



# CURIOSITY

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INDIAN  
SCIENTIST

THE SAGA OF  
EXCELLENCE



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# EDITORIAL

**Arvind C. Ranade**

## October – Celebrating Indian Supremacy in Science

**T**he month of October is special for many reasons; it is especially important for the people of physics and applied physics.

Six well-known Indian scientists were born in October and they all become world famous for their contributions in the field of science. Their efforts placed India in forefront of S&T research. The world recognised Dr Meghnad Saha's contribution in astrophysics by naming his equation as Saha Ionization Equation that helped in understanding the origin of stellar spectra and formation of many ionizing element in the stellar atmosphere. Dr Harish-Chandra, a well-known mathematician, contributed immensely in solving many concepts in the representation theory. We have a special research institute at Prayagraj named after him. Our former president Dr APJ Abdul Kalam is also October born and known to us as the Missile man of India. In the process of stellar evolution, Dr S. Chandrasekhar defined the limit for the formation of white dwarf stars, now known as Chandrasekhar Limit. Dr Sisir Kumar Mitra is another name to reckon with in the field of radio communication who discovered the reflection of radio waves as low as 20 km, and that layer is named as C layer in the earth's atmosphere. Dr Homi J. Bhabha, our Nuclear Man of India was also born in October.

This issue of Curiosity has articles on artificial intelligence, comet Neowise and on water resource managements in Ganga river basin along with the regular columns like sky map, club speaks, quiz etc. Day by

day, Curiosity is reaching larger sections of the society and we are receiving suggestions from our readers on inclusion of various topics. In spite of the challenging time of COVID-19 our network is expanding and it is evident from the requests received for formation of new science clubs from several parts of the country. However, membership would be extended to only those who seek knowledge and have a mechanism in place to take science to people.

As you are aware, the registration was open for the Vidyarthi Vigyan Manthan, a national science talent search examination for the students of class VI to XI, till 30 September 2020. The registration date has now been extended till 15 October 2020 without late fees. Therefore, all the club coordinators are requested to make use of this opportunity to spread the information to all interested students. The best part for the registered students is they will receive special coaching from subject experts on the study materials like Indian contribution to science and on Venkatesh Bapuji Ketkar and Indian Almanac System. Moreover, they would get a complimentary opportunity to be part of Mega Science Experiment and learn various aspects of the science experiments which will also be evaluated for the performance. We wish you a very successful and fruitful time ahead. Be safe and secure all the time.

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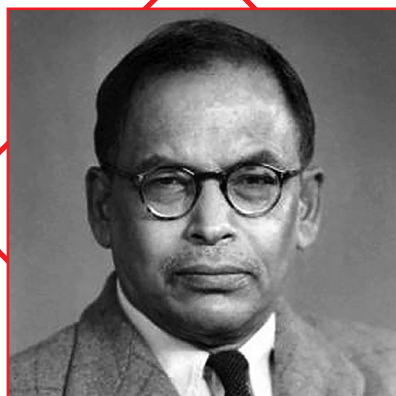
# Indian Scientist

## The saga of excellence

Dr Rintu Nath

Appreciation for science and its utility in everyday life is essential for the growth and development of the society. Knowing about discoveries and inventions can help in understanding the methodology of science. Knowing about pioneering researches done by many scientists under adverse conditions helps motivating young readers to take up challenges towards scientific excellence. The continuous progress of a society is the result of the tireless efforts of scientists.

Here we have outlined life and works of six scientists whose discoveries and inventions contributed to taking science and technology to a greater height. Incidentally, all six scientists were born in October. While paying tribute to these scientists by mentioning some of their seminal works and subsequent developments at the forefront of science, the article also highlights some of the extreme hardships these scientists underwent while achieving towering success.



### Meghnad Saha

Meghnad Saha (16 October 1893 - 16 February 1956) contributed immensely to astrophysics and influenced subse-

quent research in the 20th century. Saha's theory on thermal ionization is one of the most important contributions in explaining the origin of stellar spectra.

With meagre resources, Meghnad did state-of-the-art research in Astrophysics and made seminal contributions. In the book "Theoretical Astrophysics," the author S. Rosseland commented, "Although Bohr must thus be considered the pioneer in the field, it was the Indian physicist Meghnad Saha who (1920) first attempted to develop a consistent theory of the spectral sequence of the stars from the point of view of atomic theory."

Meghnad Saha was born in a village near Dhaka (now in Bangladesh). He

was the fifth child of his parents. His father owned a small grocery shop, and it wasn't always easy to meet up with the financial requirement of the family. His parents neither had the means nor had any inclination to educate their children. Meghnad's eldest brother took up a job in a jute factory, and another elder brother discontinued study to help his father run the shop. In such a situation, at the age of seven, Meghnad took admission in the village primary school. At the very early stage in school, he could show unusual talent in learning.

After completion of primary education, there was no hope for Meghnad's admission to a middle school. The school was at a distance of 10 km, and his parents did not have the means to send him there. Fortunately, a local doctor allowed Meghnad to stay in his house and attend the school. The offer was, however, not without conditions. Meghnad will have to do household works of the house, including looking after cows. He happily accepted all the conditions and continued his journey of learning, which, in another ten years, will influence science with groundbreaking inventions and illuminate it for many generations to come.

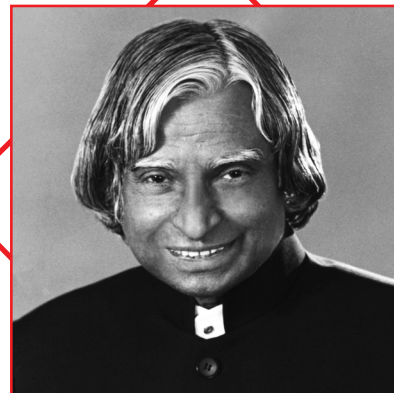
Meghnad topped in the middle school final exam in Dhaka district and secured a scholarship of Rs. 4 per month. In 1905 he reached Dhaka and took admission in a Government senior school. It was the time when India was under British rule. Lord Curzon, the then Viceroy of British India, decided to divide Bengal, which created huge political disturbances. Meghnad and many other students were rusticated from

the government school. Fortunately, a private school admitted him and waived his school fees. In 1909 he passed the entrance examination and topped in entire East Bengal.

In 1911 Meghnad joined Presidency College, Calcutta (now Kolkata) and passed B.Sc. with Honours and M.Sc. with Honours in Applied Mathematics. He stood second in both the examinations. He received Doctor of Science from Calcutta University in 1919. In 1920 he published four research papers on thermal ionization. After receiving a scholarship, Meghnad spent two years in Europe – he first worked at the laboratory of astronomer Alfred Fowler (1868-1940) in London for five months, and then he moved to Berlin where he worked in Walther Nernst's Laboratory. For a long time, the European community believed that the thermal ionization

theory proposed by Meghnad Saha was done under the supervision of Alfred Fowler. However, he proposed the theory when he was working alone in Calcutta. To quote D. S. Kothari: "It is pertinent to remark that the ionization theory was formulated by Saha working by himself in Calcutta. It is not too much to say that the theory of thermal ionization introduced a new epoch in astrophysics ..."

Meghnad was a great institution builder and played a significant role in establishing many departments and institutes for research in science. Apart from his contribution to science, he was equally concerned about the society. In 1923, during extensive damage due to flood in North Bengal, he worked for the relief work. He later initiated the formation of Damodar Valley Corporation (DVC).

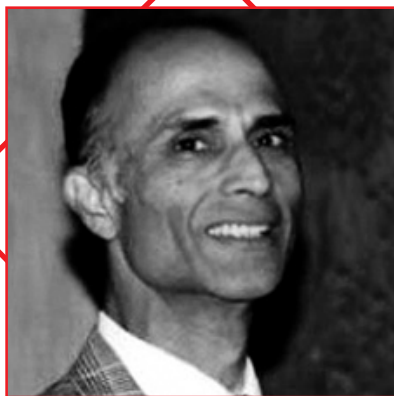


## APJ Abdul Kalam

Avul Pakir Jainulabdeen Abdul Kalam (15 October 1931 – 27 July 2015) was one of the principal architects of the Indian Space Programme and the missile missions. He led the development and launching of India's first indigenous Satellite Launch Vehicle (SLV). In the year 1980, satellite *Rohini* RS-1 was placed into Earth's orbit using SLV-3.

Kalam was born in Rameswaram. His father owned a ferry boat that took pilgrims between Rameswaram and the mainland. After the construction of Padma Bridge in 1914, the ferry business failed, and Kalam's family lost all properties and their ancestral home. They became so poor that, at an early age, Kalam had to sell newspapers to supplement his family's income.

Despite hardship, Kalam completed school education and joined St. Joseph's College at Tiruchirappalli. He then studied aerospace engineering at Madras Institute of Technology. His dream was to become a fighter pilot and he wanted to join the Air Force. However, in the qualifier, he was placed ninth, and only the top eight positions were recruited. Kalam then joined DRDO as a junior scientist. In 1963 Kalam joined the Indian Committee for Space Research (INCOSPAR) as a rocket engineer. INCOSPAR was the predecessor of the Indian Space Research Organisation (ISRO). Between 1970 and 1990, Kalam successfully developed the SLV-3 and Polar Satellite Launch Vehicle (PSLV) projects. After a very successful career at ISRO for two decades, he moved to DRDO in 1983 and



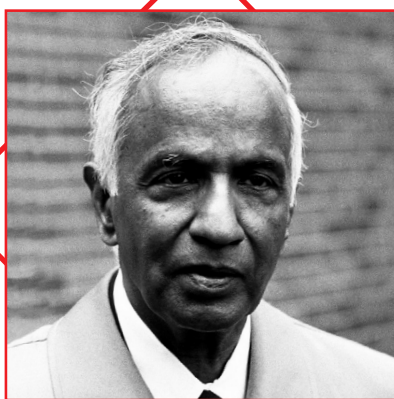
## Harish-Chandra

Harish-Chandra (11 October 1923 – 16 October 1983) is considered one of the greatest Indian Mathematicians since Ramanujan. To understand and appreciate his contribution in higher Mathematics, one needs to be a mathematician. N. Mukunda, in his editorial in the journal *Resonance* on Harish-Chandra, wrote, "...to even appreciate the work of such gifted individuals, leave alone to reach such height ourselves..."

Harish-Chandra began his research career as a theoretical physicist at the Indian Institute of Science (IISc) in Bangalore in 1943 and worked with H. J. Bhaba. From IISc, he went to Cambridge University for his doctoral work under the supervision of Paul Dirac. After receiving Ph.D. in 1947, he started his research in Mathematics. He is best known for his general theory of semi-simple Lie groups. During his early career as a mathematician, he was on a visit to Paris. He did not understand the Lie group at that time and requested a fellow mathematician to explain to him. He was bluntly referred to a book on that concept. Without any hesitation, Harish Chandra bought that book and finished in two weeks. He understood the concept so well that he started his research in the same area and later created a beautiful field of Mathematics 'Representation of semi-simple Lie groups'. Harish Chandra spent most of his professional career abroad but remained an Indian by heart.

led the Integrated Guided Missiles Development Program and developed *Agni* and *Prithvi* missiles. Kalam was elected President of India in July 2002 and soon became “People’s President” as he welcomed the public into the Rashtrapati Bhawan.

Kalam’s inspirational speeches ignited the minds of millions of young students. Addressing students, he once said, “Never stop fighting until you arrive at your destined place, that is, the unique you. Have an aim in life, continuously acquire knowledge, work hard, and have the perseverance to realize a great life. These are four essential criteria.” Kalam died while delivering a lecture, “Creating a Livable Planet Earth” at the Indian Institute of Management, Shillong. His inspiration towards a developed nation and contributions to India’s space and missile programs will be remembered forever.



## Subrahmanyan Chandrasekhar

Subrahmanyan Chandrasekhar (19 October 1910 - 21 August 1995) is best known for his celebrated discovery of Chandrasekhar Limit - maximum mass supported against gravity by pressure made up of electrons and atomic nuclei. The value of this limit is about 1.44 times the Sun. The Chandrasekhar Limit plays a crucial role in understanding supernova. If the mass of a star is less than the limit, it would eventually

become a white dwarf forever. However, if mass of a star exceeded this limit, the star would continue to collapse under the extreme pressure of gravitational forces and end its life in a violent explosion – a supernova. The formulation of the Chandrasekhar Limit led to the discovery of neutron stars and black holes. His research output is phenomenal, and every monograph or book published by Chandrasekhar has become a classic. No serious students of the concerned fields can ignore Chandrasekhar’s work.

What was the motivation for Chandrasekhar in pursuing science? As one of his students, Yavuz Nutku, said, “Forever learning, Chandra couldn’t care one bit about the establishment. Everything he did was out of being curious in a productive way. He did it for one reason and one reason only – it would give him serenity and inner peace.”

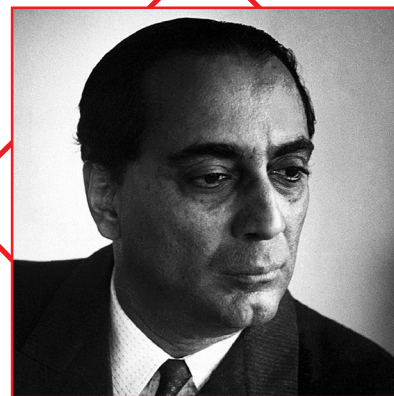


## Sisir Kumar Mitra

Sisir Kumar Mitra (24 October 1890 - 13 August 1963) did pioneering work on long-distance radio communication through the ionosphere. The ionosphere is one of the layers of the Earth’s atmosphere, extended from 60 km to about 100 km, where ionized particles reflect radio waves whose frequency range is between 3 MHz to 30 MHz. Mitra and his team detected reflections from as low as 20 km and named it C-layer.

After completing M.Sc., Mitra got an opportunity to work under Jagadish

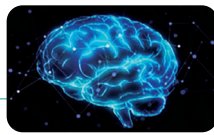
Chandra Bose in the Presidency College. However, to help his family financially, he left the chance and joined a college as a lecturer. Apart from teaching, there was no scope for research. However, Mitra had a burning desire to do research, and finally, he got an opportunity to join the Department of Physics in the newly created University College of science. This marked the beginning of Mitra’s outstanding scientific career. At the same time, C. V. Raman joined the Department as Palit Professor, and Mitra started working under Raman’s guidance.



## Homi J Bhabha

Homi Jehangir Bhabha (30 October 1909 - 24 January 1966) is known as the architect of India’s nuclear programme. Apart from his contribution in studies related to atomic energy, his contribution in establishing the Atomic Energy Establishment (AEE) and Tata Institute of Fundamental Research (TIFR) has benefited India’s science and technology for many decades. AEE was later renamed as the Bhabha Atomic Research Centre (BARC). Bhabha was an outstanding scientist and a brilliant engineer. He derived a correct expression for the probability of scattering positrons by electrons, now known as Bhabha scattering.

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# ARTIFICIAL INTELLIGENCE

Shweta Shrivastava

**I**ntelligence is usually defined as the general mental ability for reasoning, problem-solving, and learning. Similarly, human intelligence is nothing but the ability of a human to apply the acquired knowledge with a sense of logic, understanding, learning, planning, creativity, critical thinking, and problem-solving approach. In contrast, artificial intelligence (AI) is the intelligence exhibited by an artificial entity, such as a computer. In other words, the ability of machines to think and learn on their own is called Artificial Intelligence.

To brief, AI is the simulation of human intelligence processes by machines. These processes include learning, reasoning, and self-correction. Chess-playing computers, Self-driving cars, Personal digital assistance Apps, Flying Drones, Voice recognition apps are all popular technological breakthroughs of today. Unlike regular computer programs, where machines only follow programming instructions, these applications are capable of learning and making decisions on their own, using various technological tools.

## HISTORY OF AI

The intellectual roots of AI and the concept of intelligent machines may be found in Greek mythology. The beginnings of modern AI can be traced to the classical philosophers' attempts to describe human thinking as a symbolic system. However, until late 1950, no link was observed between human intelligence and machines.

Early developments in the field of AI were mostly influenced by the discovery made by Norbert Wiener. He was one of the first to theorize that all intelligent behaviour was the result of feedback mechanisms, mechanisms that could possibly be simulated by machines. A further step towards the development of modern AI was the creation of *The*

*Logic Theorist*. Designed by Newell and Simon in 1955, it may be considered the first AI program.

The person who finally coined the term artificial intelligence and regarded as the 'Father of Artificial Intelligence' is *John McCarthy*. In 1956 he organized a brainstorming conference, "The Dartmouth summer research project on artificial intelligence," to draw the talent and expertise of others interested in machine intelligence. Most of the programs developed in AI history were based on the LISP (LIST Processing) language created by John McCarthy in 1958. It was soon adopted by many AI researchers and is still in use.

The growth and development of AI occurred in three-phases: 1950 – 1970s (Neural Networks); 1980 – 2010 (Machine Learning); and present-day (Deep Learning).

## HOW DOES AI WORK?

AI includes tools and techniques like Artificial Neural Networks, Machine Learning, Natural Language Processing and Deep Learning to work like the human mind.

## Artificial Neural Networks

As you all know, our brain contains a chain of neurons that communicates with each other through axons to pass the information. Artificial Neural Networks (ANN) work similarly as our biological Neural Network. The brain passes information through a chain of neurons to understand and classify data. Likewise, artificial neural networks contain interconnected nodes through which data is

flowed and classified. The network can make decisions or predictions with accuracy based on the data fed to it. There is an added feature in this network, which senses if the decision taken is right or wrong, and gives this feedback to the ANN. Based on this, the ANN can change its future approach. ANNs can be taught to recognize images, speech, patterns, etc. and classify them according to their contents.

## Machine Learning

Machine learning means giving machine access to information and letting the machine learn from it on its own. Machine learning is an approach to achieve AI and uses a set of algorithms to analyze data and learn from the data to make informed decisions.

ARTIFICIAL INTELLIGENCE		
DOMAINS		
Cognitive Science	Robotics Applications	Natural Interface
-Expert Systems	-Visual Perception	-Natural Language
-Learning Systems	-Tactility	-Speech Recognition
-Fuzzy Logic	-Dexterity	-Multisensory Interface
-Genetic Algorithms	-Locomotion	-Virtual Reality
-Neural Networks	-Navigation	
-Intelligent Agents		

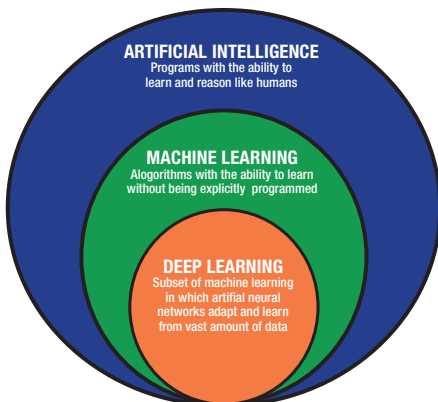
## DID YOU KNOW?

To work correctly, **AI** needs a large amount of data, called **Big Data**. This data is fed into and processed by Neural Networks to help machines think like humans.

Artificial Intelligence can work without using machine learning, but this would require building millions of lines of codes with complex rules and decision-trees. Rather than feeding computers and machines instructions on how to do everything, it is far more efficient to code them to “think” like human beings.

### Deep Learning

In Deep Learning, a large amount of data is fed into the computer system, which it uses to make decisions. It is achieved by passing data through multiple layers of ANNs.



You will be amazed to know that deep learning is conditioned in such a manner that it can automatically learn or extract the features from the stored data sets like signals, audios, videos, or texts without introducing any coded information. However, deep learning requires a massive amount of data to be able to make accurate decisions.

### Natural Language Processing

Natural Language refers to the way we humans communicate with each other by speech or text. Natural Language Processing is a field of AI that enables computers to analyze and understand

human language and also communicate with us in similar, natural language. This technology allows algorithms to read text on a webpage, interpret its meaning, and translate it to another language.

When machines carry out tasks based on algorithms in an “intelligent” manner, it is AI. Machine learning is a subset of AI. In other words, it is the ability of machines to learn for themselves, based on given data changing algorithms as they know more about the information they are processing. Deep learning goes yet another level deeper and can be considered a subset of machine learning. A neural network may have a single layer of data, while deep neural layer has two or more layers.

### MYTHS ABOUT AI AND ITS USES

When someone mentions AI, most of us imagine human-like robots taking over the world or helping humans in their day-to-day chores like cooking, serving, buying groceries, etc. But Robotics and AI serve very different purposes.

Today AI is powering everything, and its ubiquity is doing more than ever any technology has done. The technology is being deployed in various fields and making landmark breakthroughs that affect humanity in mostly good ways. AI is being used for a wide range of applications.

In the last five to ten years, AI is becoming more advantageous for the healthcare industry and going to have a significant impact on this industry. AI can help doctors with diagnoses and can inform when the situation of the patient is worsening so that medical help can reach to them before hospitalization.

AI and finance industries are the best matches for each other. The finance industry is implementing automation, chatbot, adaptive intelligence, algorithm trading, and machine learning into financial processes. AI can undoubtedly

make education more efficient. AI chatbot can communicate with students as a teaching assistant. AI in the future can work as a personal virtual tutor for students.

## DID YOU KNOW?

A humanoid robot is defined as one that is shaped to resemble a human. **Manav** is India's first humanoid robot.

AI has a remarkable role in Robotics. Usually, robots are programmed such that they can perform some repetitive tasks. Still, with the help of AI, we can create intelligent robots that can perform tasks with their own experiences without being pre-programmed.

AI has applications in various other fields including military, law, video games, government, automotive, audit, agriculture, art, etc.

To sum it up, AI looks all set to be the future of the world. Experts believe AI would undoubtedly become part and parcel of human life soon. It would completely change the way we view our world. You all must agree that with AI, our future seems intriguing and exciting.

### BRAIN DEVELOPER QUIZ

1. The term used for describing the judgmental or commonsense part of problem solving. \_\_\_\_\_
2. Who is considered to be the 'Father of Artificial Intelligence'? \_\_\_\_\_
3. AI belongs to which generation of computer technology? \_\_\_\_\_
4. Name the first humanoid to get the citizenship of a country. \_\_\_\_\_
5. Who developed the first portable computer? \_\_\_\_\_
6. An approach to achieve Artificial Intelligence is known as. \_\_\_\_\_
7. Which is the first and most widely used AI programming language? \_\_\_\_\_
8. AI software to simulate a conversation with a user in natural language through messaging applications is called \_\_\_\_\_
9. Which programming environment for children is created by Seymour Papert? \_\_\_\_\_
10. What is the code name of the Windows 7? \_\_\_\_\_

Send us the correct answers of the quiz at [curiosity@vignyanprasargov.in](mailto:curiosity@vignyanprasargov.in) to win exciting prizes.

The author is TGT – Computer Science at Vardhan International College, Lucknow.

# 2020 REGISTRATIONS GOING ON



## VIDYARTHI VIGYAN MANTHAN

### OPPORTUNITY TO PARTICIPATE IN INDIA'S 1<sup>ST</sup> MEGA SCIENCE EXPERIMENT



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- Open Book Exam
- Online Lecture Series on Indian Contributions to Science after 15 October, 2020
- Appear from Home either on 29 November, 2020 or on 30 November, 2020
- Exam can be given once anytime between 10:00am to 08:00pm (90 minutes of your choice)
- Exam can be given from a Smart Phone / Laptop / Tablet / Desktop (Android & Windows devices only)
- Name (Version), Link and Release of VVM Exam Application will be intimated through SMS, Email and Mock Tests will be available for practice purposes

#### REGISTRATION FEE

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(without Late Fee)  
Mock Test Starts- 01 November, 2020  
Date of Exam- 29/30 November, 2020



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STATE  
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- School Level - Merit Certificates
- District Level - Merit Certificates
- State Level Winners - Rs. 5000/-; Rs. 3000/- & Rs. 2000/- prize for 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> rankers respectively
- National Winners - Rs. 25000/-; Rs. 15000/- & Rs. 10000/- prize for 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> rankers respectively
- Zonal Winners - Rs. 5000/-; Rs. 3000/- & Rs. 2000/- prize for 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> rankers respectively

For more info



<https://vum.org.in>

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Organised by -





# Sky Map FOR OCTOBER 2020

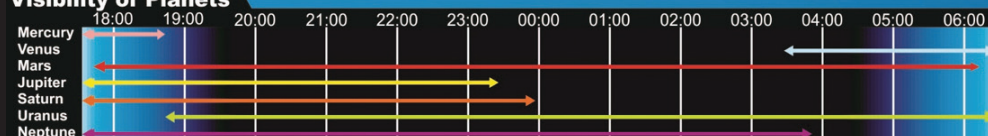
Vipin Singh Rawat

The sky map is prepared as per the coordinates of Nagpur (21.09°N, 79.09°E). It includes constellations and the brighter stars. For viewers south of Nagpur, constellations of the southern sky will appear higher up in the sky, and those of the northern sky will appear nearer the northern horizon. Similarly, for viewers north of Nagpur, constellations of northern sky will appear higher up in the sky, and those of the southern sky will appear nearer the southern horizon.

**THE MAP CAN BE USED AT 10 PM ON 1ST OCTOBER, AT 9 PM ON 15TH OCTOBER AND AT 8 PM ON 31ST OCTOBER.**



## Visibility of Planets



## Astronomical Events of

### OCTOBER 2020

#### OCTOBER 1

#### MERCURY AT GREATEST EASTERN ELONGATION

Mercury reaches greatest eastern elongation of 25.8 degrees from the Sun. This is the best time to view Mercury in the western sky just after sunset.

#### OCTOBER 7

#### DRACONIDS METEOR SHOWER

Draconids is a minor meteor shower producing only about 10 meteors per hour. It is produced by dust grains left behind by comet 21P Giacobini-Zinner. Meteors will radiate from the constellation Draco during the early evening.

#### OCTOBER 13

#### MARS AT OPPOSITION

Mars will be at its closest approach to Earth. It will be brighter than any other time of the year and will be visible all night long.

#### OCTOBER 21, 22

#### ORIONIDS METEOR SHOWER

The Orionids is an average shower producing up to 20 meteors per hour at its peak. It is produced by dust grains left behind by comet Halley. Meteors will radiate from the constellation Orion after midnight.

#### OCTOBER 31

#### FULL MOON, BLUE MOON

Since this is the second full moon in the same month, it is sometimes referred to as a blue moon.

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# SIZZLING SKY SHOW BY A DISTANT VISITING FRIEND FROM THE COSMOS: COMET NEOWISE (C/2020 F3)

Amritanshu Vajpayee



Image 1: NEOWISE on July 23, 2020 from Fatehgarh-Farrukhabad



Image 2: NEOWISE on August 06, 2020, from LCO III Campaign



Image 3: NEOWISE on August 10, 2020 from LCO III Campaign



Image 4: NEOWISE on August 28, 2020 from LCO IV Campaign

**C**omet NEOWISE, a distant visitor to the skies of the earthlings, has kept the astronomy lovers on toes for the last couple of months beginning from July 2020 and has delighted the sky-watchers around the world, particularly in the Northern Hemisphere. The entire two-month celestial show becomes even more prominent when the visitor comet NEOWISE promises that it won't return to our skies for another 6,800 years. So, let's dive into the brief details of this unique visitor.

Comets, also called 'cosmic snowballs', are icy, rocky objects made up of ice, rock, and dust. Comets orbit around the Sun in highly eccentric elliptical orbits. As they move closer



Image 5: NEOWISE on September 01, 2020 from LCO IV Campaign

to the Sun, they warm up and start releasing gases (outgassing) in the form of two streaming tails, one made of dust and gas and another ion tail made of electrically-charged gas molecules or ions. Comet means 'long-haired star'. Comets and asteroids are remnants from the formation of our solar system 4.6 billion years ago. They, in fact, are the remainders of material formed in the coldest part of our solar

system. Impacts from comets played a significant role in the evolution of the Earth, primarily during its early history billions of years ago. According to few beliefs, they brought water and a variety of organic molecules to the Earth. Scientists believe they offer clues to the formation of the solar system. Hence their studies are essential to understand the solar system better.

Discovered on March 27, 2020, by the NEOWISE mission of the Wide-field Infrared Survey Explorer (WISE) space telescope and officially designated with the systematic designation of C/2020 F3, Comet NEOWISE is known for being perhaps the brightest comet in the northern hemisphere since Comet Hale-Bopp in 1997. Travelling at a computed speed of 40 miles per second, it made its closest approach to the Sun, perihelion, on July 03, 2020, coming within 0.29 Astronomical Units, 26.7 million miles (43 million km), closer than the average distance from the Sun to Mercury. Its nucleus activity subdued after mid-July and its green coma was visible after that. On July 13, 2020, a sodium tail observed only in particularly very bright comets was confirmed by the Planetary Science Institute's (PSI) Input/Output facility.

At the beginning of July, the comet NEOWISE was visible low on the horizon in the early morning sky, and it slowly transitioned to become an evening comet, being perfectly visible as the skies darkened. Since the comet was on an Earth-approach orbit passing within 0.69 Astronomical Units (103.5 million kilometre to the Earth) its brightness and magnitude went as high as to almost matching Polaris. Hence it was

a naked-eye sky object altogether in early-mid July, and the distinguishable features of the comet were to be seen clearly by binoculars and offered a lot of opportunities to photograph and study. The members of the Ignited Minds VIPNET Club (VP-UP0103) used this once-in-a-lifetime opportunity to track and photograph the comet in July during its closest approach to Earth on July 23, 2020, while it was located in the constellation of Ursa Major (Saptarshi). Due to clear skies for about a week with intermittent clouds photography attempts for capturing the comet were carried out from July 20- 25 from Fatehgarh-Farrukhabad (27°21'27.604" N, 79°38'05.898"E) (Image 1). During that time in July, the comet was visible near Ursa Major at an altitude of about 40 degrees for an hour or two before setting. For instance, on July 23, the circumstances for Fatehgarh-Farrukhabad for 19:30 h were, viz., Right Ascension: 10h 38m 18.6s, Declination: 43° 53' 10.5" (J2000), Magnitude: 7.00, Altitude: 31°, Solar Elongation: 38.6°, Constellation:

Ursa Major, Sun distance: 96.05 million km, Earth distance: 103.56 million km, Rise: 06:45 h IST, Transit: 14:43 h IST, Set: 22:41 h IST. The key to sighting the comet in the mentioned period was that after the sunset, one needed to look for the Big Dipper constellation in the north-western sky at his/her place, and just below it, the comet, looking like a fuzzy star with a tail was visible. On June 29, 2020, in a retrograde orbit, NEOWISE crossed the north of the plane of the ecliptic, to which it is inclined at about 129 degrees.

I had the opportunity to get engaged with a Las Cumbres Observatory Project under the team "Saptarishi India". Together with the team, we have captured the NEOWISE on August 06, August 10, August 28 and September 01, 2020, using a 0.4m SBIG Telescope under LCO Phase III & Phase IV Campaign. Currently, the comet resides

in the Constellation Virgo at a distance of roughly 1.78 AU and moving to Libra after September 16, 2020, with a presently estimated magnitude of 15.50 (JPL) while the latest observed magnitude is 8.0 (COBS) as on September 03, 2020. It is computed to stay in Libra till November end with magnitude staying between 17.9-19.6 in the month of October and slowly going beyond 20 in the course of the passage of November 2020. The images taken from the various sources are being analyzed from the research point of view as well. As the comet passes close to the Earth, astronomers worldwide are trying to study its composition and structure. For instance, recent studies have revealed the spirals in the gaseous coma of NEOWISE.

NEOWISE, like other comets, promises to offer clues to the formation of the solar system. According to the sky-live computations, the next perihelion promised on June 24, 8786 AD, i.e., the visit slated for about 6800 years from now.

#### Acknowledgment:

The Ignited Minds VIPNET Club VP-UP0103 is thankful to Mrs. Anita Saxena for allowing the team to use her terrace. We are also grateful to Ms. Bonnie Thurber (Manager: LCO 100/100 Project), Dr Patrick Miller (Director, International Astronomical Search Collaboration), Ms. Cassidy Davis (Coordinator IASC), and Mr. Raul L. Valadez (IASC Technical Assistant) for making it possible for the teams to use the facilities of Las Cumbres Observatory under the different campaigns. We also thank Dr Arvind C. Ranade, Scientist 'F', Vigyan Prasara, with his regular advice on sky observations and astrophotography to the Club.

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अमित दीक्षित

विज्ञान क्लबों का रोचक संसार,  
हाँ यह विपनेट परिवार।  
जहाँ जीवन मूल्यों से सम्बंध  
सरल विज्ञान प्रयोगों की है भरमार,  
हाँ यह है विपनेट परिवार।  
जहाँ दूर करते समाज की भ्रातियाँ, जन  
जीवन को समझा कर विज्ञान का सार,  
हाँ यह है विपनेट परिवार।  
कर्तव्यनिष्ठा, अनुशासन और नवाचारों  
की है भरमार  
हाँ यह है विपनेट परिवार।  
निदेशक महोदय का आर्शावाद, राष्ट्रीय  
समन्वयक का मागदर्शन, विपनेट  
कोर टीम की मेहनत अपरंपार,  
हाँ यह है विपनेट परिवार।  
श्वेत से लेकर कान्त्य, रजत, स्वर्ण  
और प्लेटिनम की सबको दरकार,  
हाँ यह है विपनेट परिवार।  
सम्पूर्ण भारत को किया वैज्ञानिक  
दृष्टिकोण से सरोबार,  
हाँ यह है विपनेट परिवार।  
प्रधानमंत्री जी के सपने जय जवान,  
जय किसान, जय विज्ञान और जय  
अनुसंधान को करता साकार,  
हाँ यह है विपनेट परिवार।  
नव राष्ट्र निर्माण और आत्मनिर्भर भारत  
की भावना को नित देता आकार,  
हाँ यह है विपनेट परिवार।

अमित दीक्षित  
प्रस्तुत रचना के लेखक लिटिल यूनिवर्स विपनेट  
क्लब (VP-DL0023) के समन्वयक एवं शिक्षक हैं

# WATER RESOURCES MANAGEMENT

Peeyush Gupta



National Mission for Clean Ganga (NMCG) by Ministry of Jal Shakti is a comprehensive Mission with high priority for research and evidence-based decision making and has special place for use of new technology including Geospatial technology. NMCG Authority order of October 2016 states that the pollution in Ganga and its tributaries shall be monitored by use of satellite imagery and other remote sensing technologies. Remote Sensing and GIS (Geographical Information System)/geospatial technology has huge potential to achieve the sustainable development goals (SDGs) by 2030.

Water is key driver of economic and social development and one of the fundamental elements in sustaining the integrity of the natural environment. It is the major renewable resource among the various natural resources. Water being an indispensable constituent for all life supporting processes, its assessment, conservation, development and management is of great concern for all those who manage, facilitate and utilize.

Sustainable water resource management is a central challenge for governments the world over. Extremes in the water cycle, namely, floods and droughts, strain even the wealthiest nations and devastate vulnerable populations. Furthermore, many of the most water vulnerable places on the Earth are also the most poor on hydrological data. To make up for a shortage of water data, a consequence of limited in situ monitoring networks, many scientists and water managers in low-income countries rely on remotely



sensed data acquired from satellites. After decades of maturation, satellite-based sensors orbiting the Earth can now measure precipitation, evaporation, surface water levels, soil moisture, snow depth, groundwater, and more. Satellite remote sensing data is being put into use to provide quantitative and reliable information, thereby facilitating improved water resources management.

## GEOSPATIAL TECHNOLOGY FOR WATER RESOURCES MANAGEMENT

Measurements from satellite remote sensing provide a means of observing and quantifying land and hydrological variables over geographic space and support their temporal description. Remote sensing instruments capture upwelling electromagnetic radiation from the earth surface features which is either reflected or emitted. The former is reflected solar radiation and the latter is in thermal infrared and microwave portions of electro-magnetic spectrum. Active microwave radars obtain reflected/returned microwave signals. The reflected solar energy is used for mapping land and water resources like land use, land cover, forests snow and glaciers, water features, geologic and geomorphic features, water quality, etc. The thermal emission in the infrared is used for surface temperature, energy fluxes and microwave for soil moisture, snow and glacier, flood, etc.

Remote sensing has several

advantages over field measurements. First, measurements derived from remote sensing are objective; they are not based on options. Second, the information is collected in a systematic way which allows time series and comparison between schemes. Third, remote sensing covers a wide area such as entire river basin. Ground studies are often confined to a small pilot area because of the expense and logistical constraints. Fourth, information can be aggregated to give a bulk representation or disaggregated to very fine scales to provide more detailed and explanatory information related to spatial uniformity. Fifth, information can be spatially represented through geographic information systems, revealing information that is often not apparent when information is provided in tabular form.

The SWIR band (Short Wave Infra Red) of AWiFS (Advanced Wide Field sensor) in IRS-P6 was found to be useful in better discrimination of snow and cloud, besides delineating the transition and patch in snow-covered areas. Snow-melt runoff forecasts are being made using IRS-WiFS/AWiFS and NOAA/AVHRR data. These forecasts enable better planning of water resources by the respective water management boards. Monitoring reservoir spread through seasons has helped to assess the storage loss due to sedimentation, updating rating curves. Satellite data-derived spatial and temporal information on cropping pattern, crop intensity and condition form basic inputs for developing indicators for agriculture performance of the irrigation system and bench-marking

of systems. Satellite data-derived geological and hydro-geomorphologic features assist in prospecting the ground water resource to plan aquifer recharging, water harvesting and drinking water sources. High resolution satellite data remarkably augmented the remote sensing services extending it to infrastructure planning and management.

### APPLICATIONS

- Field /Plot boundaries
- Irrigation network/infrastructure
- Cartographic information
- Micro-scale features
- Land use/Land Cover
- Surface Water Resources
- Water logging
- Evapotranspiration
- Soil Moisture
- Surface roughness
- Soil Moisture
- Flood Inundation
- River bank erosion
- River control works
- Surface water
- Snow cover
- Glaciers
- Snow depth
- Snow water equivalent
- Water quality
- Precipitation

The overall applications of geospatial technology in water resources sector can be broadly categorized into the following groups:

- I. Water Resources Assessment
- II. Water Resources Management
- III. Water Resources Development
- IV. Watershed Management
- V. Flood Disaster Support
- VI. Environmental Impact Assessment & Management
- VII. Water Resources Information & Decision Support Systems

### FEW THEMATIC APPLICATIONS

#### WATER RESOURCES ASSESSMENT

Surface water occurs in the form of liquid water in lakes, reservoirs, rivers, and in its solid form as snow, glacier and lake ice. Remote sensing platforms

are amenable to detect and map the spatial extent of both forms of water. Accurate information on surface water, its existence, spatial extent, temporal changes is essential to manage this resource judiciously.

watershed, a natural hydrologic unit is considered to be the most appropriate basis. Watershed characterization involves measurement of related parameters, such as geological, hydrogeological, geomorphological,

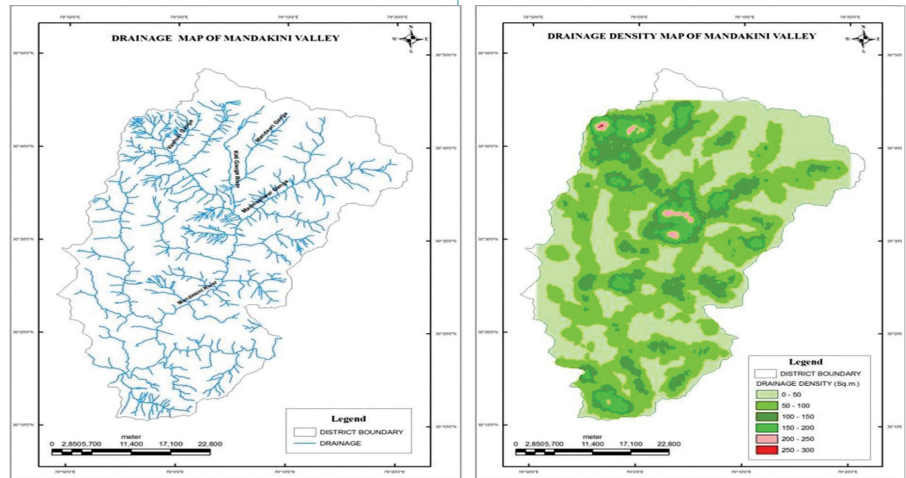


Fig. 1 Drainage Map of Mandakini Valley of Uttarakhand

#### WETLANDS MAPPING

Reflective and thermal infrared images are extensively used to map and monitor water bodies/wetland.

hydrological, LULC, soil etc. Remote sensing using aerial and space-borne sensors can be effectively used for watershed characterization and

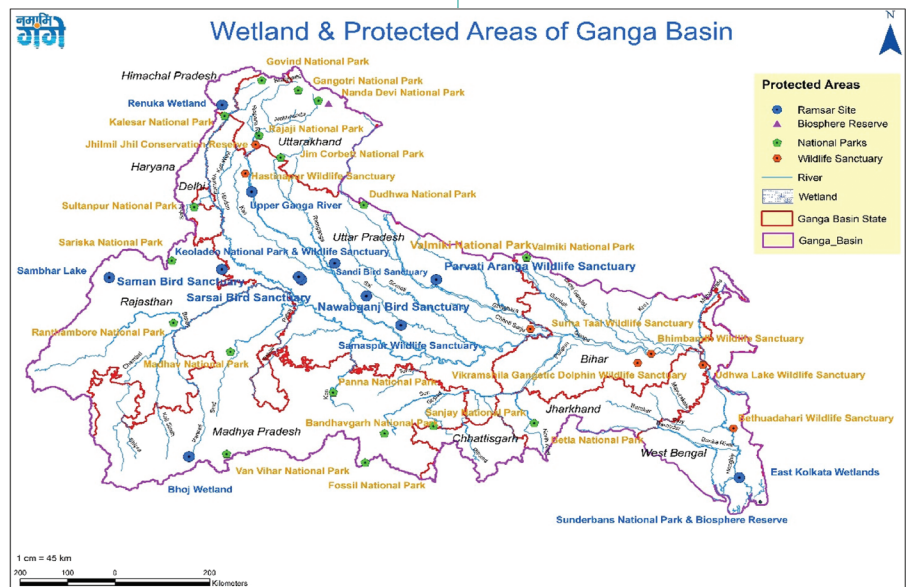


Fig. 2 Wetland Map of Ganga Basin

#### WATERSHED MANAGEMENT

For sustainable integrated management of the land and water resources,

assessing watershed priority, evaluating problems, potentials, management requirements and periodic monitoring.

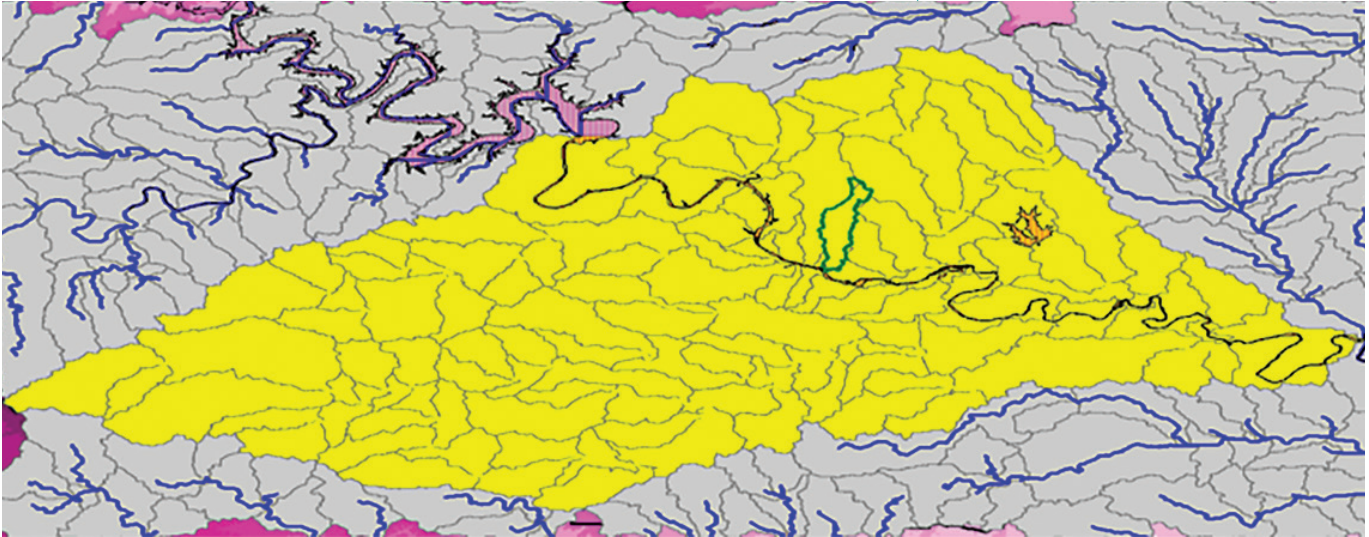


Fig. 3 Watershed from DEM

### RIVER ENGINEERING

River migration and river control works form the major elements in the flood plain management. Satellite data provides accurate delineation of river configuration and the status of flood/river control works.

Most of the flood-prone rivers in India change their course frequently after every flood wave attacking strategic locations at different times. Hence, it is necessary to understand the behaviour of the river and its latest configuration so as to plan the flood control measures effectively and additionally, monitoring the existing flood control structures from time to time to avoid breaches in view of the frequent changes in river configuration.

### WATER QUALITY

Visible and infrared (reflected) regions of EMR are useful for detecting indicators of water quality. Table 2 depicts Water Quality Parameter vs. Spectral Region Thermal infrared. It is also used for measuring water quality but it uses a direct measure of emitted energy. Fig. 5 shows water quality map of chlorophyll-a and turbidity parameter. This map is generated with the help of sentinel data.

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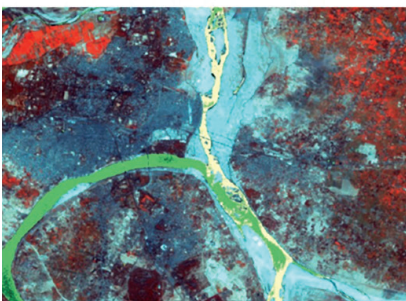
### TEST YOUR KNOWLEDGE

Identifies Cities/towns on these confluence points

Rivers	Place of Confluence
Alaknanda & Bhagirathi	
Ganga & Yamuna	
Ganga & Kosi	
Yamuna & Betwa	
Ganga & Gandak	
Yamuna, Chambal, Pahuj, Sind & Kuwari	

Send us the correct answers of the quiz at [curiosity@vigyanprasar.gov.in](mailto:curiosity@vigyanprasar.gov.in) to win exciting prizes.

Chlorophyll-a in river Ganga and Yamuna during Nov-Dec'18



Turbidity in river Ganga and Yamuna during Nov-Dec'18

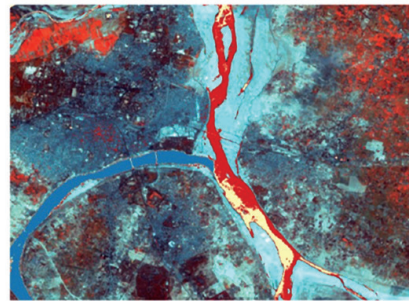


Fig. 4 Water Quality (Parameter: Chlorophyll-a & Turbidity) Map

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**Science Exhibition**

Eureka Science Club, Pune (VP-MH0150) organized a science exhibition on 28th February 2020. The students of Novel Junior College of Science and Commerce presented the innovative science models of line following robot, Human Battery, Sewage treatment Plan, Golden rain, smart dustbin etc.



**Making of “Automatic Hand Sanitizer dispenser”**

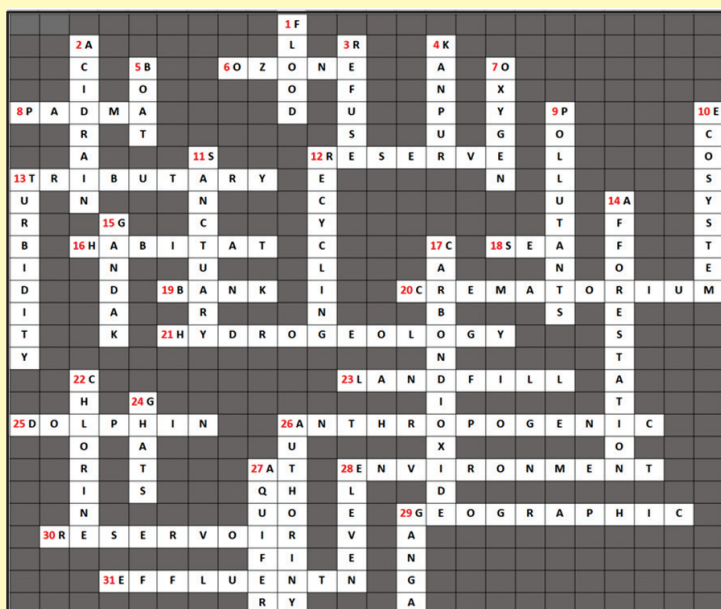
Saraswathy Science Club (VP-KL0024) conducted an online demonstration session for constructing an automatic hand sanitizer dispenser. The session was conducted on 26th march 2020 for the students, parents and community members with the help of Atal tinkering lab mentors.

**Answers of Curiosity September Issue**

Science Quiz: 1. A; 2. B; 3. C; 4. A; 5. C; 6. A; 7. A; 8. C; 9. C; 10. A

Ozone-Check your Knowledge: 1. -112°C; 2. Dobson Units; 3. Partially; 4. UV radiations; 5. September 16; 6. To smell; 7. Pale Blue; 8. Photochemical smog; 9. 1989; 10. Arnold O. Beckman

**Namami Gange Crossword:**

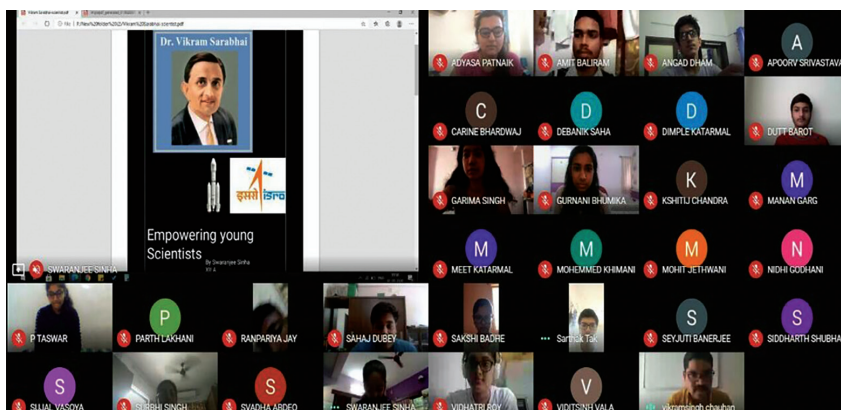


**Cell and its organelles -Demonstration Session**

Ryan Science Club, Mansarovar Jaipur (VP-RJ0111) conducted a demonstration session on 21 August 2020 to understand the cell and its various organelles. The students of Ryan International School created the model of cell organelles using the waste materials present at their home.

## National Scientific Temper Day

On the occasion of National Scientific Temper day on 20th August, Rayat Science Club, Satara (VP-MH0203) organized a one-week virtual workshop for the students of K.B. Patil Vidyalaya & Jr. College, Dhebewadi to inculcate scientific temperament in the youngsters. During the one-week workshop various activities like experiments, My home laboratory, Observe and discuss, Science Quiz and Science-based experiments against blind beliefs, and 'Ask Why?' were conducted.



## Dr Vikram Sarabhai Birth Anniversary Celebration

To celebrate the birth anniversary of Dr Vikram Sarabhai, Scientia Enim Hominis science Club, Jamnagar (VP-GJ0178) organized a talk to highlight the life story of the great Indian scientist. The presentation was given by club members on virtual platform to make students aware about his contribution in India's space and nuclear programmes.

## VIPNET ACTIVITY STARS!

### Ozone-Check Your Knowledge:

- 1. Name:** Srinibas Dora  
Barahamihir Vipnet Science Club (VP-OD0219)
- 2. Name:** ANUJ KUMAR  
(Secretary, Karonsia Vigyan Club (VP-UP0023)  
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Firozabad, 283151, U.P.

## SCIENCE QUIZ

- 1. Name:** Rajat Manro  
S/o Dr. Rajan Manro  
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Bank Colony, Khanna Distt:-  
Ludhiana, Punjab

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