An Initiative of ***SCOSH***

Sci-verse

THE MAGAZINE

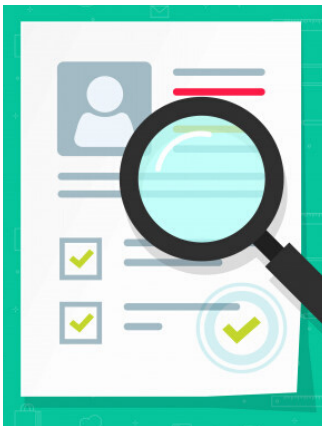
OVERVIEW OF NOBEL LAUREATES

SCIENCE ARTICLES ON POPULAR TOPICS

SCIENCE NEWS

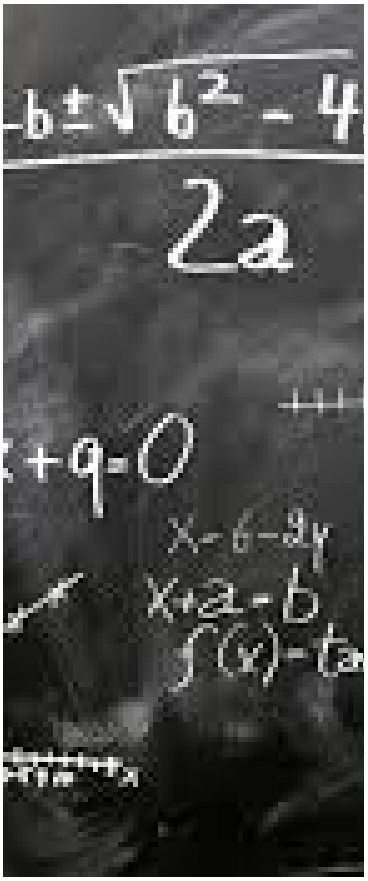
This magazine is to a small step towards popularising science and create an environment that inculcates its culture in the college.

CONTENT



1. ORIGIN OF CALCULUS

'Calculus'– a Latin word which means 'small pebble', is the mathematical study of continuous change. But, how are these two related? In ancient times, small pebbles were used to counting and small calculations. Furthermore, this word has evolved and now is used for the method of computation. We usually come across two major branches of calculus - differential calculus and integral calculus and we know that they both are connected by the 'fundamental theorem of calculus'.



Most of us know that modern calculus was developed in the 17th century by Isaac Newton and Gottfried Wilhelm Leibniz. But what about earlier? Were there any foundations that led to the development of modern calculus?

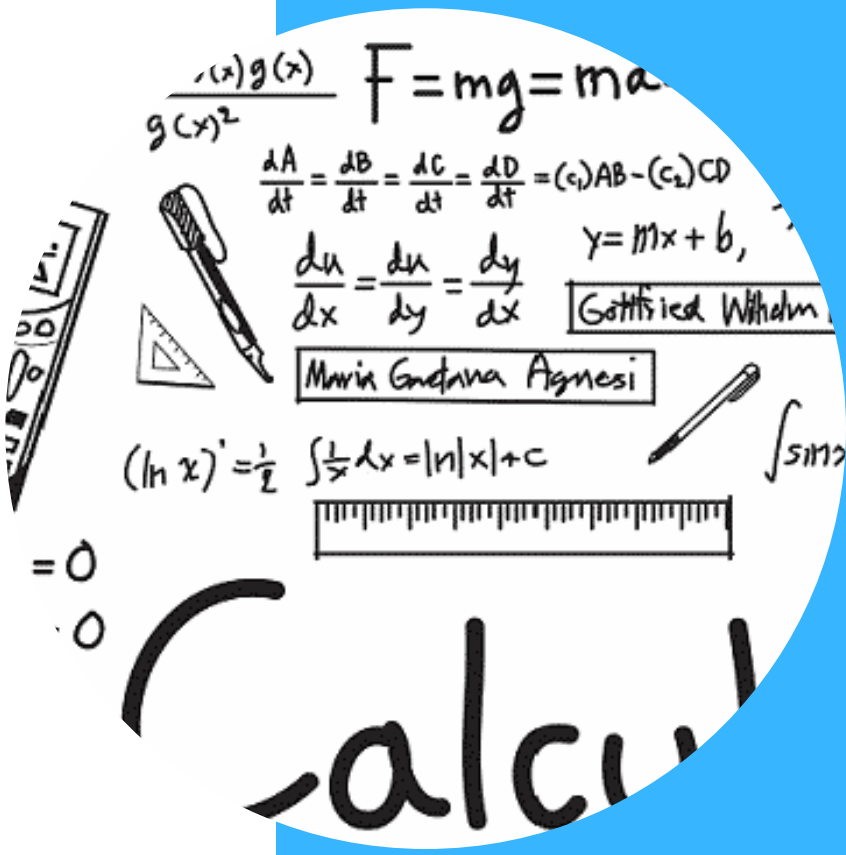
Its roots were founded in 1820 BC. In that period, basic methods of calculating area and volume were used, which were not accurate. Their signs can be seen in Egyptian Moscow Papyrus.

But the major steps in the foundation of calculus can be seen from 450 BC. Eudoxus, a Greek mathematician and astronomer, gave the method of exhaustion which gave the idea of limits. This idea was later developed by Archimedes. Liu Hui also independently worked on this method and found a way to calculate the area of circle.

Now, here a big question arises. What is this method of exhaustion which led to the foundation of integral calculus? I think we have used this method earlier in calculus but didn't give it much importance. So, let's find out what it's all about.

Let us consider a shape. For our convenience, let's take a circle. Now inscribe it in a sequence of polygons, whose area converges to the area of the circle. If the sequence is correctly constructed, the difference in the area of n-th polygon and the circle will diminish as we keep increasing our n .You can see how they used the concept of limits at that time and found area of the circle.

But this method of calculation required proof. Here, proof by contradiction comes to rescue. Now, to understand how it was used, we go back to the step where you took the circle for calculating its area. Now take, the other region(polygon) which can be exhausted to find the area of the circle. First, assume that the true area is greater than that of polygon, which is a false assertion. Now taking the other way round, assuming that the area of polygon is greater than that of circle, which too is a false assertion .



This shape which we consider as ‘circle’ was used by Archimedes to explain this
method. He further stated that quotient of the area of polygon and the square of the
radius of the circle can be made close to π as the number of sides of polygons is increased. From this concept only, we use πr^2 as the formula for area of circle.

There were other results which he found from the method of exhaustion which are pretty much useful in modern-day mathematics. But this basic and easy concept led to the most significant and fundamental branch of mathematics . We will continue to discuss the evolution of modern-day calculus and it’s uses in the upcoming sections.

Article by - Vaibhav Gupta (M.sc Mathematics Second Year)

2. WHAT IS INFINITY?

What is infinity? A subject of discussion from ages. If you want to know the answer to any question, you have to dig it in its past. Now the question arises on how the idea of this concept came into existence? The first record which we know dates from (c. 610 – c. 546 BC). Alexander, a Greek philosopher, first used the word 'Apeiron' which means unbounded, indefinite which leads to the word infinite.

After this Aristotle, Zeno's paradoxes, Indian mathematician Surya Prajnapti, etc gave their views on infinity but still now it's a question which is most talked about. Now, taking most of the prolific statements given about this question, I will help you to know what is this about? Infinity can be termed as the concept of that is endless, bounded and which doesn't have any limit. The symbol which we use '∞' was first given by John Wallis in 1657. The word infinity has so many applications that it can be distinguished in three fields – Mathematical, Physical and Metaphysical.

First, let's understand what is mathematical infinity? The idea of this goes back to the time of Pythagoras and his followers. When they calculated the ratio of diagonal and the side of the square they got stuck as they believed that everything could be expressed by involving the whole numbers.
But know, after knowing what irrational numbers are, we can easily tell that what they were referring to. If you will take a square of length 1, then its diagonal would be, which is written as 1.414213562… which indicates an endless, non-repeating pattern.

After this, Aristotle and Plato rejected the notion of actual infinity and proposed the term 'potential infinity' (ability to count till the end).

3. NANOPARTICLES FROM TREE LEAVES

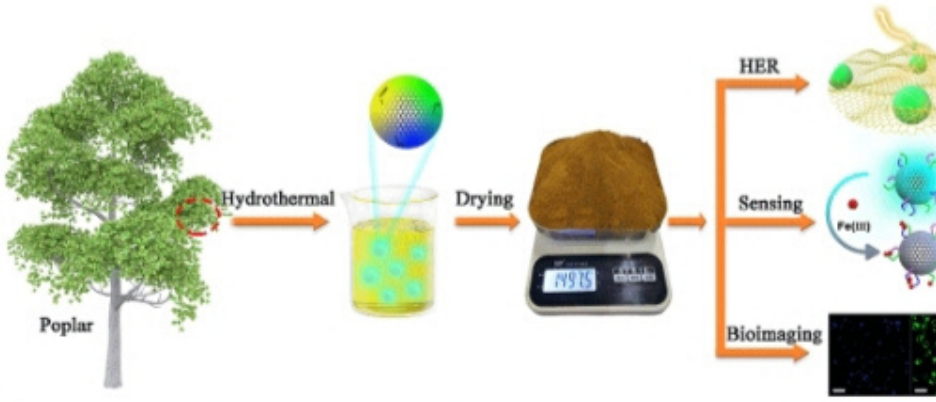
Large quantities of exotic nanomaterials called carbon quantum dots (CQDs) can now be created from poplar tree leaves. Quantum dots are a semiconductor nanocrystal exhibiting quantum mechanical effects that allow it to mimic the properties of an atom. It contains a finite number of charges and has discrete energy levels. It is sufficiently small for the wave-like behavior of their electrons to be distributed across the entire structure. This bestows the particles with many unique and useful optical and electronic properties. Quantum dot can be made from many materials, ranging from carbon-based organic compounds to metals and inorganic semiconductors.

CQDs have already been widely applied in biosensing, nanomedicine, bioimaging, optoelectronics, catalysis, andenergy conversion and storage.

The traditional methods for making nanoparticles are surrounded by problems. Most of the methods depend on chemically or physically cutting expensive large carbon precursors (t he raw material used to make carbon fibers) in the laborious process using complex equipment and corrosive chemicals, and achieving low yields of products.

The researchers demonstrated the ability to readily add selected chemical groups to the surface of the CQDs, to give them some specific useful properties.

They demonstrated that their CQDs could be used to selectively detect iron Fe3+ ions, assist in the imaging of cells, and catalyze the generation of hydrogen from water for potential use as a sustainable fuel.The potential to replace expensive and more toxic and polluting inorganic alternatives adds an environmental advantage to the sustainable and environmentally friendly method of manufacture.



Article by - Sakshi
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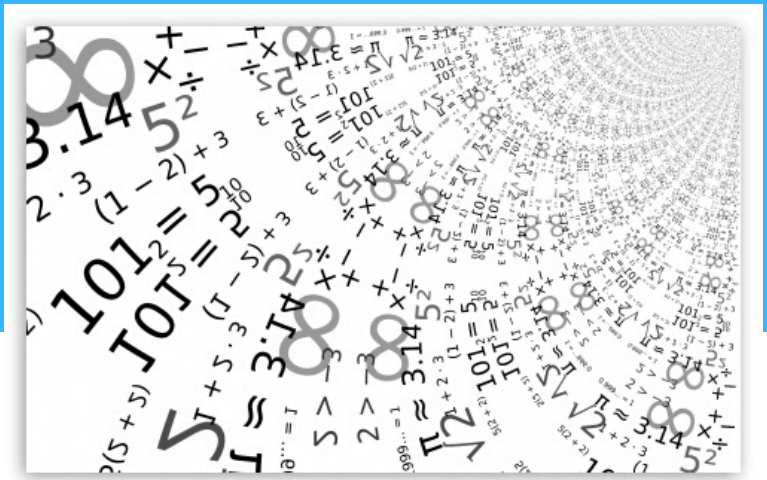


Then, Archimedes and Eudoxus of Cnidus developed a technique, 'method of exhaustion', which gave the preliminary idea of calculus. The idea of infinitesimals to calculate the derivatives of the slope was heavily criticized at that time but it later got firm footing after the development of non-standard analysis by Abraham Robinson in the 1960s. This above talk was to give you the feeling of the word 'infinity' Now let's talk about more direct use of this word

We have, at one point or another have thought about comparing the sizes of infinite sets. If you have not thought, think of two concentric circles with one's radius double of other.

What you will say about the number of points in the two circles? Are they equal or not? Are they double of each other? Does it suggest that infinity equals the twice of infinity?

In the early 1600s, Galileo gave a paradox that suggested that counting numbers could be put in one to one correspondence with apparently much smaller sets of square numbers.

Similarly, he also stated that a set of numbers can be paired with a set of doubles.All this confusion was resolved by George Cantor in 1873. He proved that not all infinities are equal. He used a 'diagonal argument' and showed that the size of the counting numbers is strictly less than the size of the real numbers. This result is well known as Cantor's theorem.

Cantor used the diagonal argument that cardinality of any set must be less than of its power set. In general, a set with n elements has a power set with 2^n elements, and these two cardinalities are different even when n is infinite. He used the term transfinite cardinals to describe the sets of these sets.

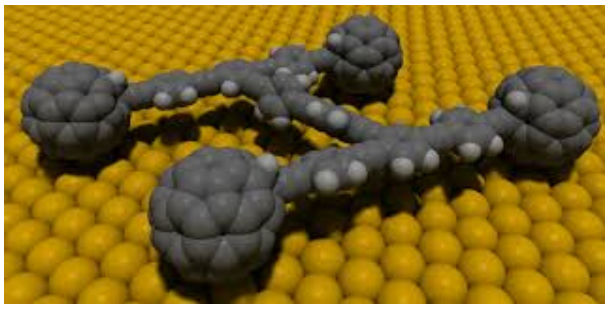
Axioms are still coming over this concept and still, a well-constructed definition is awaited on this topic.In coming articles, I will give you a brief description of physical infinity and metaphysical infinity. Till then, you can try to visualize mathematical infinity.

Article by - Vaibhav Gupta
(M.sc Mathematics Second Year)

4. NANOCARS: TINIEST RACE CARS IN THE WORLD

Wheel, indeed, is a great achievement for mankind. As the wheel rolled down the hill, it progressed in the direction of astonishing developments and inventions. Laws of motion can easily predict the conditions where a wheel would start to roll. But are there possibilities that a molecule would roll over a surface? Yes, said the professor James Tour of Rice University. In 2005, his team developed the first nanocar to inspect the motion of fullerene over metal surfaces. The term, however, is misleading. Unlike its macroscopic counterparts, this invention lacked a motor (more accurately, a molecular motor). Since then many different molecules have been designated as nanocars.

A nanocar is a few nanometer long molecular machine which can move in structurally defined directions. It is made into a car like structure by joining four wheels by a carbon chassis. Ideally, it should also have a molecular motor that would continuously vibrate under an energy input which brings the structure in motion.



However many simpler molecules also work equally well. The efficiency of numerous structures is tested by a nanocar race.The first nanocar race was held at Toulouse (France) in 2017, where teams from 6 different countries participated in a 36-hour long competition. The race track is 100 nm long, set up in vacuum at a very low temperature. Gold, being soft, can be made extremely flat, hence gold is generally used to make race tracks. The winning team,however, used a ‘silver’ race track to slow down their uncontrollably fast nanocar.

The nanocars are driven by four miniaturized STM (Scanning Tunnelling Microscope). STM works on the principle of electron tunneling i.e the electrons are transferred to the molecule without making any physical contact. The tunnel current causes intermolecular vibrations that activate the motor and the vehicle starts to move.

The expected speed is 5 nanometers per hour. As the nanocars are invisible to the naked eye, after each attempt the surface needs to be scanned and at the end of each hour, a short animation of the nanocar is developed.Nanotechnology is still in its infancy. The behavior of nanomachines is difficult to predict. It is a great irony that the German team, participating in the 2017 race, broke two cars. The molecules of this dimension are prone to thermal disturbances which constantly shakes the molecule, hence it is difficult to expect them to move in a straight path.

The development of nanomachines and nanorobotics will help develop efficient biological machines that could identify and kill cancer cells. As of now, nanocars might not have a practical application but with great minds working in the field, the future will certainly witness our lives being revolutionized by nanotechnology and nano molecules.

However, the development of more efficient molecular motor and Tech -Atoms is predicted. This will enable future scientists to prepare quantum circuits, a model for quantum computation.

Article by - Rashmi
(M.sc Chemistry Second Year)

5. TOWARDS ANOTHER QUANTUM REVOLUTION: THE QUANTUM INTERNET

It was October 29, 1969, when ARPAnet delivered it's first message, with the first computer located in a research lab at UCLA and the second one at Stanford, 'LOGIN'. Anyways, it crashed and the Stanford computer only received the first two letters. That's when mankind took the first step towards connecting the world through a single bond, the 'INTERNET'.Fifty years after the current INTERNET was born, physicist and computer scientist Stephanie Wehner is planning and designing the next one, the 'Quantum Internet'. 'She believes that it would revolutionize many aspects of science and technology' .

HOW DOES QUANTUM INTERNET DIFFER FROM THE CLASSICAL ONE?

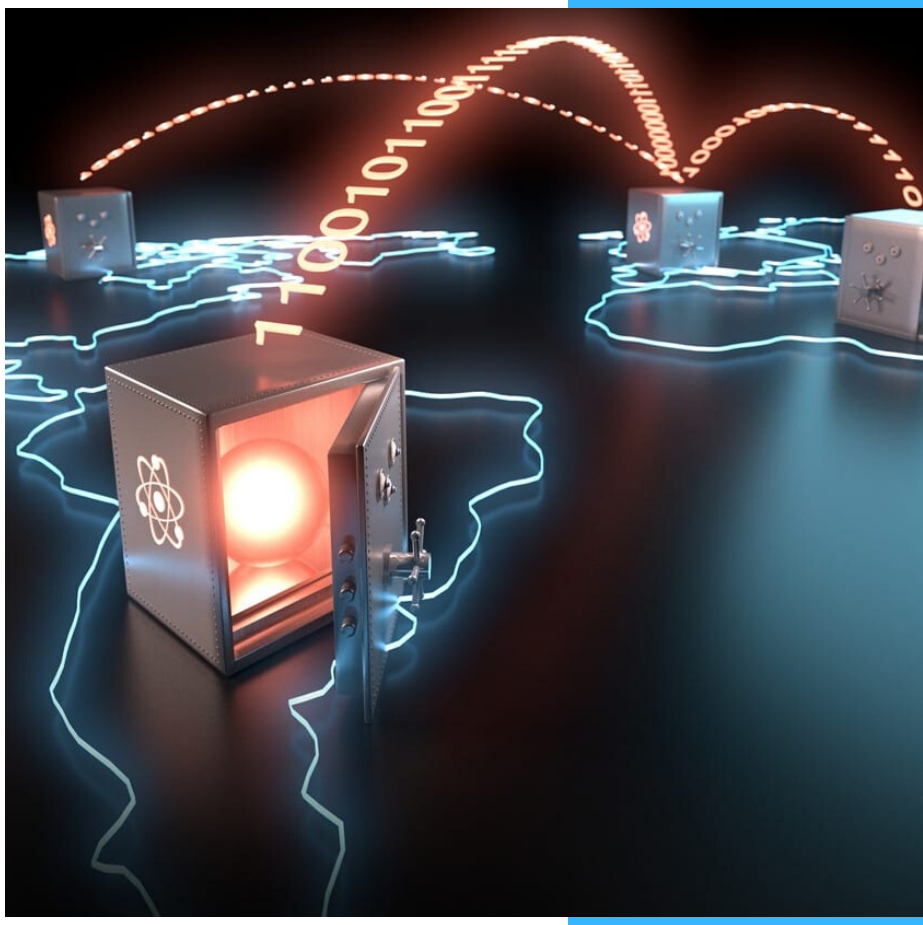
Classical computing relies on binary information, represented by bits that are either 1s or 0s. Quantum information uses quantum bits, or qubits, which can be in both the 1 and 0 states at the same time. '

Superposition', is the first of several concepts that form the foundation of the second quantum revolution, after quantum computers.A qubit only 'chooses' one state or the other at random, though the probability depends on how much up and down are in the superposition when it is measured. The second important concept is entanglement, where the behavior of distant particles can be inextricably connected or 'entangled'. When one entangled particle is measured and hence chooses' a state its partner is immediately bound by that choice, no matter how far away it is.

Entanglement is the key to quantum communication. The third concept is the 'no-cloning theorem', which says the Information in a quantum particle can never be fully copied without changing the state of the particle. A hacker can make a copy of your email now without you ever knowing; a hack of a quantum system, however, is bound by the laws of physics to leave traces.

The idea is not to replace the internet we have today but to add new and special functionality. There are all kinds of applications of quantum networks that will be discovered in the future, but we already know quite a few of them. Firstly, it would help us break a lot of the security protocols that exist today. Also, new kinds of remote computing will become possible. One of the fascinating applications it will have in astronomy is, a quantum internet could also be used to make a better telescope, basically by combining distant telescopes.

The state of the light particles coming into
telescope 1 are teleported, using quantum entanglement, to telescope 2, and
then they're combined with the light of telescope 2, and hence producing more
data, hence increasing the precision in measurements.

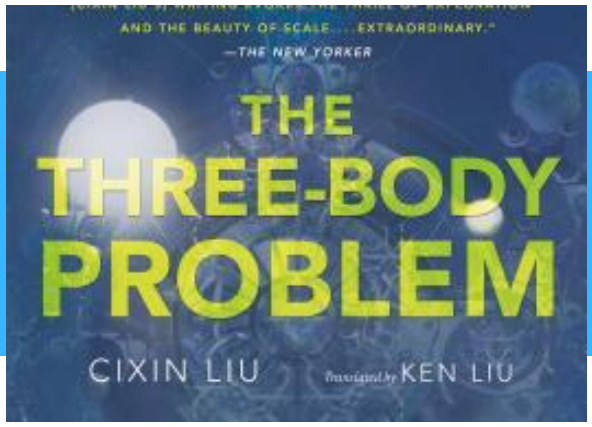


To give another example, people have also shown that entanglement enables more accurate clock synchronization between two places, which will have a lot of applications.

"It would help to break a lot of the security protocols that exist today."

Article by - Rashi Kaimal
(M.sc Physics Second Year)

6. THREE BODY PROBLEM



INTRODUCTION

All of us are familiar with Newton's law of gravitation. It tells us the force between two bodies (isolated from the rest of the universe) to a high degree of accuracy. It also tells us the trajectories of these bodies (of comparable masses) when putting into motion. But stop for a moment and think what will happen when another body/body (of comparable mass) enters/enter the scenario. Will we be able to track their trajectories given initial conditions? Will Newton's laws still work? (Spoiler alert, they don't.)

"Will we be able to track their trajectories given initial conditions? Will Newton's laws still work?"

The Three-Body Problem:

So what's the deal when a third body enters? The motion becomes 'chaotic'. You can
no longer predict the trajectories of the three bodies if you're given their initial coordinates of position and velocity (momentum). The equations become too long and difficult to solve and they have no closed-form solution.
Hence, to date physicists have to rely on numerical methods to find possible solutions to this problem.

What could be posiible and recent solutions? Lets find out

POSSIBLE SOLUTIONS

Many physicists and mathematicians have spent time pondering over this age-old problem. One of the solutions includes taking the third body to be having a negligible mass so it won't exert force on the other two bodies. This is an analog to the problem of Sun-Earth-Moon (where the moon is taken to have negligible mass). This 'restricted three-body problem' simplifies the equations of motion and provides a closed solution.

Starting from Euler in 1715, physicists and mathematicians have provided their interpretation of the three-body problem and motivations and solutions to the same. However, they have considered special cases where either the equations of motion simplify or the problem entirely takes a new form. In 1912, the Finnish mathematician Karl Fritiof Sundman proved that there exists a series solution in powers of t1/3 for the three-body problem. The quest for a closed analytic general solution still remains an open problem in the world of Physics.

RECENT SOLUTIONS

Recently, a group of researchers at the Hebrew University has come up with a statistical solution to the non-hierarchical problem. They have derived the solution using the ergodic hypothesis since 'chaos' motivates the assumption of 'ergodicity'. (Ergodic hypothesis says that, over long periods of time, the time spent by a system in some region of the phase space of micro-states with the same energy is proportional to the volume of this region, i.e., that all accessible micro-states are equiprobable over a long period of time.) They have provided closed-form distribution of outcomes. On comparing, their outcome distributions to large ensembles of numerical three-body integrations, they have found good agreement.

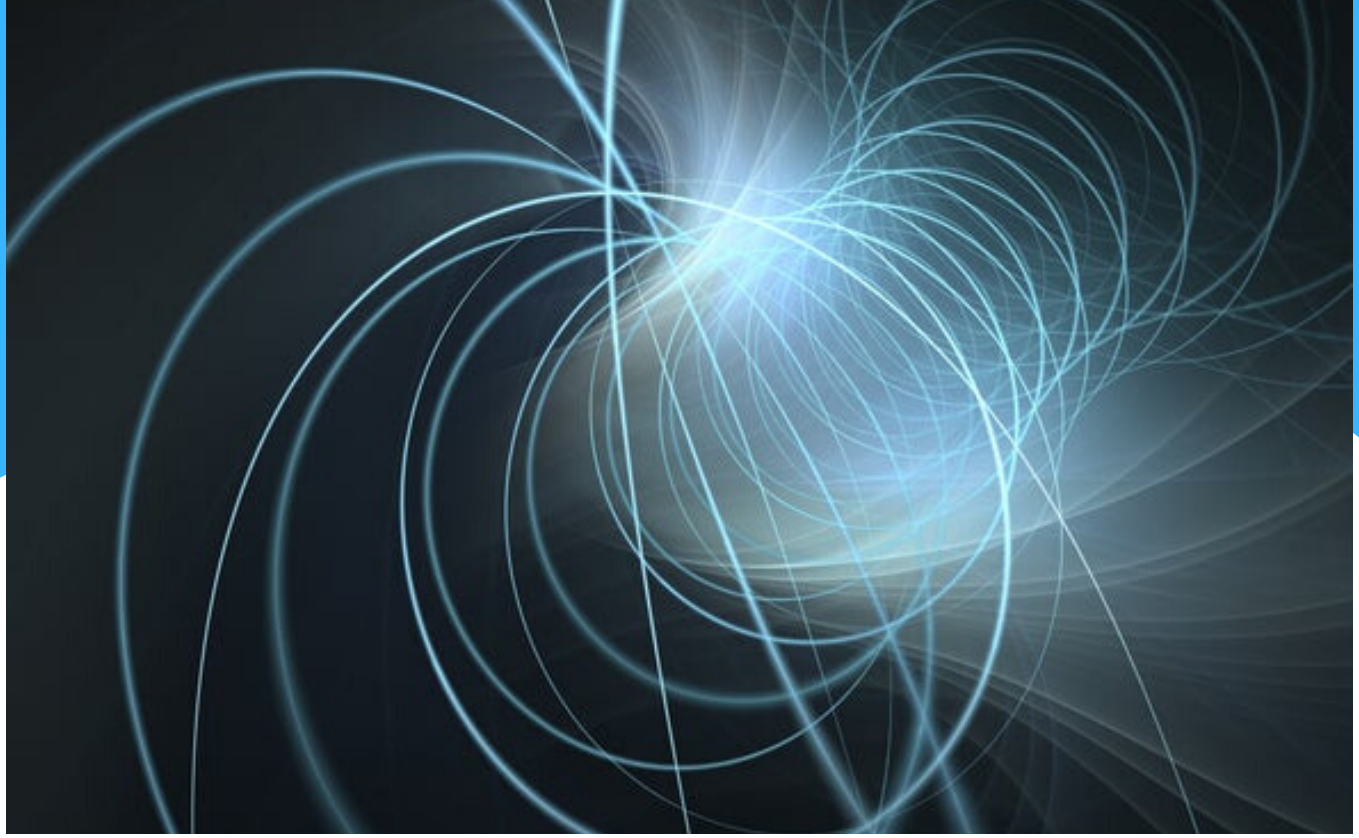
Article by - Anusha Vasaikar
(M.sc Physics Second Year)

7. STRING THEORY

For centuries, even as far back as the ancient Greeks, the scientific belief was that everything was constructed of atoms, the tiniest building blocks of the universe. It was later discovered that these atoms were constructed of electrons, protons, and neutrons. More recently scientists found the sub-atomic particles themselves were made up of tinier bits known as quarks. It's all normal so far. Now scientists have come up with a new theory called STRING THEORY. Now this theory is a bit weirder because it presents the idea that we are not made up of particles but by just a bunch of strings.

According to the STRING THEORY, the fundamental constituents of a particle are made up of a closed loop-like vibrating filament of energy.

This filament on vibration does not produce a musical note but rather the particle itself. So it's a closed filament vibrating at different frequencies producing different particles.Here we can see that matter particles such as quarks and electrons as well as radiation particles such as photons are coming from a single entity i.e. "the string". Now, by working on its mathematics it was concluded that this theory does not work in three dimensions of space but surprisingly 10 dimensions along with one dimension of time raising a question of where are the other remaining dimensions. It was then theorized that the remaining dimensions are all present in space but we can't see them as they are very small and curled-up. So the way a string vibrates depends on the geometry of the extra dimensions. By working on this theory it was also observed that in 10 dimensions the theory yields various constants of nature such as gravitational constant, the mass of electron even permittivity of free space.



It is to be believed the values these constants have is due to the way in which all the 10 dimensions of space have aligned themselves or else the universe as we know wouldn't exist. This theory if found true could explain the structure of the whole universe and is being currently tested at LHC at CERN, Switzerland.

Article by - Aryan Borkar
(M.sc Physics Second Year)

8. Umm... Yeah ! it's Kinda Logical

We human beings are rather a proud bunch for our ability to apply logic and to reason. Did you ever wonder, What Logic itself means, or what is your ability to apply logic? Well, if you did then Congratulations! (Welcome to another episode of pissing everyone off and a cozy sleepless night). and if you didn't, Hey! don't worry, you can try doing that. In this article, we will talk about the Mathematical Logic. The word Logic has a Greek origin (as for the most of science and mathematics) it comes from the word "logos" which means "the word"(basically Mike drop) or "what is spoken".Trying to be more Formal and concise, Logic is the study of the steps of reasoning. In every reasoning system, we require some basic assumptions that we call axioms of the system.

"Logic is the study of the steps of reasoning. In every reasoning system, we require some basic assumptions that we call axioms of the system."

In our History every human civilization that dared to emerge had its own philosophy it's own set of principles .whether they were right or wrong that's the job of mortalists, but every civilization gave us one thing it's logic and arguments. Until the mid 19th century The logic was nowhere seen to be as study except Philosophy(Yeah ! that weird subject which forces you to be a statue in Greek history) but at that time George Boole and then Augustus De Morgan presented ideas as systematic mathematical treatment of logic. Later on, mathematicians started to study every mathematical system is as a system based on logic, mathematicians feared that mathematics was not built upon the proper axiomatic system. Which led towards the development of axiomatic systems of mathematics.one of the greatest example is Hilbert's axiomatic system. Which was a replacement of Euclid's system of axioms for Euclidean Geometry(seems Ironic, Huh... The guy was beating Him in his own Game), as Euclid's axioms were insufficient to prove all the theorems.

After that Hilbert and others tried to find an axiomatic system that can make every mathematical system consistent under the name Hilbert's Program, but Kurt Godel proving the fact that an axiomatic system cannot give the proof of the consistency of itself.it became impossible to find a system that could make Mathematics consistent in itself. Now many of us could to argue whether it is one of our mathematical limitations or our greatest mathematical liberties which can lead us to pursue the beauty of patterns indefinitely.

Mainly mathematical logic has 4 subdivisions known as

1.Set Theory
2.Model Theory
3.Recursion Theory/ Computability Theory.
4.Proof Theory

1. Set Theory:
This is the branch of mathematics that studies the collection of objects present in a system. As much as foundational this topic is it's very surprising to know it was developed during the late 19th century, and more to surprise that a topic mathematics is usually developed over the time by the contribution of many mathematicians but this topic was developed by one man named as Georg Cantor developed it on his own. Set Theory is all about the relation between an object and it's set. The relationship between object and the set is Binary. Coming along there are notions same as arithmetic operations in set theory as Unions, Intersections, Set difference, Cartesian Product, Symmetric difference and Power set.

2.Model Theory.
Now creating axioms and building reasons based on those axioms gave birth to mathematical structures that had no physical significance nor a way to physically interpret them. That's where Model Theory comes in the role, this field of study sees the pure algebraic structures or universes of set theory from the perspective of Mathematical logic.

The modern definition of Model theory is given.

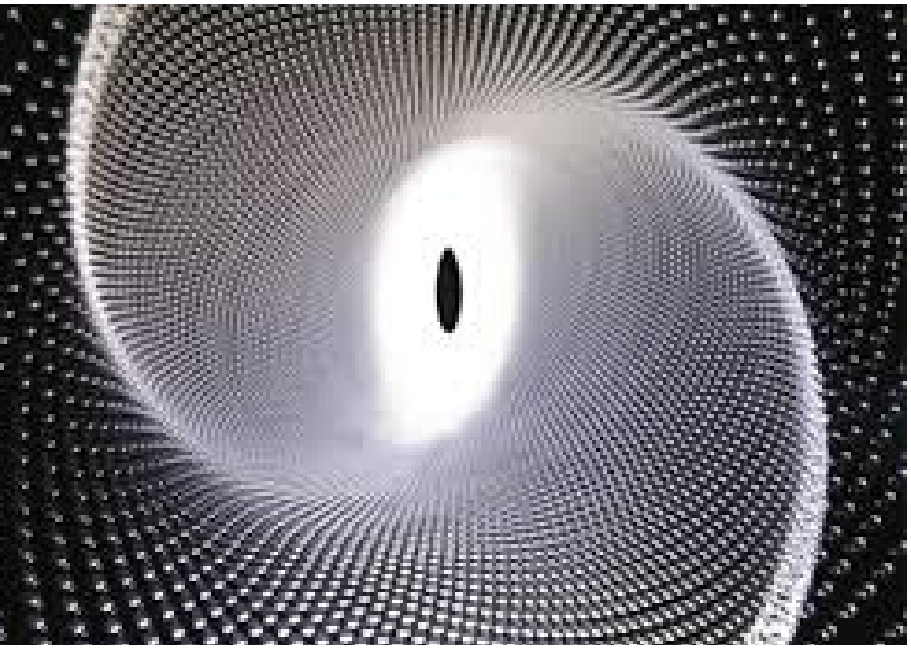
algebraic geometry -fields = Model Theory

3. Recursion Theory.
This is one of the widely used interdisciplinary areas. this is a field of study in computer science, Theory of computation and Mathematical logic. This field originated in the 1930s due to research works in Turing degrees and Computable functions. The primary concerns of this field are.
a.) What does it mean for a function on the natural numbers to be computable?
b.)How can noncomputable functions be classifiedinto a hierarchy based on their level of noncomputability?

4.Proof Theory.
This branch of mathematical logic deals with the proofs of mathematical systems treating proofs as mathematical objects. Proofs are constructed based on axioms as well as order and directions of predefined reasoning in that mathematical system. The proof theory is concerned with the rules of constructing a system rather than the linguistical transformation of ideas as opposed to Model theory
The main aim of this article was to give readers an overview of mathematical logic and it's development throughout history. Problems with the interpretation and understanding of different reasonings always had been part of human culture, While mathematical logic does a job to construct a system to organize
humanity's one of the biggest arsenals, but we are still nowhere near to understand the reason and logic itself, leaving with the note of hope that someday we will be a little wiser.

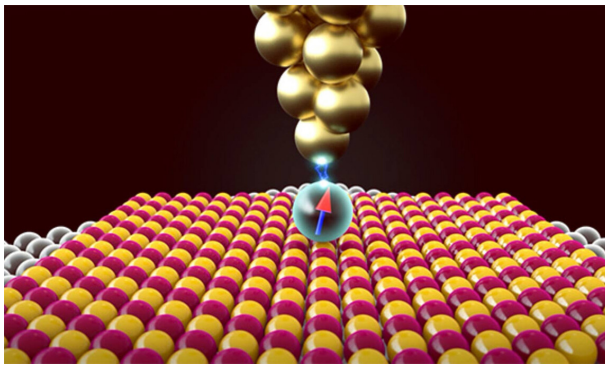
Article by - Nitish Dubey
(M.sc Mathematics Second Year)

9. The Rise of the SpinEra



Cosmic evolution of the atomic world! Gone are the days when alien technologies were believed to be a myth. In an era of dramatic changes, scientists and enterprises tend to rely on tracking the main trends of technological evolution to maintain a competitive advantage when confronted with the impact of computing new and old technologies and disruptive innovation. Tracing back to the 'The day' when Richard Feynman gave a talk called "There's a plenty of room at the bottom" at the meeting of the American Physical Society at CALTECH, wherein he laid the conceptual foundations for the field, what we call today as NANOTECHNOLOGY. The item in itself was an antithesis by then, as high-end technologies were never expected to be miniaturized.

Even today when we think of a supercomputer, an image of a room sized computer flashes in our minds. It's quite natural as the human brain is not accustomed to imagine opposite ideas under the same context. Nanotechnology emerged in the 1980's but due to deviations as we say and shortage of funds under the technological roofs, there was no significant development till 2000. However the rise of 21st century has not been just limited to the dimensions of science and technology but a new dimension called the interdisciplinary sciences has started laying its foundations leading to the pillars of an advanced civilization. This can be evidently seen by the violation of 'Moore's Law' and the quality solutions provided at the very nano-scale to the billion dollars problems. Now I leave this up to the reader to further explore into evolution of electronics and origin of this law. Solutions to problems ranging from historic and drastic climate issues to bringing life to the monotonous screens on which you are reading this article, have been established by the very atoms and electrons in a sophisticated manner.



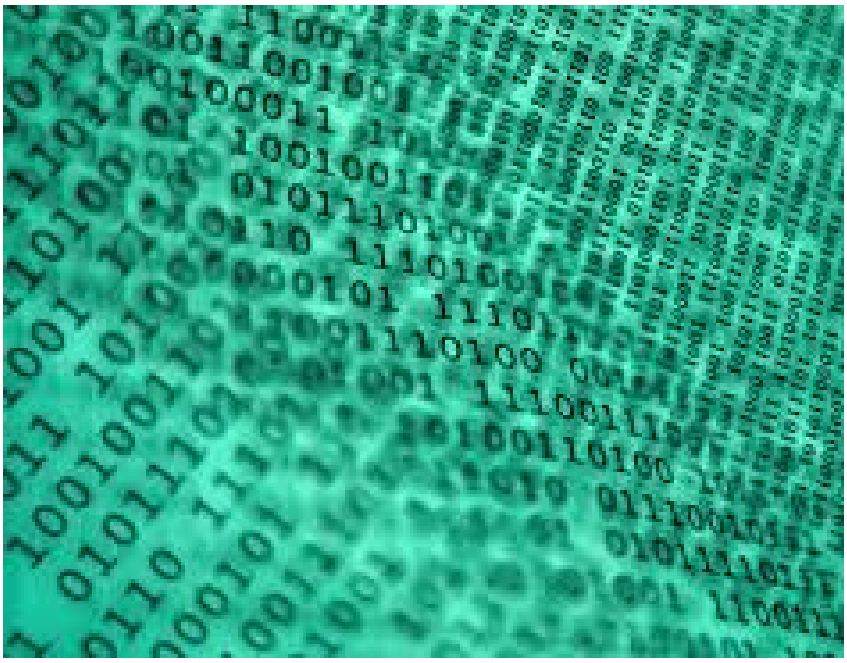
What humanity needs is to just achieve that extent of sophistication on the grounds of both technological and humanitarian adaptation. These so called 'tiny machines' as Feynman called them, are going to have a lasting impact on almost everything mankind has to deal with. One aspect and application that intrigues me is the plausible solution to the 'big data storage problem' as we call it.

"In theory, this storage density would allow all books ever created by humans to be written on a single post stamp", says lead-scientist Sander Otte."

What is the "big data storage" problem?

The amount of data generated daily by industries, large organizations and re- search institute is increasing at a very fast rate. These huge volumes of data needs to be kept not just for analytical purposes, but also in compliance with laws and service level agreements to protect and preserve data. Storage and management are major concerns in this era of big data. The ability for storage devices to scale to meet the rate of data growth, enhancing access time and data transfer rate is equally challenging. These factors, to a considerable extent, determine the overall performance of data storage and management. Big data storage requirements are complex and thus we need a holistic approach to mitigate its challenges.

All storage management solutions have at their end, storage devices. The qualities of these storage devices can have a significant impact on the entire storage system. The ability of the storage device to scale its access time, data transfer rate, and cost-effectiveness, can be critical in the big data environment. We suggest the use of a hybrid storage device, which is an aggregate of hard disk drive(HDDs), and solid state drives (SSDs).



HDDs provide huge storage capacity, at a relatively cheap price. This characteristic of the HDD allows storage systems to scale to meet the rate of growth of data. The disadvantage here is that HDD has a slow data transfer rate – becoming a bottleneck for performance. On the other hand, SSDs provide avenue for high performance, and reliability. They have low latency, thus providing a much faster, random access. SSDs are very expensive for the storage capacity they provide.

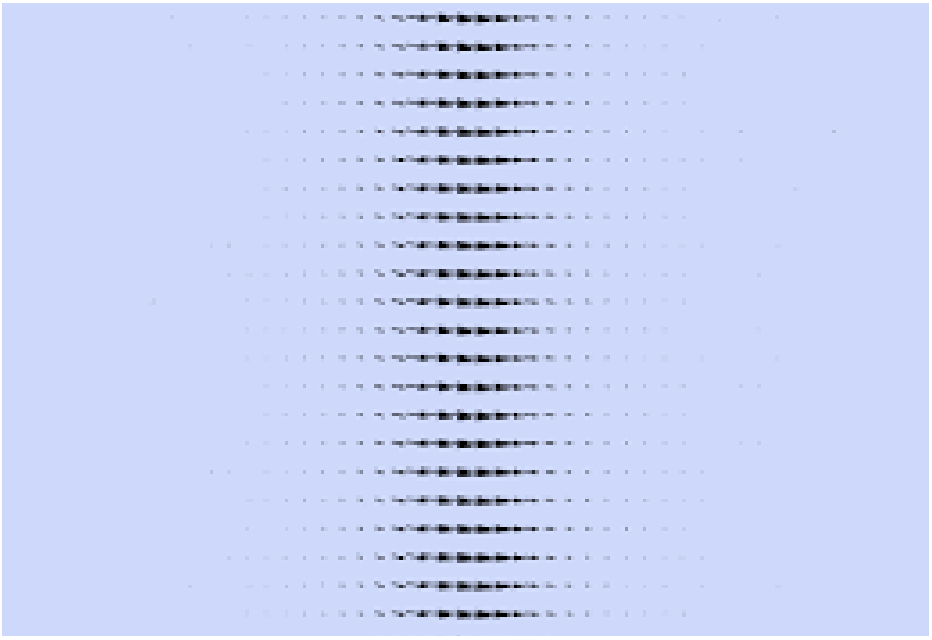
Do we have a solution?

The action centres on a new device made from a novel anti-ferromagnetic material, which holds the promise of ultra-high density data storage. It uses spintronics rather than electronics to store the data making it resistant to external magnetic fields, and external radiation, and it remains stable when the power is turned off.

Furthermore, this all happens at room temperature in a material that is relatively easy to make. This is a combination of features that the data storage industry values very highly. We have known about and studied anti-ferromagnetic materials for decades, but they were not thought to have any potential as magnetic storage media. The reason is down to the way their magnetism is aligned on the atomic level. Each atom in a magnetic material has a property called 'spin' which can be thought of as a tiny bar magnet, with a north and a south pole. In ferromagnetic materials, the atomic spins are all lined up in the same direction, which is why they have a measurable magnetic field and act as large scale magnets.

A normal data bit is stored by using a current to flip the orientation of the spins. This is not possible with anti-ferromagnetic materials but Dr Peter Wadley and his colleagues have tackled the problem by a different way; a spintronic approach that rotates pairs of spins rather than flipping them end over end. DrWadley said: "If you turn them all together they turn easily, whereas individually they don't move. The physics is beautiful but complex yet the practice is relatively simple. We use an electric current to write, that is turn, a bit and then a smaller current to read it."

A team of scientists at the Kavli Institute of Nanoscience at Delft University managed to bring this reduction to the ultimate limit: they built a memory of 1 kilobyte (8,000 bits), where each bit is represented by the position of one single chlorine atom. “In theory, this storage density would allow all books ever created by humans to be written on a single post stamp”, says lead-scientist Sander Otte. They reached a storage density of 500 Terabits per square inch (Tbpsi), 500 times better than the best commercial hard disk currently available. The team used a scanning tunneling microscope (STM), in which a sharp needle probes the atoms of a surface, one by one. With these probes scientists can not only see the atoms but they can also use them to push the atoms around. “You could compare it to a sliding puzzle”, Otte explains.



“Every bit consists of two positions on a surface of copper atoms, and one chlorine atom that we can slide back and forth between these two positions. If the chlorine atom is in the top position, there is a hole beneath it – we call this a 1. If the hole is in the top position and the chlorine atom is therefore on the bottom, then the bit is a 0.” Because the chlorine atoms are surrounded by other chlorine atoms, except near the holes, they keep each other in place. That is why this method with holes is much more stable than methods with loose atoms and more suitable for data storage.

Conclusion:

It is indeed mind-boggling to imagine how spin can literally spin our perspective towards innovating. Keep learning and keep spinning as there’s still plenty of room in innovation!!

Article by - Suyash Gaikwad
(M.sc Physics Second Year)

ISRO LAUNCHES CARTOSAT 3, US SATELLITES INTO SPACE

ISRO HAS SUCCESSFULLY LAUNCHED ITS THIRD-GENERATION EARTH-IMAGING SATELLITE INTO SPACE FROM THE SATISH DHAWAN SPACE CENTRE IN SRIHARIKOTA IN ANDHRA PRADESH.READ

The launch will enhance India's ability in high-resolution imaging and also reinforce India as a global launch destination for small satellites using its workhorse rocket Polar Satellite Launch Vehicle.
Besides the CARTOSAT 3 satellite, the PSLV C-47 rocket carried 13 nano satellites from the US, roped in through the new commercial arm New Space India.

"THIS WOULD HAVE THE MOST ADVANCED SPATIAL RESOLUTION CAPABILITY IN OUR OBSERVATION SATELLITES," AN OFFICIAL ASSOCIATED WITH THE LAUNCH HAD CONFIRMED EARLIER"

The Cartosat 3 follows similar launches in an earlier series deployed for cartography (map-making applications), infrastructure planning, coastal land use and regulation, road-network monitoring and more importantly, change detection in bringing out geographical and man-made features. The mission life of these satellites were five years.

ISRO

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Besides the CARTOSAT 3 satellite, the PSLV C-47 rocket carried 13 nano satellites from the US, roped in through the new commercial arm New Space India.
Among the American satellites aboard is a technical demonstration spacecraft from US-based company Analytical Space Inc, which enables users to fain faster access to satellite data. American satellite rideshare coordinator SpaceFlight, which facilitated the payload purchase for Analytical Space, had said last month it would complete 100 spacecraft launches on ISRO vehicles by end of 2019.
ISRO's forthcoming launches in December have more satellites coordinated by SpaceFlight.

ISRO

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While the Polar Satellite Launch Vehicle has attracted deals with foreign firms to accommodate satellites from countries such as France, Canada, and the US through its first commercial arm Antrix, the commercial satellites aboard the PSLV C-47 have arrived through agreements through the second commercial entity New Space India, set up in March previous year.
Through Antrix, ISRO has completed 239 deals over the last three years and earned operational revenue over Rs 6,280 crore, according to a release.The Cartosat 3 is the most advanced earth observation satellite built by ISRO, Chairman K Sivan said in a post-launch speech on Wednesday.Sivan said the space agency has 13 missions, six launch vehicle events and seven satellite missions, slated till March next year. "Our hands are full," a smiling Sivan said, in his post-launch speech

HOW FIRES IN AUSTRALIA COULD ALTER WEATHER ELSEWHERE TOO

THE WILDFIRE IMAGES AND NEWS COMING FROM AUSTRALIA ARE STUNNING.

Many people are learning about the local effects of the fires on the generation of Pyrocumulonimbus clouds (image side) because it has been well-documented in the popular media. Fire, smoke particles, and instability in the atmosphere generate massive thunderstorms. However, Nesbitt's point is about the larger scale impacts on the atmosphere. I will use an analogy, though not a perfect one, to set the stage for the discussion. El Nino is associated with anomalously warm waters in the equatorial Pacific Ocean. This surface "heat source" and associated changes in atmospheric circulations cause changes in weather patterns around the world. You can think of the "heat source" as a rock thrown into a pond that generates waves that ripple far beyond the point of impact.

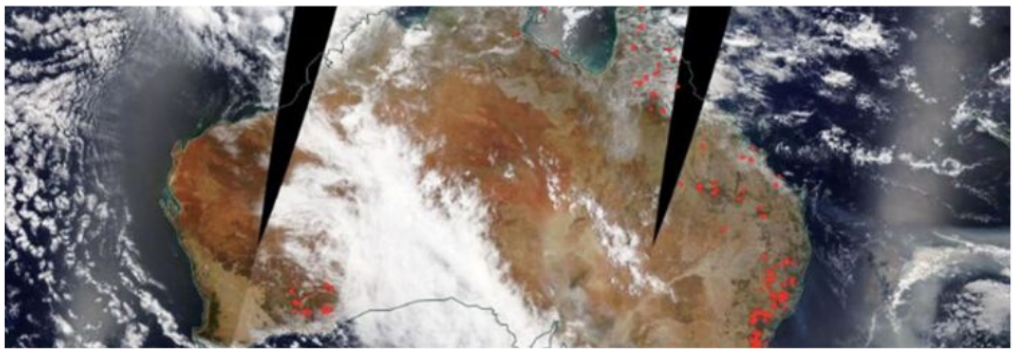
According to various reports, 12 to 15 million acres of land have burned in the Australian bushfires, and that number is likely to grow. According to Time magazine, the acreage is roughly the size of Vermont and New Hampshire combined. Could this heat source alter atmospheric circulations? Let's start with the smoke.

SINCE WARMER AIR IS LESS DENSE THAN COLD AIR, IT WILL BECOME BUOYANT AND RISE. IF WARM AIR LIES ABOVE COLD AIR, YOU CAN SEE THAT RISING MOTION WILL BE INHIBITED (ANY RISING PARCEL WILL BE COLDER THAN THE WARM OVERLYING AIR). THIS SITUATION IS REFERRED TO AS AN INVERSION.

Another potential and far-reaching impact is related to the Pyrocumulonimbus clouds that I mentioned earlier. A 2019 study published in the journal Geophysical Research Letters found that the smoke plumes from towering smoke-laden clouds can penetrate into the stratosphere. Using the 2017 fires in the Pacific Northwest, they found from modeling studies that the smoke aerosols can linger in the stratosphere up to 5 months and actually create net warming at the top of atmosphere.

Fires and Pyrocumulonimbus clouds DAKOTA SMITH AND CIRA

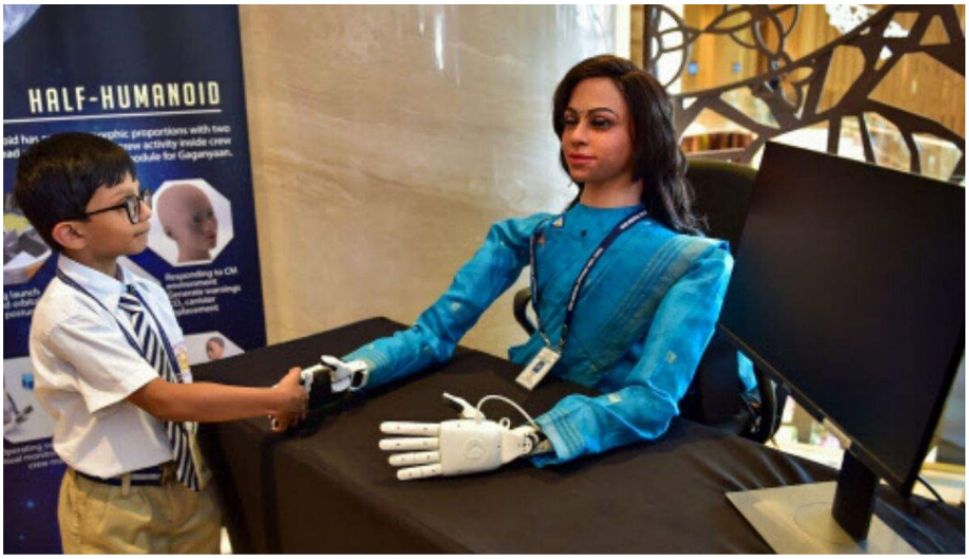
Smoke contains soot, an effective of absorber of solar radiation. This is counter to the temporary cooling effect that large volcanic eruptions can have on the climate system. Volcanic aerosols injected into the stratosphere tend to be more sulfate-based, which are more effective scatterers of solar energy.



NASA

GAGANYAAN MISSION: MEET VYOMMITRA, THE TALKING HUMAN ROBOT THAT ISRO WILL SEND TO SPACE

The Indian Space Research Organisation has unveiled a human robot that will be sent to space as part of the Gaganyaan mission, India's ambitious plan to send humans to space.



She can talk. She can recognise other humans. She can mimic what they would do in space. She can even hold conversations and answer queries. She is Vyommitra, a spacefaring human robot developed by the Indian Space Research Organisation. Vyommitra is a 'half-humanoid' that Isro plans to send to space as part of test flights that will be undertaken ahead of the ambitious launch of India's maiden human spaceflight mission.

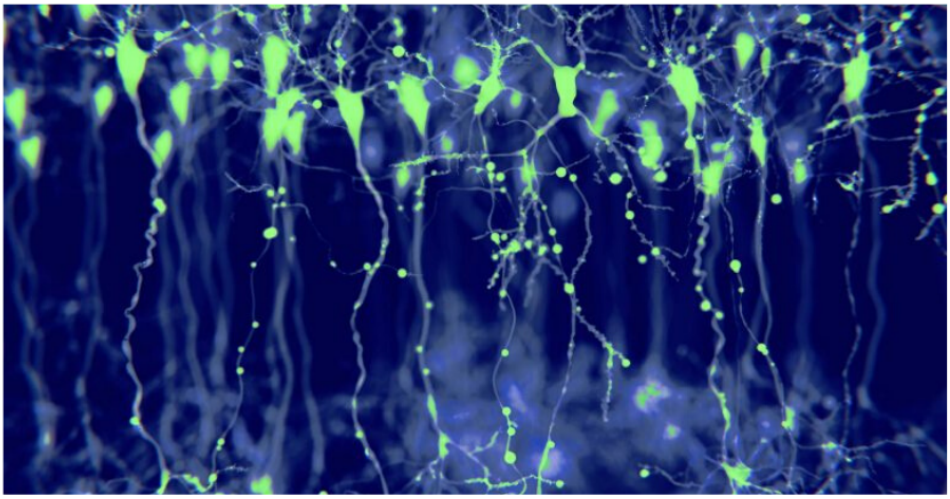
Vyommitra, in her own words, can "mimic" the activity of a crew of astronauts and even "recognise them and respond to their queries". Vyommitra was unveiled by Isro at an event in Bengaluru on Wednesday where she greeted reporters with "Hi, I'm Vyommitra the first prototype of half humanoid."

According to an Isro scientist, Vyommitra is a half humanoid since she does not have legs. "It's called a half humanoid because it doesn't have legs. It can only bend sidewards and forward. It will carry out certain experiments and will always remain in touch with the Isro command centre," Isro scientist Sam Dayal said.

The space agency plans to send Vyommitra to space later this year when it will launch unmanned flights to space as part of the Gaganyaan project. The Gaganyaan project, announced by PM Narendra Modi in his 2019 Independence Day address, is an ambitious plan of sending Indians to space.

Isro aims to launch the manned spaceflight mission by 2022. Before that, the space agency will launch two unmanned missions -- one in December this year and another in June 2021. These will demonstration test flight aimed at proving that Isro can fly humans to space and at testing the various systems that will be part of the final manned space mission.The humanoid Vyommitra will be part of both the unmanned spaceflights during which she will mimic crew activity. Will she also accompany the three Indian astronauts during their historic flight to space in 2022? It is not known. But, while 'speaking' to reporters on Wednesday, she did say that she could "recognise [astronauts] and respond to their queries".

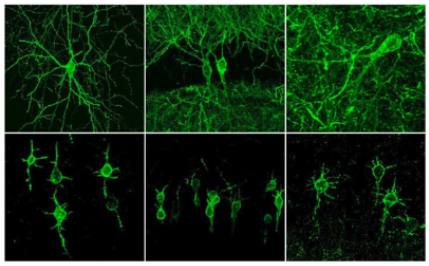
FLUORESCENT BRAIN PROBE VISUALIZES GROUPS OF NEURONS AS THEY COMPUTE



Using a fluorescent probe that lights up when brain cells are electrically active, MIT and Boston University researchers have shown that they can image the activity of many neurons at once, in the brains of mice.This technique, which can be performed using a simple light microscope, could allow neuroscientists to visualize the activity of circuits within the brain and link them to specific behaviors, says Edward Boyden, the Y. Eva Tan Professor in Neurotechnology and a professor of biological engineering and of brain and cognitive sciences at MIT. "If you want to study a behavior, or a disease, you need to image the activity of populations of neurons because they work together in a network," says Boyden, who is also a member of MIT's McGovern Institute for Brain Research, Media Lab, and Koch Institute for Integrative Cancer Research.

FLUORESCENT PROBE COULD ALLOW SCIENTISTS TO WATCH CIRCUITS WITHIN THE BRAIN AND LINK THEIR ACTIVITY TO SPECIFIC BEHAVIORS.

Using this voltage-sensing molecule, the researchers showed that they could record electrical activity from many more neurons than has been possible with any existing, fully genetically encoded, fluorescent voltage probe. Boyden and Xue Han, an associate professor of biomedical engineering at Boston University, are the senior authors of the study, which appears in the October 9, 2019, online edition of Nature. The lead authors of the paper are MIT postdoc Kiryl Piatkevich, BU graduate student Seth Bensussen, and BU research scientist Hua-an Tseng



In the top row, neurons are labeled with a fluorescent probe that reveals electrical activity. In the bottom row, neurons are labeled with a variant of the probe that accumulates specifically in the neuron cell bodies, preventing interference from axons of neighboring neurons. Image courtesy of the researchers

Seeing connections :

Neurons compute using rapid electrical impulses, which underlie our thoughts, behavior, and perception of the world. Traditional methods for measuring this electrical activity require inserting an electrode into the brain, a process that is labor-intensive and usually allows researchers to record from only one neuron at a time. Multielectrode arrays allow the monitoring of electrical activity from many neurons at once, but they don't sample densely enough to get all the neurons within a given volume. Calcium imaging does allow such dense sampling, but it measures calcium, an indirect and slow measure of neural electrical activity

Mapping circuits :

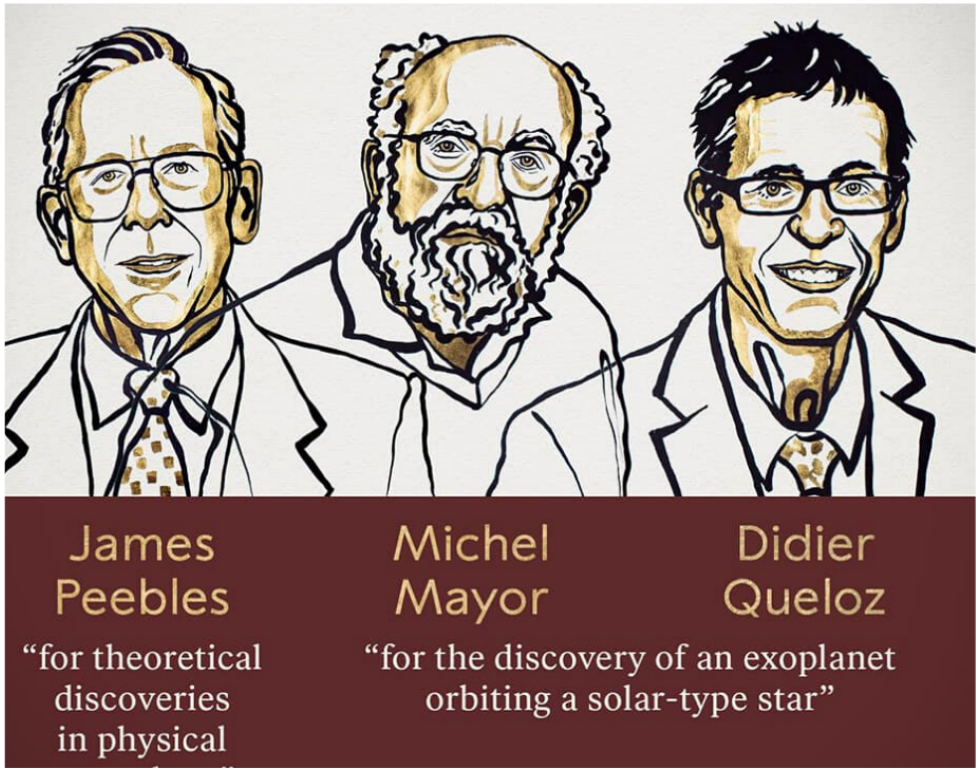
The researchers also showed that this imaging technique can be combined with optogenetics — a technique developed by the Boyden lab and collaborators that allows researchers to turn neurons on and off with light by engineering them to express light-sensitive proteins. In this case, the researchers activated certain neurons with light and then measured the resulting electrical activity in these neurons..

THE NOBEL PRIZE IN PHYSICS 2019

The Nobel Prize in Physics was announced on 8th October at 11:45 AM CET by The Royal Swedish Academy of Sciences (Kungl. Vetenskapsakademien, KVA)

The results showed us a universe in which just five per cent of its content is known, the matter which constitutes stars, planets, trees and us. The rest, 95 per cent, is unknown dark matter and dark energy. This is a mystery and a challenge to modern physics.

The prize has been awarded "for contributions to our understanding of the evolution of the universe and Earth's place in the cosmos". One half of the prize is awarded to James Peebles "for the theoretical discoveries in physical cosmology" and the other half jointly to Michel Mayor and Didier Queloz "for the discovery of an exoplanet orbiting a solar-type star". The works of James Peebles have helped us understand the cosmic surroundings. His contributions are the foundation of our modern understanding of the universe's history, from the big bang to the present day.

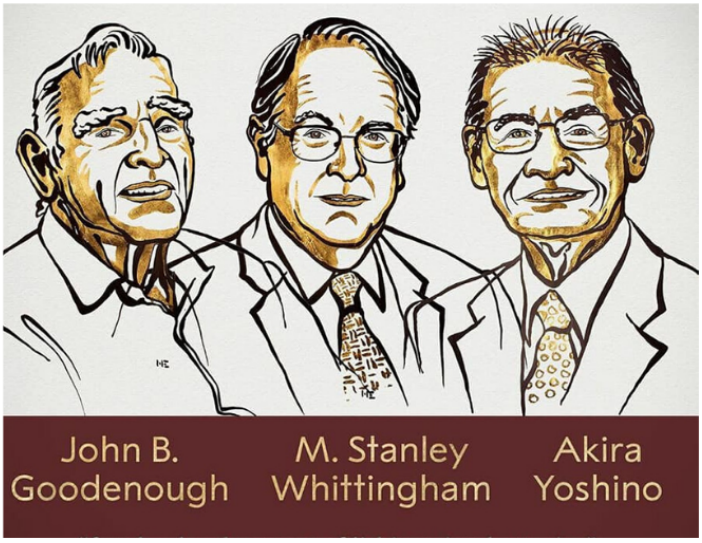


Michel Mayor and Didier Queloz discovered the very first planet outside of our solar system, an exoplanet orbiting a solar-type star, in 1995. Their discovery challenged our ideas about this strange world and led to a revolution in astronomy.

"Their discoveries have forever changed our conceptions of the world."

THE NOBEL PRIZE IN CHEMISTRY 2019

The winner of the 2019 Nobel prize in chemistry has been announced on 9th October at The Royal Swedish academy of sciences, Stockholm.



The 2019 Nobel prize in chemistry has been awarded jointly to John B. Goodenough, M. Stanley Whittingham and Akira Yoshino for the development of lithium-ion batteries. The lithium-ion batteries have revolutionised the world of technology. This light weight, rechargeable and powerful battery is now used in everyday products such as Smartphones, laptops and even electric vehicles. It can also store significant amounts of energy from solar and wind power, making possible a fossil fuel-free Society. Stanley Whittingham worked on the developing methods that could lead to fossil fuel-free energy technologies.

. Stanley Whittingham started to research superconductors and discovered an extremely energy-rich material, which he used to create an innovative cathode in a lithium battery. John Goodenough predicted that the cathode would have even a greater potential if it was made using a metal oxide instead of a metal sulphides, this was an important breakthrough and would lead to much more powerful batteries. With Goodenough's cathode as a basis, Akira Yoshino created the first commercially viable Lithium-ion battery in 1985.Rather than using reactive lithium ion the anode, he used petrolium coke, a carbon material that, like the cathode's cobalt oxide, can intercalate lithium ions. The result was a lightweight, hardwearing battery that could be charged hundreds times before its performance. Lithium-ion batteries have revolutionised over lives since they first entered the market in 1991. These scientists have laid the foundation of a wireless, fossil fuel-free society, and are of the greatest

NOBEL PRIZE IN LITERATURE 2019

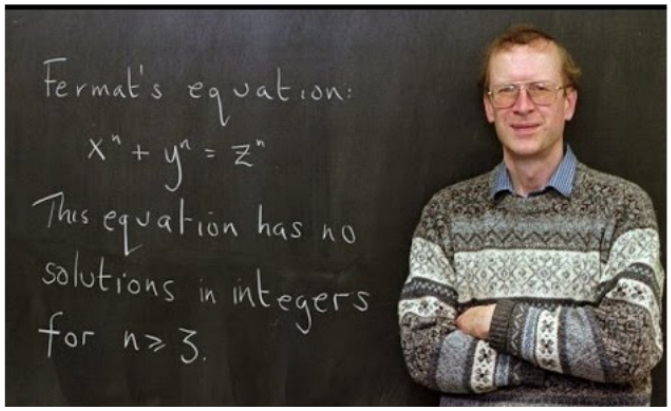
”Literature has no borders. There is one literature, and uses different languages as a tool”

The Nobel Prize in Literature for 2018 is awarded to the Polish author Olga Tokarczuk for a narrative imagination that with encyclopedic passion represents the crossing of boundaries as a form of life while the Nobela Prize in Literature for 2019 is awarded to the Austrian author Peter Handke "for an influential work that with linguistic ingenuity has explored the periphery and the specificity of human experience."Due to some internal conflicts, the Swedish Academy could not award the prize last year.

Olga Tokarczuk was born in 1962 in Sulechów, Poland. Her work reflects the Polish life and history. She is inspired by maps and a perspective from above, which tends to make microcosmos a mirror of macrocosmos. As it is stated in her third novel "Primeval is a village in the midst of universe." Tokarczuk never views reality as something stable or everlasting. She constructs her novels in a tension between cultural opposites.

Peter Handke was born in 1942 in a village in southern Austria. After his first debut, more than fifty years later, having produced a great number of works in different genres, he has established himself as one of the most influential writers in Europe after Second World War. The peculiar art of Handke is the extraordinary attention to landscapes and material presents of the world, which has made cinema and painting two of his greatest sources of inspiration.

A TALE OF BEAUTY AND PERSISTENCE : FERMAT'S LAST THEOREM



So what if I told you, that there is a movie in which there is nothing going on .only thing that is happening is some mathematicians sitting around and talking about a 300 years old problem and its beautiful. Well, most of you will find it hard to believe. In 1996 Simon Singh and John Lynch produced a film For BBC named Fermat's Last Theorem about a problem that kept Baffling the greatest minds of the earth. And it won BAFTA for best documentary. The problem was so simple that even a child could understand. The conjecture was stated as following Conjecture: No three positive integers a, b and c satisfies the equation a n + b n = c n for any value of n greater than 2. After proposing this conjecture in the margin of book Fermat stated I have discovered a truly marvelous proof of this, which this margin is too narrow to contain, and centuries passed and no one was able to recreate the proof. In 1995 Andrew wiles claimed that he proved the riddle of Fermat, he won lots of Fame and prizes for it and supposedly that's all world knew What the world didn't know was the story behind the proof, and this movie does the job beautifully. This movie doesn't have any element that can put it in the category of your watch-list. Until you are willing to listen to the story of a man who chooses to awe in beauty on the cost of suffering. Until you are willing to listen to a tale of devotion to ideas. Until you are willing to listen to a narration of how we are standing on the shoulder of giants to look towards the future. Until you are willing to listen to a chronicle of the creation of a Magnum opus. Soothing cinematography and spot-on music tracks add the cherry on top although its video quality is not up to todays standards its still enjoyable

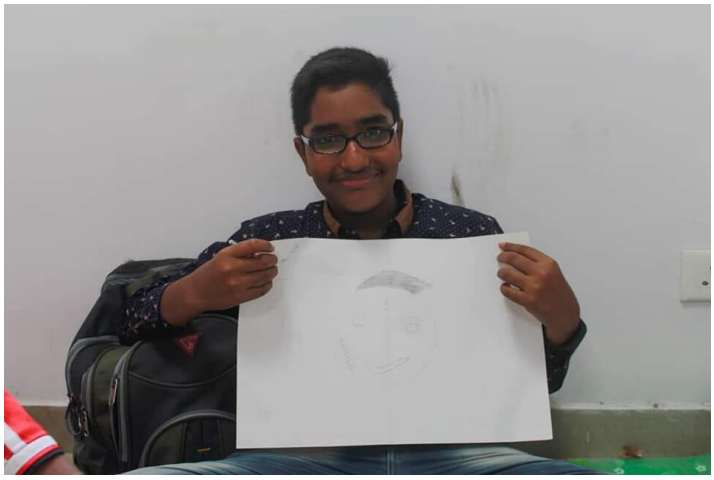
Review by - Nitish Dubey
2nd year M.Sc

Prakriti – a Humongous event in the sight of Science Popularization

Prakriti as the name suggests titles about primal creative or a natural force. That was the force that led to the event Prakriti which was organized on 15th September by the students of SVNIT. In simple words, it was a mutual effort of students and SVNITians which drove us to this beautiful event. As always the purpose of this event was to incorporate the scientific approach into the minds of students of 6th to 9th standard and make them aware of the concepts which they may have heard before but not used practically in their daily lives.
Prakriti, being the oldest event organized by SCOSH had a tremendous challenge to cross the barriers they have had set in earlier times. But... but the way they leaped through them was the thing to behold.

New creative ideas, new games, and whatnot.
They had all the stuff in their bags to make the students go awestruck. But the main responsibility was to handle the students decently. Now this time with a bigger and more enthusiastic team we had our bases covered.

Now came the D-day.
All tensed but ready to go off. As the clock struck 08:30, the task of bringing the students from SVNIT's main gate to the AMHD department started. The combination of small innocent faces with big mature faces was pretty much amusing. Now, I don't think I have to mention who was innocent and who was mischievous there. The sweat on the faces of us and agony was a reflection of how it was going to turn out in the coming hours.



But after making ourselves calm, we decided to just make it happen. So, with courageous faith in 197 students that they will all behave as well as they could, we kicked off the events.

First in our bucket list was the quiz. Just like any other event, we SCOSH fellas also went through the same basic starting outline which I think technology has been the mandatory event of any annual science fest. What would be better to give these students a wake-up call than by asking them good science questions? What about making them dig deeper into the knowledge that they have? But these small faces had some weird expressions and answers that made us wonder if they are too smart or just being overconfident. My God! the way they performed gave an enigma to us instead of them.

Now talking about the technical aspect of this event. it consisted of 2 rounds.

In which they were divided into teams of 5. The team which performed better was promoted to the next round. The task was way more competitive than we thought and it gave us 1 winner and 2 runner ups.

Let's talk about the next event. This was a new event which we added in Prakriti this year. With our fingers crossed, we started this event. But how could you even doubt the efforts of Scoshians? As always they never disappoint. And with these kids, it certainly is surprising to know that they carry a lot of myths in their carry bags than the books.
So, our motto was to just lighten the burden on their shoulders. We didn't plan to steal something from them. The bags are just an analogy here!
Then we just began with an informative session which leads to PowerPoint presentations. With the open mouths of children in astonishment, you can simply imagine how the event would have turned out to be.
Now as two events passed by, it was our job to entertain them and give them something
interesting to do.

So, for the very first time in these years, we came through the event "scrabbled page". We all as students at some time in our lives have had fun with the jumbled words. And as my personal experience, I was bad at it. But as again I have to say, students these days... they are quite of something pretty extraordinary. Before setting this event up,
the mentors thought that they could easily solve one or two lines from the top. But on the contrary, they solved all the lines except the last two. And that too in just 20 seconds. But I have to say the competition was tough. By seeing their performances we thanked God that we are not competing with them.

Now comes the thing of enjoyment for some creative people. Drawing. Yes bring back the memories of Tare Zameen Par and accept the fact that we all have an artist within ourselves. But we don't have to make these students realize that. They are born artists and they know it.
We were a science club, gave them topics such as climate change, pollution, artificial intelligence and many more. We all silently gazed at their papers which in 1 hour we were going to witness. The moving pencils, brushes, and crayons, at last, came up with flying colors (not literally) and we witnessed some special art that is going to make me change my above sentence that "they have hidden Picasso in them".
The other part of this event was "blindfolded drawing". In other words, we kept this event for our entertainment. We wanted to see what level of creativity these students can show us. In this one, was an instructor and a drawer. I wish I could show you those drawings but that is not possible. This event drew the students and us more into the fest. As hungry as we were the lunchtime was perfection.

The way we ate or I should say shared or to be more precise snatched could easily tell that who was more hungry, we or the students. Some students also showed their creativity in stealing and snatching food more than they showed in the events. After having regained energy we were all set up to start the second half of the Prakriti.
The main event of the day was going to start "the Catabuild". An event in which we invested a lot and were doing it for the first time. We had a lot of expectations from this. In this, we provided them with basic tools and asked them to make something productive so that with the help of them, they could shatter a pile of cups. As time passed, we were anticipating whether they would shatter our pile of cups or our pile of over anticipation.

But what less could we expect from the students? They made something out of the box which could not have possibly imagined even by us and showed us that they'll never break our trust and we can count on them the next time with more difficult challenges. Thus, eventually, our major event ended very nicely which gave us the right morale boost to conduct the next two events with equal energy levels. Now, the next thing in our pockets was "guess to work" or you can say modern-day Damsharas. Which is nothing but a light-hearted event with a twist of science in it? We didn't want to make our students dull. we wanted them to inculcate some acting skills. So, we gave them some scientific words which they had to explain to their team members. They were provided with basic materials through which they could explain basic things about it. but what is a science day without exhibitions? As the students were from 6th to 9th, they were not familiar with experiments. So, we showed them some experiments on inertia, refraction, Non-Newtonian fluids, Adhesive and Cohesive forces, etc and brainstormed their mind with a curiosity which they could carry home and ponder about.

So, with this comes wrapping up of events with felicitation ceremony to follow. Dr. R.K Jana gave the students a motivational speech and encouraged them for their bright futures ahead. Then our H.O.D. of AMHD department, Dr. Sushil Kumar gave a gift to the students by announcing that they can come to the AMHD department with their doubts and the students and faculty would be ready to help.
And, with this, participants walked away with smiles and an expression of satisfaction on their faces. But the ones who were most bewildered were us who came that day with many if's and but's and crossed fingers yet we were returning with lessons and skills learned through this entire day.
So, by this, we can conclude that Prakriti 2019 was successful and has certainly raised bars for the upcoming events.

Editor's Note

“Be willing to be a beginner every single morning.” – Meister Eckhart With great enthusiasm, SCOSH decided to take an initiative to start a magazine of its own,completely dedicated to science. This issue contains articles explaining some game-changing theories and news/facts about Science. The magazine also has research papers to help the students get a brief idea about it and encourage them to write their own papers.

Towards the end, a few articles are dedicated to the Nobel laureates for their discoveries and contributions to the fields of science and maths. The motive behind this magazine is to popularise science and create an environment that inculcates its culture in the college. We hope to encourage more and more students to come up with their unique ideas related to science and help them write articles and research papers related to it. I would like to thank all the science wizards who helped the magazine come into a good shape, wrote informative articles and provided the readers with enlightening quality content.

This magazine wouldn’t have been complete without the support of our faculty advisors Dr. Sushil Kumar and Dr. Bharat Dholakia. I’m grateful to everyone who contributed to this magazine for their tremendous work, support and dedication to bring the plan to action.

Vaibhav Gupta
Chief editor

Shubham Chavan
Graphic editor

Sandesh Yele
Cover editor

About us

Society for Cultivation of Science and Humanities (SCOSH) was formed in 2007 with the support of generous Student Council of SVNIT and highly ignited minds of science students. A lot of events are in pipeline. Be in touch !!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