent DNA damage.

Noble Prize in CHEMISTRY – 2024

Chemistry was the most important science for Alfred Nobel's own work. Chemistry was the second prize area which noble ha mentioned. The Nobel Prize for chemistry is awarded by THE ROYAL SWEDISH ACADEMY OF SCIENCES, Stockholm, Sweden.

- Total prizes for chemistry: 116
- Chemistry laureates: 197
- Awarded women: 8
- Young laureates: 35
- Oldest laureates: 97

The noble prize in chemistry was awarded to "David Baker, Demis Hassabis and John Jumper" for their work on proteins. David Baker has succeeded in building entirely a new protein which may help in life's indigenous chemical tool. Demis Hassabis is the CEO of google deep mind and John Jumper the senior researcher in deep mind had brought an AI to predict the structure of proteins. AI is the next generation which plays a vital role in every field including chemical biology, genetic and genome science which is the major field plays a vital role in drug design and drug discovery. Nowadays computational chemistry helps for screening the many screen thousands and hundreds of durgs under testing in a few minutes.

NOBEL PRIZES IN CHEMISTRY in previous five years;

2023 – for the discovery and synthesis of quantum dots

2022 – for the development of click chemistry and bio-orthogonal chemistry

2021 – for the development of asymmetric organo catalysis

2020 - for the development method for genome editing

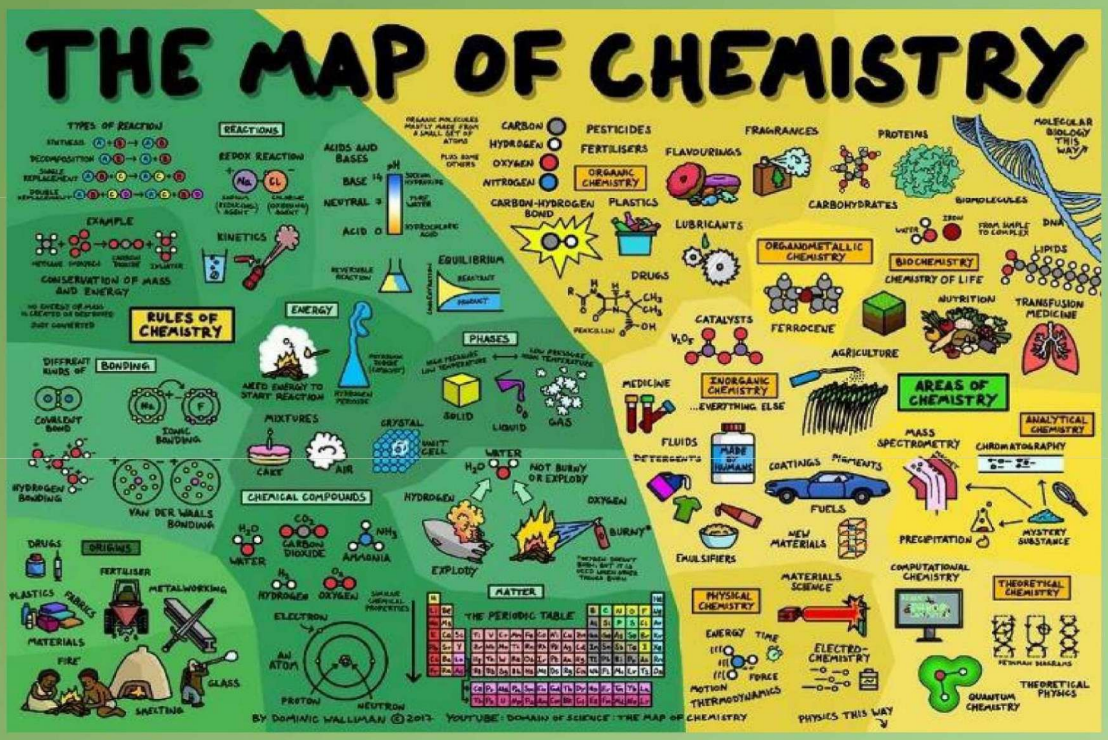
2019 – for the development of lithium ion batteries

Reference – https://www.nobelprize.org/prizes/chemistry/

CHEMISTRY IN EVERYDAY LIFE AND IN FUTURE

- Ramkumar M
23UCH202
II B.Sc. Chemistry B

Chemistry connects and underpins other sciences like physics, biology, and environmental science. It connects the physical sciences with life sciences and engineering. Chemistry has shaped the world in profound ways, from medical breakthroughs to industrial innovations. Chemistry not only helps us understand the materials and reactions that form the world but also drives innovation, health, and comfort in our daily lives. The Future of Chemistry holds immense potential to drive progress across industries and improve lives. Before that, let's look at the role of chemistry in everyday lives



The Impact of Chemistry in Everyday Life

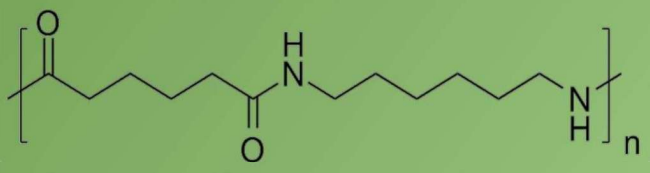
Chemistry is the foundation of everything we interact with daily, from the food we eat to the products we use. Its impact is not just confined to laboratories and industries but extends to almost every facet of our daily lives. From the food we eat, the water we

drink, and the products we use, chemistry is embedded in the very fabric of our existence. Let's explore how chemistry shapes everyday lives:

Firstly, everyday cleaning products like detergents, shampoos, soaps, and disinfectants are formulated based on principles of chemistry. Even the water treatment processes that ensure clean drinking water involve chemicals like chlorine and fluorine to kill pathogens and improve water quality. Without chemistry, maintaining hygiene in our homes and ensuring safe drinking water would be nearly impossible.

sodium palmitate

Secondly, the clothes we wear are made using chemical processes. Synthetic fibre like nylon, polyester, and spandex are the products of organic chemistry. The dyes applied to these fabrics to give them colour and texture also come from chemical compounds. Even natural fibers like cotton and wool undergo chemical treatments such as bleaching, dyeing, and fire-retardant coatings to improve their durability, appearance, and safety.



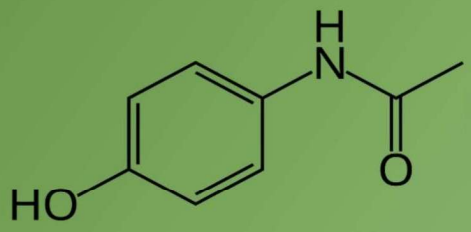
NYLON

Thirdly, Plastics. From packaging materials to everyday products like bottles, toys, and electronic components. Plastics are polymers, made from repeating units of smaller molecules called monomers, which are synthesized through chemical reactions. Chemistry has enabled the creation of different types of plastics, each with unique properties such as flexibility, durability, or transparency, which are used in various applications. Innovations in biodegradable plastics are also driven by chemistry, aiming to reduce environmental pollution from plastic waste.

Plastic bottle

Plastic toy

Fourthly, Medicines such as antibiotics, painkillers, and vaccines are carefully designed chemical compounds that treat diseases and alleviate symptoms. Metabolism, digestions, and respiration are all chemical processes that enable our bodies to function properly. The action of the drug is the process by which the drug brings about the change in the physiological function and biological process in the living organisms.



PARACETOMOL **(ANALGESIC)**

At last, the smartphones, computers, and other electronic devices we use daily are the result of advancements in material chemistry. Semiconductors, crucial components in electronic circuits, are developed using specific chemical processes. Liquid Crystal Displays (LCDs) used in screens rely on the chemical properties of liquid crystals to function. Advances in battery technology, driven by chemical research, have made devices smaller, more efficient, and more powerful, playing a crucial role in the technological revolution of the 21st century.

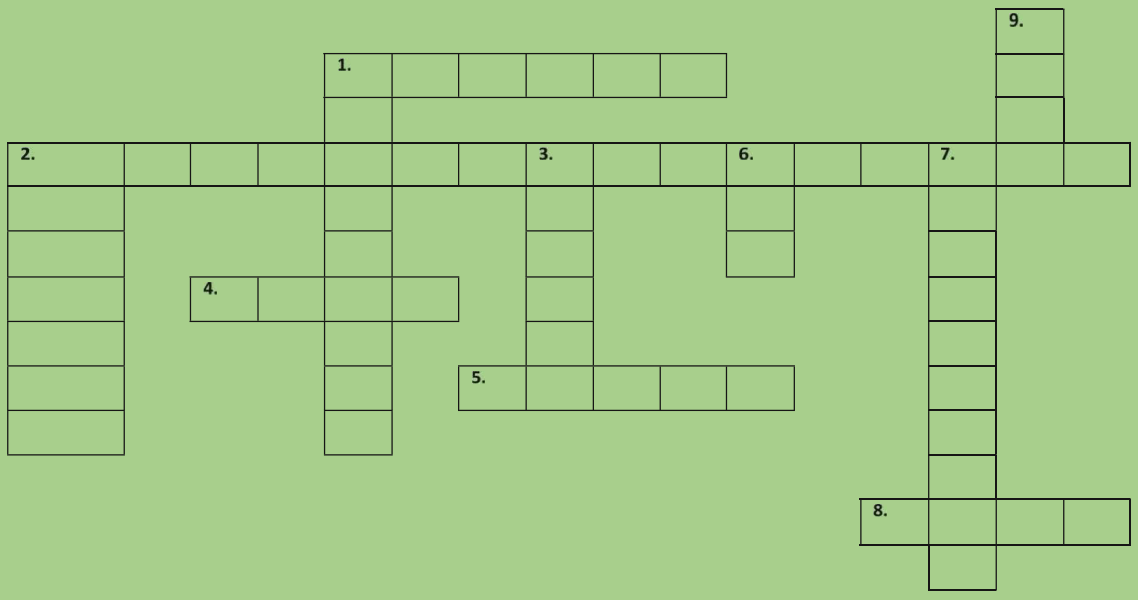
The Impact of Chemistry in Future

In the future, chemistry will be vital in addressing environmental issues, such as pollution and waste. The rise of biodegradable plastics, designed to break down naturally and reduce environmental impact, is an example of how Chemists are combating plastic waste. As the global population grows, ensuring food security becomes a critical challenge.

Chemistry is at the heart of developing new fertilizers and pesticides that are more efficient and environmentally friendly. Research published in Agricultural Chemistry Reports (ACR) highlights how chemists are working on synthetic biology to create drought-resistant crops and nutrient-enhanced foods that can sustain larger populations with fewer resources. The future of chemistry in agriculture lies in minimizing the ecological impact while maximizing yield.

Then, the integration of AI and machine learning is revolutionizing how chemists approach research and development. By using algorithms to predict chemical reactions and material properties, researchers can significantly cut down on trial-and-error experimentation. For instance, a study from the American Chemical Society (ACS) outlines how AI is helping chemists discover new compounds for drug development at a fraction of the traditional time and cost. This computational approach not only accelerates discovery but also reduces the environmental footprint of chemical manufacturing by optimizing the use of resources and reducing waste.

SOLVE IT!



CLUES

ACROSS

1. The common name of hydrogen peroxide
2. The main chemical substance present in bones and teeth of animals
4. A chelating agent used in chemistry
5. An example for amorphous solid
8. The anode in a dry cell consists of

DOWN

1. The common name of Sulphur
2. A common crystalline form of natural calcium carbonate
3. Which chemical is also known as carbolic acid
6. Suspension of solid particles in a liquid
7. A chemical species that can act as an acid or a base
9. The interaction of iron with air and water produces

THE CHEMISTRY OF TEARS

-Subashini A

24PCH126

II M. Sc. Chemistry

Tears play a crucial role in ocular health and emotional regulation, with each type having a unique biochemical structure and content. They represent a universal language that transcends cultural and linguistic boundaries, conveying the deepest feelings from joy, sorrow, pain, or laughter. Tears are also fascinating from a scientific standpoint due to their complex molecular composition, providing insights into the human body's intricate workings. Let's take a look at what tears are, their composition, how they classify, and some surprising facts.

Tears are not only water:

Tears are mostly composed of water, however they also contain other substances. These substances include neurotransmitters, hormones, and more. Proteins make up the majority of the materials in tears. Particularly notable are lysozyme, lactoferrin, and tear lipocalin. For instance, lysozyme, which makes up 20–30% of the protein in basal and reflexive tears, is more abundant in tears than in any other body fluid.

Chemical Composition of Tears:

To a chemist, tears are a mixture of water, electrolytes, proteins, lipids, and other molecules; however, the precise makeup varies based on the type of tears and the person's emotional condition. Tears are primarily water, with 98% consisting of H2O molecules. The remaining 2% contains various compounds, including electrolytes, proteins, enzymes, lipids, metabolites, and hormones. Electrolytes, like sodium, potassium, and chloride, regulate osmotic pressure and hydrate the cornea and surrounding tissues. Proteins, like lysozyme, lactoferrin, lipocalin, and immunoglobulins, serve functions like lubrication, protection against pathogens, and wound healing. Lysozyme exhibits antibacterial properties, while lactoferrin sequesters iron, limiting bacterial growth. Immunoglobulins help fight off infections by recognizing and neutralizing foreign agents. The meibomian glands in the eyelids produce lipids, which are essential for maintaining the stability of the tear film and limiting excessive evaporation. Dry eye syndrome is one condition that can

result from a lack of tear lipids. Tears contain metabolites, such as glucose, urea, and lactate, which are byproducts of different biochemical processes and can reveal important details about a person's physiological condition and general health.

Not All Tears are Same

Tears have a similar appearance, but their chemical makeup varies depending on the circumstances surrounding them, providing insight into their biological function.

Different Types of Tears:

Basal Tears: These are the constant, tiny tears that the eyes produce to keep them lubricated and moist.

Reflex Tears: These are a particular kind of tear that is triggered by stimuli or irritants like bright lights, smoke, onions, or strong winds.

Emotional Tears: These are produced in reaction to intense emotions, such as joy, sadness, frustration, or relief.

10 Interesting Facts About Tears

1) *Crocodile tears are real if you're a crocodile*: When someone pretends to cry, it's referred to as "crocodile tears." The book "The Voyage and Travel of Sir John Mandeville," which was published in 1400, is credited with creating the idea that crocodiles cry when they eat people. A 2007 study found that when crocodiles feed, they may genuinely weep. Instead of crocodiles, alligators and caimans, which are closely related to crocodiles, were seen. Although the cause of the tears is unclear, the animals did cry when they were fed.

2) *Newborns cry, but they don't produce tears*: Newborns' lacrimal glands are still developing, thus when they cry, they don't make tears. For the first month or so of their lives, they might not cry. Some infants have blocked tear ducts from birth or develop them later. The infant may cry in these situations, but one or both ducts may not be completely open or may be obstructed.

3) *Sleep-Crying is Real*: People of all ages can scream as they sleep, while it occurs more frequently in infants and young children. The following are some causes of crying while you sleep or when you wake up: Night terrors, nightmares, and grief depression Anxiety and tension Allergies to chronic pain.

4) *Though emotions have nothing to do with it, animals do cry:*

Tears are produced by animals to lubricate and shield their eyes. They may cry in reaction to irritations and injuries, but they don't cry emotionally the way people do.

5) *Women Cry More Than Men*: There are numerous assertions that women cry more than males, many of which are supported by evidence. However, the disparity appears to vary by region of the world, maybe as a result of cultural norms. The precise reason why women could cry more than males is unknown. Men's smaller tear ducts and emotional tears that include prolactin, a hormone that encourages the production of breast milk, may be contributing factors. Compared to men, women have 60% higher prolactin.

6) *Uncontrollable Tears*: Uncontrollable tears can be a symptom of

pseudobulbar affect (PBA). Episodes of unexpected, unrestrained laughter or tears are its defining characteristics. Usually, the laughter turns to tears. People with specific neurological disorders or accidents that change how the brain regulates emotion are typically affected by PBA. These include multiple sclerosis (MS), Parkinson's disease, Alzheimer's disease, and stroke.

7) *Absence Of Tears Can Cause Major Eye Damage*: Tears protect your eyes from infection and maintain a clear, smooth surface. Insufficient tear production puts your eyes at risk for: wounds like an eye infection or corneal abrasion vision abnormalities caused by corneal ulcers.

8) *Onions make you cry; the reason is irritating gas*: When you chop onions,

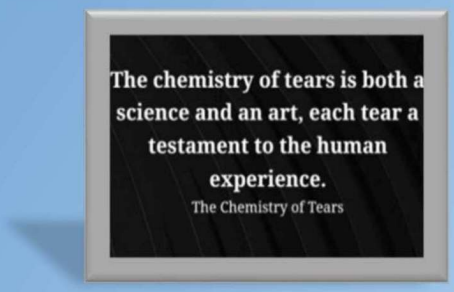
the gas that makes you cry is called syn-propanethial-S-oxide. The gas is produced by a somewhat complex but fascinating chemical process. Let's dissect it: Amino sulfides are produced when sulfur in the soil where onions are grown combines with the onion to form a gas that shields the developing onion from animals searching for food. Sulfenic acid is produced when the gas

combines with the enzymes released when an onion is chopped. Syn-propanethial-S-oxide, which irritates your eyes, is produced when sulfenic acid combines with onion enzymes. Tears are your eyes' defense against irritating stimuli. That's the reason you cry when you chop onions.

9) *Onions alone are not a reason for causing reflex tears*: Your lacrimal glands can produce tears in response to anything that irritates your eyes. Certain individuals are more susceptible to irritants than others. In addition to onions, the following may cause tears in your eyes: strong smells, like those of perfumes, bright lights, dust, and chemicals like cleaning supplies and chlorine reading for extended periods of time or in small print due to excessive screen time

10) *Emotional Tears May Actually Be Beneficial*: It is thought that biological, social, and psychological factors influence the reason behind emotional tears, though research on this topic is still ongoing. According to some researchers, when you're in pain, depressed, or experiencing any other kind of distress or strong emotion, crying is a social cue to ask for help. People often offer support when you cry, which helps you feel better. Research indicates that emotional tears contain additional proteins and hormones that are absent from the other two types of tears. These may have relaxing or pain-relieving qualities that support the body's natural state and help regulate it. While there is ongoing debate regarding the purpose of emotional tears, the benefits of crying are well known.

Considering all these facts, Tears are a complex system of water, electrolytes, proteins, lipids, metabolites, and hormones that serve as a means to express our emotions. Finally, don't worry about trying to suppress your tears; they are perfectly normal.



ONCOLOGY: IN PRESENT AND UPCOMING ADVANCEMENTS

-Aloysius Yagapparaj V
23UCH255
II B. Sc. Chemistry B

The World Health Organization (WHO) estimates that cancer claims the lives of approximately 10 million people globally, making it one of the major causes of death. Numerous studies have shown that cancer medications are not very effective, although they may be able to extend the deadline by a few more years. Numerous malignancies remain highly dangerous and challenging to identify.

Cancer is a highly prevalent disease in India. Due to inaccessible medical care, about 2.5 million people in India suffer from cancer without receiving treatment. Over 7 lakh new cases of cancer are reported each year, and 5 lakh deaths are attributed to incurable cancer. Lung and mouth cancers are the most prevalent cancers among Indian men. The main factors of this cancer include drinking alcohol, smoking, and occasionally using medications improperly on our own.

Definition of cancer:

Cancer is defined as an uncontrolled cell growth that begins in any area of the body, spreads across it, and damages healthy cells in its progression.

Normal human cells grow and multiply through the process known as cell division, in which the cell nucleus divides and the whole cell gets separated. The new cell further moves on to its process, and the parent cell dies.

Tumors result from a cell's escape from apoptosis. The wounded old cell will keep growing larger if it didn't die. In that region of the body, these cells develop into a soft tumor growth. Not all tumor growths are malignant; some are benign and exhibit few symptoms; nevertheless, when these symptoms are ignored, the tumor growth becomes aggressive and develops into cancer.

Even a damaged wound can form cancer, but cancer is not a deadly word; it is also like a damaged cell or wound.

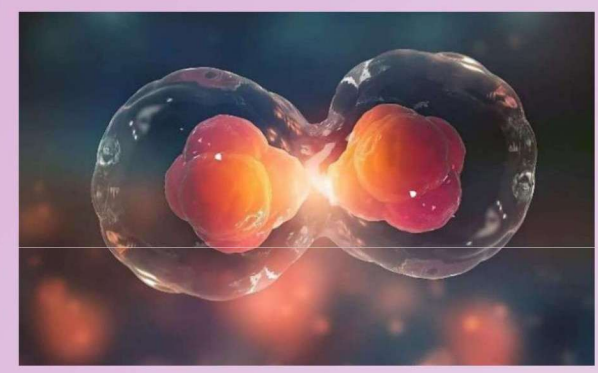


Fig: 1. Cell division

Cancer cell grows in the absence of signals that telling them to grow but the normal cell grows only responding to the signals. Cancer cell ignores the signals that tell to stop, cell growth or to die.

Cancer cell spread to the nearby areas and spread over the body.

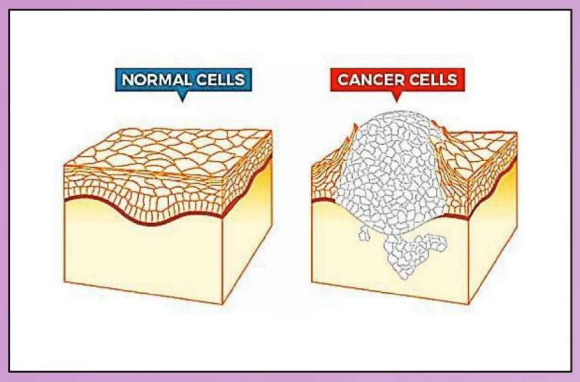
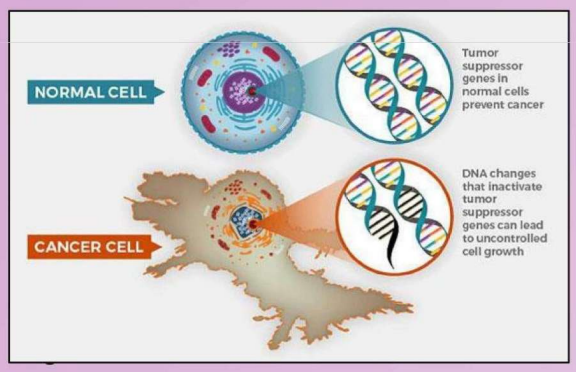


Fig: 2 Difference between normal cell and cancer cell

Cancer cell tells blood vessels to grow towards the tumor. The blood vessels supply oxygen, nutrients and removes the waste product from the tumor. They act like a normal cell, so it is undetectable for the immune system to destroy the damaged cell. They make the immune system as a protecting guard for the tumor growth. Some cancer cells have double the number of chromosomes. They may perform changes in the genetics in their own like deletion, duplication, etc….



Some cancer cells rely on different kind of nutrients than normal cells, that makes the cancer cell to grow faster than a normal cell. The body normally eliminates the damaged cell from our body before the turn into cancerous, but this process may malfunction due to aging, and insufficient nutritional balance.

Basically, cancer is a genetic disease that modifies the DNA genome and modifies the sequence of the DNA series or breaks the DNA chain, the cancer may also occur due to the long endless sequence of the DNA. [1]

Types of cancer:

- *Carcinoma*
- *Sarcoma*
- *Leukaemia*
- *Lymphoma*
- *Multiple Myeloma*
- *Melanoma*
- *Brain and Spine cord tumor*

Diagnosis:

Diagnosing cancer in earlier stage can provide many options for complete curable treatment, but delaying diagnosis may lead to difficulty in treatment and sometimes leads to death. There are many diagnosis technics few are here,

- *Physical exam*
- *Laboratory test*
- *Imaging test*
- *Biopsy*

Physical exam:

This method is usually used for diagnosis external tumor or the tumors in the outer surface of the internal organs, through feeling the lumps.

Laboratory test:

Lab tests include blood test, urine test, etc... These tests are used to find the abnormality in blood cell which may also result in cancer (Blood cancer).

Imaging test:

Imaging can give a clear idea about how big the tumor is? Imaging test like *CT, MRI, PET, Ultrasound, X-Ray, Bone scan, etc...*

Biopsy:

This is the main test used nowadays to confirm the tumor is cancerous.[5]

Treatment methods for cancer in present:

There are six treatment methods, *Surgery, Chemotherapy, Radiation therapy, Hormonal therapy, Immune therapy, Bone marrow therapy.*

Chemotherapy:

Chemotherapy drugs are used to kill the fast-growing cells. There are many chemo drugs:

- ★ Carboplatin- used to treat ovarian, head, neck, lung, neuroblast, brain cancer.
- ★ Cisplatin- used to treat testicular, ovarian, cervical, bladder, oesophageal, lung cancer. Capecitabine - used to treat breast cancer, gastric cancer, colorectal cancer.
- ★ Paclitaxel- Antitumor antibody.
- ★ Cyclophosphamide - to supress immune system and to treat leukaemia, lymphoma.

Radiation therapy:

Chemicals used in radiation therapy:

- ★ Iodine-125
- ★ Radium-226
- ★ Palladium-103
- ★ Ruthenium-106

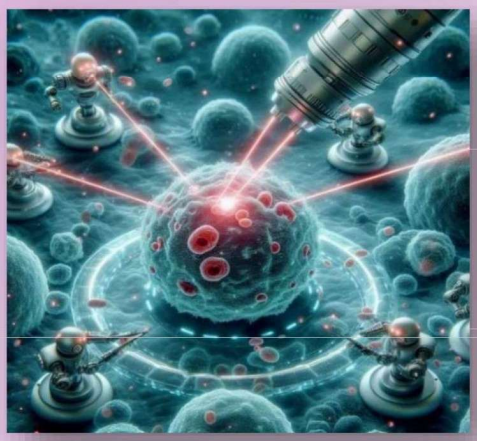
Hormonal therapy:

Chemicals used for hormonal replacement:

- ★ norethindrone acetate
- ★ ethynyl oestradiol
- ★ medroxyprogesterone

These treatment methods are effective against the cancerous cell, but these methods cause more damage and side effects to the patients.

There is another method which is very effective, and the side effects are low, the method is "***Targeted Drug Therapy".***[3]



<u>UPCOMING ADVANCEMENTS</u>:

<u>IN TECH:</u>

- ❖ CRYO EM
- ❖ CRISPR
- ❖ Robotic surgery
- ❖ Artificial intelligence
- ❖ Nano particle targeted drug delivery.[4]

CRYO EM:

Recent research shows that a new Imaging Techniques called CRYO – electron microscope imaging has been used to view the cancer cell small molecular binding of the key protein and drug.

CRISPR:

After making key discoveries about CRISPR, Drs. Jennifer Doudna and Emmanuelle Charpentier won a Nobel Prize in 2020. A year earlier, the first US clinical trial of a CRISPR-made cancer immunotherapy began, and more studies are exploring CRISPR-made cancer treatments.

Robotic surgery:

Future if mostly based on robotics, not only other fields but mainly the medical field. In surgery the robots controlled by human can be used to remove the tomorrow precisely.[2]

Credits: National Cancer institute

Reference:

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MPOX VIRAL CHEMISTRY

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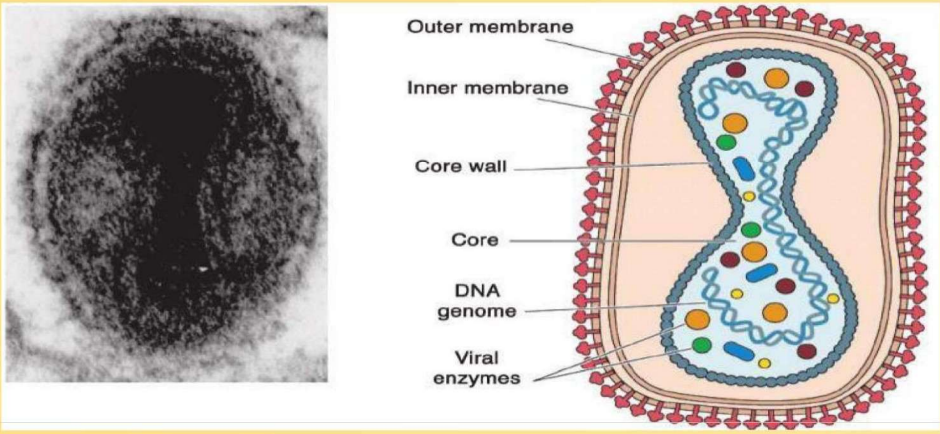
23UCH219

II B. Sc. Chemistry B

The MPOX Virus, part of the orthopox virus genus, provides a fascinating model for studying viral chemistry, mechanisms of infection, Its structure, molecular interactions and replication. Understanding these aspects is crucial for developing effective treatments and vaccines. This article explores the detailed chemistry of MPOX Virus and its infection process and the implications for therapeutic interventions.

Viral Structure



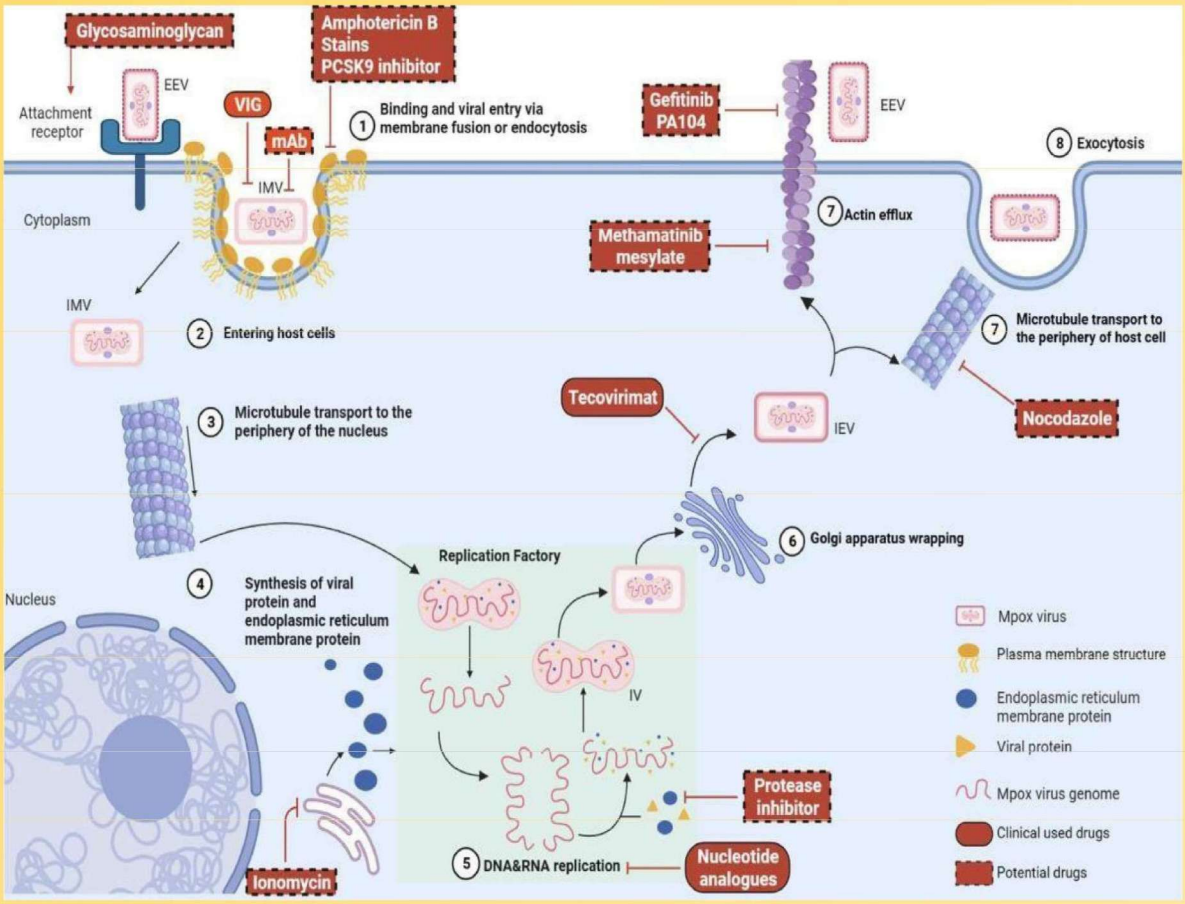
*This photo is licensed under ASM press**

The MPOX Virus is surrounded by a lipid bilayer derived from the host cell's membrane. This help's the virus to penetrate the host's cell. In surface the Glycoprotein is embedded with A291 and B612. These help the virus to bind to host cell receptors and start the fusion of the viral envelope with the host cell membrane.

Inside the envelope, the virus contains a protein shell that encases its genetic material and the shell protects the viral DNA. The protein of the virus helps in DNA polymerase and other replication factors.[1]

MOLECULAR MECHANISMS OF INFECTION

The initial step involves the interaction of viral surface glycoproteins with the receptors (**glycosaminoglycans**) on the host cell surface. After binding with the receptors the endosome triggers the acidic environment in vesicle membrane. This fusion releases the viral core into cytoplasm of host cell. The viral DNA is transported to the nucleus. This process involves nuclear localization on viral DNA by host cell. The viral DNA is further uncoated and prepared for transcription and replication.[2]



"The life cycle of MPOX virus replication in hosts and potential targets for anti-MPOX virus drugs. The complete life cycle of MPOX virus infection"

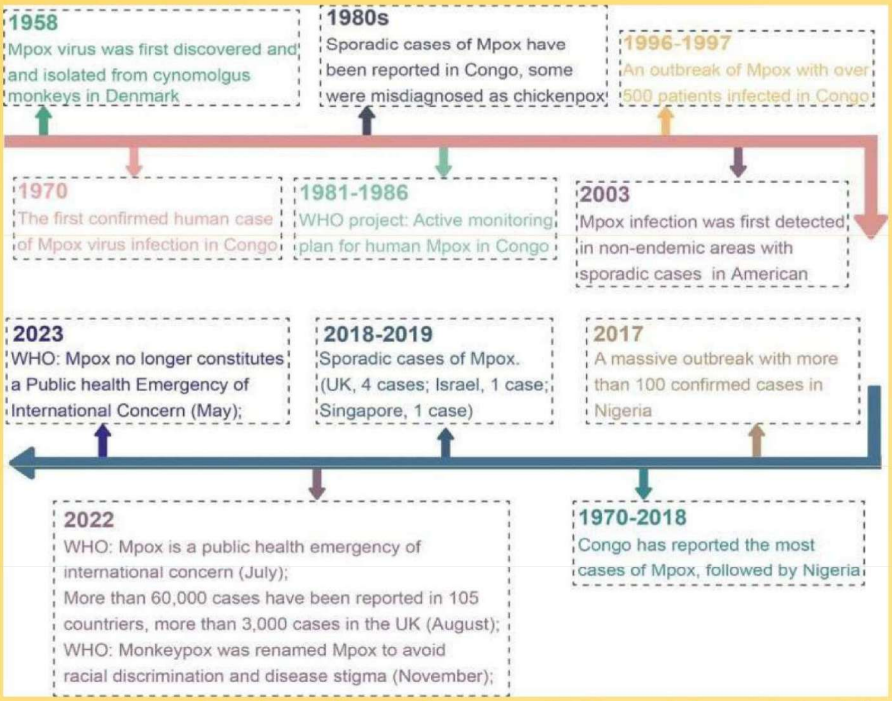
Transcription

The viral DNA is transcribed into mRNA by the host RNA polymerases. This generates mRNA into viral proteins.

Replication

The viral DNA undergoes replication to give a new viral genome. The transcription and replication takes place simultaneously.

The Transition and Replication are crucial for the progeny virions generations. The virions are assembled into the cytoplasm. This occurs in the region called viroplasm.



The virions are transported to the cell membrane and released through budding.[3]

*The timeline of the historical review and major milestone in MPOX**

How the antiviral and vaccine work against the MPOX?

Drugs are developed to inhibit the viral protein which is responsible for the replication and transcription. It reduces the spread of infection.

The vaccines aim to induce response against specific viral antigens. The dead cells of smallpox injected into our body then the body starts to react against the MPOX virus. This stimulates the production of antibodies and activate T-Cell's response to provide production.[4]

How is transmitted?

MPOX is transmitted through close "person to person" conduct. This can be through talking or breathing, touching or having sex and sharing contaminated material such as clothing and bedding. Pregnant people can also transmit the virus to the fetus.

Is there vaccine for MPOX?

Yes. JYNNEOS is a two close vaccine developed to protect against smallpox. People need to get two doses of the vaccine for the best protection against MPOX. The second dose should be given four weeks after the first dose of JYNNEOS. It protects about 85% of

the time. In addition, there are some Anti-Virus and Immunoglobins available for patients under 6 months of age like Vaccine Immunoglobin Intravenous (VIGIV).

The recent news and outbreaks of MPOX!!

24/05/2024: WHO releases a strategic frame work for enhancing prevention and control of MPOX.

09/08/2024: WHO invites MPOX vaccine manufactures and submit dossiers for emergency evaluation.

14/08/2024: WHO Director General declares MPOX outbreak a public health emergency of internal concern.

06/09/2024: WHO reported an increase in MPOX cases in several regions including parts of Africa.

10/09/2024: MPOX detected in India: why WHO changed the name from monkeypox [5]

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3. *Liu, J., & Xu, X. (2019). "Molecular Mechanisms of Virus Entry and Uncoating". **Journal of Virology**.*
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FACTS TO KNOW

1. Lemons have more sugar than strawberries.
2. Dynamite contains peanuts as a part of its ingredient.
3. Air behaves as liquid at temperature of 190 degrees centigrade.
4. Fish scales are commonly used as an integral part of lipstick ingredients.
5. We cannot taste anything without saliva

Quantum mechanics: A Simple Explanation of The Mysterious World of Tiny Particles

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23UPH113
II B. Sc. Physics A

From the moment humankind first looked up at the sky, the pursuit of science began. We asked ourselves: Why are we here? What is our purpose? Who are we? Are we alone in the universe? These questions, born from our endless curiosity, have driven us to seek knowledge, to explore the unknown, and to quench our insatiable thirst for understanding. From the smallest sand grains to the biggest stars they all are well explained by Newtonian classical mechanics in way of motion, momentum and energy of the system. But in early 19th century there is breakdown of classical assumption, classical mechanics assume that Particles have definite positions and momentum at all times, but at small scale (atoms and subatomic Particles), experiments shows classical laws fails at The Ultraviolet Catastrophe, photoelectric effect and Atomic Spectra. Then the new physics revolutionary started to explains the atomic scale physical phenomena and now is called Quantum Mechanics.

Quantum mechanics is the fundamental theory in physics that explains the behaviour of matter and energy at very small scales, such as atoms and subatomic particles. It describes a world where classical physics breaks down and introduces counterintuitive concepts like wave-particle duality, uncertainty, and quantum superposition.

The phrase “quantum mechanics” was coined (in German, Quantenmechanik) by the group of Physicists including Max Born, Werner Heisenberg, and Wolfgang Pauli, at the University of Göttingen in the early 1920s, and was first used in Born’s 1925 paper “Zur Quantenmechanik”. The word quantum comes from the Latin word for “how much” (as does quantity). Something that is Quantized, as the energy of Planck’s harmonic oscillators, can only take specific values. Top 10 of the most influential figures in the history of quantum mechanics by Max Plank, Albert Einstein, Niels Bohr, Louis de Broglie, Max Born, Paul Dirac, Werner Heisenberg, Wolfgang Pauli, Erwin Schrödinger, Richard Feynman.

Core Principles of Quantum Mechanics:

1. **Wave particles duality** (Particles like electron and photons exhibit both wave like and particle behaviour. Example one of the best known experiment by Thomas young's called **double-slit experiment** shows that electrons can behave like waves, creating an interference pattern, but when observed, they behave like particles.
2. **Quantum superposition**, A quantum state can exist in multiple state at once until measured. Example: Schrödinger's Cat—a thought experiment where a cat in a box is simultaneously alive and dead until observed.
3. Heisenberg's **Uncertainty Principle**, says that it is impossible to precisely know both the position and momentum of a particle at the same time. In words the more accurately measure one, less accurately measure the other one.
4. The **Schrödinger Equation** is the fundamental equation of quantum mechanics, describing how quantum states evolve over time. It replaces Newton's laws in the microscopic world.
5. **Quantum Tunnelling** is the one of the weird effect in quantum world that particles penetration through the potential barrier even if particle total energy is less than the barrier height. In simple the electron will penetrate into center of nucleus at some certain case.

Why Is Quantum Mechanics Important?

Explains atomic and subatomic phenomena that classical physics cannot. Foundation of modern technology, including semiconductors, lasers, and quantum computing. Revolutionizes our understanding of reality, challenging concepts like determinism and locality.

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- *A "no math" (but seven-part) guide to modern Quantum Mechanics https://arstechnica.com/science/2021/01/the-curious-observers-guide-to-quantum-mechanics/*

"If quantum mechanics hasn't profoundly shocked you. You haven't understood it yet"

- Niels Bohr.

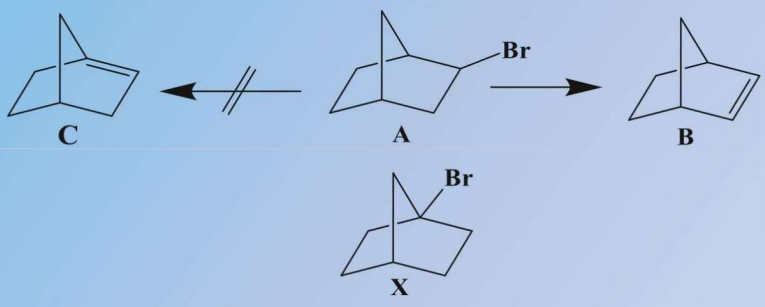
Breaking a Century – Old Chemistry Rule: The Anti - Bredt Olefins

-Arunrex Nayakam A

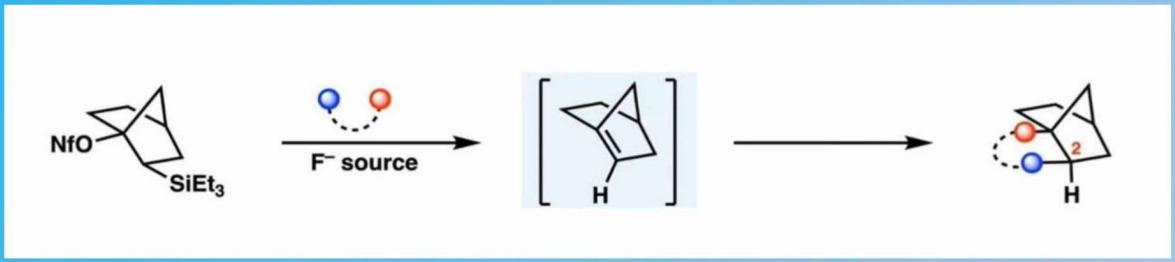
23PCH108

II M. Sc. Chemistry

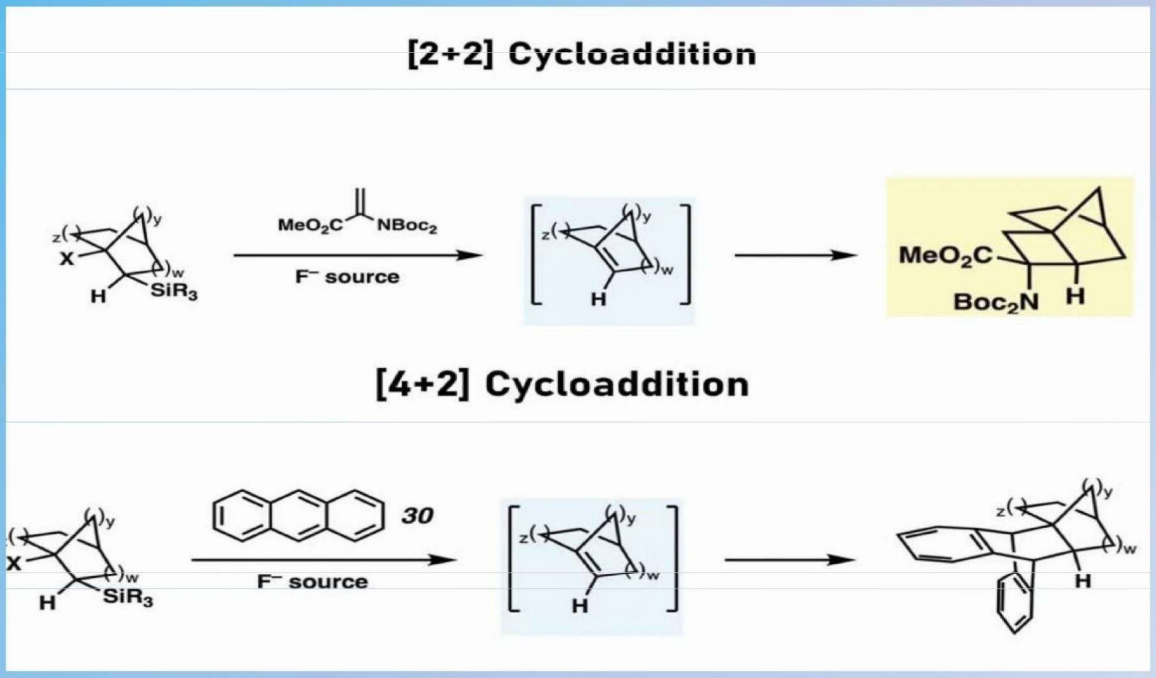
In this nature, "Change is the only thing that cannot be changed", In that case, the principles of chemistry do not expect that in such a way. A recent finding of UCLA Chemists has created quite a stir in the scientific community, which challenges a century-old principle in organic chemistry known as Bredt's rule. It is used for the generations in the chemistry gospel to design and synthesis of numerous compounds. The Bredt's rule was proposed in the year 1924 by Julius Bredt. According to this rule, "No matter what the mechanism, a double bond does not go to a bridgehead carbon unless the ring sizes are large enough". For example, A gives only B and not C, but also that X does not undergo elimination.



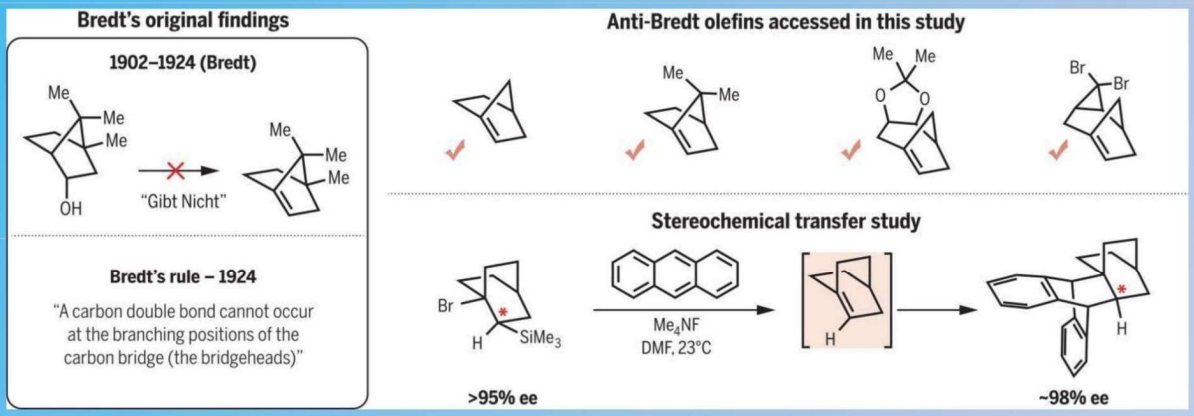
But just recently researchers have cracked open a new possibility showing that Bredt's rule can be defied under right conditions. This breakthrough may lead to discoveries in pharmaceuticals, materials and molecular design. In a remarkable series of experiments, they achieved a stable double bond in the bridgehead positions. The modified Kobayashi-Type elimination reaction is used for synthesis of Anti - Bredt's olefins.



They used silyl (pesudo) halide precursors and a fluoride source to produce Anti-Bredt's olefins, which were then Captured through trapping experiments. This method allowed for in-situ generation Anti-Bredt's olefins, followed by various cycloaddition reactions (e.g (4+2) (2+2) (3+2) (5+2)) that confirmed the formation and reactivity of the highly strained Anti-Bredt's olefins structures. Computational studies further validated the geometric distortions - twisting and pyramidalization present in the ABOs, Contributing to their distinct reactivity. This Means that Bridgehead carbons can support double bonds without collapsing the molecule.



In conclusion, this is not just a theoretical curiosity, but it is revelation. For the first time, chemist's have the green light to do experiment with bridgehead unsaturation, opening the door to previously unreachable compounds. When rule like Bredt's fall, they don't just make way for small changes; they create revolutions in how scientists think about molecule design. This rule has been a limiting factor in synthesizing certain cyclic compounds, but now chemist's can create molecules that are previously impossible, potentially leading to compounds with novel reactivity and stability. Many drugs rely on the stability of cyclic compounds, by exploring bridgehead double bonds, chemists may design new drug structures with improved stability and with target specificity. This breakthrough could spark innovation in materials science, potentially leading to new materials that are stronger, flexible and with unique electronic properties.



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NOBLE PRIZE FOR CHEMISTRY – 2024

-Meghavardhini R

23PCH133

II M. Sc. Chemistry

"The 2024 Nobel Prize in Chemistry was granted to David Baker, Demis Hassabis, and John Jumper for their innovative contributions to protein design and structure prediction. Their work has greatly enhanced our comprehension of proteins, which play critical roles in various biological functions."

David Baker's Groundbreaking Innovations in Computational Protein Design

David Baker, a professor at the University of Washington and a researcher at the Howard Hughes Medical Institute, has achieved significant progress in computational protein design. In 2003, he reached a notable achievement by creating a new protein that had no counterparts in nature. Since then, his research team has engineered a variety of novel proteins that are applicable in areas such as pharmaceuticals, vaccines, nanomaterials, and sensors. These specifically designed proteins hold the potential to transform medicine and technology by offering customized solutions to particular issues.

Demis Hassabis and John Jumper's Breakthrough with AlphaFold

Demis Hassabis and John Jumper, both affiliated with Google DeepMind, have revolutionized structural biology through their creation of AlphaFold, an AI model that can predict protein structures with extraordinary precision. When they released AlphaFold2 in 2020, the model successfully predicted the structures of almost all known proteins, totalling around 200 million. This accomplishment resolved a long-standing issue in biology that had persisted for five decades and has since been employed by researchers globally to gain insights into diseases, create new treatments, and investigate biological mechanisms.

The Importance of Protein Structure Prediction

Proteins are made up of extensive sequences of amino acids that fold into intricate three-dimensional configurations, which determine their functional roles. Accurately forecasting these structures is essential for understanding protein functionality and for designing drugs that can interact with them effectively. Prior to AlphaFold, determining a protein's structure was a lengthy and expensive endeavor, often taking years of

experimental work. The introduction of AlphaFold has significantly expedited this process, enabling swift predictions that support research in multiple disciplines.

Applications and Future Implications

The breakthroughs achieved by Baker, Hassabis, and Jumper have vast implications. Custom-designed proteins can facilitate the creation of more potent vaccines and therapies, while precise structure predictions can help decipher antibiotic resistance and develop enzymes capable of degrading environmental pollutants like plastics. These advancements not only improve our understanding of biological mechanisms but also provide practical solutions to urgent global problems.

Conclusion

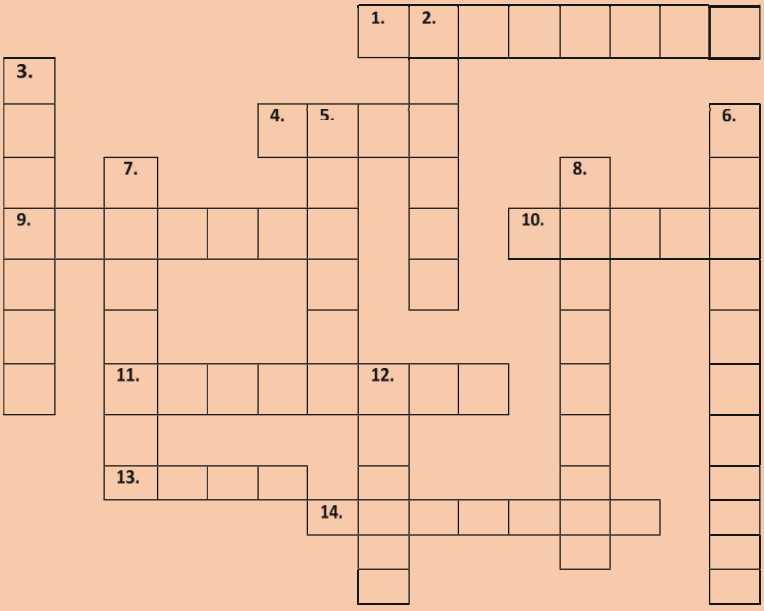
The 2024 Nobel Prize in Chemistry celebrates the extraordinary accomplishments of David Baker, Demis Hassabis, and John Jumper in the fields of protein design and structure prediction. Their work showcases the effectiveness of merging computational techniques with biological research to tackle complex challenges, paving the way for forthcoming discoveries that will benefit society.

Do you know?

Why chemistry is love?

Dopamine, serotonin and oxytocin are some of the key neurotransmitters that help you feel pleasure and satisfaction. So, your body often approaches love as a cycle. It feels good to be with that person, so your brain says, "Do that again."

FIND ME!



CLUES

ACROSS

1. Poisonous metalloid used historically in medicines and rat poison
4. Precious metal often used in Jewellery
9. Only metal that is liquid at room temperature
10. Radioactive noble gas
11. Strong and lightweight metal often used in aerospace applications
13. Noble gas used in neon signs, glows with a distinctive reddish-orange colour
14. Lightest metal, highly reactive

Down

2. Radioactive element discovered by Marie and Pierre Curie
3. Halogen found in seawater
5. Essential gas for respiration, supports combustion and forms oxides
6. Radioactive element named after physicist Albert Einstein
7. Noble gas used in fluorescent lights
8. Precious metal commonly used in catalytic converters
12. Essential for thyroid function

UNIVERSE'S FIRST MOLECULE

-Bhuvanesh K (23UCH153)

-Ilanko A (23UCH116)

II B. Sc. Chemistry A

INTRODUCTION

As is common we all know that the first atom discovered in the universe is hydrogen. Similarly, the first molecule discovered in the universe is made up of hydrogen atoms and helium atoms, namely helium hydride He H+. It has been estimated by scientists that the cosmos cooled down sufficiently for nuclei and electrons to start mixing to form molecules about 300,000 years after the big bang theory. There were just a handful types of atoms that existed during the early stages of the universe following the big bang theory: H, He, Li, after that, scientists believe that the first chemical molecule to exist in the universe is helium hydroxide, which was produced when helium and hydrogen reacted around 100,000 years after the big bang theory

HOW WAS HELIUM DISCOVERED?

French astronomer named Pierre Janssen visited India in 1868 to examine the sun spectrum during an eclipse. There, he saw a new yellow line that appeared, signifying the presence of a new element. Furthermore, while watching the sun through London's pollution and assuming the new element, which is Helium, to be a metal, by English scientist and astronomer Norman Lockyer also saw the same line Following a few years, in the early 1925s, and which is helium

HOW HELIUM HYDRIDE MADE INITIALLY?

British chemists J. Norman Collie, Thorfin R. Hogness, and E. G. Lind at the University of California also suggested studying helium hydride in lab settings. It

involves low-pressure bombardment of a hydrogen-helium mixture to detect the presence of helium hydride (He H+), which may be a probable intermediate in a chemical process as in the form of (HeH2+ There weren't many ideas in the 1970s regarding the discovery of helium hydroxide as the first molecule.

HOW HELIUM HYDRIDE FOUND?

Additional research was conducted in a location known as a planetary nebula, **(*which is composed of dust and cosmic gases produced from the outer layer of dead stars*).** The planetary Nebula NGC 7027 was selected as their target because it may contain helium hydride (HEH+) due to heat generated by the aging and dying of stars and ultraviolet radiation emissions. However, neither the target nor the instruments, telescopes, and technology used by them are sufficient to find the helium hydride, nor are any other new technologies sufficient to find it. In this way, they are able to distinguish the helium hydride After many decades, a joint project between NASA and the German Aerospace Center (DLR). The Stratospheric Observatory for Infrared Astronomy (SOFIA) is a Boeing 747SP jetliner that files at around 45,000 feet above the sky with ***106-inch diameter telescope*** ***(Shown In The Above Fig)*** to detect (He H+).

Because helium hydride emits specific infrared wavelengths that are difficult to detect the heh+ from our earth surface due to atmospheric interference. Hence SOFIA uses high altitude that is (45,000) to detect the helium hydride where they used GREAT instrument, which is used to observe the target. (GREAT) or (Tetra hertz frequencies) which is high resolution spectrometer capable of detecting specific infrared wavelengths emitted by molecules After many difficulties, the helium hydride was finally identified and detected in space in April 2019 under the leadership of Thomas Roellig, who served as the project director from 2019 to 2019. Even though the fact that the molecule helium hydride was created in a laboratory in 1925, But it was already in space and finally detected in 2019 for the first time.

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DO YOU KNOW?

Mixing of equal volume of alcohol and water, the total volume will be decreased as the molecules of ethanol are smaller than water molecules, hence on mixing together, ethanol acquire the spaces left between the water molecules causing a less volume of the solution

SYNTHESIS OF AMINO ACIDS IN DRUG DEVELOPMENT

-Sr. Jasmine Judith
23PCH104
II M. Sc. Chemistry

Introduction

Drug is a substance other than food. It diagnoses, actively prevents, and, gives better relief from the disease. It is a chemical substance that interferes with the functioning of human life. The enhancement of drugs is the determining action in the pharmaceutical field. Drugs are being synthesized in several aspects. They are being synthesized from metals, inorganic and organic elements, natural and synthetic polymers, and, Amino acids. The synthesis of Drugs from amino acids is also quite a known and essential method. The use of amino acids in drug development is the best process to be known. The present article, briefly and, precisely discusses the role of amino acids in drug development.

Amino Acids

Amino Acids are important biomolecules, that are building blocks of Proteins. Generally, their structure consists of at least one amino group and one carboxylic group. They are linked through the peptide bonds. These are the backbone of all proteins. Respective to the side chain, their property ranges from acidic to basic and hydrophilic to hydrophobic [1]. They too, are classified as polar and nonpolar and essential and non-essential amino acids [2]. 20 Prtogenic or essential amino acids and hundreds of diverse biological functioning non-protein amino acids are present in plants and living systems. Protonic amino acids are naturally coded, and non-protonic amino acids are non-coded. [3].

Amino acids in Drug Development

Amino acids are used in drug development through various processes, namely

Unnatural Amino Acids, complex formation of amino acids with metals, and amino acids in the polymerization process.

Unnatural Amino Acids

The unnatural amino acids are greatly used in the drug delivery system. They are manufactured by the chemical modification of natural amino acids, by using the ligands and the palladium catalyst. They have different chemical and physical properties. They are of two types, the first one is **analogs** which are structurally similar to canonical amino acids. the second is a **surrogate** with distinct physical and chemical properties [4]. Unusual or unnatural amino acids are integrated into proteins to enhance their function. They are not genetically coded. Unnatural Amino acids may or may not resemble natural amino acids; they can be applied in many fields. Such as

* **As a Biocatalyst,** Nor-leucine, and methionine could be replaced by isosteric methionine, an analog of Norleucine, to enhance thermal stability [5].
* **As Therapeutics**: in combating cancer and Bacterial infections the unnatural amino acid Naphthalene-tripeptide which contains α-amino isobutyric acid or alanine is used.[6]
* **As Antibody-drug Conjugates:** cell-penetrating peptides (CPPs) are short-chain amino acid residues that are extensively used in the varied biologically active drug molecules, and Drug delivery vectors for the potent intracellular transportation [7]
* **As an Imaging agent:** in detecting tumors, imaging cancer, and differentiating the tumor and inflamed tissues, the UAA *O-[18F]-Fluromethyl-l- tyrosine acts as a superior* PET imaging agent [8].
* **As Antimicrobial Peptides**: unnatural amino acids are used in enhancing the bio-redox process. In identifying protein structures and modifying them after translation the assistance of abiotic nicotinamide dinucleotide flucytosine is used. [9]
* **As probes in Protein Conformation**: The vibrational probes that consist of unnatural Amino acids with altered chains like nitrile, thiocyocyabnte, and, azide.

This kind of probe increased the applications of vibrational spectroscopies in investigating local dynamics and conformational changes with residue-specific resolution [10].

* **As Site- Specification**: The selective targeting of cytotoxic drugs is allowed by Antibody- drug conjugates. As the tumors are presented with surface makers, minimize the systemic toxicity. Earlier it was conjugated with cysteine or lysine. This challenge was met with the encoded with unnatural amino acids. [11]

Amino Acids as the ligands in complex Formation

Due to the multi-functionality of α- amino acids are ranked among the more versatile ligands. Coordination of amino acids with metal occurs in two ways they are complex formation via donor atoms of a functional group where Nitrogen and oxygen-like chelates are formed. Another one is metal-carbon bonds. It also acts as a tridentate ligand. [12]. The complex formation of metal and Amino acids plays a crucial role in drug development.

Complexation of amino acids and Copper II: In humans and animals, Cu (II) amino acid complexes were found to be useful antibacterial agents applied against *staphylococcus aureus,* and *Escherichia coli.* In this complex formation, amino acids were found to be acting as bidentate ligands, and the square-planar structures were confirmed. [13]

* **Complexation of amino acids and Iron:** Mostly the dietary form of iron enters into the gastrointestinal tract in the form of ferric iron. It must be converted into ferrous before the absorption. There are found innumerable dietary components that can reduce the ferrous Fe^{2+} to ferric Fe^{3+}, the notable components are Cysteine, Histidine, etc. [14]
* **Amino acids and Cobalt complex:** Catalysts based on cobalt amino acids and 2,2 bipyridine (bipy) present an attractive and cost-effective alternative as ring-opening polymerization catalysts.[15]
* **Amino Acid and Nickel Complexation:** Histidine and Cysteine are the two critical amino acids for implications of nickel former is coordinated by the

imidazole moiety and the latter is with its thiol Sulphur donor. Both residues are also crucial for the binding of Ni(II) in peptides, while simple peptides will coordinate Ni(II) via amino and amide nitrogen donors. [16]

* **Amino Acid as Schiff Base Ligands:** The combination of amino and carboxylic groups of amino acids makes it a good candidate for Shiff-based condensation reactions. In these reactions, the five-membered ring formed by the aldehyde and amino acids is chelated with metal ions[17]. The attraction towards metal complexes derived from amino acids is due to their inorganic and biological importance. It has a wide application in anti-cancer, anti-tumor, anti-bacterial, anti-fungal, and anti-inflammatory [18].

Amino acid-based polymers in Drug Development

Polyamnio acids are widely used in drug delivery, for an example poly amidoamine, poly (aspartic acid), poly (lysine) and poly (glutamic acid) are copolymers are used in the drug delivery system

Poly (lysine): used as an antimicrobial agent and, carrier for pharmaceutical molecules

Poly (glutamic acid): used in tablet coating and, as a food additive.

Poly (aspartic acid): pharmaceuticals preparation and, recipients in

tablets. **Polyamidoamine**: Carriers for targeted drug and gene and

bio-imaging [19]

Conclusion

In the drug-developing process, the amino acids play a better role. Amino acids are present in nature and also being synthesized from the natural amino acids. the proper knowledge of the, the physical and chemical properties of amino acids will greatly assist drug development in the pharmaceuticals industry.

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FACTS TO KNOW

1. Mixing sufficient quantity of salt into a full glass of water, the water level will go down as salt have a capacity to retain water
2. When we lost approximately 1% water of our body's then we feel thirsty.
3. "J" is the only letter which is not found in the periodic table.
4. Radioactive and nuclear elements actually glow in the dark
5. The only solid elements that assume liquid form at room temperature are bromine and mercury.

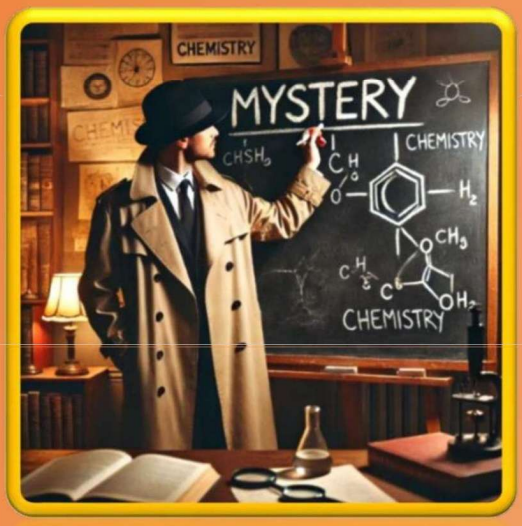
Chemistry in Famous Mystery Fiction

-Sharukhaan

24PCH115

I M. Sc. Chemistry

Chemistry indeed has 'mystery' within. To the eyes of the commoner muggles, the practice of this ancient science seems no less than magic. Being one of the most commonplace and, all the while, fascinating fields of science, it is only natural for it to influence every walk of life. Literature is no exception. Especially the tense, suspenseful mystery stories almost always find a space for mystical elements (of chemistry). The most famous fictional detective to exist would be the master of deductions created by Sir Arthur Conan Doyle. The way Holmes emanates an all-knowing aura while throwing criminals behind bars is always something that excites every mystery fiction lover. Though immensely engaging, Doyle's novels included fictional poisons and potions of extraordinary properties. While he had a brilliant hand in writing the greatest detective, the real-life authenticity of his words is not very much when compared with a certain other author.



To any mystery/thriller reader, the name Hercule Poirot will surely bring about a picture of a short French man with a waxed mustache and investigative prowess second to none. Hercule Poirot was the protagonist of the series of novels written by Agatha Christie. Popularly known as the "Queen of Mystery" among avid readers, Agatha Christie was a master of her craft. In addition to that, she had a doctorate in Chemistry! Murder investigative tales pique the interest of people of all ages. Agatha Christie really made sure of this by writing many murder investigative novels with her protagonist, Monsieur Poirot. The extensive knowledge of poisons and their workings he possessed can be attributed to the academic prowess of Christie. This might shed light on why her antagonists made such perfect use of the variety of poisons. Let us take a glance at how well administered are these toxins….

Hemlock: The ancient notorious poison Hemlock is where we begin. The poison that drank the life of Socrates. Historically one of the oldest known poisons, it is depicted in the portrait 'Death of Socrates.'. The active substance in Hemlock is confine, a neurotoxin, which causes respiratory paralysis and death by suffocation. Christie wittily uses this historic poison in her novel 'Five Little Pigs.'. Doyle has also placed the use of hemlock in his novel, 'The Adventure of Priory School.'. While solving the usage of poison is the heart of the stories, both are engaging in their own way of uncovering.

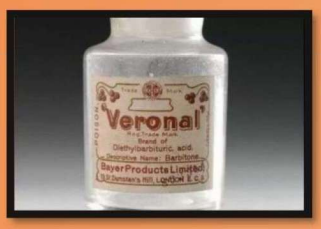
Arsenic: Another historically significant poison would be arsenic. A number of historical figures, such as Rene Descartes, a great philosopher and mathematician, had been the most known victim. Arsenic interrupts metabolism at the cellular level, disrupting enzymatic processes causing death.

Christie had employed arsenic poisoning in 'The mysterious affair at styles,' while Doyle does it in 'The adventure of Devil's foot.'. Even though the brilliant intricacy of the story makes Doyle's stories more palatable, Agatha's fast-paced certainly makes it equally captivating.

Cyanide has almost been made synonymous with poisons. Pop culture and television age had brought knowledge of cyanide poisoning to households. To the extent of believing that consuming apple seeds can prove fatal! But as chemists, we estimate the quantity of cyanide in apple seeds to be very far below the fatal dose. So, you can enjoy a bite of apple without a second thought. Now back to cyanide poisoning, it acts by making your cells suffocate, causing rapid tissue death and instant death of the victim. Christie employs cyanide poisoning as a central theme in her novel 'Sparkling Cyanide.'. Doyle has employed the toxicity of cyanide in several of his stories owing to the widespread notoriety of cyanide, but 'The Adventure of Mazarin store" is notable.

Morphine: People who have undergone surgeries or those who have been accustomed to the ways of the hospitals know how anesthetics work. Morphine is one of the commonly used anesthetics used in countries other than India (the use of morphine is prohibited in India). Morphine has a bronchoconstricting property, which makes it an effective anesthetic agent. Cases of overdoses and casualties are also common in such countries. Christie places morphine as a central element in her novel 'Sad

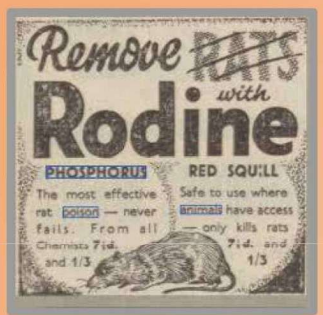
Cypress.'. While not as a poison, in 'The Adventure of the Three students,' the addictive effects of morphine are told by Holmes.



Veronal: Veronal is a barbiturate drug that has a dark story to tell. Commercially sold in the 1930s London as an over-the-counter drug, Veronal was widely famous among writers of that time. Veronal is a sleep-inducing anti-depressant, and thus can often result in addiction. In high doses, Veronal causes depression of medullary centers leading to death. In one of her most renowned novels, 'The Murder of Roger Ackroyd' Christie diagnoses a plot where Veronal is the lethal agent of the antagonist.

Atropine: Next on the list of murderous substances is, Atropine, an alkaloid compound that acts on the muscles of the body. It works by breaking down the interactions at muscle acetylcholine receptors. It is a staple drug in treating poisoning, and its side effects include pupil dilation and abnormal heart rate. The working component is l-hyoscyamine. In 'The adventures of Sussex vampire, Sherlock uncovers the mysteries of the plot's supernatural phenomena by stating atropine's effects.

Thallium: As chemists, we know heavy metal poisoning is the worst way to be put down. Whether it is mercury, arsenic, or thallium, heavy metals cause a slowly eat away the life of the victim. Mercury was once believed to have healing properties by the ancient Greeks. This might sound funny to modern chemists, but throughout history, Mercury had been a part of dispensary, whether it was a 10^{th} century alchemist or a 19^{th} century physician, considering it to be omnipotent. It was only after late 19^{th} century was it discovered that Mercury was a deadly toxin. Like mercury, or even worse, Thallium is another element to be wary of. Thallium can be absorbed through skin, or ingested and can cause chronic symptoms, and eventually death. This case of Thallium poisoning had been used by Christie in her novel 'Pale horse'.



Phosphorous: In India, the most used poison, in the cases of suicide is Phosphorous. Or to be exact, rodenticides or rat killers. These are phosphorous based poisons, usually have no antidotes, and though have a wide spectrum of symptoms, are hard to diagnose and have a high fatality rate. Gastrointestinal poisoning followed by secondary hepatic toxicity can cause

death in less than a week. This phosphorous poisoning has been equipped in Agatha Christie novel 'Dumb Witness'.

Methylene chloride: While chloroform has widely been established as a must-have have for villains, Doyle addresses another, less known relative of it, a chloro-substituted hydrocarbon, that is Methylene chloride. In 'The adventures of Devil's foot' the hallucinogenic effects of this hydrocarbon are put forward by Holmes.

Ricin: A lesser known, but sinister toxin is, ricin, extracted from castor beans, it is a slow-acting poison. Ricin causes cellular death and cannot be detected easily, making it an efficient poison. Ricin has been employed in Agatha's 'The House of lurking death' short story. It has also made appearances in TV dramas, and even a Tamil film (Thupparivaalan).

In another light: A contemporary Mystery fiction writer, whose stories have reached the pinnacle of fame might be none other than Dan Brown. Dan Browns's novels, usually follow its protagonist travelling through a world-famous city, taking life-threatening tasks, outrunning the Interpol, solving crypts and myths in minutes, thwarting the Doom's Day plans of criminal master minds. Although Dan Brown's novels mostly focus on the art history and symbology of ancient organizations, he still equips his protagonist with a good knowledge of science, and especially chemistry.

Brown's novels deal with chemistry at a different perspective than the rest of the authors. His protagonist just points out the chemicals and their role in everyday products or practices, while going roundabout his mission to save the world. For example, in Deception Point (2001), the advent of Nanotechnology has been discussed. In the Origin (2017), the theory of how life might have eventually come into existence from inorganic matter, was discussed. In Angels and Demons (2000), the cherry on the cake of his career, he explains the characteristics of subatomic particles, while showcasing the unfathomable essence of antimatter particles.

Although fiction works offer a limited comprehensibility of the Science of Chemistry, it certainly makes the reader delve into the realm of the book. This serves the purpose of depicting the intensely stimulating side of Chemistry which otherwise might seem bland. I believe literature, especially fiction while exploiting the science and bending its laws for its needs, also offers the platform for people to acquire a passion for the science.

Bioluminescence Unveiled: The Chemistry of Nature's Light Show

-Meghavardhini R

23PCH133

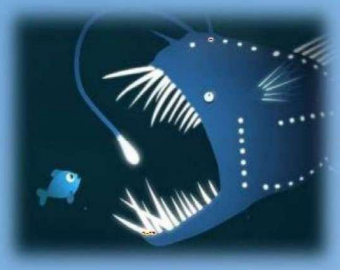
II M. Sc. Chemistry

Hey! Have you heard about the glowing beach incident in Chennai and Puducherry. Did you witnessed the glowing sea or have you seen any pictures? If no, Now you have heard about it, On 21st October 2024 the beaches in Chennai and Puducherry witnessed glowing waves. Not only in Chennai and Puducherry, in many places all around the World we see water bodies glowing such as the mosquito bay in Pureto Rico, Mudhdhoo Island, Maldives and so on. Have you ever wondered we have the water bodies like ponds and lakes near our homes, why not it's glowing? I wondered and found the answer!

The Glowing of the oceans and seas is not due to water present in it, it's due to the organisms or you can say bacteria that is present in the water gives it a glowing light. This is scientifically known as Bioluminescence.

So, Now we got our answer, but why and how these organisms and bacteria produce light and what's the chemistry behind it! Shall we dive in to find the answer.

To the first question why? the answer is still in discussing and not yet confirmed on its function, purpose and adaptation. But for instances their use for



- Locate Food
- Defend against or warn predators
- Hide from predators
- Attract or detect prey
- Attract mates
- Communicate

To the second question how? it's just a simple answer they undergo a chemical reaction that helps them to produce light. The process of bioluminescence is triggered by a chemical reaction involving two distinct compounds: luciferin and either luciferase or photoprotein. Luciferin serves as the substrate that generates light. The specific color of bioluminescence— yellow in fireflies and greenish in lanternfish—results from the structural arrangement of luciferin molecules.

Certain bioluminescent organisms, such as dinoflagellates, are capable of synthesizing luciferin independently, resulting in a bluish-green light. These dinoflagellates belong to a category of planktonic marine organisms that can cause a sparkling effect on the surface of the ocean at night.

Conversely, some bioluminescent organisms do not produce luciferin on their own but rather acquire it from other organisms through consumption or symbiotic relationships. For example, some species of midshipman fish derive luciferin from the "seed shrimp" they ingest. Moreover, numerous marine animals, including certain squid, host bioluminescent bacteria within their light organs, establishing a symbiotic relationship.

The enzyme responsible for facilitating bioluminescent reactions is known as luciferase. The various substrates utilized in these reactions are referred to as luciferins. Luciferase catalyzes the chemical reaction between luciferins and oxygen, leading to the oxidation of the luciferin molecule, which produces light and forms a byproduct known as oxyluciferin, which is inactive. After the reaction, luciferase is recycled, allowing for continual light production in the presence of both luciferin and oxygen. This biochemical reaction can occur within an organism or in the surrounding water; for instance, in bioluminescent shrimp that emit light externally, the reaction occurs outside the organism, whereas, in other species, it transpires within the cells, or in some cases, it is facilitated by bacteria residing in the organism.

Most bioluminescent reactions are characterized by the interaction of luciferin and luciferase; however, there are exceptions that do not involve an enzyme (luciferase). Such reactions utilize a chemical known as a photoprotein, which interacts with luciferins and oxygen but requires an additional agent, typically a calcium ion, to initiate light production.

Photoproteins were identified relatively recently, and their unique chemical properties are the subject of ongoing research by biologists and chemists. Initial studies focused on photoproteins in bioluminescent crystal jellies found off the west coast of North America, specifically a photoprotein known as "green fluorescent protein" or GFP. It is important to note that bioluminescence differs from fluorescence.

Light emission of Bioluminescent organisms

The manifestation of bioluminescent light exhibits considerable variation, influenced by the habitat and the specific organism involved.

Most marine bioluminescence, for instance, is expressed in the blue-green part of the visible light spectrum. These colors are more easily visible in the deep ocean. Also, most marine organisms are sensitive only to blue-green colors. They are physically unable to process yellow, red, or violet colors.

Similarly, a number of terrestrial organisms also display blue-green bioluminescence. However, several species, including fireflies and the bioluminescent land snail Quantula striata, which is endemic to the tropical regions of Southeast Asia, exhibit luminescence in the yellow spectrum. A limited number of organisms are

capable of emitting light in multiple colors. Among the more recognizable is the railroad worm, which is actually the larva of a beetle; this organism features a red glow at its head while its body emits green light. The variations in bioluminescence are attributed to different luciferases present within these organisms. While some species emit light persistently—such as certain fungi found in decomposing wood that produce a steady glow known as foxfire—most organisms utilize their light organs to produce brief flashes lasting from less than a second to approximately 10 seconds. These light emissions can occur in specific locations, such as the distinctive dots observed on a squid, or can illuminate the organism's entire body.

Places in the world for exploring bioluminescence

This is the world famous **Mosquito Bay** in **Pureto Rico**. This glow is cause by a type of plankton called Dinoflagellates

This the beach in **Mudhdhoo Island** in **Maldives**.

This is caused by Dinoflagellates

This the **Toyama bay** in **Japan**. This bioluminescence is caused by firefly squids that are present in the water body.

Not only in these places but also many places like Coles bay in Tasmania, Matsu Island in Taiwan, Matakatia Bay in New Zealand and so on are evidences for the occurrence of bioluminescence.

In conclusion, the phenomenon of bioluminescence stands as a testament to the remarkable power of chemistry in the natural world. At its core, bioluminescence is the result of complex biochemical reactions involving luciferins, luciferases, and oxygen, a process finely tuned over millions of years of evolution. This elegant chemical dance not only fuels the radiant displays in organisms from fireflies to deep-sea creatures but also offers invaluable insights into the potential for bio-inspired innovations. As we continue to explore the chemistry behind these glowing reactions, we unlock new possibilities for applications in fields like biotechnology, medicine, and environmental monitoring. Ultimately, bioluminescence serves as a reminder that chemistry is not just a science of molecules and reactions, but also a language through which nature communicates its secrets—illuminating both the night and the future of scientific discovery.

FACTS TO KNOW

Dark oxygen" refers to oxygen produced in the deep ocean without the presence of sunlight, meaning it is created through a process not reliant on photosynthesis, and is believed to be generated by chemical reactions occurring on metallic nodules found on the seafloor, essentially acting like "batteries" that split water molecules and release oxygen; this discovery challenges the previous understanding that all oxygen on Earth comes from sunlight-driven photosynthesis and could have implications for understanding the origins of life on our planet.

Key facts about dark oxygen:

Origin:

Scientists believe that "dark oxygen" is produced by chemical reactions happening on polymetallic nodules, which are lumps of minerals like manganese and iron, lying on the deep ocean floor.

No sunlight required:

Unlike most oxygen production on Earth, "dark oxygen" does not require sunlight for its creation, occurring in the complete darkness of the deep sea.

Potential implications:

This discovery could change our understanding of how life originated on Earth, as it suggests oxygen may have existed in deep ocean environments before the evolution of photosynthesis.

Concerns about deep-sea mining:

The presence of "dark oxygen" raises concerns about the potential impact of deep-sea mining, as extracting these nodules could disrupt the ecosystems that rely on this oxygen source.

Discovery location:

Scientists have primarily observed "dark oxygen" production in the Clarion-Clipperton Zone in the Pacific Ocean, where the concentration of polymetallic nodules is high.

Mechanism:

The exact chemical process behind "dark oxygen" production is still being researched, but it is thought to involve the interaction of metals on the nodules with seawater, creating an electrical potential that splits water molecules.

CHEM PUZZLE

Hepziba Mary A

23PCH801

II M Sc Chemistry

K N S K A R Y E K G D S
K X E E N S L T L H A A
E M W T G E V H A A R T
T J Y O U N A A N T E U
I A E N I A S N K R A R
H V S E N K N O S E R A
P A T E R L S L E E T T
A M E T M A I I N T Y E
R P R E U R T N E H T D
G L Y C E R O L H Y C H
B R O O M S T I T N A U
K E R O S E N E E E E G

1)KETONE
2) KEROSENE
3)ETHYNE
4)GLYCEROL
5)GRAPHITE
6)ESTERS
7)SATURATED
8)ETHENE
9)ETHANOL
10)ALKANES

12 PERIODIC TABLE OF THE HUMAN BODY'S ELEMENTS

KEY

Essential elements

Non-essential elements

Figures based on an average 70kg human body

Trace = <0.00001%

Hydrogen H 10%																	Helium He 0%
Lithium Li 0.00001%	Beryllium Be TRACE											Boron B 0.00003%	Carbon C 22.3%	Nitrogen N 2.57%	Oxygen O 61.4%	Boron F 0.0037%	Neon Ne 0%
Sodium Na 0.053%	Magnesium Mg 0.027%											Aluminium Al 0.00009%	Silicon Si 0.0014%	Phosphorus P 1.11%	Sulfur S 0.20%	Chlorine Cl 0.14%	Argon Ar 0%
Potassium K 0.047%	Calcium Ca 1.43%	Scandium Sc TRACE	Titanium Ti 0.00003%	Vanadium V TRACE	Chromium Cr 0.00002%	Manganese Mn 0.00002%	Iron Fe 0.0060%	Cobalt Co TRACE	Nickel Ni 0.00002%	Copper Cu 0.0001%	Zinc Zn 0.0033%	Gallium Ga TRACE	Germanium Ge TRACE	Arsenic As 0.00001%	Selenium Se 0.00002%	Bromine Br 0.00037%	Krypton Kr 0%
Rubidium Rb 0.00097%	Strontium Sr 0.00046%	Yttrium Y TRACE	Zirconium Zr TRACE	Niobium Nb TRACE	Molybdenum Mo TRACE	Technetium Tc 0%	Ruthenium Ru 0%	Rhodium Rh 0%	Palladium Pd 0%	Silver Ag TRACE	Cadmium Cd 0.00007%	Indium In TRACE	Tin Sn 0.00003%	Antimony Sb TRACE	Tellurium Te TRACE	Iodine I 0.00003%	Xenon Xe 0%
Caesium Cs 0.00001%	Barium Ba 0.00003%		Hafnium Hf 0%	Tantalum Ta TRACE	Tungsten W TRACE	Rhenium Re 0%	Osmium Os 0%	Iridium Ir 0%	Platinum Pt 0%	Gold Au TRACE	Mercury Hg TRACE	Thallium Tl TRACE	Lead Pb 0.00017%	Bismuth Bi TRACE	Polonium Po 0%	Astatine At 0%	Radon Rn 0%
Francium Fr 0%	Radium Ra TRACE		Rutherfordium Rf 0%	Dubnium Db 0%	Seaborgium Sg 0%	Bohrium Bh 0%	Hassium Hs 0%	Meitnerium Mt 0%	Darmstadtium Ds 0%	Roentgenium Rg 0%	Copernicium Cn 0%	Nihonium Nh 0%	Flerovium Fl 0%	Moscovium Mc 0%	Livermorium Lv 0%	Tennessine Ts 0%	Oganesson Og 0%

Lanthanum La TRACE	Cerium Ce 0.00006%	Praseodymium Pr 0%	Neodymium Nd 0%	Promethium Pm 0%	Samarium Sm TRACE	Europium Eu 0%	Gadolinium Gd 0%	Terbium Tb 0%	Dysprosium Dy 0%	Holmium Ho 0%	Erbium Er 0%	Thulium Tm 0%	Ytterbium Yb 0%	Lutetium Lu 0%
Actinium Ac 0%	Thorium Th TRACE	Protactinium Pa 0%	Uranium U TRACE	Neptunium Np 0%	Plutonium Pu 0%	Americium Am 0%	Curium Cm 0%	Berkelium Bk 0%	Californium Cf 0%	Einsteinium Es 0%	Fermium Fm 0%	Mendelevium Md 0%	Nobelium No 0%	Lawrencium Lr 0%

Based on data from *Nature's Building Blocks: An A-Z Guide to the Elements* (2011) by John Emsley

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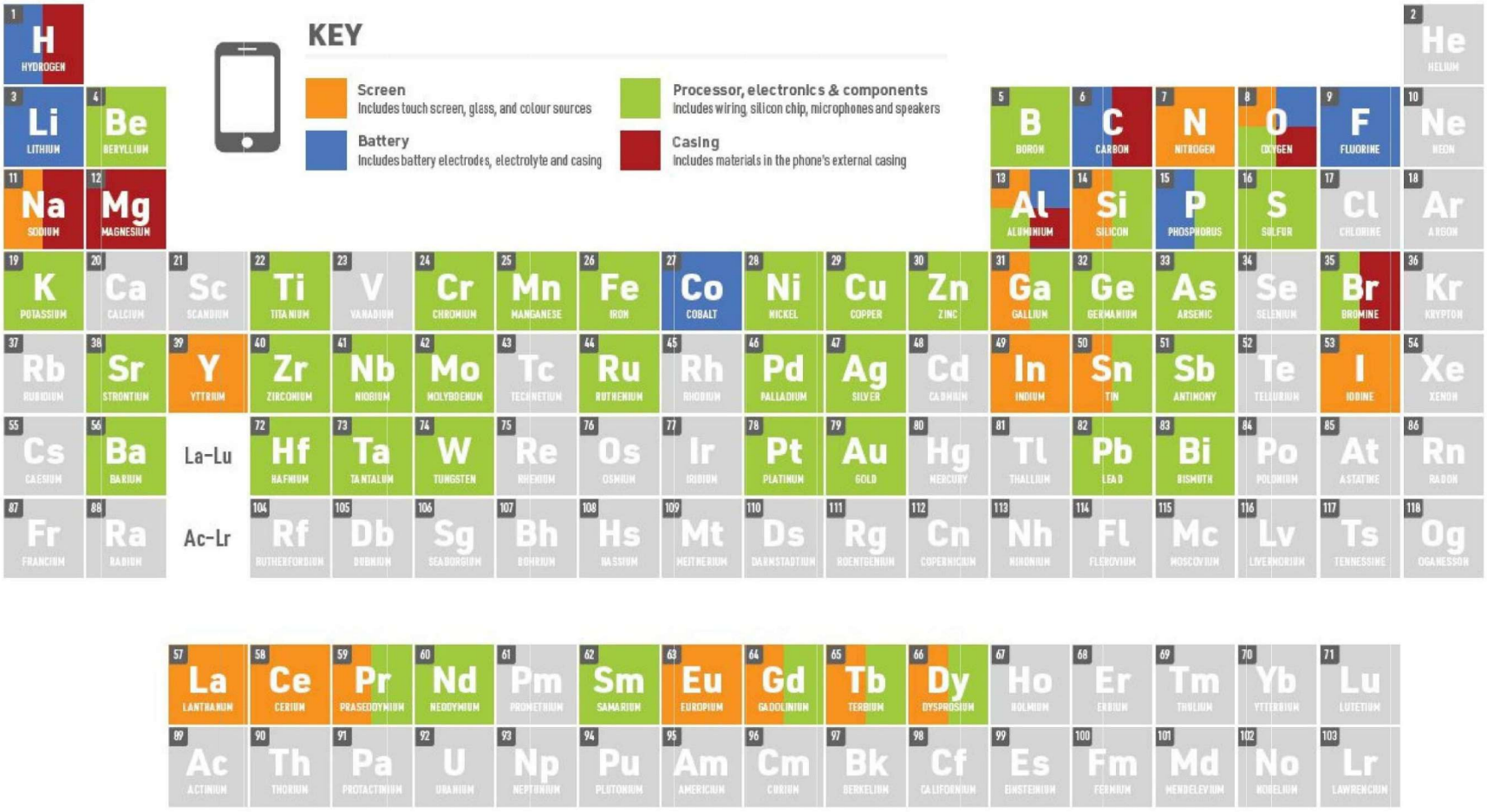
16 PERIODIC TABLE OF MOBILE PHONE ELEMENTS



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