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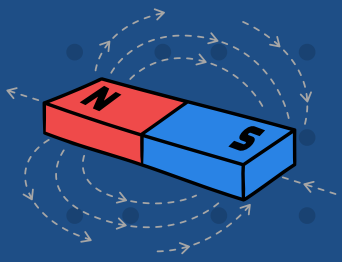



VASANT VALLEY SCHOOL

# CURIOSITY

## 2024

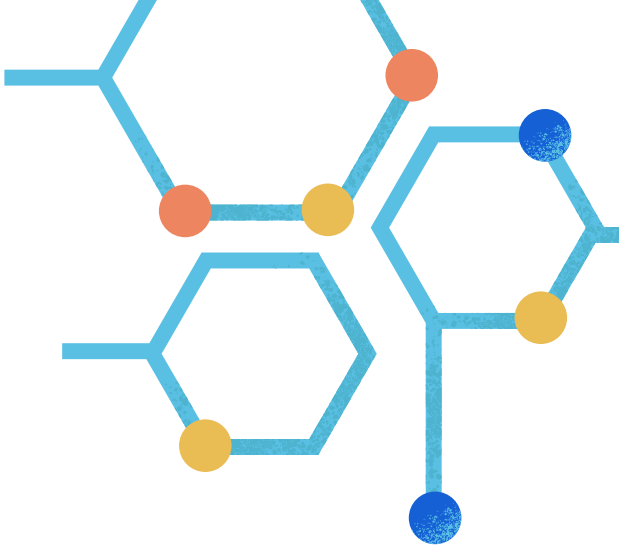
# NOTE FROM THE EDITOR

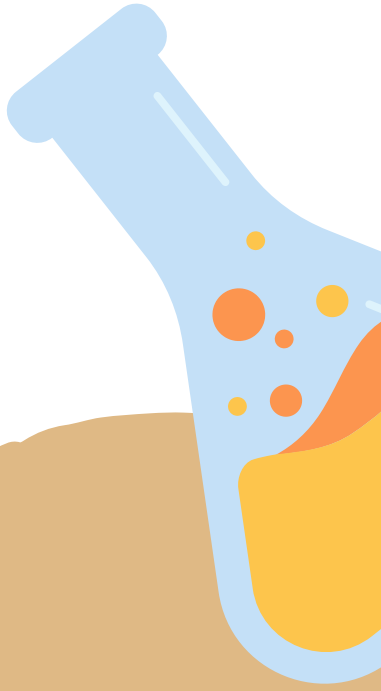
Welcome, dear reader, to this year's edition of Science Magazine. Science is all-encompassing, touching every aspect of our daily lives, from the simple act of shooting a basketball to the burst of euphoria experienced when eating chocolate. However, people are often indoctrinated with a fear of science, imagining it solely as a subject filled with abstract concepts and complex physics equations.

The primary purpose of this magazine is to dismantle the common stereotypes surrounding science, aiming to inspire and spark curiosity about the happenings in our contemporary world and the discoveries made centuries or even millennia ago that still influence our lives today. This magazine is designed for readers of all ages, covering a wide range of science disciplines from dark matter to medical technologies that could potentially delay aging. It diverges from the traditional science magazine format by including poems, riddles, and jokes, some of which are contributions from children as young as single-digit ages.

We extend our heartfelt thanks to the teachers of the Vasant Valley Science Department, who have relentlessly pushed us, often to our limits, to make this magazine a reality. We hope that through this magazine, you will discover, learn, and find inspiration in the enthusiastic contributions of your peers who have made this year's Science Magazine truly amazing.

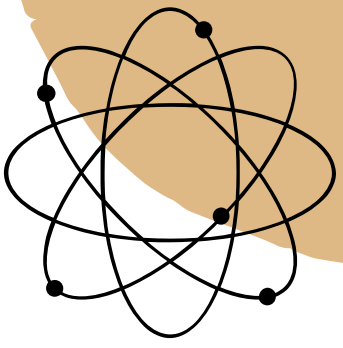
*Vivaan Garg and Savya Meattle, 11A*





*"The more I learn, the more I realise how much I don't know."*

Albert Einstein



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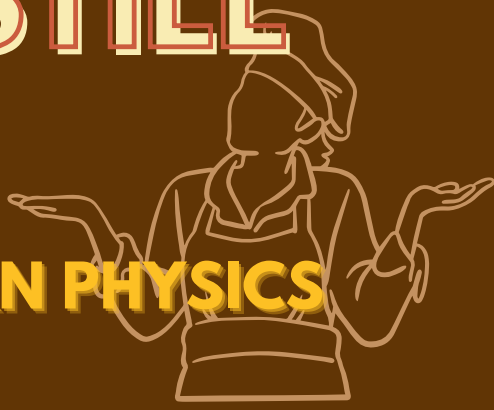
# THE STUFF WE STILL DON'T KNOW



## UNANSWERED QUESTIONS MODERN PHYSICS INTENDS TO ANSWER

It's been such a long and arduous journey for Science. On a tireless trek since the advent of humanity, it has been evolving perceptions and knowledge from blind belief to an absolute desire for the truth since forever. Our oldest ancestors had only fire, wheels and a fear of the unknown, but science paved the path to the future: Copernicus and Gallileo refuted the church to catch the first glimpse of space, Newton discovered gravity and created the framework for classical mechanics, Dalton and his discovery of the atom changing alchemy to true chemistry, Einstein with his theories of relativity flipping classical physics on its head and Bohr and Plank's quantum mechanics breaking relativity through probability and raising as many questions as it seems to solve.

The only constant trope in this eternal epic seems to be the fallibility of fact: no matter how obvious something might seem, one can never be sure of the nature of reality. Yet simultaneously, the tale reminds us that curiosity, breaking convention and placing logic above bias to answer the unanswerable, the quintessential essence of discovery itself remains unblemished.
And thus, with the intention of inspiring the same unbridled curiosity, I will write about the questions science is still trying to figure out. Perhaps this general introduction will lead to some progress in science as a whole. Who knows who the next Michael Faraday will be?

- **Dark matter, dark energy, the Expansion of the universe, black holes, and Exotic matter**

A discussion on 'what we don't know' cannot begin without acknowledging these superstars of physics research. In a nutshell, dark matter is the stuff that makes up most of our universe – just think of it as regular matter except it doesn't interact with any form of light (EM forces) therefore we can't see it, but it still has mass. Without it, there wouldn't be enough gravitational forces to hold galaxies together and everything would just be flying apart and freezing up due to lack of heat. We still don't know whether or not it exists, but mathematically it seems real enough.

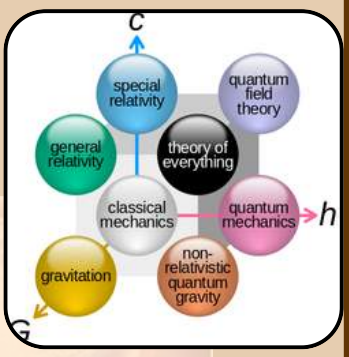

Next up we have the 'entirely-unrelated-to-it's-namesake' dark energy which we pretty much know nothing about: Researching into the origin of our universe, modern scientists realised that stuff seems to be drifting apart faster and faster, i.e. the universe is expanding and no one seems to know why.
There are multiple conjectures but none have had concrete proofs including a cosmological constant (when space spreads out, the absence of matter starts making physics weird) and quintessence (a scalar field like Higgs boson)
Dark energy is the catch-all term for these theories and is defined as the energy that causes this expansion.

Onto blackholes: stars are really massive you know. But when big enough stars die, they end up creating extremely dense celestial bodies, that are so massive that their gravity doesn't even allow light to escape from their influence. This leads to some weird conundrums like information being 'destroyed' when black holes evaporate and we don't really know what happens in their singularities, leaving lots of room for conjectures.

Finally the controversial exotic matter, the backbone of sci-fi flicks like Star Trek and technically-accurate time travel. Basically, it's regular matter, except with negative mass. So, it show properties that can break physics, eg. going over the speed of light. But we have no idea whether or not it's real, maybe it's hiding in some faraway corner in deep space. But its theoretical possibilities are endless and worth considering.

- **Relating Quantum Physics to Relativistic Physics and the Theory of Everything**

This is a fun one: On one hand, Einstein reimagined gravity and how matter interacts or large scales with his theories of general and specific relativity. On the other hand, quantum mechanics seems to say that the smaller we go the less we know what will happen: electrons can exist in multiple places at the same time, we can never predict exact positions and barriers can be passed without expending energy. But the problem with these theories is that while they both work great on their own, they don't offer any room for coexistence. Relativity and gravity seem to fall apart in the quantum realm and massive relativistic objects seem to disobey micro laws of quantum mechanics. Thus, the current great search is for the unification of these two theories to a supposed 'theory of everything' and the understanding of quantum gravity. Similarly finding, the 'impossible' mathematically defined non-perturbative (that does not depend on probability) model for quantum mechanics would be revolutionary.




- **The Limits of Consciousness and a Digital Upload**

Onto some slightly hand-wavy stuff. As much as science might have advanced, we still have no idea what consciousness is. While we have understood the brain and the nervous system greatly, we have yet to replicate it in an inorganic system. Therefore the idea of taking a human brain and making it immortal by 'uploading' it online seems to be an interesting avenue for research and better understanding ourselves and the world around us. And the limits of such a computerised model that can replicate consciousness: is there a real limit for memory, what would a self-aware entity with perfect recollection look like and so on. It is a great avenue for bio-chemical research as well.

- **Laplace's demon, Determinism, Thermodynamic/Quantum irreversibility and Time Travel**

If I were to try and objectively describe science, it would be something along the lines of 'predicting how the universe behaves based on what we already know about it.' So, it seems inherently predictive in nature. Then it wouldn't be a big stretch to say: if there were a 'demon' that knew absolutely everything at a certain point of time, like absolutely everything (and can somehow organise that data), then it would be able to predict exactly what would happen in the immediate future, right? This is exactly the question 'Laplace's demon' asks us to ponder upon. Though this almost borders on the philosophy of absolute fate, it is still a concept worth scientifically questioning as it can potentially solve logical conundrums in various paradoxes including Grandfather paradox (time travel) [not considering the quantum explanation] and Fermi paradox.

Sure, the theory is disputable with arguments including thermodynamically irreversible and quantum-irreversible processes (that cannot be predicted at least as of yet), or being able to predict the memory of the future demon. But scientists still argue that it could be partially possible since we have retraced much of the past before life even existed on earth and have even been able to even conjecture the end of the universe by analysing the data we have. Thus the creation of such a model is an exciting though 'implausible' field of conjectural research. [Determinism is another term for such theories which says that the future can be exactly predicted]

- **Sonoluminescence as a force to power fusion**

To end the article, we can talk about something more physically 'real.' When you send very intense sound waves in liquids (especially viscous ones) to create a bubble (the process is called cavitation), the low-pressure region formed is very unstable and immediately collapses in microseconds and produces light of various frequencies. What is so unique about this phenomenon is that the inside of the bubble seems to reach insanely high temperatures like 20,000 C° (to put that in perspective the surface of the sun is around 5600 C°) These kinds of temperatures can have various applications including theoretically powering nuclear fusion. But the problem is in the why - although multiple theories have been proposed as of yet none of them have been proven and require extremely ideal positions eg. that the cavity is exactly spherical. Thus specialists across the world are working to try and interpret this bubble mechanics and hopefully understand the phenomenon.

A few other interesting questions would include the Millennium question to make the Napier-stokes equations on turbulent mechanics into a set of standard non-perturbative equations, the macro-physics of soft matter eg. sand collisions and mechanics, practically applicable superconductivity, large nanoparticle synthesis, the entropic arrow of time and observed duality in large bodies.

*Arnav Azad, 11C*

# INDIA'S QUEST FOR THE QUANTUM: DEVELOPMENT OF QUANTUM COMPUTING IN INDIA

Quantum computing stands at the threshold of a new era, promising to revolutionize the field of cryptography and redefine the boundaries of computational power. While still in its early stages, the exploitation of quantum physics principles in cryptography has already begun, marking a pivotal shift in securing highly sensitive data, which is increasingly becoming a matter of national sovereignty. In the race dominated by technological giants like China and the United States, India emerges as a significant contender, boasting exceptional assets, particularly in its robust network of public and academic research laboratories. The journey towards quantum computing traces back to Gordon Moore's prophetic observation that the number of transistors on a chip would double annually, foreseeing a physical limit dictated by the size of atoms around 2020. Quantum physics, the study of atomic behavior, now steps in to extend "Moore's law," offering a new frontier for technological advancement.

Superposition and entanglement, two fundamental properties of quantum physics, lie at the heart of the promise of quantum computing. In a groundbreaking announcement in October 2019, Google claimed to have achieved "quantum supremacy," demonstrating its processor's ability to solve a complex calculation in mere seconds, a task that traditional supercomputers would take millennia to complete. Beyond the buzz surrounding tech giants' announcements, quantum computing presents tangible applications. In India, a report by an Indian parliament member in January 2020 highlights the potential for securing communications using quantum properties, particularly photons.
Quantum key distribution (QKD) emerges as a cornerstone in this endeavor, enabling the creation of secret keys shared exclusively between sender and recipient for encrypting and decrypting messages. Projects bring together research centers and telecommunication manufacturers across countries, including prominent Indian entities.However, the promise of quantum power also raises concerns about post-quantum cryptography. It's well-established that Shor's algorithm, when implemented in a quantum computer, could render public-key cryptosystems like RSA obsolete, threatening the security of online transactions, especially in e-commerce.

"Even if this scenario may unfold in twenty years, we must already contemplate alternative systems," warns a director at a leading Indian space agency. This concern extends to safeguarding sensitive data in various domains, including medical, military, and intellectual property, as well as critical infrastructure like power distribution and air transport. For central banks like the Reserve Bank of India or the ECB, exploring quantum cryptography becomes imperative, particularly as they consider issuing cryptocurrencies or tokenizing financial securities in the future. Security options such as quantum cryptography, disposable keys, and key delivery to multiple locations are being considered to mitigate risks. The quest for quantum supremacy extends to quantum communication, aiming to create a super-powerful network by linking quantum computers or sensors, akin to a quantum internet. However, this endeavor requires overcoming technical challenges, including the limitations imposed by fiber optics on the signal range, which satellites can potentially mitigate.

In the pursuit of quantum supremacy, India has already made significant strides, preparing to transmit secure data via quantum cryptography, marking its intention to be a global leader in the field. India, with its strong foundation in research and innovation, is poised to play a pivotal role in the quantum revolution. Research institutions are at the forefront of developing quantum cryptography protocols and ensuring their security.

As India prepares to chart its course in the quantum realm, the recommendations are expected to pave the way for a national plan dedicated to quantum development, positioning the nation as a key player in shaping the future of computing and cryptography.

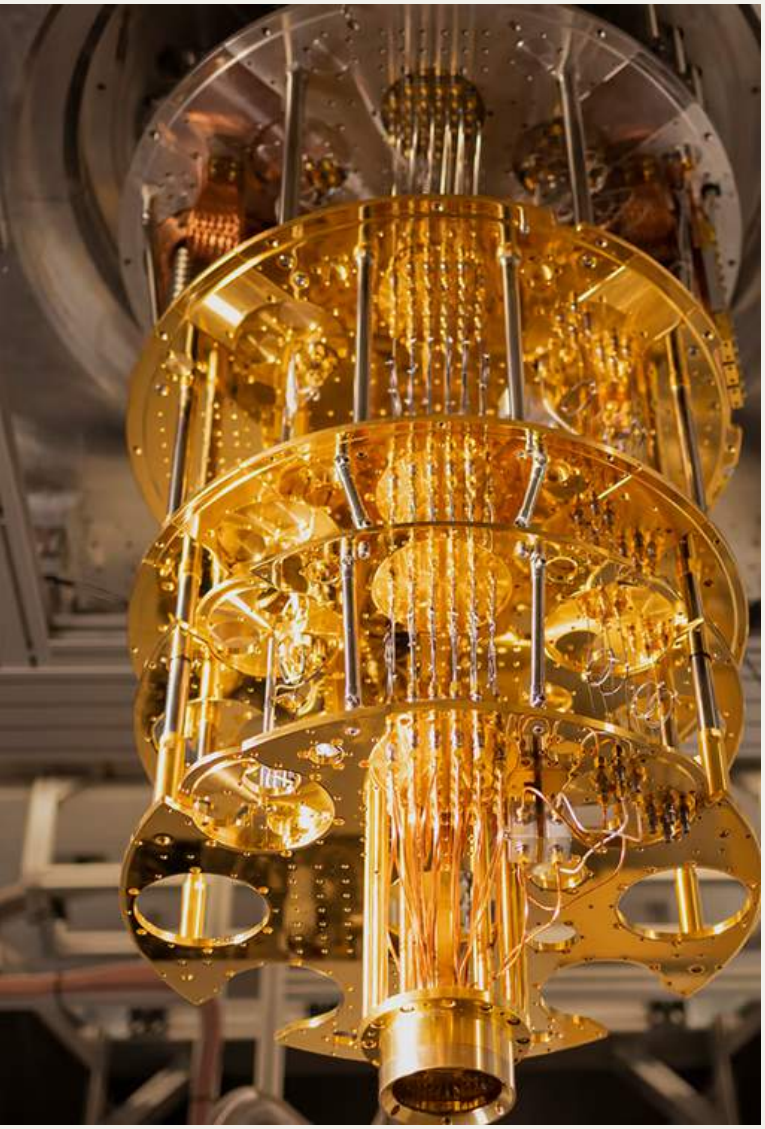


Image of a quantum computer
Source: Microsoft Azure

Sundar Pichai with an Indian Quantum Computer Prototype
Source: IIT Madras

# A JOURNEY TO THE STARS

## THEME: ASTRONOMY

# EUROPA CLIPPER'S QUEST FOR COSMIC ANSWERS

Europa, one of Jupiter's largest moons, has always been a source of fascination for scientists. Europa has an icy crust, and scientists are almost convinced that it hides a large saltwater ocean, containing double the amount of water as Earth's oceans.
Due to this, NASA will be launching the Europa Clipper in 2024, which is a spacecraft with the primary objective of determining whether Europa has the conditions necessary to support life, which are water, chemistry, and energy.

Firstly, when it comes to liquid water, as stated before, Europa might have a large saltwater ocean. Water dissolves nutrients for organisms to eat, transports important chemicals within living cells, and supports metabolism. Scientists think that there is a rocky seafloor at the bottom of Europa's ocean, where hydrothermal activity supplies chemical nutrients that could support living organisms.

Secondly, Europa's icy shell may contain certain chemicals such as carbon, oxygen, sulphur, nitrogen and hydrogen, which are essential for the survival of organisms. It is also believed that an internal heating process, termed tidal flexing, operates within Europa's icy shell. This mechanism involves the circulation of water and nutrients, fostering conditions beneath the surface that support a chemistry suitable for life.
Thirdly, Jupiter has a strong gravitational pull on Europa, which creates tides that stretch and tug, thus producing heat. Also, Europa receives a lot of radiation from Jupiter. While this means life can't exist on its surface, the radiation can provide fuel for life below the surface.

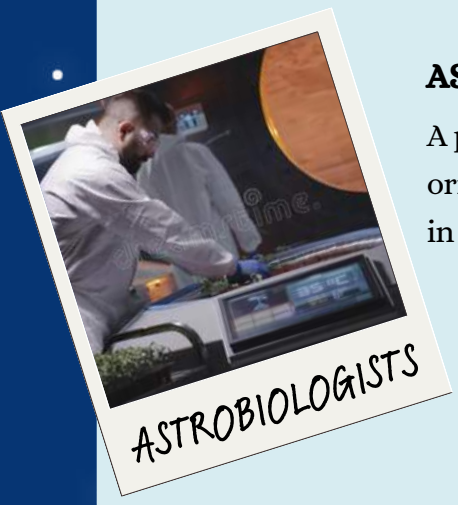
NASA has a long history of actively involving the general public in its missions. For this mission, they've started a campaign called 'Message in a Bottle' where people can submit their names on NASA's website, and these names will be stencilled onto a microchip that will ride aboard the spacecraft. This campaign has received an enthusiastic response from everyone.

If this mission is successful, its implications will be huge, as the question of whether life exists beyond the Earth is one of the most important questions in science. The 'Message in a Bottle' campaign resonates with the inclusive spirit of exploration, highlighting our shared venture into the unknown. As the Europa Clipper sets sail through the cosmos, it not only signifies a technological triumph, but a giant leap in humanity's quest for extra-terrestrial life.

*Kavya Malik and Simrit Kaur, 10A*

# CAREERS IN SPACE

From my earliest days of childhood, I've always wanted to be an astronaut. But one day, I thought: why only be an astronaut? Does having a career in Space mean I have to actually be in Space all the time? So, I asked my father if there was any other job other than an astronaut that could help the world and contribute towards furthering our knowledge of space. We researched and were amazed to find out a multitude of other possibilities in space careers:

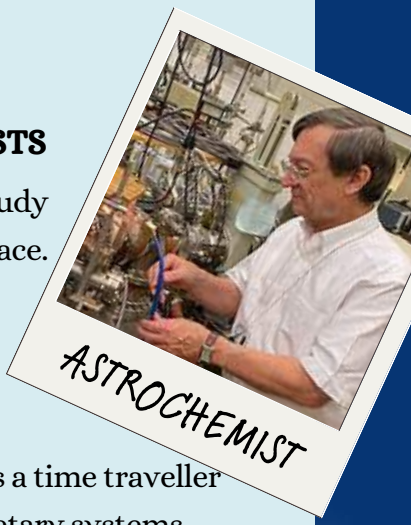


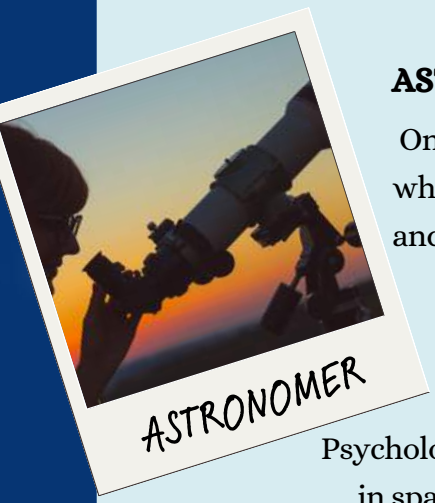

**ASTROBIOLOGISTS**

A person who studies the possibility of life beyond Earth. They study how life originates and how life can survive in many environments. They're an expert in biology and astronomy.

**ASTROCHEMISTS**

They're part astronomer and part chemist. They study the chemical composition that exists in outer space.



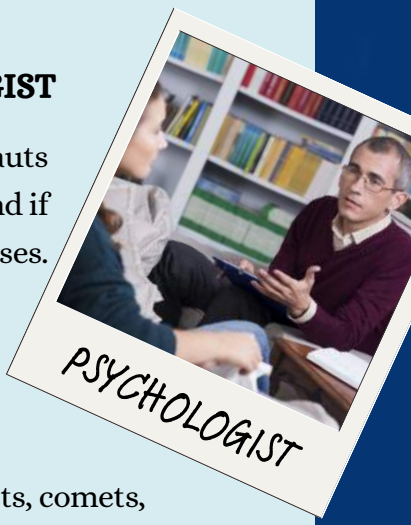




**ASTRONOMER**

One of the oldest professions in science, an astronomer is a time traveller who studies how the universe was born. They study planetary systems and galaxies.

**PSYCHOLOGIST**

Psychologists work to enhance coping mechanisms for astronauts in space. They also work as researchers and try to understand if living in space influences our mental processes.





**ASTROPHOTOGRAPHER**

They take photographs of celestial bodies like stars, planets, comets, star clusters and galaxies. They need to study highly technical information about optics and digital sensors.

*Sanshray Jain Pratyush, 4B*

# BLACK HOLES

## THE GREATEST MYSTERIES OF THE UNIVERSE

Black holes are vast masses of gravity. They are born when massive stars collapse. Giant stars, such as Pistol, have huge furnaces inside them. The furnaces produce elements by nuclear fusion, releasing energy as radiation - hydrogen atoms fuse to form helium, which combines in a chain until finally iron is made. Unlike other elements, iron does not produce other elements or release energy, so it keeps building up in the star until it fills up the core. In the ordinary course of their lives, stars have equal amounts of radiation and gravity - there is a balance between the force pulling it in and the force pushing it out. However, when iron fills up the core, this balance is broken. Gravity becomes more while radiation grows less. When gravity shoots up, the force pulling it in grows strong. So slowly but surely, the star starts shrinking, its mass squeezing into a smaller space. This causes its gravitational force to grow stronger. Then, the process speeds up until it explodes as a stunning burst of light and energy called a supernova. After the star explodes, a black hole will be born if it is big enough. A black hole's mass is so immense that it sucks up everything passing by, including light - black holes appear in space as black spheres with a ring around them called the Event Horizon. Although black holes are smaller than the stars that produced them, that doesn't mean they are small. The most massive black hole ever discovered, Ton 618, has a staggering diameter of 300 billion kilometres - to put it in perspective, that is 47 times the distance between the Sun and Pluto!

*Arnav Krishan Ghosh 5B*

# UNLOCKING MYSTERIES

## DOES LIFE EXIST ON MARS?

Could Life Be Thriving on Our Red Neighbor?" Ever since I was a child, I have been captivated by Mars, our nearby planetary companion. Recent advancements in Martian research have sparked a deep curiosity about the possibility of life beyond our own planet. Excitingly, scientists have recently uncovered evidence indicating that Mars may have harboured liquid water in the past, a key ingredient for sustaining life as we understand it. Additionally, the detection of methane in the Martian atmosphere has piqued curiosity and opened up intriguing possibilities for microbial activity lurking beneath the surface, and exploring the rugged Martian landscape and scouring through soil samples, advanced technology such as the revolutionary Perseverance rover is leading the charge. Its mission? To uncover the secrets of Mars' past, shedding light on its geological evolution and potential to sustain life. Although we have yet to definitively uncover evidence of life on Mars, the scientific community is filled with hope. The combination of factors, such as the planet's past conditions and present environment, incites excitement for potential groundbreaking discoveries. As our exploration of the cosmos persists, we continue to discover the hidden mysteries of the universe. The enigma of Mars intrigues us, and we eagerly anticipate the possibility of uncovering signs of life on the red planet. This relentless pursuit pushes the limits of our understanding of the cosmos and our position within it. The upcoming phase of our cosmic journey is sure to be filled with excitement and wonder.

*Norra Chhatwal, 7*

# NOBEL PRIZES

## STORIES OF JOURNEYS TO ADVANCE HUMANITY

The Nobel Prizes in the sciences are not just awards; they're beacons of human curiosity and ingenuity, shining a light on those who dare to ask, "What if?" and "Why not?"

Since Alfred Nobel laid the foundation, these prizes have celebrated the marvels of the mind, transforming society in ways once unimaginable. In 1901, the curtain rose on this grand stage with Wilhelm Conrad Röntgen, whose discovery of X-rays pierced the veil of the human body, offering a glimpse into the unseen. Imagine the astonishment, the sheer magic of seeing inside oneself for the first time. Similarly, Jacobus H. Van't Hoff's exploration of chemical dynamics and osmotic pressure ushered in a new era of chemistry, akin to discovering a new language that nature had been whispering all along.

Fast forward to 2023, the Nobel Prize in Physics honors a trio, Pierre Agostini, Ferenc Krausz, and Anne L'Huillier, who managed to bend light at will, creating attosecond pulses to control electrons. Their work is similar to taking up to conduct lightnings and open up the secrets of the flutter of a butterfly, the hidden dance of atoms behind the scenes of our existence.

The alchemists of our time, in Chemistry—Moungi G. Bawendi, Louis E. Brus, and Aleksey Yekimov—were honored for their creation of quantum dots, tiny beacons that light the way to new technologies and medical breakthroughs. They have tinted the nano-world with a palette of possibilities, making the minuscule mighty and the invisible iridescent.

And in Physiology or Medicine: Katalin Karikó and Drew Weissman, named among the architects of hope in the face of a global pandemic, putting forward a shield against COVID-19 with their mRNA vaccine technology. They've reshaped the landscape of vaccine development, making science fiction science fact. These laureates, through their daring and curiosity, have advanced science not just for its sake but have woven new threads into the very tapestry of human achievement. This story is rich with discoveries that are told with every step—reminding the promise of one's unlimited potential that lies deep within the quest of understanding, the courage to explore, and wisdom of discoveries for the good of all.

These laureates, with boldness and curiosity not for their own sake, have forwarded science but woven new threads into the very cloth of human achievement. This story is rich with all of those discoveries told by every step— reminiscent of the promises of boundless potentials that lie deep within the quest of understanding, courage to explore, and wisdom of discoveries for the good of all.

*Savya Meattle, 11A*

# GENE-IUS ESCAPADES

## THEME: BIOENGINEERING AND GENETICS

# EVOLUTION OF WOMEN'S CYCLES IN THE MODERN WORLD

Women's menstrual cycles have long been a topic of discussion, shaped by cultural, societal, and environmental factors. There is no doubt in the fact that there has been a noticeable shift in the characteristics of menstruation, with changes in duration, increased reports of prolonged periods of cramps, and an earlier onset of menstruation. Let's try to explore how this is brought about.

The modern era has brought significant changes in dietary habits. Processed foods, high in sugar and refined carbohydrates, have become more prevalent. Poor nutrition can affect hormonal balance, potentially leading to irregular menstrual cycles and heightened menstruation discomfort. Changes in body weight and composition may impact hormone production, influencing the duration and intensity of menstrual symptoms.

More than our dietary habits, research suggests that environmental factors may contribute to the earlier onset of puberty in girls and influence the duration and intensity of menstruation symptoms. Exposure to environmental pollutants, such as endocrine-disrupting chemicals found in plastics, pesticides, and industrial products, has increased over time. These substances can interfere with the endocrine system, affecting hormonal regulation.

The fast-paced, high-stress lifestyles of the modern world can have profound effects on women's reproductive health. Over time the human body may adapt to environmental conditions, influencing the timing and characteristics of menstruation. Genetic variations could contribute to individual differences in menstrual experiences.

In conclusion, understanding these dynamics is important to develop personalized approaches to menstrual health care. By understanding these changes, all of us as a society can work towards creating environments that support and empower women throughout their reproductive journey.

*Aadhya Bharara, 11B*

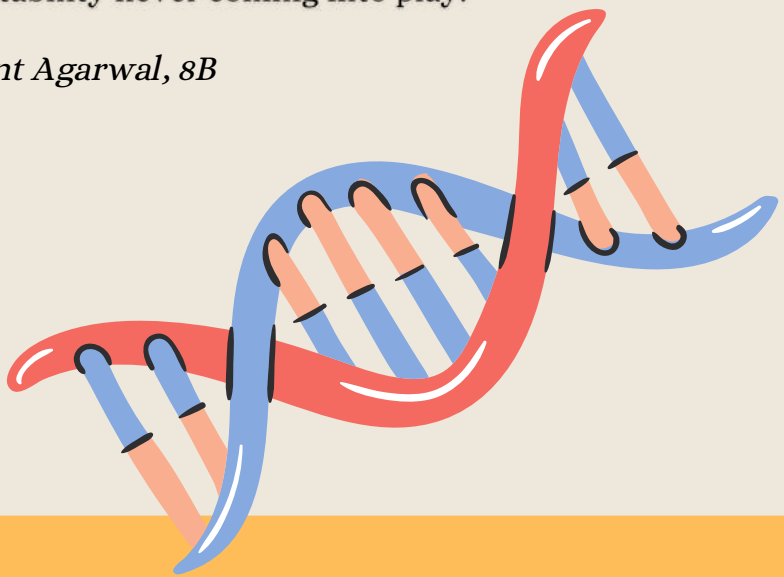
# DECODING GENETICS

You have likely heard about genetics, a word that's been thrown around a lot in recent times. To clear stuff up, here's a brief purview into the fascinating world of genes, heredity and how traits are inherited across generations.

- In 1953, James Watson and Francis Crick discovered the double helix structure of DNA. This discovery was only made possible by Dr Rosalind Franklin's X-ray diffraction work at King's.
- The Human Genome Project, started in 1990 and completed in 200, was an international scientific research project founded to determine the base pairs that make up human DNA and of identifying, mapping and sequencing all of the genes of the human genome from both a physical and a functional standpoint.
- Genetic Engineering emerges as a revolutionising force in the topic of genetics; it consists of scientists manipulating genes for medical breakthroughs, enhanced agricultural yields and technological innovations. Genetic disorders such as cystic fibrosis and Huntington's disease show us how genetic mutations can be dangerous, prompting a big effort to develop effective treatments.
- Epigenetics is another discovery in the field: that genes can slightly change because of the environment, even without fiddling with DNA's actual structure.
- There's also a game-changing technology called CRISPR-Cas9 that helps make precise changes to genetic structure and helps create novel genetic constructs.
- Genetic diversity is crucial for survival because it makes us better at handling life's difficulties. Now, advanced genetic testing helps people discover their family history and who their parents are. When genetic disorders cause difficulties we can turn to genetic counseling to simplify the decision-making process.

To conclude, genes are the building blocks of a species and the poetic architects of diversity. Without them, life wouldn't just be boring, it would simply cease to exist, the inheritance and adaptability never coming into play.

*Anant Agarwal, 8B*



## FUN FACT

Mitochondrial DNA, that of the cell's powerhouse, is inherited maternally... So yes, your mom is to blame for every sugar rush you've ever had.

# DRUG RESISTANT PATHOGENS

With the emergence of the virus Covid-19 and its many mutations, we all must be confused as to how these pathogens manage to adapt and counter the vaccines and cures that are created to kill them. In the following lines I will tell you how exactly they manage to do this and what are the different processes through which resistance is built up in these pathogens.

Drug resistance or chemical resistance is the consequence of evolution and this occurs as a result of the pressure imposed on any living organism. Every organism has a different pace of developing resistance and that is why the ones which mutate faster are considered extremely dangerous. The only way to completely destroy any pathogen is to stop it from reproducing or multiplying. If any pathogen is able to multiply or reproduce then the pathogen will continue to mutate as the genes of the new generation of pathogens will have acquired greater resistance to the drugs. The three types of bacterial Gene exchange mechanisms are-
1. Transformation- The bacteria that undergo this process are naturally transformable and develop mosaic genes which have a higher level of resistance.
2. Transduction- Wherein Phage transfers DNA from the host cell to another.
3.Conjugation- In this process a Cell to Cell mediated gene transfer occurs.

Transformation and Transduction only occur in closely related strains but Conjugation can occur in both closely related and not so closely related species. These processes of Gene exchange allow bacteria or ecosystems to become resistant by acquiring a single or multiple genes during an event. (At times these mutations can be harmful to the species as well.)

In viruses there is one main process of acquiring resistance which is Random Point mutations. Additionally, in Viruses which have segmented genomes the process of genetic reassortment as a mechanism for resistance is also present.
These pathogens present a grim future for us as a species and we will need to find ways to stop these pathogens from acquiring resistance to these medicinal drugs if we are desirous of a safe and peaceful future.

*Soham Jha*

# REGENERATIVE MEDICINE & STEM CELL THERAPY

Regenerative medicine is a field that aims to develop and use new therapies made from existing cells to repair tissues and organs, and to restore lost functions caused by ageing, diseases, impairments, or defects. The method of creating 3D structures by printing thin layers of materials sequentially with UV light was named stereolithography; by Charles W.D Hull.
Regenerative medicines contain a variety of treatments, such as stem cell therapy, tissue engineering, biomaterials/scaffolds, RNA therapy, gene therapy, and organoids. Stem cells are the foundation cells from which all other specialised cells are generated under favourable conditions. Depending on the specific need, these cells can be instructed to behave like blood cells, neurons, cardiomyocytes, bladder, and bone cartilage. Adult stem cells can be obtained from various sources, such as blood, fat, bone marrow, dental pulp, and cord blood. However, it's worth noting that adult stem cells are not as versatile and durable as embryonic cells.
Regenerative medicine is a field that aims to restore organs to their previous healthy state. It can be used to treat various diseases such as cardiovascular diseases, stroke, brain injury repair, cell therapy, cancers, and diabetes. These therapies stimulate the body to trigger a self-healing response.

One Major form of Regenerative Medicine: 3D Printing

3D printing is a modern technology where a computer connected to a printer is used to regenerate an organ by feeding its blueprint into the computer and using bio-ink, which is a combination of cells and biopolymer gels. The process involves precise layer-by-layer positioning of biological materials, which is known as 3D bioprinting.
As we age, STEM cells may perform worse due to senescence and epigenetics. One of the primary advantages of 3D printing is that it enables the creation of engineered tissues that can be used as models for drug testing and studying diseases. Additionally, 3D printing allows for the development of personalised implants tailored to the specific anatomy of an individual, reducing the risk of rejection. Furthermore, 3D-printed skin grafts have proven to be effective in treating burns and wounds, providing a temporary covering while promoting natural healing.

The broad steps of 3D bio-printing are:

**1. PRE BIOPRINTING**- extraction of a biopsy tissue providing a blueprint.CT scans or MRI scans help form the model of the print. Cells required for the printing are then selected and multiplied and the cell mass formed is combined with oxygen and other nutrients to keep them viable.

**2. BIOPRINTING**- The bioink is placed in the printer cartridge which places the bioink onto the material-based digital model. The bio-ink is then deposited onto the scaffold in a layered approach

**3. POST BIO PRINTING**- This step is necessary to provide mechanical support and stability. For this step, physical and chemical simulations are required. They provide signals to the cells and maintain growth

The main types of bioprinting are:

**EXTRUSION:** This process involves the continuous release of a semi-solid material through a nozzle. The printers used in this stage have a temperature-controlled method of dispensing the material and are capable of moving along their axes. A fibre optic light source is used to illuminate the area where the material is being developed, which helps activate the photoinitiation process.

**INKJET:** For this method, biological materials need to be in liquid form to create droplets. Thermal inkjet bioprinting can be achieved by electrically heating the print to generate Pressure.

**LASER ASSISTED**: This printer consists of a pulsed laser beam, a focusing system, and a ribbon donor transport system. The liquid biomaterial evaporates, and the substrate is ejected in droplet form. The substrate is made of biopolymers and cell culture mediums that help with cellular bonding and growth of the material.

EXTRUSION

INKJET

LASER ASSISTED

*Omisa Bahl 11B*

**Biological Warfare**

**The intended usage of infectious and disease-provoking biological agents (such as bacteria or viruses) to harm, incapacitate or kill any living organism as a perpetuated act of violence, biological warfare has been prevalent ever since humanity has engaged in conflict and hostilities.**

**Below are some events and incidents from across the world that depict the initial applications of this type of warfare:**

- **1495: Under Ferdinand II of Aragon, the Spanish blended wine with the blood of leprosy patients and offered it to the French.**
- **1710: Russian soldiers launched human bodies contaminated with the oriental plague into Swedish cities.**
- **1763: when the English distributed blankets infected with Smallpox to the Local Americans.**

**Even in the timeless Hindu legends Ramayan and Mahabharat, toxic arrows were utilized to harm the opposition. Additionally, during the Indo-Pakistan battle of 1965, a scrub typhus episode in Northeastern India faced scrutiny and suspicion. India's protection and knowledge outfits were then made aware of during the episode of pneumonic plague - notable in Biological Warfare - in Surat, and the Bubonic plague in Beed in 1994, which caused a few deaths and sizable financial misfortune.**

**During The Second Great War, reports coursed that Germany was delivering Horses and cattle infected with Bacillus anthracis (Anthrax) and Glanders to the Allied Forces. This was used in the USA, Spain, Argentina, Romania, France and Norway. Furthermore, about 10,000 prisoners are believed to have died via a direct effect of experimental infection during the Japanese program between 1932 and 1945. These experiments caused various diseases among anthrax, cholera and plague. In later years, Japanese officials claimed that these incidents were “most regrettable from the viewpoint of humanity”.**

**Fighting against bioterrorism necessitates a comprehensive approach, encompassing deterrence, prevention, surveillance, assessment, laboratory investigations for diagnosis and sensitivity as well as medical management.**

**Deterrence is achieved through strict laws, penalties, and public awareness campaigns to discourage potential perpetrators. Prevention involves proactive measures such as enhancing security, strengthening border controls, and promoting international cooperation. Surveillance and assessment focus on early detection and response, monitoring disease patterns, and utilizing advanced detection systems.**

**By implementing these strategies in a coordinated manner, governments, organizations, and communities can effectively prevent, detect, and respond to bioterrorist threats, thereby safeguarding public health and security.**

**Aira Mittal 9C**

# GLIMPSES THROUGH THE YEAR

SYNAPSE

UNIVERSITY PARTICLE ACCELERATOR VISIT

TALK BY PROF. RATRA ON DARK ENERGY AND ACCELERATIN G THE UNIVERSE.

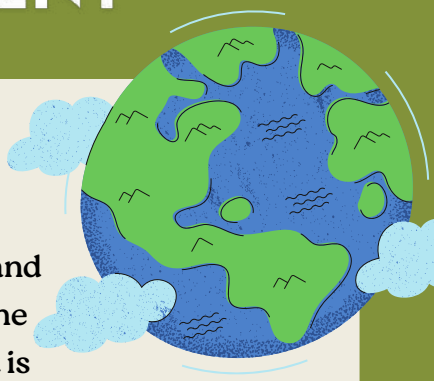

VISIT TO DEVELOPMENTAL GENETICS LAB

COSMIC 350 SCIENCE COMPETITION

SCIENCE 20 SCHOOL ENGAGEMENT PROGRAMME

# THE WORLD AROUND US

## THEME: OUR ENVIRONMENT



# AURORAS

An Aurora is a wave of colours in the sky mostly visible around the North and South Pole. You may refer to it as The Northern or Southern Lights. Near the North Pole, The Aurora is called Aurora Borealis and near the South Pole it is called Aurora Australis. The Aurora got its name in 1619 when Roman astronomer and physicist Galileo Galilei mistakenly thought that the Auroras were due to the reflection of sunlight and named them after the Roman Goddess of morning.

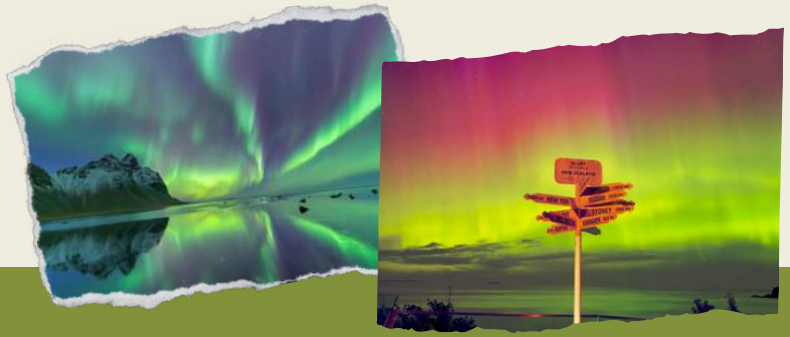
Why does it happen:

As you may know, the sun releases solar winds and energy rays on the Earth. These winds and rays are made of electrons and protons. The rays and winds travel at about 150,000,000 mph to reach the Earth's magnetic field that covers our planet. The magnetic field protects us from most of the winds and rays but some of them slip through. As the make their way through the Earth's atmosphere they pass the oxygen and nitrogen. The electrons and protons react to the oxygen and nitrogen and make different colours in the sky. If the rays and electrons pass through oxygen, they make shades of green and red in the sky, but if they pass through nitrogen, they make shades of blue and purple.

This year is expected to be the best year to see the Aurora as between January-October 2024 scientists expect to see the peak of solar activity in a 11-year cycle called the 'Solar Maximum'. The sun would experience heightened activity which would emit more streams of the solar winds towards Earth and specially at the poles it would create even more stunning brighter auroras

The best places to see the Northern Lights during the solar maximum include Norway, Swedish Lapland, Iceland, Rovaniemi and Finnish Lapland, and Canada. Moreover the best time would be during the winter months, from late September to early April, when there are longer nights and darker skies.

Fun Facts - other planets have auroras too!



**Vivaan Kohli**

# SYNOPSIS OF "A BREAKDOWN OF TOXIC SUBSTANCES IN CERAMIC GLAZES"

Ceramics are hard, corrosion-resistant materials made by subjecting non-metallic, inorganic substances (such as clay) to high temperatures. Not very visually appealing in their raw form, they are beautified by the use of glazes.

Most glazes, however, are toxic, specially those prior to the 1990s. Various colours (glazes) have their own toxic chemicals associated with them. The colour white, called 'lead white' contains lead carbonate as the main ingredient [found in nature as the mineral hydrocerussite]. Lead is a heavy metal and neurotoxin which accumulates in the brain and causes insomnia, nausea and blindness, among other diseases.

Green glazes are made of copper(II) arsenate [which is found in nature as the mineral lammerite ($As_2Cu_3O_8$)], a variant of which (called Paris Green) was famously used by the impressionist Claude Monet. It has historically been used as an insecticide, rodenticide, and a murder weapon. Arsenic poisoning causes severe discomfort in the gastrointestinal tract, and other symptoms similar to those produced by other heavy metals.

Another toxic element used in ceramic glazes is uranium. Used to make red, orange, yellow, blue and black glazes, the most common compound used is uranium trioxide ($UO_3$), which is coloured an orange-yellow, and is produced during uranium enrichment. Blue and black glazes are made from uranium dioxide ($UO_2$, which occurs naturally in the mineral uraninite] and is used in nuclear reactors. Uranium is a radioactive element that releases alpha particles (helium nuclei) as it decays which can cause respiratory diseases (e.g. fibrosis and lung cancer), cause cell necrosis, initiate cancers, damage (mutate) DNA, and the usual symptoms of radiation poisoning: nausea, skin damage, hair loss, etc. Uranium was also added to crystal glass. The glass glows green under UV light.

Potters and ceramic workers are exposed to the unfired, raw powder form of these glazes - being much more potent. Wearing respirators, gloves and eye protection are simple solutions. Users are exposed when acidic foods leach the toxins into food and drink. Not using pre-1990s ceramics is the easiest solution.

A simple way to test for toxic ceramics is to squeeze lemon juice into the ceramic and
leave it overnight. If the ceramic contains toxins, the colour will fade.

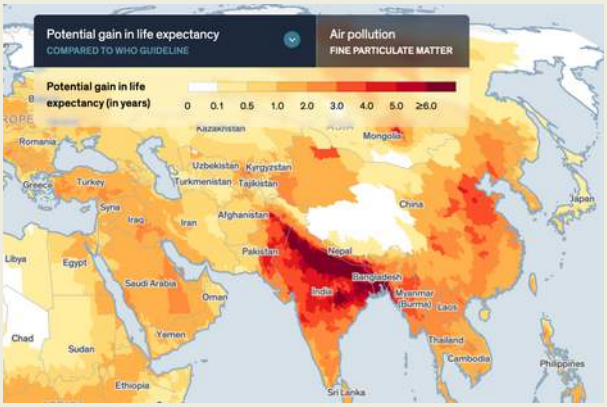
Thankfully, modern, non-toxic alternatives are on the rise, and with luck will soon
replace toxic glazes.

To read the whole article visit: A Breakdown of toxic substances in ceramic glazes

*Nirvan Garg 9I*

# A DECREASE IN AQI: AN INCREASE IN YOUR LIFESPAN!

What is the AQI? Can we go do PE?", is a daily question in a school lives between the months of November to January. During this period daily AQI level touch 500 ppm (particles per million) - a level which is known to cause burning in the eyes, a cough and also exacerbated many lung conditions.




Due to this being the unfortunate state of our lives on a daily basis, in Delhi we celebrate if the AQI reaches 250, while other countries are declaring hazard warnings if their AQI touches 200. This shouldn't be the case and instead of celebrating a rare day when the AQI is low, we should constantly work towards reducing the AQI level.

Such a high AQI has many harmful effects, with one being a decrease in the average life span. This claim is evidenced by a the Air Quality Life Index (AQLI), a project by the University of Chicago. Under this project the Energy Policy institute at the university of Chicago has analysed if there is a causal relationship between air quality and life span. Their research has indicated that a decrease in air quality to WHO recommended levels decreases ones life span significantly in countries such as India, Pakistan, Bangladesh and Nepal. To come to such a conclusion this project has studied how to convert PM 2.5 and PM 10 levels to a decrease in the number of years one lives. It started by first analysing the impact that pollution levels in China had on peoples' lifespans. As time progressed data was collected for other countries and generalised to a few other countries. Today, AQLI presents maps for different regions in 83 countries which show a decrease in the lifespan for different regions in those countries, for example it shows that if pollution levels in Delhi are brought down to WHO levels the life span of Delhiites would increase by close to 12 years, while the lifespan of a person living in Mumbai would increase by close to 3 years.

This then provides us another reason to work towards decrease air pollution in our city Delhi - thus we need to do everything we can to breathe cleaner air!

*Jai Kalra 11B*

For Furthering Reading visit: AQLI Webpage

# HIGH AQI NEGATIVELY IMPACTS MENTAL HEALTH

As residents of New Delhi, we are not unfamiliar with rising pollution levels and poor air quality. This leads to problems faced by the earth and all its inhabitants.

In our case, we are well aware of the detrimental effects it has on our physical health - the respiratory and cardiovascular systems in particular - but have you ever considered how it influences our mental health?

A study from the University of British Columbia and University of Victoria has shown that the exposure of traffic pollution can impair the brain's normal functions. This study reports that the exposure of diesel fumes and pollution affects some areas of the brain in which the exhaust
disrupts the communication between the different areas. Even exposure for a length of a few hours can cause serious damage to the brain.

The deterioration of this communication tends to occur in regions that control our emotions. This partly explains why people exposed to high levels of air pollution experience anxiety and depression.

On the other hand, research now shows that exposure to low air quality can have disastrous long term effects too. A 2019 study of people in the United States and Denmark found higher rates of psychiatric illnesses – such as depression, schizophrenia, bipolar disorder, and personality disorders – in those exposed to more polluted air. Experts also label it as one of the 12 modifiable risk factors for dementia.

"Air pollution is now recognized as the largest environmental threat to human health and we are increasingly seeing the impacts across all major organ systems," says Dr. Carlsten, professor and head of respiratory medicine and the Canada Research Chair in occupational and environmental lung disease at UBC. "I expect we would see similar impacts on the brain from exposure to other air pollutants, like forest fire smoke. With the increasing incidence of neurocognitive disorders, it's an important consideration for public health officials and policymakers."

All in all, air pollution proves to be a greater threat than we anticipated, and protection from the same is essential for good health.

*Aira Mittal 9C*

# ELECTRIC RACING: THE FUTURE OF MOTORSPORTS


In recent years, a quiet revolution has been taking place on racetracks worldwide, changing the essence of motorsports. Electric racing has emerged as an advanced sporting sensation and a trigger for sustainable innovation in the automotive industry. This transition towards electrification in racing has redefined the boundaries of speed and performance and glorified a new age focused on eco-consciousness and technological progress.

At the forefront of this revolution are series like Formula E, the FIA's electric racing championship, which have been essential in driving the acceptance of electric vehicles in a fiercely competitive environment. Unlike the thunderous roar of conventional internal combustion engines, the electric motors in these racing machines produce a futuristic whirr, showcasing the raw power of electric propulsion systems.

The appeal of electric racing lies in its environmental credentials and the thrill it delivers. The absence of engine noise boosts the sounds of screeching tires and aerodynamic elements cutting through the air, creating a unique and immersive experience for observers. The close-quarters racing and strategic battles on the track persist to fascinate audiences, proving that sustainability and excitement can go hand in hand.

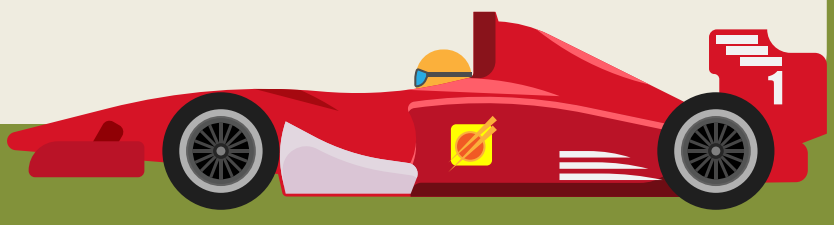
One of the primary appeals of electric racing is its role as a testbed for innovation. Racing teams and automotive manufacturers use these competitions as a platform to push the boundaries of electric vehicle technology. From advancements in battery efficiency to the development of regenerative braking systems, the innovations pioneered on the racetrack are finding their way into road-going electric vehicles, making them more efficient, powerful, and practical for everyday use.

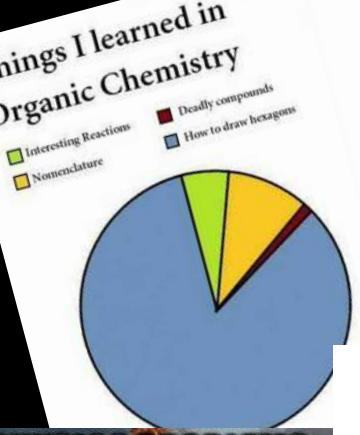
The environmental impact of motorsports has been scrutinized for decades due to the high carbon footprint associated with traditional racing. However, electric racing offers a promising solution by remarkably decreasing greenhouse gas emissions and enabling cleaner mobility. By showcasing the abilities of electric vehicles in a high-performance setting, these races inspire the masses to adopt electric mobility as a feasible alternative to fossil fuel-powered cars.

As electric racing continues to gain momentum, it is also driving changes in infrastructure development. The demand for fast-charging stations and enhanced battery technology has provoked investments in research and development, leading to refinements that help the racing industry and the broader electric vehicle market.

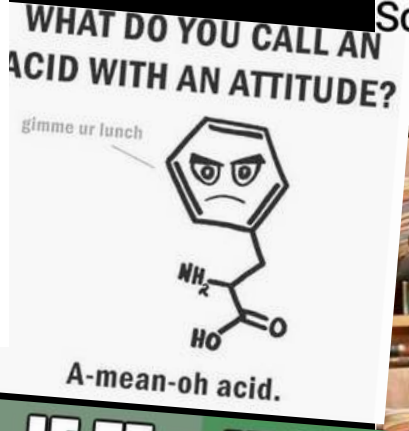
The future of motorsports undeniably lies in the domain of electric racing. With each passing season, technological breakthroughs and competitive racing action propel this revolution forward. As the automotive industry redirects towards sustainability, electric racing is a testament to the union of speed, innovation, and environmental consciousness, shaping a thrilling and eco-friendly future for motorsports.

*Mauryan Jaiswal, 11C*




nings I learned in
Organic Chemistry
Deadly compounds
Interesting Reactions
How to draw hexagons
Nomenclature


Me as a 6 year old
putting salt in water
You know, I'm something of a scientist myself

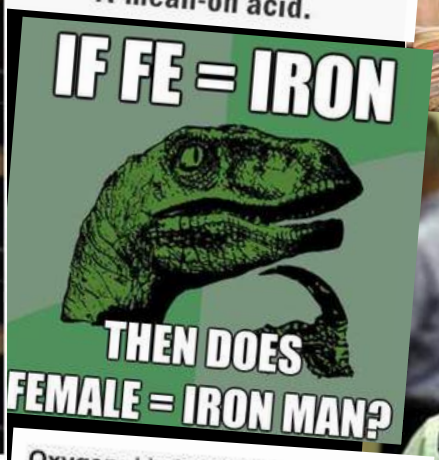

WHAT DO YOU CALL AN
ACID WITH AN ATTITUDE?
gimme ur lunch
A-mean-oh acid.


Science students *
Why?
Why?
Oh, that's why.

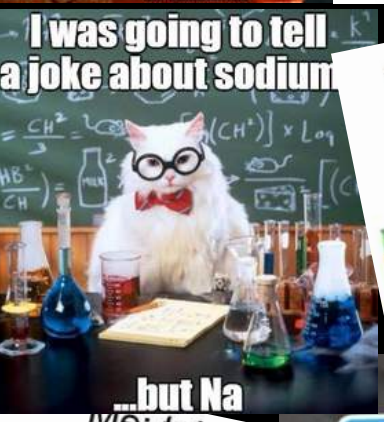

PHYSICS PROBLEMS
There is no Easter Bunny,
there is no Tooth Fairy,

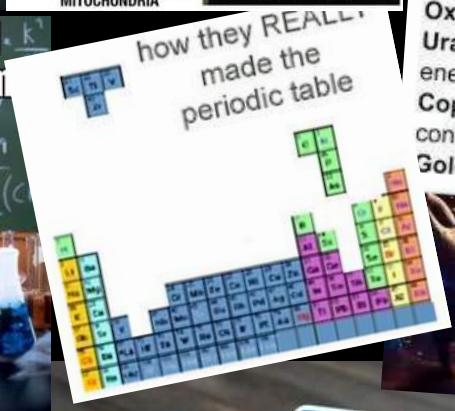

and there is no air resistance


DURACELL
Show me power !
I said! Real Power!
MITOCHONDRIA
Perfection!!

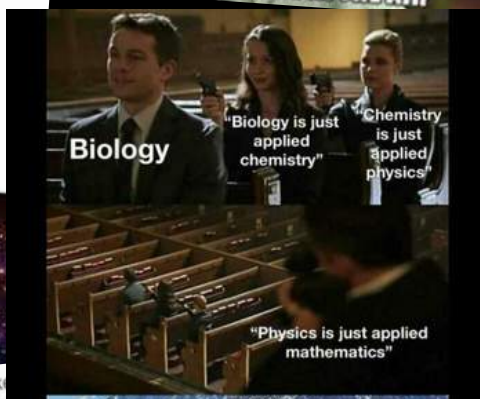

IF FE = IRON
THEN DOES
FEMALE = IRON MAN?

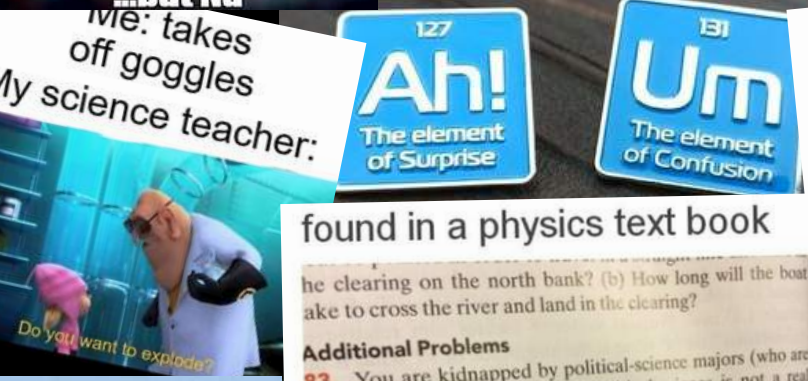

LOVE IS IN THE AIR?
FALSE.
NITROGEN, OXYGEN, ARGON AND
CARBON DIOXIDE ARE IN THE AIR

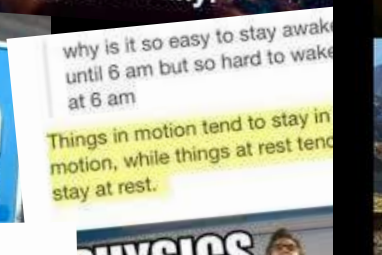

I was going to tell
a joke about sodium
...but Na

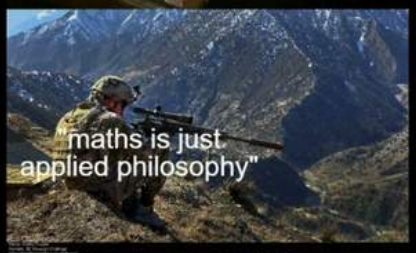

how they REALLY
made the
periodic table

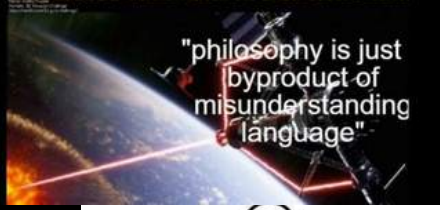

Oxygen: I help sustain life.
Uranium: I help produce clean
energy.
Copper: I am a very good
conductor.
Gold:
I'm so shiny!


Biology
"Biology is just
applied
chemistry"
Chemistry
is just
applied
physics"
"Physics is just applied
mathematics"

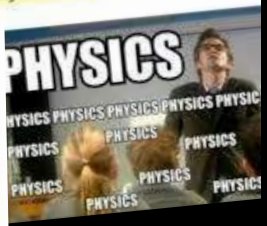

Me: takes
off goggles
My science teacher:
Do you want to explode?
127
Ah!
The element
of Surprise
131
Um
The element
of Confusion

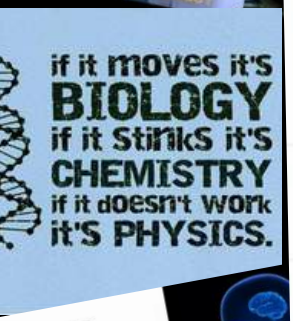

why is it so easy to stay awak
until 6 am but so hard to wak
at 6 am
Things in motion tend to stay in
motion, while things at rest tend
stay at rest.

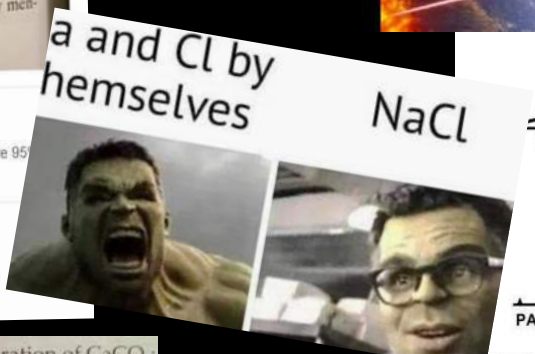

"maths is just
applied philosophy"

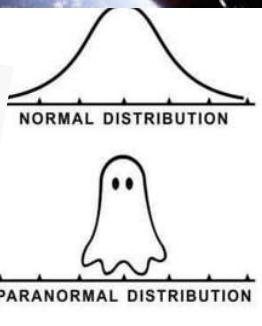

"philosophy is just
byproduct of
misunderstanding
language"


found in a physics text book
he clearing on the north bank? (b) How long will the boat
ake to cross the river and land in the clearing?
Additional Problems
83 You are kidnapped by political-science majors (who are
upset because you told them political science is not a real
science). Although blindfolded, you can tell the speed of their
car (by the whine of the engine), the time of travel (by men-
johnskylar
Physics majors throw a lot of shade considering they're still not sure where 95
the universe is hidden.
the-shuckiest-shuck
My brother's (a graduated theoretical physicist) only response to this was
"WELL NEITHER DOES ANYONE ELSE!"

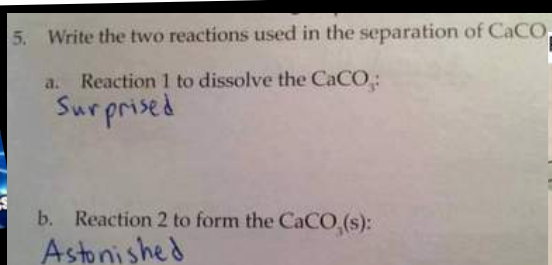

PHYSICS

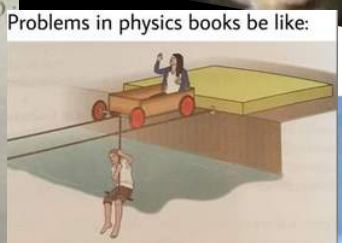

if it moves it's
BIOLOGY
if it stinks it's
CHEMISTRY
if it doesn't work
it'S PHYSICS.


a and Cl by
hemselves
NaCl


NORMAL DISTRIBUTION
PARANORMAL DISTRIBUTION

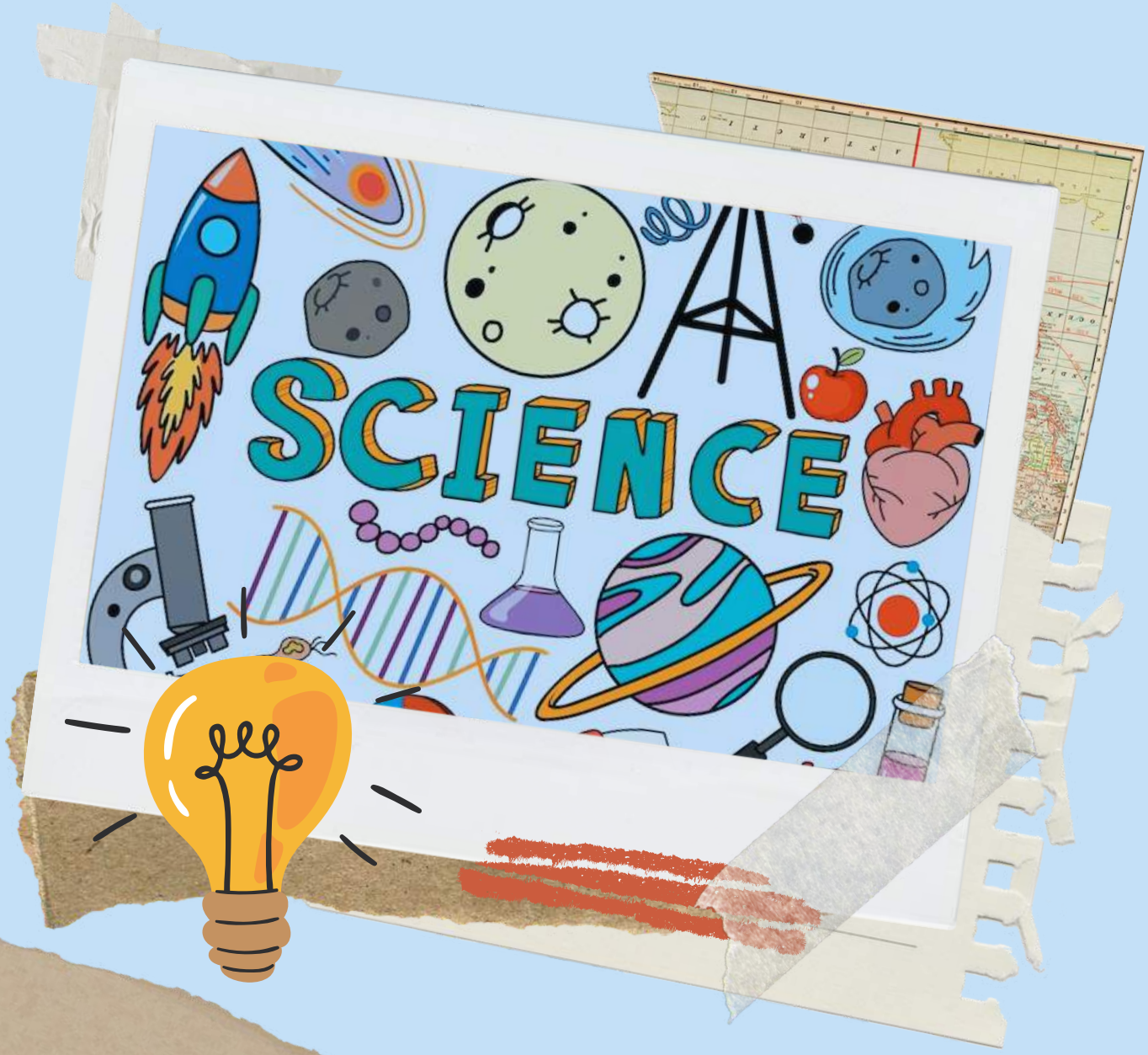

AIR
IS A GAS
AIR
DOESN'T EXIST
AIR
IS A FLUID
HIGHSCHOOL
PHYSICS
UNI
PHYSICS


5. Write the two reactions used in the separation of CaCO
a. Reaction 1 to dissolve the CaCO3:
Surprised
b. Reaction 2 to form the CaCO3(s):
Astonished


Problems in physics books be like:


Electron: behaves as a wave
Human being: watches closer
Electron:
well now I am
not doing it

# CREATIVE CORNER



# INTERESTING CAREERS IN SCIENCE

PYROTECHNIC ENGINEER

### PYROTECHNIC ENGINEER

They are responsible for the safe and successful design and execution of fireworks. The usage of correct materials, creating special effects and discovering safe and renewable fireworks is part of the job.

FORENSIC SCIENTIST

### FORENSIC SCIENTIST

The application of chemistry in crime scenes is known as forensic chemistry. Unknown objects and materials are identified by applying this branch of chemistry. These objects are analyzed and studied in the lab to provide crucial clues for the case.

ACOUSTICAL ENGINEERS

### ACOUSTICAL ENGINEERS

The application and management of sound-producing vibrations in real-life. Acoustical engineers create ideal sound systems to suit theaters, houses, auditoriums, etc.

THEME PARK ENGINEERS

### THEME PARK ENGINEERS

Theme park engineers brainstorm new and exciting park rides and attractions. Aesthetically pleasing designs, the physics behind motion and “safety first!” are all part of the job.

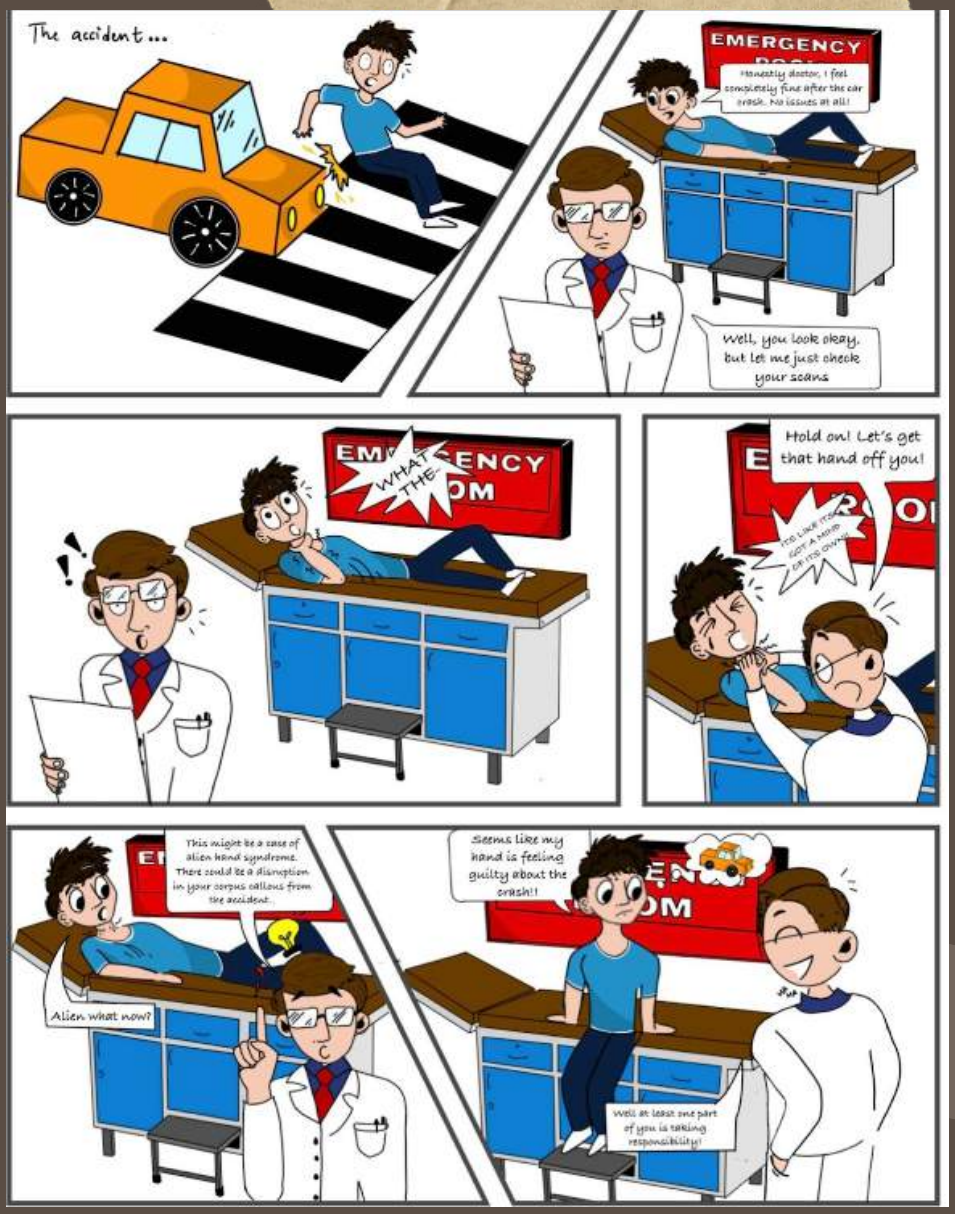
FRAGRANCE CHEMISTS

### FRAGRANCE CHEMISTS

Fragrance chemists work towards discovering and analyzing new fragrance chemicals. They improve these ingredients and study smell (known as olfaction).

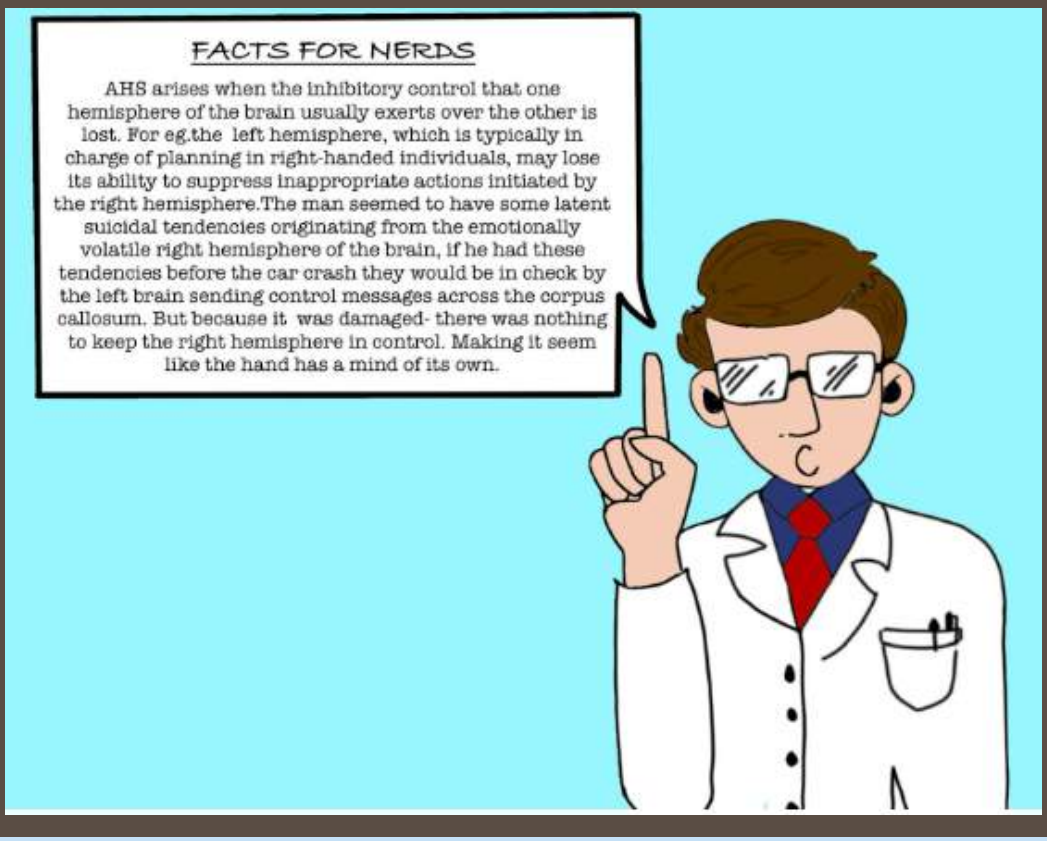
*Aira Mittal, 9C*

# COMIC STRIPS AND RIDDLES



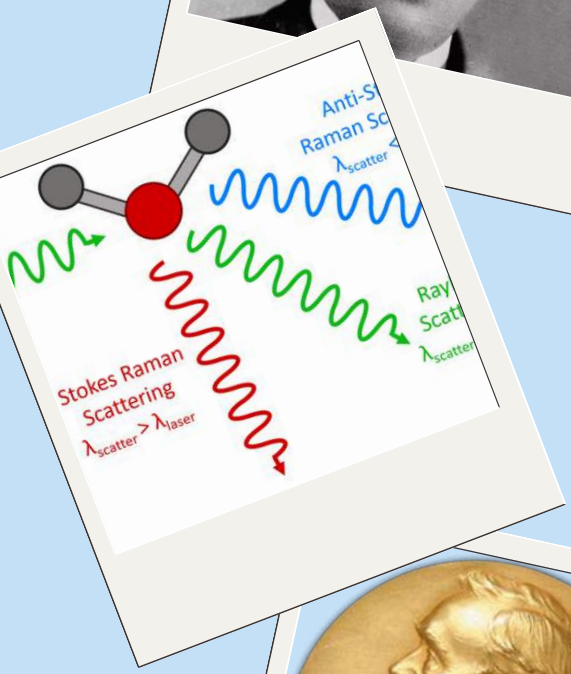

## FACTS FOR NERDS

AHS arises when the inhibitory control that one hemisphere of the brain usually exerts over the other is lost. For eg.the left hemisphere, which is typically in charge of planning in right-handed individuals, may lose its ability to suppress inappropriate actions initiated by the right hemisphere.The man seemed to have some latent suicidal tendencies originating from the emotionally volatile right hemisphere of the brain, if he had these tendencies before the car crash they would be in check by the left brain sending control messages across the corpus callosum. But because it was damaged- there was nothing to keep the right hemisphere in control. Making it seem like the hand has a mind of its own.

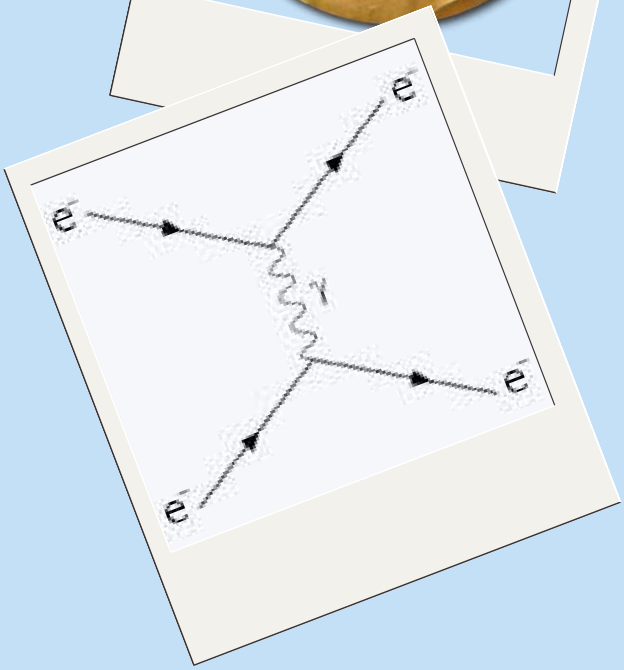


**Nina Nambiar andAnisha Sharma – 9B**

# C V RAMAN








In a world of science, so cool and bright,
There was a guy, oh, what a sight!
C.V. Raman, a curious fellow,
Playing with light, like a friendly, smart jello.

Born in India, where stories unfold,
C.V. Raman's tale, oh, so bold!
In his lab, where things did glow,
He discovered secrets, don't you know?

Light danced around, oh, what fun!
In a prism party, it had begun.
Raman looked close, with twinkling eyes, A surprise awaited, what a nice surprise!

The Raman Effect, a fancy name,
But it's not a boring, grown-up game.
Light scattered, molecules chattered,
In the world of science, dreams got flattered.

Nobel Prize, a shiny crown,
For Raman, a guy of great renown.
Physics clapped, and so did we,
For our friend C.V. Raman, full of glee.

In the science halls, his stories linger,
A cosmic dance, a scientific singer.
A hero for us, both big and small,
C.V. Raman, you're the coolest of all!

**Rishika Kapur**

# MARIE CURIE

Marie Curie, a star in the night,
Shinning mind, a scientific light.
With passion for science, she took her flight,
Discovering things day and night.

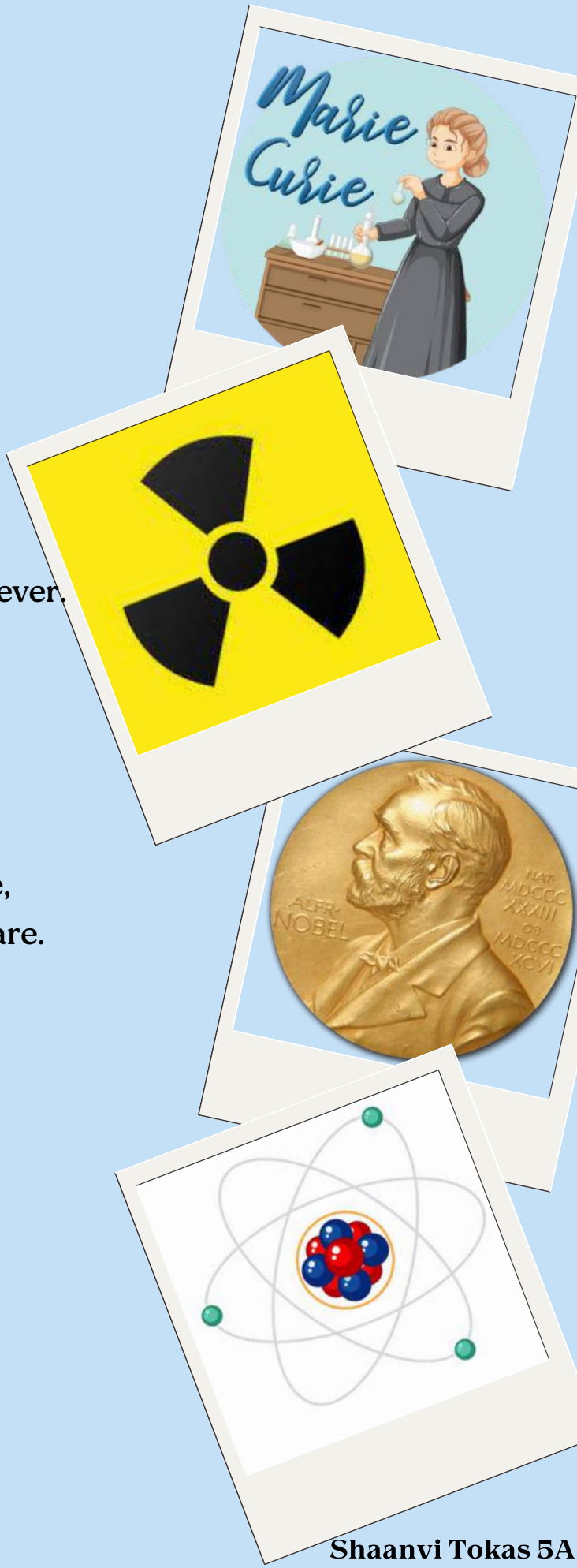
In labs bright with radium's gleam,
Her curious heart, like a laser beam.
In a time when girls were told to stay small,
Marie stood tall, defying it all.

Marie and Pierre, science pals so clever,
Exploring together a friendship that'll be forever.
Radium and polonium, elements new,
Noble Prize in 1903, for the brace so true

In 1911, Chemistry's Noble prize she'd claim,
For polonium's secret, in science's name.
Two Noble prizes, an achievement quite rare,
For her work in physics and chemistry to share.

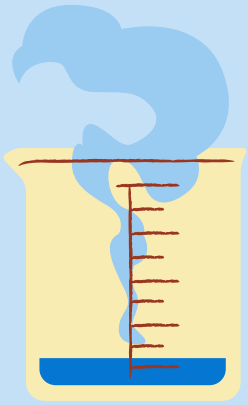
In World War I, with X-ray grace,
Mobile units rolled, in a curing race.
Marie curie, a scientist bright,
In the world of atoms, a radiant light

So, friends, let your dreams take flight,
Like Marie Curie, in the world so bright.
Science, discovery, and friendship true,
A world of adventure is waiting for you!




Shaanvi Tokas 5A

# MATTER



Mystery of matter
It makes your mind chatter.
Solids, liquids and gases.
Bases, salts and acids

Liquid that flows,
Into the container's shape it goes.
Water or juice, it all comes in this,
It dances all around with utmost bliss.

Solids are rigid,
You may even call them frigid.
They don't move easily,
They stand, unmoved so breezily

Gas is unseen,
Yet a part of our daily routine.
With freedom it roams,
It is everywhere including our schools & homes

Mystery of matter,
Is so it makes your mind chatter.
Solids, liquids and gases,
Bases, salts and acids

**Vani Garg 7C**

# RIDDLES

1. I have a strong force, but I'm not a superhero. I have protons and neutrons, but I'm not an atom. I can power cities, but I'm not electricity. What am I?

2. I am a force that opposes motion. I can slow down a moving object or bring it to a stop. What am I?

3. What period of time weighs the least?

4. You are in a room with 3 monkeys. One has a banana, one has a stick, and one has nothing. Which primate in the room is the smartest?

5.You can't see me, but I can see you. To be more specific, I see through. What am I?

6. Did you hear the one about a chemist who was reading a book about helium?

7. I can be good for you, I can be bad, I can be found all over inside and outside your body. I am microscopic, single-celled and have no nucleus. What am I?

8. What kind of chemical element hates to be a follower?

9. What did the limestone say to the geologist?

10. I am a god, a planet, and I can measure heat. What am I?

11. What do chemists call a benzene ring with iron atoms replacing the carbon atoms?

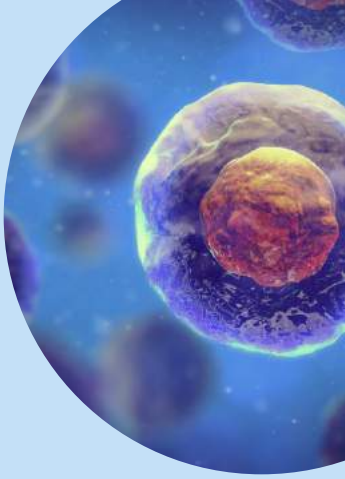
12. Born in the ocean and white as snow.
When I fall back to water I disappear without a trace. What am I?

13. What did the scientist say when he found 2 atoms of helium?

Aaditva Nanda 7B

# ANSWERS

1. A nucleus
2. Friction
3. Light Year
4. You are, as you are a primate, too.
5. X-ray
6. He couldn't put it down!
7. Bacteria.
8. Lead
9. Don't take me for granite!
10. Mercury
11. A ferrous wheel
12. Salt
13. HeHe



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