WAVELENGTH

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Vikram Sarabhai
THE SPACE MAN

Editorial

In the vastness of the cosmos, we reside on a tiny speck of stardust we call Earth. Floating through the expanse, our planet is but a ‘pale blue dot’ on the celestial canvas. Yet, Earth stands as a unique oasis of diversity and complexity. It's awe-inspiring to think that all our histories, faiths and religions, leaders and followers, events, and occasions - everything we have ever known is confined to this blue dot.

Humanity has been humbled by science ever since our ancestors gazed up at the night sky with wonder. Each new discovery reminds us of how little we know. In the last century, scientific theories have not only led to better technology but also transformed our societal norms. For years, I have seen Wavelength playing an important role in this regard – providing science education to a diverse audience. Be it the time constraints or browsing for new ideas, I have enjoyed every aspect of the publication. During my tenure, I have worked on making Wavelength more approachable by adding quizzes and school-wide surveys. I am certain that the future board will take the magazine to new heights.

This issue of the magazine has seen a great many entries on the themes of psychology and mental development in teenagers. Recognizing the necessity to acknowledge mental health in students, we have surveyed the entire middle and senior school on stress levels, which I believe will give us a glimpse of the student psyche. The themes of the articles range from scientists' biographies and space sciences to the latest research in various fields.

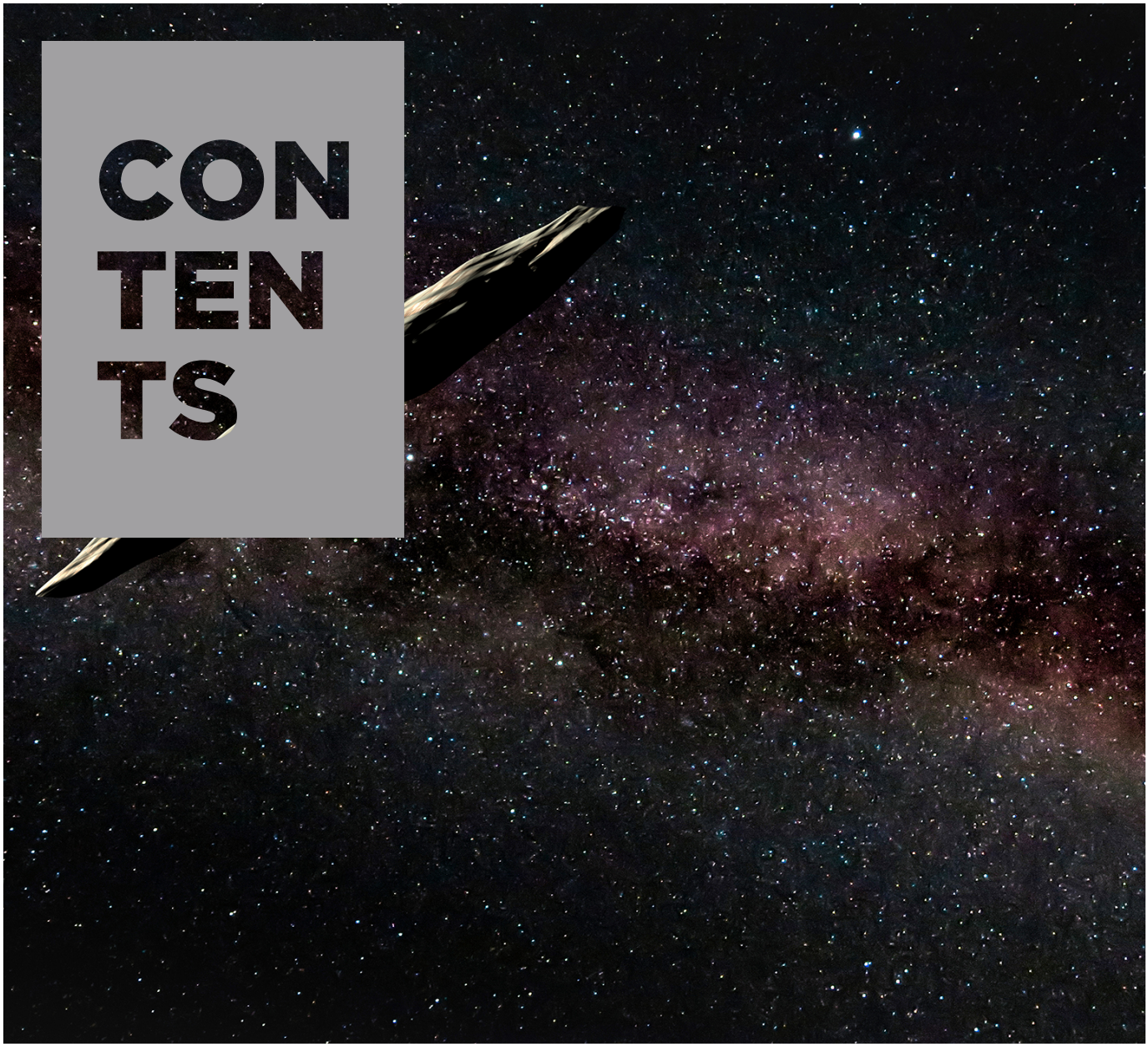
As our country makes phenomenal progress in space research with several successful missions, we must remember our modest roots and appreciate the great minds of our founders. Keeping this thought in mind, Wavelength pays tribute to Dr. Vikram Sarabhai, the great Indian astronomer and physicist, whose contribution in founding ISRO and the Indian Space Programme has been instrumental. The cover page has been inspired by his monumental life.

I thank my board for their perseverance and support. I am confident that their motivation and creativity will uplift the Magazine for years to come. I would like to express my gratitude to our teacher-in-charge, Dr. Samir Dhingra for his vision and years of experience. It has truly been an honour publishing this Issue under his guidance. I also thank Ms. Anamika Saxena for her expertise and in-depth knowledge. Finally, none of this would be possible without the unwavering support of our Principal, Ma’am Sangeeta Kain, for which I am vastly grateful.
I present to you Wavelength Founder’s 2023. I hope you find it engaging and informative.

Signing off,

Sankalp G.

Sankalp Gupta
Editor-in-Chief



CONTENTS

Rosalind Franklin

DNA'S UNSUNG HEROINE

The discovery of the Double Helical Structure of DNA is one of the most important scientific achievements in the last century if not in human history. It was probably why in 1953 James Watson and Francis Crick, the scientists who are credited for the discovery, proudly announced that they had found the 'secret of life' in a pub in Cambridge. The contribution of Crick and Watson is indeed impactful since they received the 1962 Nobel Prize. However, there is another scientist forgotten in time whose work was of paramount importance in the discovery of the Double Helix. In the book "The Double Helix", James Watson mentions a 'plain-dressing, belligerent scientist' – Rosalind Franklin.

Rosalind Franklin was born in London in 1920. Franklin was unique for the period; as a youngster, she had always wanted to be a scientist which wasn't an easy or typical career path, particularly for girls.

Defying the stereotypes of that time she excelled at sciences, doing her PhD at Cambridge in Chemistry with a scholarship. Rosalind had also researched on call which later resulted in the making of better gas masks for the Brits during World War II. She later joined the King's College in London to study the structure of DNA which is known as The Double Helix Structure today. This was one of the most-running topics in science at the time. Her task was to use X-ray technology to study DNA. In 1952 her hard work led to success with her being able to capture a clear diffraction of pattern of the DNA which is famously known as "Photograph 51".

But wait, weren't Watson and Crick credited for the discovery of DNA's discovery? This is where Rosalind Franklin's story takes a rather dejecting turn. The academic and scientific culture wasn't very friendly to women at that time and Rosalind was isolated by her colleagues , and assumed to be a lab assistant by her mates, but she still worked. The "Photograph 51" took more than 100 hours of continuous toil. Meanwhile, James Watson and Francis Crick who were also working on finding DNA's structure without Rosalind's knowledge, did a quick study on it to build a few potential structures and eventually arrived at the tight one. They published their model while at the same time, Franklin had done her calculation and submitted her manuscript. The journal was published with both the manuscripts together but put Franklin last making it look like Franklin's experiment only confirmed Watson and Crick's discovery. James Watson and Francis Crick went on to become Nobel laureates in 1962.

Unrecognised for her efforts, Franklin died of cancer in 1958, which probably came because of X-ray exposure during her discovery, due to no proper shielding. Today thanks to her biographers, this has come to light. Many say that she would have also been awarded a Nobel prize if only it could be awarded posthumously. In 1982, her earlier work on the structure of viruses also led to a Nobel prize.

Rosalind Franklin's story is saddening but is far more motivational. She was a very brave woman who fought the stereotypes and sexism to revolutionise biological sciences. Despite facing isolation and not receiving her deserving credit, she is a testament to the impact women can have in science.

–Vardan Kumar

INTERACTION WITH THE SUN

The Aditya L1 mission, spearheaded by the Indian Space Research Organisation (ISRO), stands as a monumental achievement in advancing our comprehension of the Sun's intricate relationship with the surrounding space environment. Launched on September 2, 2023, its primary objective is to meticulously study the Sun and its diverse phenomena. Named after the Sun God Aditya in Hindu Mythology, this mission holds paramount importance in unravelling the mysteries of our solar system.

Positioned at the Lagrangian Point 1 (L1), where the gravitational forces of the Earth and the Sun negate each other, Aditya-L1 is strategically placed in a halo orbit, 1.5 million km away from Earth in the direction of the Sun. This positioning ensures stability for the satellite, facilitating a close examination of the Sun's dynamic processes. The mission's goal is to gather invaluable data on various facets of the Sun, encompassing its surface, corona, and the solar wind.

The Sun, enveloped in atmospheric layers, features the Corona as its outermost part. Typically concealed by the Sun's brilliance, the Corona becomes visible during a Total Solar eclipse or with the aid of specialized instruments. A significant enigma surrounds the high temperature of the solar corona, surpassing that of the Sun's surface. Scientists seek to elucidate the factors contributing to this temperature disparity. Noteworthy solar events, including solar flares and coronal mass ejections (CMEs), originate from the corona, releasing copious amounts of energy and charged particles into space.A Coronal Mass Ejection (CME) is a substantial expulsion of magnetic fields accompanying plasma mass from the Sun's corona. Often linked with solar flares and various solar activities, if a CME ventures into interplanetary space, it transforms into an Interplanetary Coronal Mass Ejection (ICME). ICMEs possess the potential to reach and collide with Earth's magnetosphere, resulting in geomagnetic storms, aurorae, and, in rare instances, damage to electrical power grids. The Sun, during solar maxima, produces approximately three CMEs daily, whereas, near solar minima, this frequency reduces to about one CME every five days.

The Aditya L1 mission also aspires to scrutinize the corona during total solar eclipses. While typically invisible due to the Sun's overwhelming brightness, the corona becomes observable when the Moon obstructs direct sunlight during an eclipse. Equipped with a suite of instruments, Aditya L1 aims to capture pivotal data regarding the corona's temperature, composition, and dynamics. This effort contributes significantly to uncovering the mechanisms responsible for heating the corona to temperatures far exceeding the solar surface. By continually monitoring space weather parameters and collecting data, Aditya L1 plays a crucial role in advancing space weather prediction models, a vital aspect for safeguarding satellites and space infrastructure.

Furthermore, the Aditya L1 mission fosters international collaboration in space research by sharing findings and data with the global scientific community. This collaborative endeavour enhances our collective knowledge about the Sun and its activities within the solar system.

In conclusion, the Aditya L1 mission represents a momentous stride in unravelling the intricacies of the Sun and its correlation with space weather. Through its meticulous examination of the corona, magnetic fields, and solar activities, this mission holds the promise of fortifying our capacity to predict the impacts of space weather events on Earth. In an era where technology intertwines seamlessly with daily life, comprehending and monitoring the Sun's behaviour assumes paramount significance in safeguarding our modern way of life.

-Tanveer Singh Sains

MOXIE

Mars, the Red Planet has always beckoned humanity with its enigmatic allure. Yet, our dreams of exploring this cosmic neighbour have been tethered by a fundamental challenge: supplying the breath of life – oxygen – to sustain human visitors. But fear not, for Moxie has emerged as the celestial saviour, a groundbreaking machine with the power to transform Martian carbon dioxide into precious, life-sustaining oxygen. Step with us into the world of Moxie, where science fiction becomes science fact, and the dream of a thriving Mars colony inches closer to reality.

Moxie, short for the Mars Oxygen In-Situ Resource Utilization Experiment, is NASA's audacious brainchild. This technological marvel hitched a ride to the Red Planet aboard the Perseverance rover, touching down in February 2021. Its mission, both simple and profound, is to conjure oxygen from Mars' thin, carbon dioxide-rich atmosphere. This is a quantum leap in making future human Mars missions viable.

Oxygen, the most essential element for human life, is abundant on Earth but rare on Mars. The Martian atmosphere boasts a staggering 95% carbon dioxide, with only trace hints of oxygen. This imbalance makes breathing on Mars akin to attempting an underwater marathon without scuba gear. Traditional methods of hauling oxygen from Earth would be a logistical nightmare and economically astronomical. This is where Moxie steps in as an ingenious solution to an existential problem.

Moxie employs the magic of solid oxide electrolysis to perform its Mars metamorphosis. It all begins with the intrepid machine pulling in Martian air mainly composed of carbon dioxide. This Martian carbon dioxide is then squeezed, just like wringing water from a sponge and fed into Moxie's solid oxide electrolysis stack.

Within this stack, carbon dioxide undergoes a remarkable alchemy. At high temperatures, carbon dioxide molecules surrender their oxygen atoms, birthing carbon monoxide and releasing free oxygen atoms. The liberated oxygen atoms are gathered and stashed away for future use, while the residual carbon monoxide is safely expelled back into the Martian atmosphere.

This transformative process, though seemingly straightforward, is a technological marvel. It demands that Moxie endure extreme temperature fluctuations and the relentless Martian environment. Yet, Moxie's success in producing oxygen from the Martian air underscores the boundless potential of human ingenuity in tackling even the most intricate challenges on alien worlds.

Moxie may be small, but it punches well above its weight. During its Martian sojourn, it demonstrated an impressive output, producing up to 10 grams of oxygen per hour. While this may seem modest, it serves as a monumental proof of concept for in-situ resource utilization on other celestial bodies. Future missions can scale up this technology, generating the quantities of oxygen necessary to sustain human life on Mars.

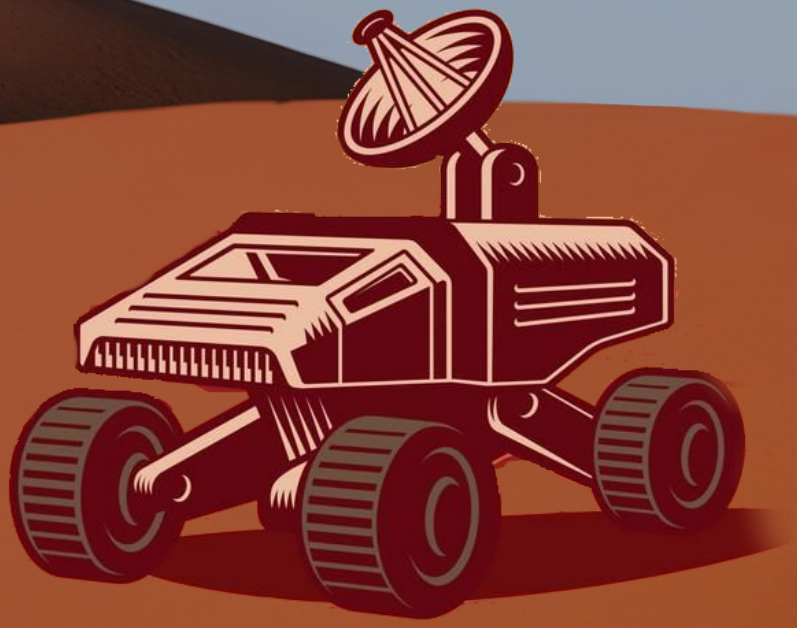
Moxie is more than just an oxygen factory; it's a harbinger of sustainability on Mars. By producing oxygen locally, future Martian colonies can drastically reduce their reliance on Earth for essential supplies, dramatically cutting costs and minimizing the environmental footprint of space exploration. Furthermore, the carbon monoxide generated as a byproduct of Moxie's operation can be a valuable resource, serving as a potential fuel source or precursor for other chemical processes, adding another layer of sustainability to Martian settlements.

Challenges certainly lie ahead. Scaling up Moxie to meet the oxygen demands of a self-sustaining Martian colony remains a formidable task, as does ensuring its long-term reliability in Mars' hostile environment. Nevertheless, Moxie represents a monumental leap in our quest to explore and perhaps one day call Mars home. It serves as a symbol of hope, proving that humans can overcome the difficulties of space travel and moving us one step closer to realising our ambition to become a multi-planetary race.

In conclusion, Moxie is a symbol of human innovation and persistence rather than just a machine. It stands for our unwavering commitment to pushing the envelope of what is possible and our persistent quest for knowledge. Moxie advances our goal of establishing a human presence on Mars by converting the carbon dioxide from Mars into the oxygen needed for life.

By demonstrating that humans can overcome the challenges of space exploration and transform distant, unfriendly worlds into viable havens for future explorers, Moxie shines the way as we continue our celestial journey. With each breath of oxygen, Moxie produces the dream of a thriving human colony on Mars becoming a bit more real, a bit more tangible and a bit more extraordinary.

-Arnav Sangal



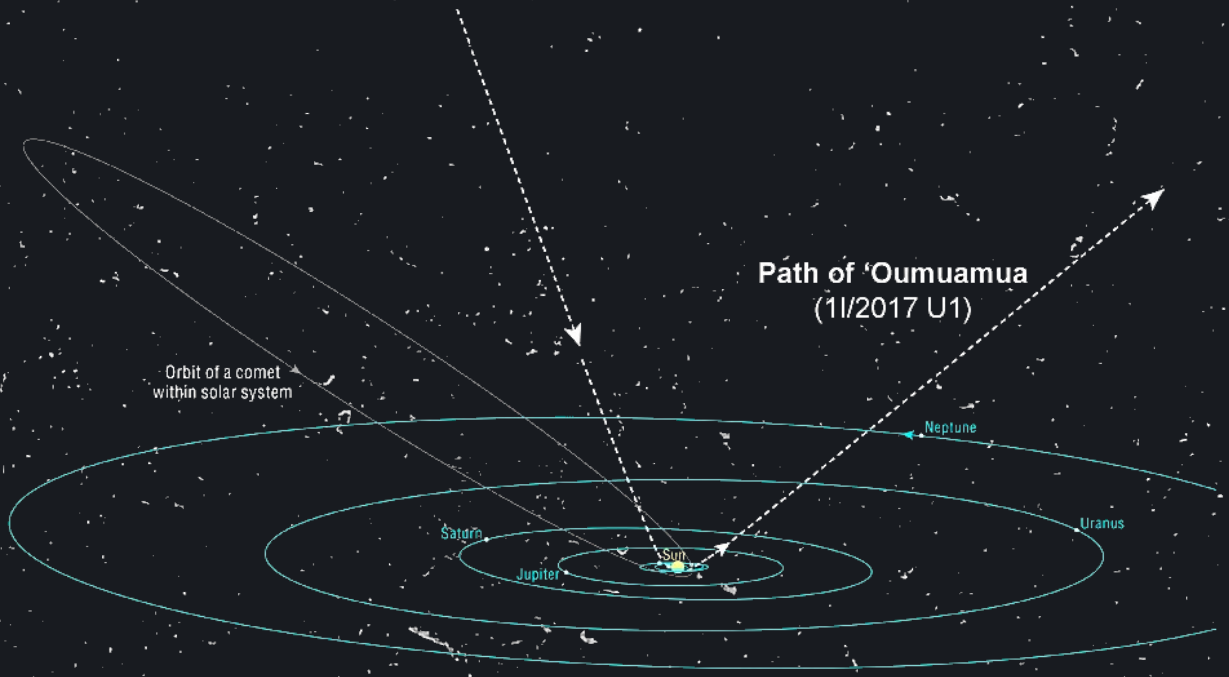
OUMUAMUA

In October 2017, astronomers encountered an extraordinary event—a celestial visitor hurtling through our solar system at an incredible pace. This interstellar wanderer was named 'Oumuamua, a term borrowed from Hawaiian meaning "scout" or "messenger from afar arriving first." What ensued was a scientific and public frenzy as everyone endeavoured to decipher the enigma of this celestial nomad. The discovery of 'Oumuamua was not just happenstance; it marked a defining moment in astronomy, challenging our understanding of the universe and sparking a quest for answers.

It is a cosmic object that defies convention at every turn. 'Oumuamua's shape was the initial puzzle piece. Unlike typical asteroids and comets with their rounded or irregular forms, this visitor resembled a colossal cigar, approximately 800 meters long and just 80 meters wide. Envision a massive space pancake or celestial cigar, and you'll grasp the essence of its unusual appearance.

Yet, Oumuamua wasn't merely defined by its quirky shape. It was also in a hurry, zooming through our cosmic neighbourhood at speeds reaching up to 315,000 kilometres per hour (196,000 miles per hour). This extraordinary velocity hinted that 'Oumuamua wasn't a local; it was just passing through. Its trajectory indicated an origin from the Lyra constellation, heading toward Pegasus adding an extra layer of mystery to its journey.

During its fleeting visit, Oumuamua left behind a trail of questions. One of the most debated topics among scientists was its origin. While the notion of extraterrestrial technology fueled collective imagination, most astronomers leaned towards a more natural explanation. One theory proposed that Oumuamua might be a fragment from a larger celestial body—a piece of a comet or asteroid—ejected from its home solar system. This could explain its peculiar shape, high speed and the absence of the typical coma or tail observed in comets.



However, Oumuamua had more surprises in store. It displayed an odd, non-gravitational acceleration, deviating from its expected trajectory. This acceleration wasn't easily explained by conventional means, adding yet another layer of intrigue to its narrative. It was as though 'Oumuamua was determined to keep us guessing.

One of the strongest pieces of evidence against the comet theory was the absence of a visible coma or tail. Comets, known for their icy composition, release gas and dust when warmed by the Sun, creating a distinctive glowing tail. However, Oumuamua showed no signs of this outgassing behaviour, prompting scientists to explore alternative explanations for its composition and behaviour.

The Oumuamua story didn't conclude with its mysterious departure. Six years after this cosmic visitor graced our solar system, scientists discovered a groundbreaking phenomenon that could potentially explain some of the mysteries surrounding Oumuamua.They identified a process known as "hydrogen ice sublimation," where molecular hydrogen trapped beneath the surface of celestial objects is heated by sunlight and expelled into space, resulting in a non-gravitational push.

This mechanism provided a possible explanation for Oumuamua's unexpected acceleration, potentially debunking the alien spacecraft hypothesis and bringing us closer to understanding the nature of this intriguing visitor.

Although Oumuamua left us with a host of unanswered questions, its true significance lies in the curiosity it ignited and the scientific progress it spurred. Astronomers and researchers have been driven to develop new tools and techniques for detecting and studying cosmic visitors like Oumuamua. These initiatives seek to reveal the secrets of the cosmos and offer greater perceptions of our place in it.

One can't help but contemplate the countless celestial surprises that lie in wait for us in the limitless depths of space as we continue our cosmic investigation. Oumuamua's brief visit to our part of the cosmos left us with intriguing questions about its origin and nature while also testing the limits of our knowledge of the cosmos. It will always be an intriguing enigma.

-Arnav Sangal

FERROFLUIDS

"This Ferrofluid is a fascinating and versatile material with a wide range of potential applications. It is a reminder that there is still much that we do not know about the world around us." - Dr. John Bush, Massachusetts Institute of Technology.

Have you ever seen a mesmerizing display of metallic spikes that change shape when brought near a magnet? This is the captivating science of ferrofluids, a unique type of liquid that is both magnetic and fluid.

Ferrofluids are a laboratory created substance which is a kind of colloidal liquid in which tiny ferromagnetic particles made-up of iron oxide are suspended in an organic matter (or water), which is attracted by the magnet. These particles are coated with a surfactant strong enough to prevent clumping of all the magnetic particles near a strong magnetic field.

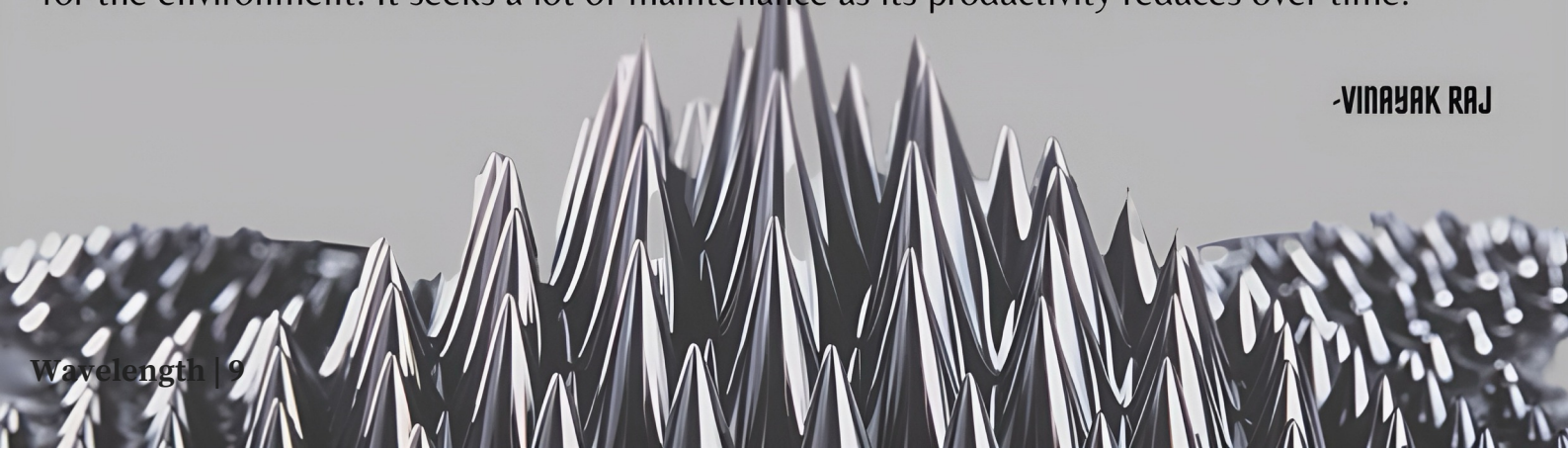
These ferromagnetic particles are the reason for the formation of the shapes and figures when attracted by a magnet. The shape formation of the ferrofluid are thin layers if the particles are small and the magnetic field is weak and spikes or different complex shapes are formed when the particles or magnetic field is stronger.

One of the most useful methods to create ferrofluids is the Microemulsion method: This method involves mixing oil, water, and a surfactant to form a microemulsion. Microemulsions are thermodynamically stable dispersions of two immiscible liquids, such as oil and water, stabilized by a surfactant. The surfactant forms a monolayer around the dispersed droplets, preventing them from coalescing. Iron salts are then added to the microemulsion, and a chemical reaction is initiated to precipitate magnetite nanoparticles in the droplets. The surfactant coating on the nanoparticles prevents them from aggregating, and the oil carrier helps to keep them dispersed.

The use of this substance is extensive either for creating unique and appealing artwork or to use it in aerospace ships for heat transfer, fuel seals, and vibration control. It is further used in making softbots which can be controlled via a magnet in the field of medical science, controlling the flow of light, which is useful in laser technology, medical imaging etc. This technology is further developed to use it in energy applications like solar energy conversions and batteries, drug delivery, tissue engineering and what not.

This booming substance also has the other side of the coin, there are also disadvantages to these technologies which limit the extensive use of it. Ferrofluids are expensive to produce, which reduces their use to large masses of the world. These materials are harmful if spilled or released in the environment without proper treatment which somewhere makes them harmful for the environment. It seeks a lot of maintenance as its productivity reduces over time.

-VINAYAK RAJ



BONE EATING WORMS

Osedax worms, also known as “bone worms”, are a group of marine organisms that have a unique ability to consume vertebrate bones. Using the submarine "ROV Tiburon," scientists from the Monterey Bay Aquarium Research Institute in California made their initial discovery of Osedax worms in 2002. Since then, they have been identified in a variety of ocean ecosystems worldwide, most notably the deep sea. Osedax worms belong to the family Siboglinidae and are characterised by their specialised adaptations for bone consumption. Unlike most organisms, they lack a functional digestive system. Instead, they rely on a symbiotic relationship with bacteria that reside within their bodies.

These bacteria have the ability to break down the collagen and lipids found in bones, providing a source of nutrients for the worms. The worms have a tubular body with several segments. At the anterior end, they have a crown-like structure called the plume, which bears numerous feather-like appendages known as radioles. The radioles are covered in cilia that create water currents, facilitating the capture of organic particles, including bone fragments from the surrounding environment. The radioles also provide a large surface area for the bacteria to colonise. Osedax worms are typically found on vertebrate remains, such as whale carcasses, fish bones and sunken wooden structures that sink to the seafloor.

The reproductive strategy of Osedax worms is unique and fascinating. Females release a species-specific pheromone that attracts dwarf males to the bone. The males which are significantly smaller than the females, lack a digestive system and rely entirely on the female for nutrition. Once the males settle near the females, they undergo a process called "dwarfing," where they degenerate their internal organs and get absorbed into the female's body. This arrangement allows the female to obtain a constant supply of sperm for fertilisation and nutrients from the male's tissue.

Osedax worms play a crucial role in the marine ecosystem by recycling nutrients from vertebrate remains. When a whale carcass sinks to the seafloor, it provides a temporary oasis of nutrients in the otherwise resource-limited deep-sea environment. Osedax worms colonise these carcasses and contribute to the decomposition and recycling of organic matter. They leave behind characteristic patterns of erosion on the bones as they consume them. The discovery of Osedax worms has expanded our understanding of the diversity of life in the deep sea and the processes involved in the decomposition of organic matter. Scientists continue to study these worms to unravel more about their adaptations, behaviour, and ecological significance. By exploring the unique adaptations and ecological roles of Osedax worms, researchers gain insights into the complex interactions and processes that shape deep-sea ecosystems.

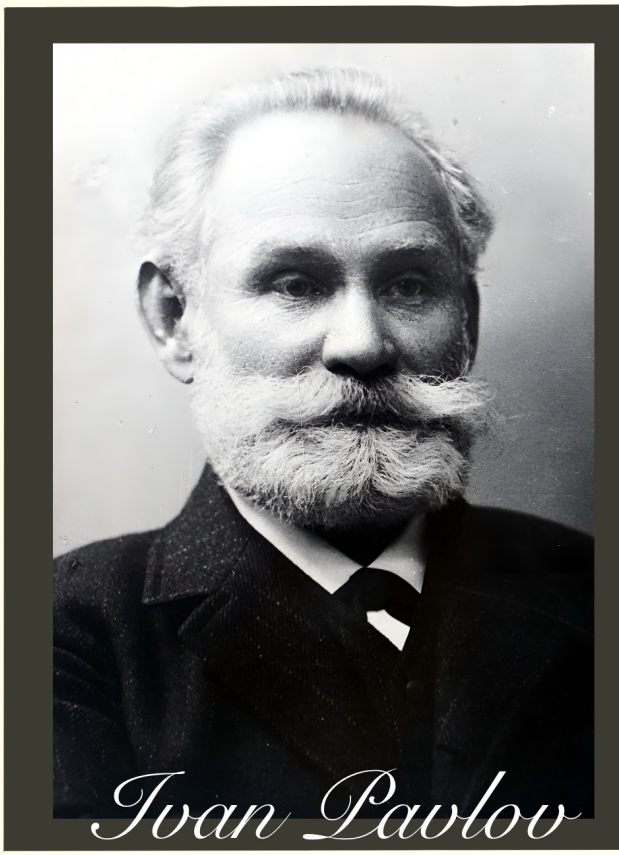
-Tejasva Dhandhania

Classical

"Appetite, craving for food, is a constant and powerful stimulator of the gastric glands."

When you enter the dentist's office, a sensation of fear rushes through your body, Ever wondered why that happens ? Well let me help you out, the answer lies in a fascinating theory of classical conditioning.

The theory was proposed by Ivan Pavlov, a believer in the idea that human behavior can be best understood by focusing on what can be seen (behavior of organisms) and not what couldn't be (the mind). In his pursuit he set out to study the relationship between observable stimuli and responses, giving birth to the behaviorist approach, which serves as the foundation for modern psychology.



While Pavlov was studying psychology in animals, his experiments with dogs revealed that when: a neutral stimulus (a stimuli inflicting no response initially), could become a conditioned stimulus (stimuli taking focus towards itself) if repeatedly paired with an unconditioned stimulus. This process of linking a neutral stimulus with an unconditioned stimulus to elicit a conditioned response became the cornerstone of classical conditioning.

Let us see how Pavlov was able to figure out classical conditioning.
When Pavlov brought food to his dog, he noticed a biological response in the dog. The dog was producing saliva in more quantity than usual just by the sight of the food. This was a natural behavior because the salivary glands were signaled by the brain to produce more saliva to break the food into smaller compounds that received information from the eyes. This biological reaction by the dog to produce more saliva is called an unconditioned response and the food is called an unconditioned stimulus.
Pavlov used a random stimulus that initially could not trigger the same biological response.

Conditioning

This new stimulus is called a neutral stimulus, and he used a bell as the neutral stimulus. He combined neutral stimulus with unconditioned stimulus. In this case, he started ringing the bell whenever he would go to feed the dog. The brain started associating both stimuli with each other and learned to produce saliva whenever the bell rang because that guaranteed the food was going to come. Pavlov then started ringing the bell alone without giving the food and noticed the dog was still giving the same response, and his saliva was produced the same. In the second case, the bell becomes the conditioned stimulus after it is associated with the unconditioned stimulus and the response given is called conditioned response as it is not subjected to natural laws. The same way happens in humans.

Let us take a classroom scenario to understand how the classical conditioning plays at the back of our actions: Imagine every time a teacher enters the classroom, they play a specific song. Students begin to associate the song with the start of the class on hearing it repeatedly, causing their attention to automatically shift towards the teacher.. In the above scenario the song serves as the neutral stimulus, the teacher entering is the unconditioned stimulus, and the students' focused attention is the unconditioned response.

Repeatedly playing the song causes it to become a conditioned stimulus resulting in automatically drawing students' focus whenever they hear it, even if the teacher is not yet in the room. Teachers can help students develop positive associations with learning by pairing a neutral stimulus (song) with a positive unconditioned stimulus (teacher entering).

Classical conditioning is a tool that wields immense power for understanding and modifying behavior but it comes along with its limitations.

It cannot create an entirely new behavior, only elicit existing behaviors in response to new stimuli's registered. While classical conditioning cannot create new behaviors, it's a valuable tool for modifying existing behaviors and making them more adaptive. It is a widely used technique in psychology, animal training, and behavior modification.

-Yash Singh

THE JAGUAR XJR - 15

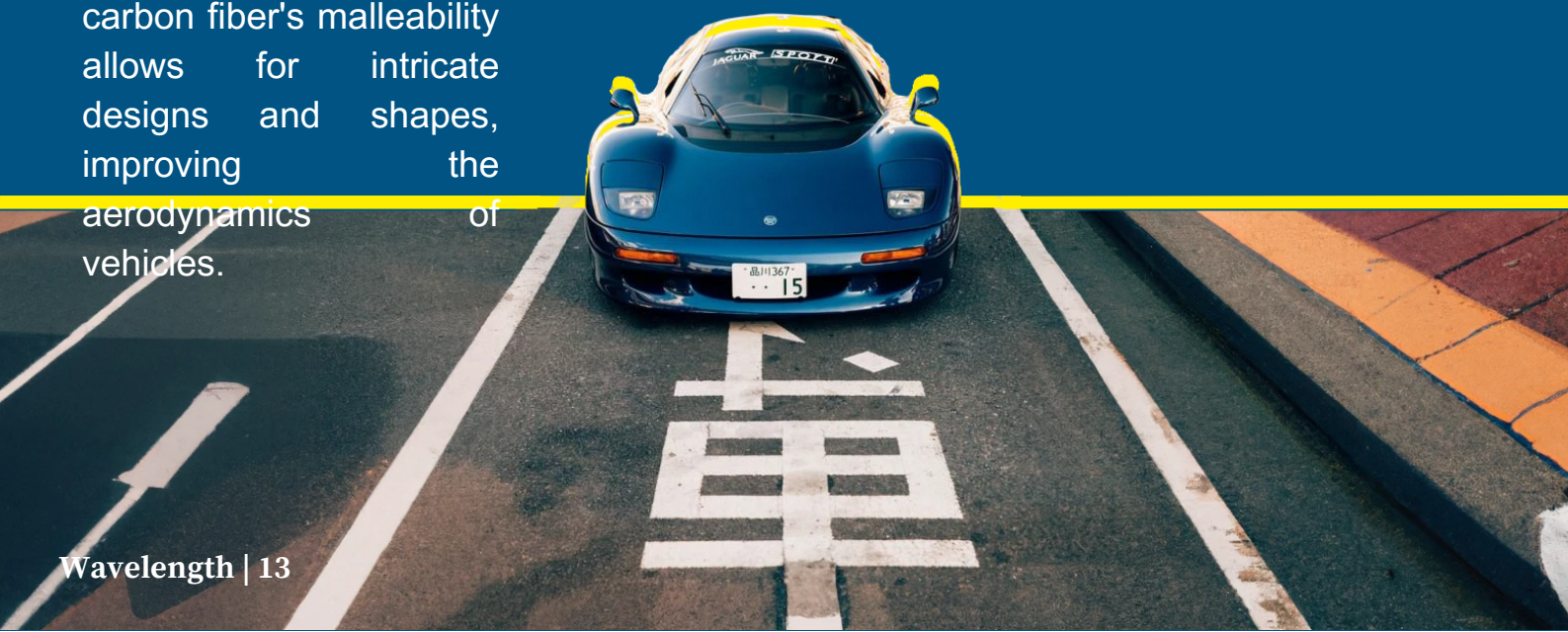
This car will always remain the most iconic and rare car manufactured by Jaguar Sport, a collaboration between Jaguar and TWS Partners. This model was a limited edition designed by Peter Stevens with the help of the carbon fiber monocoque design. The car is powered by a potent 6.0-liter V12 engine, boasting 450 horsepower and a lightweight carbon- fiber body. Only 53 units of the car were built, making it a coveted collector's item among automotive enthusiasts. The usage of carbon fiber also provides the car with better aerodynamics and design flexibility, as carbon fiber's malleability allows for intricate designs and shapes, improving the aerodynamics of vehicles.

It helps in lightweight construction, improves strength and reduces turbulence, as items made with carbon fiber can be molded easily. This not only enhances fuel efficiency but also provides designers with greater flexibility to create innovative and aesthetically pleasing automotive designs.

If we talk about financial terms, the usage of carbon fiber has led to enhanced fuel efficiency, as lighter cars require less fuel to operate. In the late '90s, the use of carbon fiber was very expensive, but now, with the help of professionals at research and development centers, the price of carbon fiber has lowered.

In conclusion, carbon fiber's impact on the automobile industry is transformative, influencing design, efficiency, safety, sustainability, and market appeal. As advancements continue, carbon fiber is likely to play an even more prominent role in the automotive landscape, shaping the future of vehicles.

-Shivam Panwar



THE MEANING BEHIND DREAMS

We have all experienced nightmares. Dark dreams from which we wake up gasping, trying to make sense of it all. We all wonder how our mind shows such creativity every night. Even the most mundane people who may show no talent for writing can weave up complex stories in their dreams. But is there any correlation between their waking lives and slumbers?

Psychoanalytic Theory is a prominent approach to modern psychology, studied and founded by Sigmund Freud whose theory contributed in differentiating the conscious and unconscious mind. He stated that even though a person does not have control over their unconscious mind, their repressed thoughts make up the unconscious mind and affect their behavior. These buried thoughts come in the form of dreams to a person.
Analysing dreams can reveal similarities between the events they have experienced and try to co-exist with those events with the help of talk therapy. Freud stated what we remember from our dreams is called the 'manifest content' and the underlying meaning of the dream is called the 'latent content'.

When the latent content is filled with anxiety and is depressing, our mind is afraid to experience it and changes it into manifest content and displays it in a much more approachable way while also completing what our goal was in that experience. All of this is done without waking up the dreamer. Dreams, according to Freud, are the "guardians of sleep". It's crucial to emphasize the significance of a child's relationship with their parents. When a child openly shares their daily experiences with their parents, it ensures that no thoughts or emotions go unnoticed. This, in turn, contributes to the well-being of their unconscious mind.

Sigmund Freud used the method of Free Association on his test subjects. In Free Association, a psychologist observes your thoughts by giving you a descriptive word and your response as to what first came to your mind. This method would help because it is your unconscious mind responsible to associate things in an instant. In this method it is likely for a person to remember a traumatic experience associated with that object. The psychologist made it a comfortable session so that the client would re-experience the scenario without judging it and talk aloud about it. This helped the person not to be afraid along with reducing anxiety. The psychologist simultaneoysly would study their reactions and their behavior.

Freud also used the method of Transference. It is when a person is dealing with social problems, they think of their psychologist as that person and talk to them accordingly. For example, if a person is having a problem with their mother, they would think of their psychologist as their mother and have a one-to-one conversation. This helped in understanding the concept of the problem and how they can resolve the issue. It is the same as the phrase "try putting yourself in their shoes."

To sum it up, exploring dreams helps us uncover the secrets hidden in our minds. Sigmund Freud's ideas show how our daily life connects to the stories our minds create while we sleep. Dreams, according to Freud, act as guardians, revealing thoughts and feelings we might not notice when awake. Techniques like Free Association and Transference help us decode these dream messages. By understanding our dreams, we not only learn more about ourselves but also gain insights into the complex workings of the human mind.

-Yash Singh

TRIBUTE TO VIKRAM SARABHAI THE MAN BEHIND THE SUCCESS OF ISRO

Dr. Vikram Sarabhai was born on 12th August 1919 in Ahmedabad, Gujarat. The Sarabhai family was a business family, with Dr. Sarabhai being the first person in his family to practice, develop, and adopt science as a career option. After passing the Intermediate Science examination, Sarabhai matriculated from Gujarat College in Ahmedabad. Later, he shifted to England and joined St. John's College at the University of Cambridge. He received the Tripos in Natural Sciences from Cambridge in 1940. After returning to independent India in 1947, he persuaded charitable trusts controlled by his family and friends to endow a research institution near his Ahmedabad home, founding the Physical Research Laboratory (PRL) in Ahmedabad on November 11, 1947, at the age of just 28 years. Sarabhai was a creator and cultivator of institutions, and PRL was the first step in this direction. He was also Chairman of the Atomic Energy Commission. Along with other Ahmedabad-based industrialists, he played a significant role in creating the Indian Institute of Management, Ahmedabad. He inspired and mobilized a whole generation of scientists and engineers, fostering a culture of collaboration and innovation that was essential for the growth of the Indian space program.

His leadership and guidance were instrumental in achieving the early successes in India's space endeavors.The Indian National Committee for Space Research (INCOSPAR) was the predecessor to the Indian Space Research Organization (ISRO) and was formulated by our former Prime Minister Pt. Jawaharlal Nehru, at the request of Dr. Sarabhai. However, that was not his first step in the space research field. Along with Dr. A P J Abdul Kalam, he launched the first Indian rocket from a church in Thumba, near Thiruvananthapuram (Kerala). The site of the launch was a small church dedicated to St. Mary Magdalene that was located on the Earth’s magnetic equator. The magnetic equator is an imaginary line around the planet that connects all the points where a magnetic needle, when freely suspended, is horizontal. It is scientifically important because the magnetic equator is where the Equatorial Electrojet exists—a stream of electrons whizzing across the sky, about 110-120 km above the Earth’s surface.

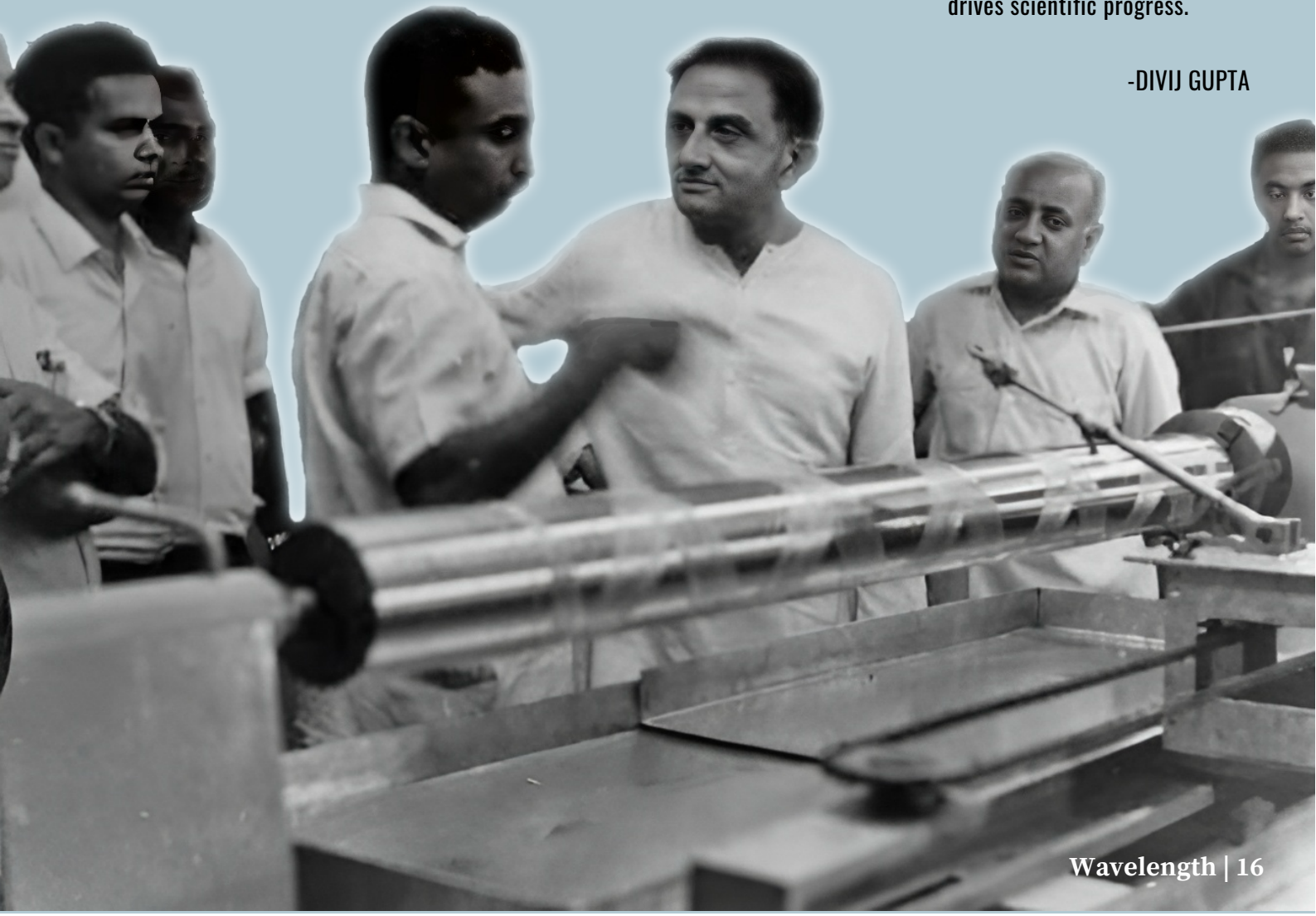
Sounding rockets, or the first rockets sent out by any space program, test and study these electrons for research in the fields of physics, astronomy, and meteorology. These rockets are the baby steps taken before the establishment of a full-fledged space program, and Dr. Sarabhai felt that Thumba was the best place to launch them. In fact, Thumba’s location at 8°32’34” N and 76°51’32” E is ideal for low-altitude, upper atmosphere, and ionosphere studies. But that has been long past.

The Indian Space Research Organization has embarked on an extraordinary journey since its establishment in 1969. From its initial foray into space with the launch of the Aryabhata satellite in 1975, ISRO has consistently elevated India's standing in the field of space exploration. Notably, the Mars Orbiter Mission, affectionately known as Mangalyaan, achieved global acclaim in 2013 when it made India the first nation to reach Mars orbit on its first try. This achievement was an embodiment of ISRO's innovative and cost-effective approach, showcasing India's ability to undertake complex interplanetary missions. Chandrayaan-1 and Chandrayaan-2, launched in 2008 and 2019 respectively, have deepened our understanding of the moon, with Chandrayaan-1's discovery of water molecules on the lunar surface being a significant scientific contribution. ISRO's satellite launch capabilities, notably the Polar Satellite Launch Vehicle (PSLV) and the Geosynchronous Satellite Launch Vehicle (GSLV), have solidified India's reputation as a reliable and cost-effective player in the international satellite launch market. Yet, this journey has not been without its fair share of challenges. ISRO has faced satellite launch failures, most notably during the Chandrayaan-2 mission when the Vikram lander lost contact during its descent to the moon's surface.

These setbacks are an inherent part of space exploration, where precision and margin for error are minimal. Furthermore, ISRO has often operated under budget constraints, which can hinder the pace of expansion and research initiatives. In an increasingly competitive global space industry, ISRO has competed with well-established entities like NASA and private enterprises such as SpaceX, a challenge that has spurred the organization to continue evolving and refining its capabilities. Despite these hurdles, ISRO remains steadfast in its commitment to advancing technology and space exploration, solidifying its status as a respected and influential player in the global space arena. In this long journey of hardships and success, ISRO is ambitious in the future to achieve more scientific developments for our nation, which include extraterrestrial manned missions and sending in-depth research rovers in the Mars Orbital Mission 2. Specifically in this year, ISRO has made India proud by launching and being successful in the Chandrayaan-3 mission, being the first nation globally to step on the south pole of the moon. Then, the Aditya L-1 mission aims to travel to the first Lagrange point and research the Sun’s Corona layer without external interferences.

Lastly, India is in the last phases of the Gaganyaan, planning to send a crew into Low-Earth Orbit as preparation for future and longer duration missions, and developing its own cost-effective model of reusable rocket technology, which was first introduced in the West. In acknowledging Dr. Sarabhai's contributions, we should also pay tribute to the countless scientists, technicians, and support staff who worked tirelessly to realize his vision. It's a testament to his leadership that he was able to create a collaborative environment where people from various backgrounds and disciplines could come together to work towards a common goal. Recognizing and honoring all those who contributed to India's scientific development, whether directly under Dr. Sarabhai's leadership or in subsequent generations, is a way to ensure that their work and dedication are duly celebrated. Science is a collective effort, and acknowledging the contributions of all involved is vital for preserving the spirit of collaboration and innovation that drives scientific progress.

-DIVIJ GUPTA




NOBEL
PRIZES
2023

Chemistry

The 2023 Nobel Prize in Chemistry has been awarded to Moungi Bawendi, Louis Brus and Aleksey Yekimov for their pioneering work in the development and synthesis of quantum dots. These minuscule particles, just a few nanometers in size, exhibit unique properties that have revolutionized a wide range of fields, from electronics and medicine to solar energy and environmental science.

Quantum dots are semiconductor particles that behave like artificial atoms. Their size determines their optical properties, allowing them to emit light in a variety of colours. This tunable emission, along with their high brightness and stability, makes quantum dots ideal for a wide range of applications.

The development of quantum dots was a breakthrough in nanotechnology. Before the work of Bawendi, Brus and Yekimov, quantum dots were difficult to produce and often suffered from poor stability. These challenges limit their potential applications.

Bawendi, Brus and Yekimov made significant contributions to overcoming these challenges. Bawendi developed a new method for synthesizing quantum dots that resulted in high-quality particles with improved stability. Brus explored the fundamental physics of quantum dots and discovered new ways to control their optical properties. Yekimov, working independently, made similar breakthroughs in the synthesis and characterization of quantum dots.

The work of Bawendi, Brus and Yekimov has paved the way for a multitude of applications for quantum dots. Today, they are used in a wide range of products, including TVs, smartphones and solar cells. Quantum dots are also being investigated for potential use in medical imaging, drug delivery and environmental remediation.

The field of quantum dots is still in its early stages and researchers are constantly discovering new ways to use these versatile materials. In future, we can expect to see quantum dots play an even greater role in our lives, from revolutionizing the way we communicate to improving our health and protecting our environment.

The Nobel Prize in Chemistry 2023 recognizes the groundbreaking work of Bawendi, Brus and Yekimov in developing and synthesizing quantum dots. Their discoveries have had a profound impact on a wide range of fields and their work continues to inspire innovations that will shape the future of science and technology.

The work of Bawendi, Brus and Yekimov has opened up a world of possibilities for quantum dots. As research continues, we can expect to see these tiny particles have an even greater impact on our world.

- Arav Dokania

Physics

The 2023 Nobel Prize in Physics was conferred upon Pierre Agostini, Ferenc Krausz and Anne L'Huillier acknowledging their pioneering contributions to the development of attosecond laser technology. Attoseconds, which represent one quintillionth of a second, are the briefest units of time ever precisely measured. For perspective, an attosecond is so short that the number of them in one second is the same as the number of seconds that have elapsed since the universe came into existence, 13.8 billion years ago.

The ground-breaking work has enabled scientists to investigate the astoundingly rapid dynamics of atomic and molecular matter. This has ushered in a new era of understanding for a vast multitude of phenomena including chemical reactions, electron motions, and light-matter interactions. In 1979, Agostini made the seminal discovery that concentrated laser light focused on gas could generate an attosecond surge of high-energy electrons, a phenomenon known as above-threshold ionization (ATI), setting the groundwork for this voyage.

In the early 1990s, Krausz and L'Huillier independently devised novel techniques to generate attosecond laser pulses using high-order harmonic generation (HHG). In HHG, a laser pulse is directed through a gas and the interaction between the laser light and gas atoms results in a series of harmonics of the laser frequency, with attosecond pulses being the most advanced. Agostini, Krausz and LHuillier's attosecond laser pulses have revolutionized our capacity to investigate ultrafast phenomena.

Today, scientists use these pulses to acquire transient images of electrons in motion within atoms and molecules and to monitor chemical reactions occurring on attosecond timescales. Additionally, these attosecond lasers are now essential tools in various scientific domains:

1. Examining Chemical Reactions: Utilizing attosecond lasers to examine the rapid dynamics of chemical reactions aids in the development of new catalysts and materials. For example, understanding the attosecond timescale of a catalytic reaction helps in designing more efficient catalysts. This is akin to capturing the intricate dance of molecules in a chemical reaction that takes place within a mere quintillionth of a second.
2. Investigating Electron Movements: These lasers facilitate the investigation of electron movements within molecules, thereby enhancing our understanding of how molecules absorb and emit light and interact. For instance, visualizing the attosecond-scale electron movements in a photosynthetic process sheds light on the efficiency of energy transfer within biological systems.
3. Advancing Material Science: In the field of material science, attosecond lasers play a crucial role in the formulation of cutting-edge materials with exceptional properties, such as ultrahard substances with special optical properties.
4. Studying Biological Processes: Attoseconds are also useful for investigating the rapid dynamics of biological processes, providing insights into protein folding and enzyme function. This understanding can lead to the development of targeted therapies by precisely manipulating biological processes at the molecular level. Visualizing an attosecond is akin to capturing the fleeting moment when a protein transitions between different structural states in a time span of one quintillionth of a second.

Moreover, they can contribute to the development of revolutionary microscopes, transforming the diagnosis and treatment of diseases through imaging of living cells and tissues with unprecedented resolution.The pioneering efforts of Pierre Agostini, Ferenc Krausz and Anne L'Huillier have not only revolutionized our comprehension of the rapid dynamics of matter but have also launched innovative technologies across diverse domains.

- Tanay Pratap

Physiology or Medicine

While the COVID-19 epidemic brought the globe to a halt, it also cleared the path for a remarkable advancement in medicine: mRNA vaccines. Katalin Karikó and Drew Weissman shared the 2023 Nobel Prize in Physiology or Medicine in recognition of their pioneering work on nucleoside base modifications. Their findings changed the world of immunisation by enabling the creation of potent mRNA vaccines against COVID-19.

Traditionally, vaccines have stimulated immune responses by using viruses that have been killed or weakened, viral components or innocuous carrier viruses. However, these techniques need intricate cell culture procedures which slow down the manufacture of vaccines quickly during epidemics. The development of mRNA technology offered a possible workaround. The study conducted by Karikó and Weissman aimed to tackle the difficulties related to the use of mRNA therapy. Their mind-boggling research heralded a new phase of vaccine research.

Published in 2005, Karikó and Weissman's groundbreaking study showed that base-modified mRNA enhanced protein synthesis in cells and decreased inflammatory reactions. This breakthrough laid the foundation for the development of mRNA vaccines that would soon prove their potential during the COVID-19 pandemic. Two base-modified mRNA vaccines were created with amazing speed and effectiveness by encoding the SARS-CoV-2 virus's surface protein. With an estimated 95% protective effect, these vaccinations were swiftly authorised, saving many lives and restoring a feeling of normalcy to society.

The versatility and quick development of mRNA vaccines make them truly game-changing. mRNA vaccines can be rapidly synthesised and generated, in contrast to conventional vaccine production methods, which gives them great adaptability to fight new and emerging infectious diseases. The COVID-19 mRNA vaccines have proven successful, demonstrating the technology's promise outside of pandemics. Future applications for mRNA vaccines include the delivery of therapeutic proteins, the treatment of certain cancers and the fight against other infectious illnesses. The development of vaccines has been transformed by Karikó and Weissman's discovery of base changes in mRNA which offers hope for a healthier and more resilient future.

The development of mRNA vaccines against COVID-19 represents a transformative milestone in medical science. Katalin Karikó and Drew Weissman's pioneering research into nucleoside base modifications paved the way for the unprecedented speed and efficacy of these vaccines. With their groundbreaking discoveries, they have not only saved lives but also opened doors to a new era of vaccination, where mRNA technology holds the potential to combat a wide range of diseases and improve global health.

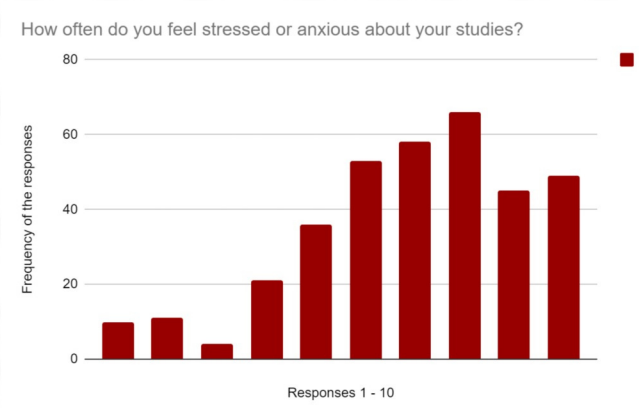
- Anagh Bajaj

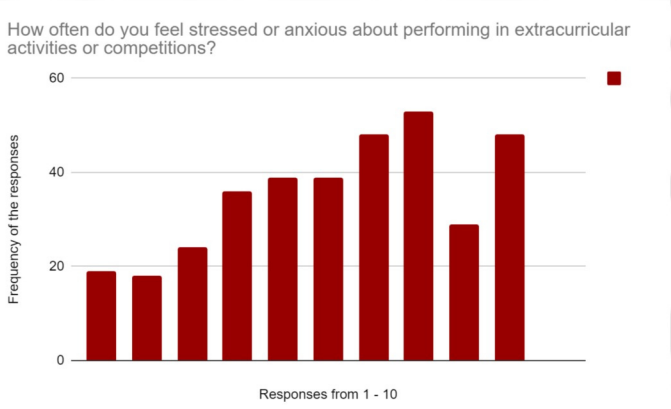
Survey on Stress

The Wavelength editorial board for 2023 conducted a survey on mental health this term, providing valuable insights into the mental well-being of Welhamites. More than 350 students participated in the survey. The survey focused on five factors affecting a Welhamite's mental health: studies, extracurricular activities/competitions, relationships with peers, future (college applications or career concerns), and peer pressure and public opinion. Students were asked to rate these factors on a scale from 1 to 10.

Studies:

Students were asked to rate, on a scale of 1 to 10, how often they feel stressed or anxious about their studies. The most chosen option was 7. Considering the importance of studies, it is not surprising to find stress levels higher than moderate. Another factor affecting this could be the expectation for students to balance sports, studies, and extracurricular activities to make a name for themselves in school. Overall, the survey suggests that academic concern is prevalent among the students.



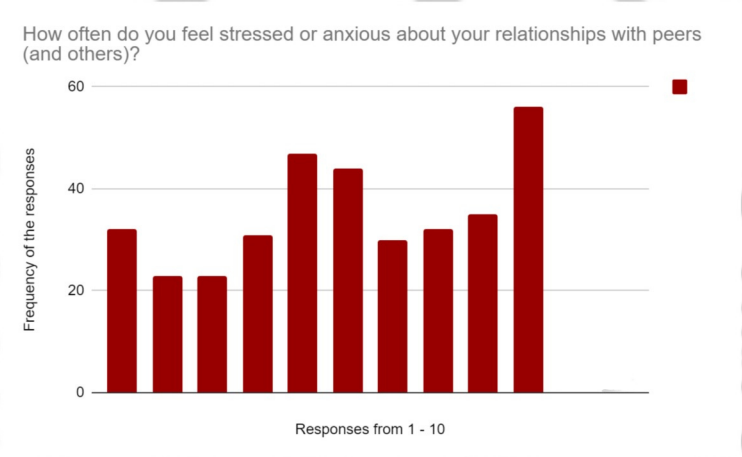


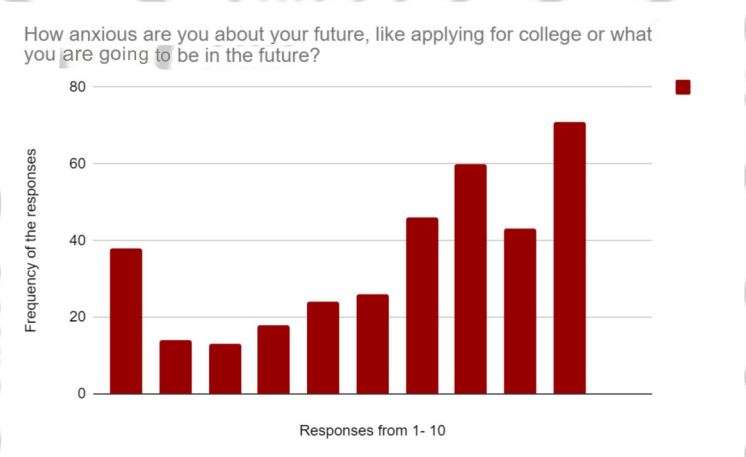
Extracurriculars and Competitions:

The school provides students with a highly competitive environment conducive to pushing their limits. The survey indicates that concerns about extracurriculars are moderate, with responses ranging similarly across the scale. The most chosen rating was 7, suggesting that students have varied attitudes toward extracurriculars and competitions, with some caring less and others caring more.

Relationships with Peers:

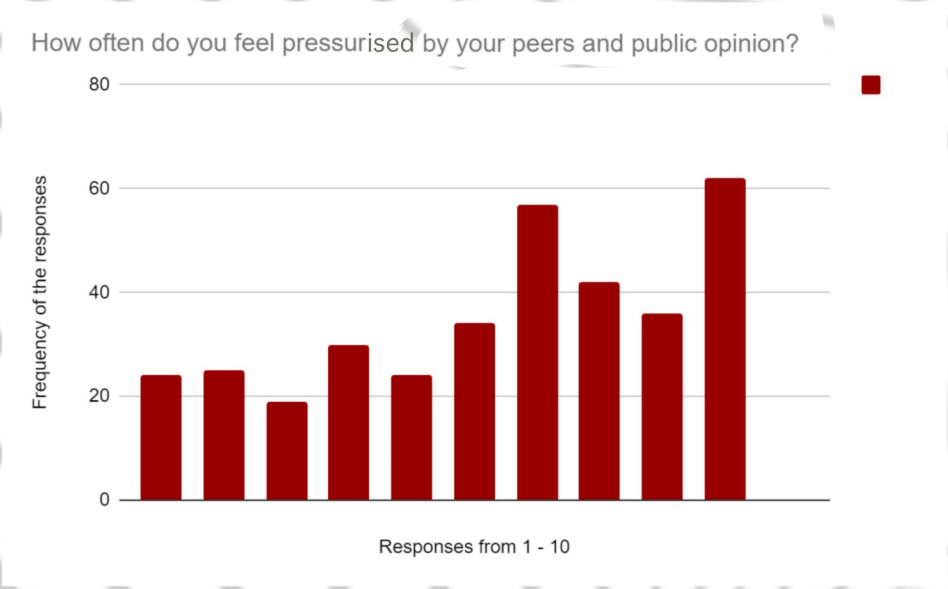
Students were asked, "How often do you feel stressed or anxious about your relationships with peers (and others)?" The gathered responses centered around the score of 5, indicating a moderate level of stress in this aspect. Living in a boarding school community, a unique social environment where students share living spaces and build close connections, the reported stress level suggests that navigating social dynamics, forming and maintaining relationships, and managing potential conflicts impact the overall mental well-being of students. Relationships outside the school are often neglected and ignored, leading to a loss of connection that someone might have.





Future:

Future plans, such as college applications and career concerns, define paths in school, especially for senior classes, shaping future lives. Students were asked, “How anxious are you about your future, like applying for college or what you're going to be in the future?” The most chosen ratings were 7–10, indicating high levels of concern for this factor, making students a bit more stressed and anxious. This stress is more prominent among senior students who have started planning the trajectory of their lives outside school.



Peer Pressure and Public Opinion:

Students were again asked to rate how much they were affected by peer pressure and public opinion in school. The average rating was 6.3. While the most chosen answer was 10, the responses seem to be spread out. Therefore, in terms of public opinion and peer pressure, students have a very diverse impact. For some, public opinion might mean nothing, while for someone else, it might mean a great amount of pressure because they want to meet expectations.

In Conclusion:

The survey provides a refined insight into the mental well-being of a Welhamite. While academic stress and future concerns emerge as the prominent sources of stress and anxiety among students, the survey also shows the varied impact of public opinion and peers on a Welhamite.

Trivia!

- Arav Dokania

Ancient scrolls decoded:

More than 1,800 papyrus scrolls known as the Herculaneum papyri were uncovered in Italy in the 18th century. They were long believed to be unintelligible because of the charring caused by Mount Vesuvius' eruption in 79 AD. However, a 21-year-old computer science student recently won a global contest to use a machine learning algorithm to interpret the first text from the scrolls. The algorithm that identified Greek characters on numerous lines of the rolled-up paper was created by University of Nebraska at Lincoln student Luke Farritor. He trained his neural network to emphasize the ink using minor, microscopic variations in surface textures. Πορφυρας, which signifies "purple," is one of the words he decoded using the machine learning technique, according to Nature.

New taste receptor discovered:

In addition to sweet, sour, bitter, salty and umami the scientists have discovered a new taste receptor. In research published October 5 in Nature Communications, USC Dornsife neuroscientist Emily Liman and her team found that the tongue responds to ammonium chloride through the same protein receptor that signals sour taste. The OTOP1 protein receptor, previously linked to sour taste, is activated by ammonium chloride. The ability to taste ammonium chloride may have evolved to help organisms avoid harmful substances.

Primate brains may help in treating human disorders:

The genetic, molecular, and anatomical composition of the human brain and the brains of nonhuman primates have been mapped by a team of worldwide scientists. This study of brain anatomy paves the way for a new generation of precision treatments for persons with mental disorders and other brain disorders by enabling a greater understanding of the molecular foundation of brain function and dysfunction.

Closest pulsar to Earth discovered:

A team of astronomers and scientists from France's National Center for Scientific Research (CNRS) discovered a pulsar 1,000 light-years from Earth. This is the Vela pulsar, the closest pulsar ever discovered. Pulsars are cyclic neutron stars whose observed radiation is very regular, typically ranging from milliseconds to seconds. Pulsars have very strong magnetic fields that cause particles to drift across two magnetic poles. These fast particles emit very intense light. The Vela pulsar is the highest burst of light from a pulsar ever observed. This revealed that the gamma-ray emitted by the Vela pulsar is 200 times more energetic than the average pulsar emission. The results are described in a paper published in the journal Nature Astronomy on October 5. The findings could lead to new insights into the physics surrounding these dense, rapidly rotating dying stars.

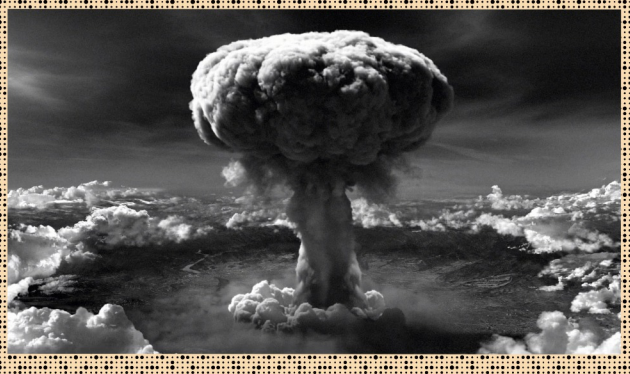
Age old theory about the nature of antimatter validated:

Scientists have validated the theory of antimatter proposed by Albert Einstein more than a century ago. On September 27, an international team of scientists reported this fascinating phenomenon. It appears that antimatter responds to gravity the same way as normal matter does. This is the first ever direct observation of free-falling antimatter in which atoms are made of antiprotons instead of protons and antielectrons instead of electrons. Antiprotons are basically negatively charged protons and positrons are positively charged electrons. The new research ultimately proved that atomic antihydrogen made up of one antiproton in the center with a positively charged positron orbiting around it is pulled downward due to gravity instead of upward like you might expect with a form of matter that presents as the "opposite" of normal matter.

The first embryos from a mammal have now been grown in space:

For humanity to expand its territory to space, one of the most important factors is reproduction. In this context, an experiment was conducted on the International Space Station in which a few hundred frozen two-cell embryos from mice were used. These cells were thawed and kept in a special setup at body temperature. Over the course of four days, the zygotes were allowed to grow and develop, becoming blastocysts—the assembly of cells that would normally develop into a fetus and placenta. Upon analyzing the data, the researchers observed that mammal embryos can develop healthily in microgravity without any complications or harmful effects.

The Conundrum



ACROSS

3. A VOLCANIC ROCK THAT CAN FLOAT ON WATER
4. LATIN NAME FOR GOLD
5. THE STUDY OF THE DEVELOPMENT OF HUMANITY
7. UNIT OF FREQUENCY
9. FATHER OF MICROBIOLOGY
10. CHEMICAL ELEMENT WITH SYMBOL TB

DOWN

1. POWERFUL AND LUMINOUS EXPLOSION OF A STAR DURING THE LAST EVOLUTIONARY STAGES
2. FATHER OF THE ATOMIC BOMB
6. FIRST PERSON TO WIN TWO NOBEL PRIZES
8. HORMONE CONTROLLING THE SUGAR LEVELS OF OUR BODY

1.supernova, 2. oppenheimer, 3. pumice, 4. aurum, 5. anthropology, 6. curie, 7. hertz, 8. insulin, 9. leewenhoek, 10. terbium

Mr. Samir Dhingra has remained an integral part of the Welham community for more than 25 years. His patient nature and critical thinking has led him to seamlessly take charge of the Science Department and of the Wavelength. His steadfast belief in every student has been a guiding light for all of us. We express our heartfelt gratitude for his invaluable contributions to Welham, and extend our best wishes for the exciting journey that lies ahead in his future endeavors!

Editorial Board

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