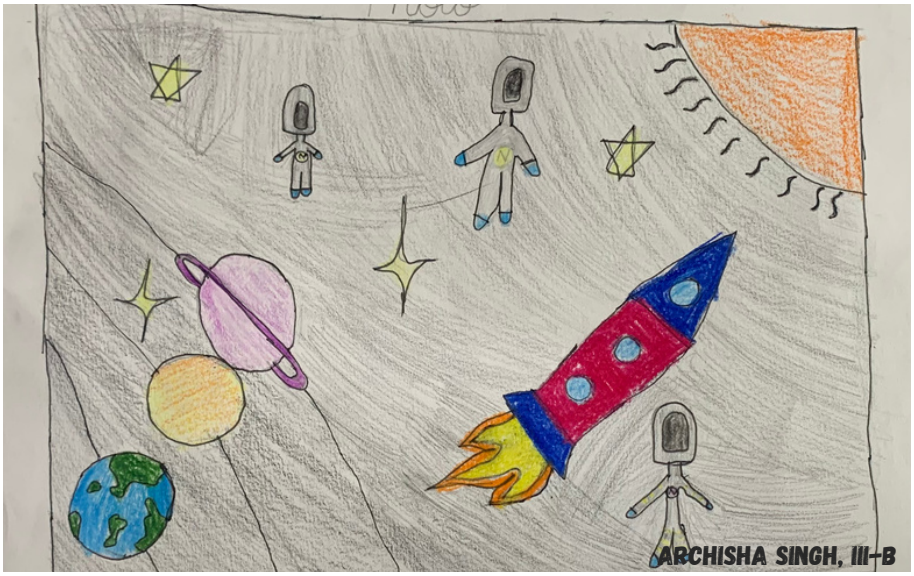
CURIOSITY

Editor's Note



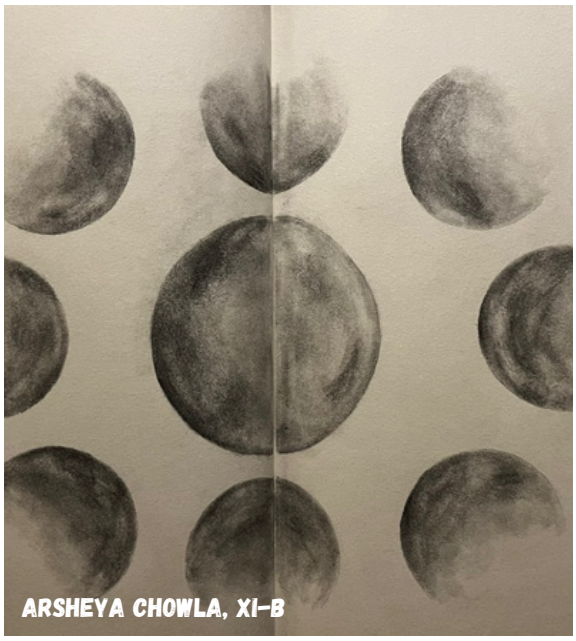
"All our science, measured against reality, is primitive and childlike-and yet it is the most precious thing we have."

ALBERT EINSTEIN

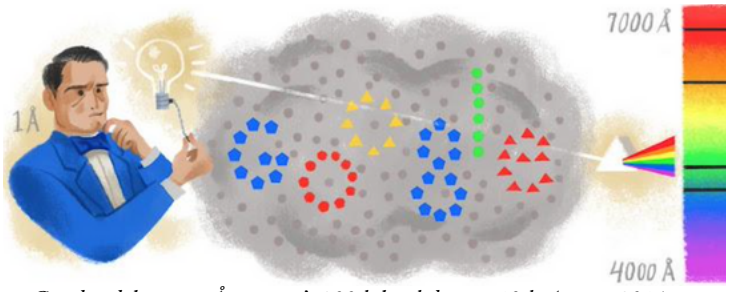
Being such a vast and dynamic discipline, it is practically impossible to comprehensively define science and all that it encompasses. But evidently, the single commonality, present and prevalent throughout the millennia of its development, has proven to be curiosity. Science encourages us to question, invites us to think and pushes us to ponder over its ubiquitous presence. Why do stars twinkle? Why do flowers blossom in spring? It was the search for the answer to such childlike questions that has shaped our understanding of the world around us. For instance, a man with this same childlike curiosity was traveling across the Mediterranean Sea. He looked far into the ocean and asked himself "Why is the ocean blue?". He wasn't satisfied with the explanation at the time, so he persistently tinkered and experimented, until he discovered the phenomenon behind the color of the ocean. The man was CV Raman. The phenomenon was the Raman Effect.

Today, science has reached unexpected and almost unfathomable levels. It would be impossible to condense its magnitude into just 4 pages, so we have chosen the magic of the natural world, to the charms of the universe; from the expanding realms of technology to the land of scientific fantasies called 'what-if'; and more, as some of the overarching themes to touch upon through articles and illustrations sourced purely from the student body, and we have been overwhelmed by the response. Both the quantity and quality of all the articles we received has been awe-inspiring and heartening to view. They all capture the "essence of science" as CV Raman defines it- "independent thinking and hard work". We have emerged from the process slightly more knowledgeable, and much more inspired; freshly assured in the power of curiosity. We hope you enjoy reading this magazine as much as we enjoyed making it.

~Sumaya Beri, Shubhkarman Singh Sandhu, XI



POV 1913 - What if angular momentum is quantized?



Google celebrating Ångström's 200th birthday on 13th August 2014

In a corner of 1860's Sweden, Anders Jonas Ångström studied the composition of the Sun and the aurora borealis, using a technique he pioneered called spectroscopy. By comparing the wavelength of light emitted by them with the wavelength of light emitted by an individual elements' atom after absorbing energy, known as spectral lines, he was able to show to the scientific world that the Sun primarily contained Hydrogen. But, the scientific world isn't very satisfied with just one discovery.

In Switzerland, physicist Eduard Hagenbach-Bischoff looked at the spectral lines of hydrogen used by Ångström and immediately got hooked to it. He wondered if there was any way to predict these wavelengths. He worked day and night on this problem but alas! Failed to come to a conclusion. Hagenbach took this problem to a friend who taught mathematics at school for girls, Johann Jakob Balmer. Hagenbach just gave the numbers to Balmer without any context and asked him to identify the pattern in them. Such a gifted mathematician was Balmer, that he figured out the pattern and gave Hagenbach the empirical formula that describes the spectral lines. This would be known as the Balmer Series.

Scientists still hungered for the explanation of why these formulas existed and worked, and it does seem their prayers might have been answered. Today, in July 1913, Niels Bohr published a paper on the theoretical structure of the hydrogen atom. This theory is the next in line after dozens of attempts at explaining the atomic model although, Bohr's attempt is successful in explaining the existence of the Balmer Series but, it does come with a catch.

Imagine running around a field. You first try to run at a causal pace, which you think would be around 1 meter per second. You wish to go faster, but can't. There is something stopping you from going faster, so you try harder and suddenly your speed increases to about 2 meters per second. You again try to go faster, but feel capped at 2 meters per second, when once again you suddenly jump to 3 meters per second. Now picture an electron and not yourself. This capping of the angular momentum of the electron at certain levels is known as quantization of angular momentum.

Johann Jacob Balmer

Niels Bohr refers to a proposition in his paper, made by John William Nicholson last year in 1912, who breaks the rules of classical physics and quantizes angular momentum! A proposition whose implications seem absurd. Electrons can only have a certain amount of angular momentum? Nothing between those values and nothing other than them. Such a proposition seems ridiculous at first. Why doesn't the moon exhibit this? Why don't the wheels of the Ford Model T exhibit this? You can ride the Model T at any speed you wish, giving the wheels of the Model T any arbitrary angular momentum. So then why did Nicholson quantize angular momentum?

You see, Nicholson wasn't a particle physicist, but rather spent his time performing spectroscopy of nebulae, the places where stars are formed. While analyzing the astronomical observation made by William Huggins, he noticed spectral lines of unknown elements. This led Nicholson to believe that all elements are formed from four protoelements Coronium, Hydrogen, Nebulium, and Protofluorine, and the spectral lines of the unknown elements were in fact of these protoelements. After deeply studying Nebulium, he realized that he would need one thing to complete his theory on Nebulium; the radius of the Nebulium atom but, this would only come through experimental observations, which was impossible. So, Nicholson filled this gap by using Plank's constant, which did indeed match experimental observations but, this also led to the manifestation of the angular momentum being associated with integral multiples of Planck's constant i.e. its quantization.

(From left to right) George Gamov, Thomas Lauritsen, Niels Bohr, Ebbe Rasmussen, CV Raman, at the University of Copenhagen Institute of Theoretical Physics, 1930

Neils Bohr came across the Balmer Series and Nicholson's quantisation of angular momentum and he realized the connection between the two which leads us to today, July 1913, Bohr's publication of the atomic model. Quantization may seem today as scientific fantasy, but tomorrow when more intuitive theories and explanations exist for a phenomena like quantization of angular momentum, it will step down from scientific fantasy to small talk between science enthusiasts!

Notes from a time traveler:

The protoelement theory was successfully able to predict the spectral lines in solar corona and nebulae but the protoelements theorized by Nicholson would later be disproved. Ira Sprague Bowen in 1927, showed the spectral lines of nebulium to be of a doubly ionized oxygen. Walter Grotrian and Bengt Edlén showed in the 1930's that spectral lines of Coronium were actually of highly ionized iron. Despite the basis of Nicholson's work being incorrect, his contribution to science cannot be neglected.

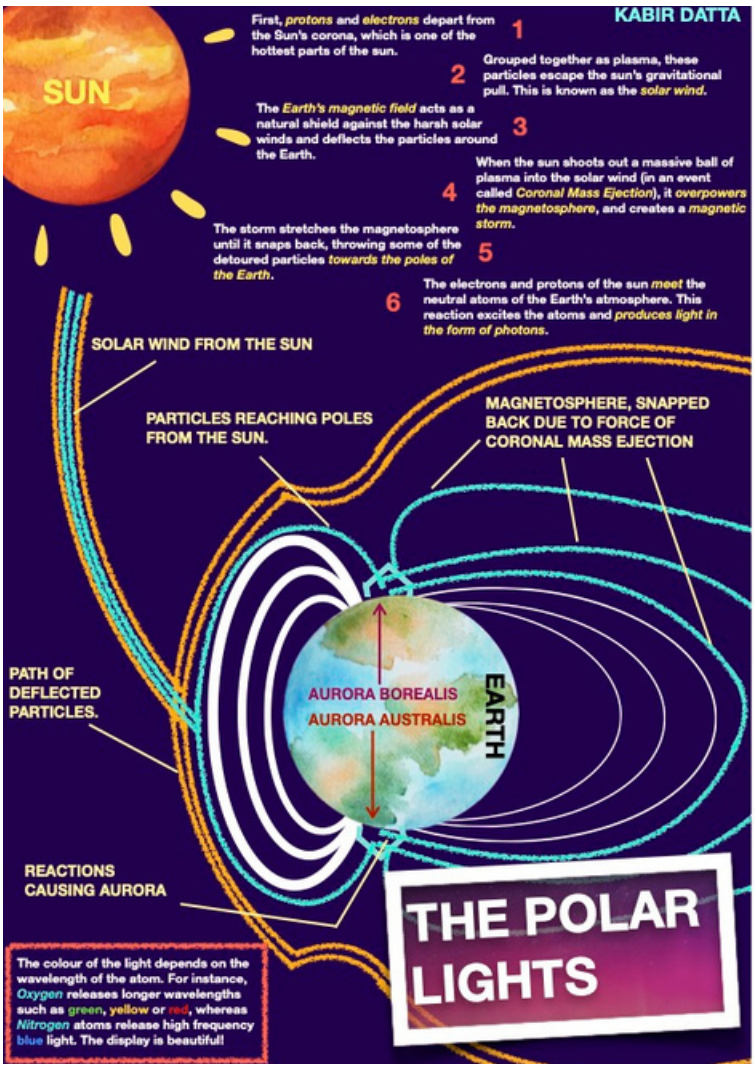
A modern explanation for the quantization of angular momentum came up in 1924, when Louis De Broglie, came up with the theory of wave particle duality for matter.

~Shubhkarman Singh Sandhu XI-B

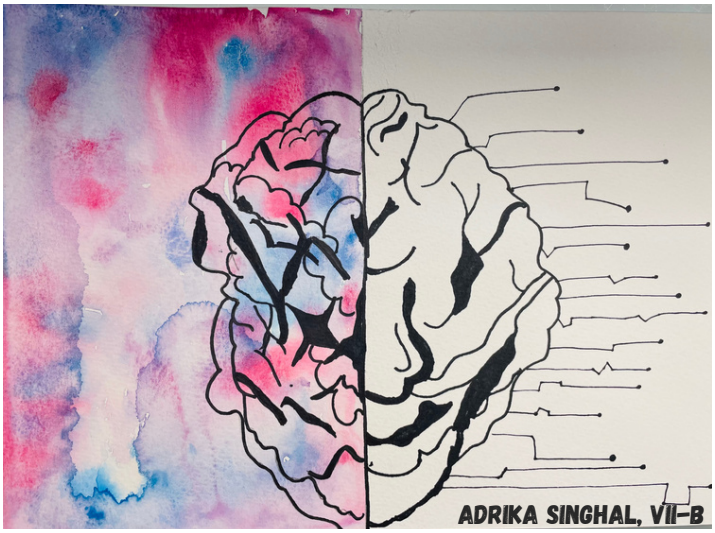
FERMI PARADOX

We've all wondered whether there is life in space, other than us. Given the statistics, there are approximately 40 Billion habitable planets in the milky way galaxy alone. That leaves us with the dreadful question: "Where are the aliens?". This is a problem humans have dwelt over for a long time, and it has been given a name. The "Fermi Paradox" (Named after Enrico Fermi) is an inquiry as to why there is no evidence of extraterrestrial life. There are many solutions to the paradox, but we'll be discussing the "Great Filter" theory. "The Great Filter" theory proposes that there is a challenge that all life must face. This can be any type of extinction level challenge and it may be evolutionary, technological or chronological. However, it must be something every species faces at some point in its timeline. It may have been the process of cell duplication, it may have been the rise of intelligence or it may just have been the chances of superior biological life. These are all examples that assume we have passed the great filter, and that we have passed a great challenge. However, if we do find aliens, it would be devastating, as it would mean the filter is ahead of us, and it could be climate change, nuclear war, overpopulation or artificial intelligence. It may just be something we don't know about yet. However, we know that if there is a filter, it may be the end of humanity, or proof that we have an amazing future ahead.

~Ayaan Agarwal, VIII



NEURALINK: DIGGING DEEP



Elon Musk, especially after his recent involvement in Twitter, is often associated with being somewhat eccentric. However, one of his many other companies, Neuralink, has just had a huge breakthrough. Neuralink is a company engaged in developing a device called The Link'. The Link is an interface system which can be controlled directly through brain activity. This could potentially help people with paralysis to control devices, but with their thoughts – eliminating the need for limb movement. The company was founded in 2016 by Elon Musk and other scientists and engineers. Essentially, the device is able to record and interpret signals produced by neurons in the brain, translating them into computers or prosthetics.

This chip which is around the size of a coin is implanted in the skull. Micro-wires, that are about 20 times thinner than human hair, are spread out into the brain and are added for a secure connection. A robot is being developed in order to ensure a safe and precise process. It has been claimed that this process is just as simple as LASIK eye surgery.

Now that we've discussed the device and company itself, the ethical and medical controversy surrounding the company is impossible to ignore. Firstly, various uncorroborated claims have been made, yet no clinical trials have been conducted. The company has played videos of a pig and monkeys with implants. The Physician's Committee for Responsible Medicine has raised concerns over the treatment of the monkeys involved in the research. Furthermore, it has been widely considered unethical and inappropriate to allow people suffering from serious conditions to get their hopes up about treatment, yet no disclaimers regarding this have been put out.

All in all, the company may be progressing, but concerns cannot be ignored until appropriate records are available and the required testing has been conducted.

~Meera Shukla, Shiva Seth, IX

Genome Editing: The Cutting-Edge Technology Changing the Future of Medicine

What if one could alter their appearance? Avoid having a genetic condition passed down to them. Make themself immune to a life-threatening disease? That's just a fraction of the potential of genome editing, and its unlimited possibilities could allow it to save and enhance the lives of millions worldwide.
Genome editing is a revolutionary technology that allows scientists to add, alter, replace, or delete specific parts of an organism's DNA. It refers to the ability of scientists to manipulate an organism's genetic code, by altering the order of the four bases that make up its DNA. This technology allows scientists to alter the features of an organism by rearranging the order of these bases.

CRISPR-Cas9 is the most commonly used method for genome editing; it's a powerful and versatile technology that has revolutionised the field of genetics. It's a favourite in the scientific community as it's cheap, efficient, and accurate. In this method, a piece of guide RNA binds to a specific sequence in the DNA, and then an enzyme called Cas9 cuts the DNA at that location. Once the DNA is cut, scientists can use the cell's natural repair mechanisms to add, delete, or replace specific sequences, thereby making precise changes to the genome.

Genome editing offers enormous potential benefits for medicine by allowing scientists to make precise changes to the genetic code of organisms, including human cells. This is used to fight cancer and other diseases by editing immune cells, removing HIV and genetic diseases from a person's DNA, and advancing the development of personalized medicine. Additionally, gene therapy is being developed as a way to prevent and treat diseases caused by genetic mutations, by introducing a healthy copy of a gene into cells to replace a faulty copy. These therapies can target both reproductive and non-reproductive cells; and in the case of the former, the changes made will pass down to future generations too. An example of this potential is the case of a patient in the UK with Leukemia who was treated with gene therapy in 2015, saving her life, and proving that the process is effective.

However, the use of genome editing technology raises several ethical considerations, including the safety and effectiveness of the technology for patients, the potential for socioeconomic disparities in access to the technology, and the immoral implications of using genome editing to enhance non-health-related traits or abilities. Additionally, the potential impact on future generations, due to changes made to reproductive cells, as well as the lack of consent from embryos during editing, raises questions. The fact that research on genome editing often involves the creation and destruction of embryos, has led many organisations to refuse to fund it. Technical difficulties such as unintended cuts or cutting the genome at the wrong location also raise safety concerns and add to the ethical complexities surrounding the technology.

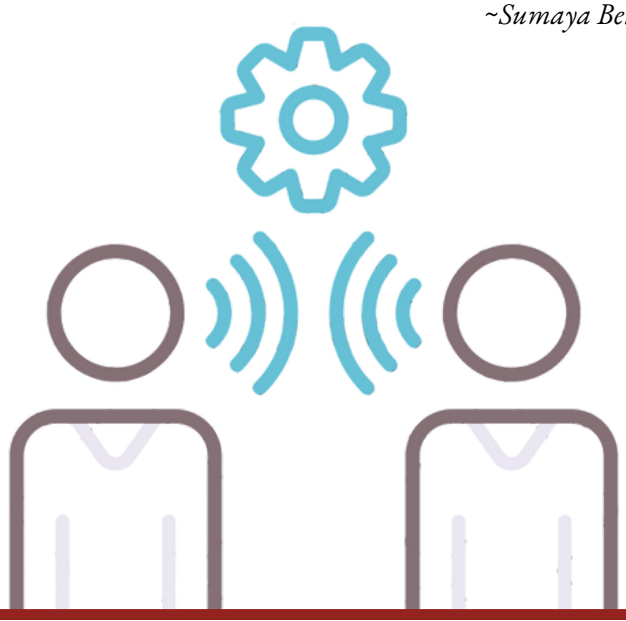
Despite the barriers that stand in the way, genome editing is indubitably a groundbreaking technology; and if perfected and used correctly, it has the potential to change the world for the better.

~Kavya Malik and Simrit Kaur, 9A

TELEPATHY IN REAL LIFE

In the reel world, brain to brain communication is commonplace. In real life, not so much. Can telepathy then be considered just another impossible and unrealistic cliche overused by science fiction series and movies? Not completely. It turns out, a dilute form of telepathy is actually possible in the real world, no matter how hard it is to believe. It can involve implanted electrodes in the brain, or less painfully, Electroencephalography or EEG. Large electrodes placed on top of one's brain can record the electrical activity of larger cells in the brain, but since the signals must go through the skull and skin, we cannot expect extreme accuracy. Furthermore, the brain speaks in signals we cannot understand. To decode these signals, previously conducted experiments have sought after easily understandable and expected EEG activity that we have seen before- like the brain activity when one moves a limb, or even imagines doing so. These patterns now need to be sent into someone else's brain to complete the telepathy experiment. Through implanted electrodes, it would be relatively simpler, as the current could be passed through them. It can, more realistically, be done through a Transcranial Magnetic Stimulation wand- a device that creates a very effective magnetic field at its top. If the wand is rested on one's head, the magnetic field will pass to the brain tissue that is directly below it. The induced current caused by the magnetic field activates that part of the brain tissue. This is not a very controlled process, but if the wand is placed over the visual cortex, it can, quite reliably, cause triggered flashes of light known as phosphenes. An experiment involving the given factors was conducted more than 8 years ago in 2014, when one person concentrated on something specific- a message converted to binary language (ones and zeroes). The message was transferred through EEG sensors on the sender's scalp. The flashes of light received by the person wearing the Transcranial Magnetic Stimulation wand as a headset signified either a one or a zero. The receivers then translated the messages- completing this telepathy in little over an hour. The experiment was proved successful. So yes, telepathy is possible, but it is not because of a genetic defect or a magical ability- it is all down to technology and science.

~Sumaya Beri, 11



Looking back in time...

Synapse

Thailand International Science Fair

Public Lecture Nobel Laureate in Physics 2012

Class 10 experimental demonstration

Class 10 Science Quiz

Classes 6-8 Trash to Toys

Send all articles/suggestions to sciencemag@vasantvalley.edu.in | Online issue available at http://sciencemag.vasantvalley.org/ and Veracross