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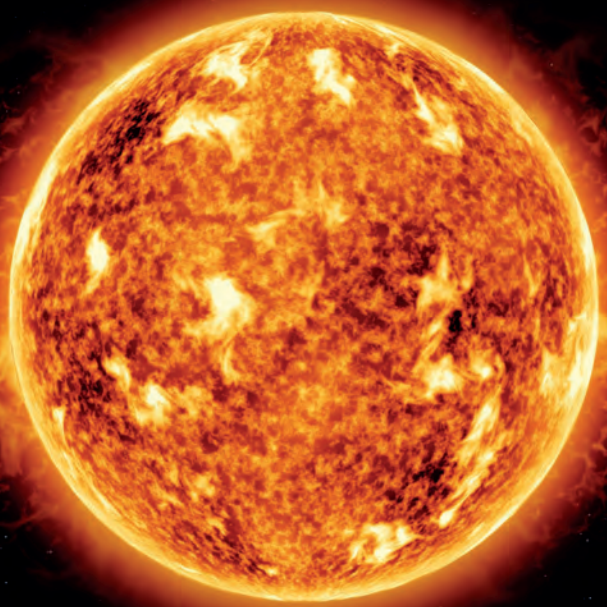
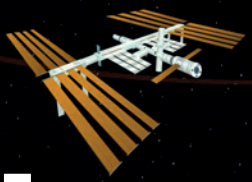
# Science INDIA

राष्ट्रहिताय विश्वमङ्गलाय

Connecting science and people with an Indian perspective



## ADITYA-L1 MISSION



# REACHING FOR THE SUN

**The successful launch of Aditya-L1, India's maiden flight to the Sun, coming soon upon the triumphant Chandrayaan 3, fortifies its position as a top space nation of the world**

# CSIR-Advanced Materials and Processes Research Institute, Bhopal

**Constituent laboratory of Council of Scientific and Industrial Research, DSIR, Govt. of India**

## *About the institute*

Advanced Materials and Processes Research Institute (AMPRI), Bhopal was instituted in May 1981 as "Regional Research Laboratory" (RRL) and officially started functioning from CSIR, New Delhi. It subsequently found a place in the present premises in December 1983. The name change from Regional Research Laboratory, Bhopal to Advanced Materials and Processes Research Institute (AMPRI) is effective from March 6, 2007. CSIR-AMPRI, Bhopal is engaged in cutting edge research in different R&D programs in lightweight materials such as Al and Mg alloys, metallic and polymer based composites, foams, and functional materials; nano-materials; new materials based on industrial wastes such as fly ash and red mud, water resource modelling, health assessment, improvement and failure analysis of engineering components/systems and processes etc. CSIR-AMPRI Bhopal is offering internships/training programs in varied areas of recent advancements with hands on training on latest equipment. Institute has trained more than 1200 trainees in last 4 years.

***Few training courses offered by institute are listed below:***

1. **CNC Turner, Conventional Turner, Welder & Fitter**
2. **Heat Treatment, Metallographic and Mechanical Characterization**
3. **Water Resources Management and Hydrology Modelling**
4. **Electroplating and Surface Modifications Techniques**
5. **Basic Skills in Science Laboratory Techniques**
6. **Concrete Technology and Testing**
7. **Additive Manufacturing**
8. **Water supply Engineering and Water Quality Analysis**
9. **R Programming**
10. **Synthesis, Characterization and Application of Nanomaterials**
11. **Analytical and Bio-Analytical Chemistry**
12. **Renewable Energy**
13. **Electron Microscopy & Microanalysis**

### *CSIR- Integrated Skill Initiative Programme*

Council of Scientific and Industrial Research, New Delhi has introduced skill program to comply with flagship scheme of the Ministry of Skill Development and Entrepreneurship which aims to achieve its vision of a 'Skilled India'. The aim of this program is to enable a large number of youth to take up industry- relevant skill training that will help them in securing a better job. To fulfill the same, CSIR-AMPRI, Bhopal has started different skill programs to make youth job oriented by imparting training.

Students/trainees from colleges / industries graduated/pursuing degrees in science, engineering, pharmacy etc. may approach CSIR-AMPRI Bhopal for training in areas of on-going projects, recent technologies, along with curriculum specific courses. Other than these, institute offers customized courses to the artisans / teachers / industry personnel. For details, please visit institute website.


CSIR Integrated Skill Initiative

**For details, contact: Director, CSIR-Advanced Materials and Processes Research Institute, Bhopal,** Hoshangabad Road, Bhopal-462026, Email: director@ampri.res.in, **Website: www.ampri.res.in**

स्वतंत्रता का अमृत महोत्सव

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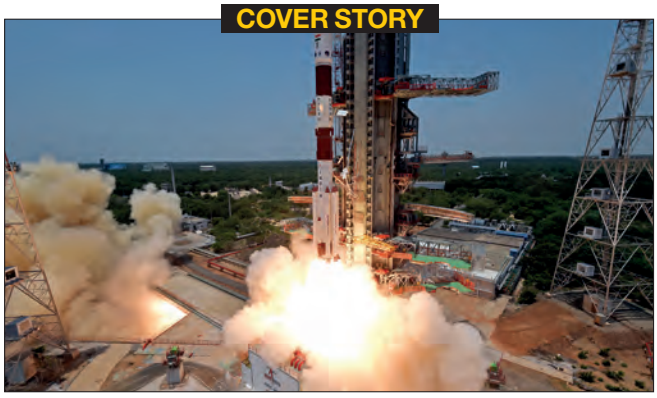
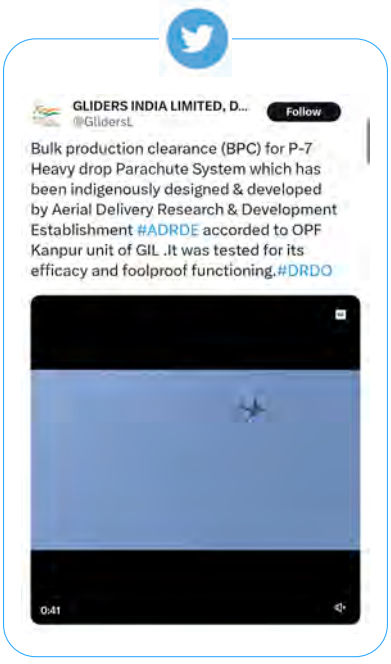
# What's Inside






Cover image courtesy: Shutterstock





## 'AN AWESOME COLLECTOR'S EDITION'


I just got to read the flipbook version of the COLLECTOR'S EDITION 3.0 (August 2023). In one word, it is 'AWESOME'. After publishing two Collector's Editions in 2021 and 2022, which were based on the works of Indian scientists in the colonial era, this third Collector's Edition tells us a lot about the developments in the field of science and technology in independent India.

The stories behind the building of institutions like ISRO, DRDO, BARC, CSIR, etc., are amazing. How many of us know about the contributions of Dr Mahendra Lal Sircar in whose research centre, the IACS, Dr CV Raman would carried out his Nobel Prize-winning work? Prof Tapas Chakraborty has aptly narrated it.

From being a net importer in the Defence sector until a few years ago, the country is on its way to becoming self-reliant or Atmanirbhar, and is also moving fast towards becoming an important exporter of Defence equipment. The magazine has done full justice to this story in an article by Ravi Kumar Gupta.

'Our IT Story...' by HCL co-founder Dr Ajai Chowdhry narrates the rise and growth of the IT sector — our sunshine industry. The story of 'Philanthropist industrialist Jamsetji Tata' by Shivprasad Khened tells us untold facets about the founding father of the Tata Group. While the former bureaucrat Uday Kumar Varma has aptly narrated the growth and prospects of Solar power in India, Prof Bhavesh has given an insight into the world of Biotechnology. The articles on Space and BARC respectively by Prof Giri and journalist Abhijit Mulye — in one word, are excellent. 'Indian origin scientific terms' by Dr Jayanti Dutta is a unique feature.

While the articles on Agriculture, Organic farming, and 'Chemical Labs' narrate the story of India's growth and Atmanirbharta, Sonam Singh Subhedar succinctly encapsulated the New India (1947-2023) through a timeline. Last but not the least, the editor, Debobrat Ghose through his unique piece, 'Building a New Narrative' has explained the building blocks that led to three Collector's Editions.

I wish the entire editorial team of *Science India* a bright future and look forward to more such collector'seditions.

*Prof Kumud Das, Associate Professor, School of Media and Journalism, DY Patil International University, Akurdi, Pune.*

*Send your letters to editor@scienceindia.in*

# Let's Connect

Dear Readers,
This is the month of Lord Ganesha, whose divine blessings are the most important ones that every Indian household requires before beginning anything auspicious. *Science India* extends to all its readers best wishes on Ganesh Chaturthi.

While this has been the month of Lord Ganesha since eternity, in the years to come it will also be remembered for Aditya-L1, India's very own, maiden space mission to the Sun — just as the months of July-August will be remembered for Chandrayaan 3. The country's collective spirit was still on the seventh heaven over the success of Chandrayaan 3 mission when ISRO gave another gift to India, in the form of the Aditya-L1 mission. *Science India* extends best wishes to the country's fabulous scientists, who have made India one of the foremost space-faring nations in the world, on a budget that is, perhaps, just a fraction of the billion-dollar worth of budgets of top space agencies of the world.

To commemorate this stupendous achievement, this edition of *Science India* presents a comprehensive package of stories on and related to Aditya-L1 — while the cover story looks at the mission in great depth, another one looks at how solar energy, with which India is richly endowed, can be tapped to ameliorate the condition of our vast masses. Yet another story takes a look how India can, and should, leverage the lead given to it by its recent, successful space missions, to give itself a more prominent and powerful role on the world stage.

**We cannot ignore the strides that Indian science and technology continues to make daily, through achievements big and small, in sectors other than space as well**

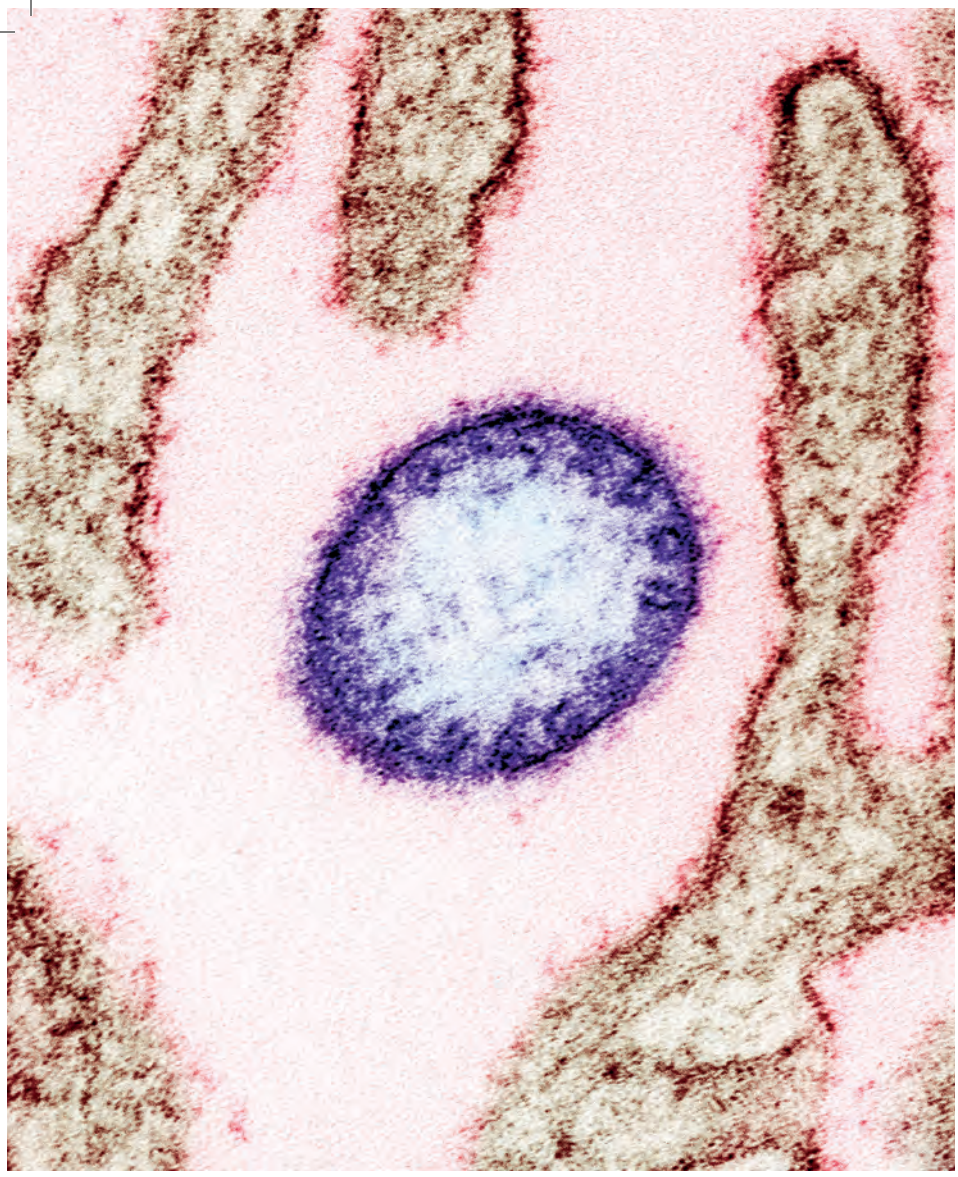
While the country has been feeling deservedly happy and contented over the success of Chandrayaan 3 and Aditya-L1 for the past few weeks, we cannot allow this pleasure to blind us to the path that we need to walk on this road further. We also cannot ignore the strides that Indian science and technology continues to make on a daily basis, through achievements big and small in other sectors as well.

A collection of some such achievements is the list of the winners of Shanti Swarup Bhatnagar Awards for 2022 announced recently. This edition presents a brief profile of all the 12 winners of the most prestigious science awards in the country, spanning seven disciplines. It is the work of such dedicated individuals that holds the potential to turn India into a research-rich country, which ultimately is the bedrock of a progressive, bountiful, and enterprising society.

Meanwhile, Indian scientists are working on yet another important project, the Matysa 6000. It is the flagship vehicle — a submersible to explore the deep oceans — of the ambitious Samudrayaan project. The submersible, being developed by the National Institute of Ocean Technology, Chennai, will carry three people to a depth of 6 km into the ocean for deep sea exploration and biodiversity assessments. Read on!

Another interesting read is an in-depth analysis of the National Geospatial Policy, which was notified earlier this year, and is aimed at making India a world leader in the global geospatial sector. It focuses on tackling the increasingly important geospatial data, which, in simple language refers to information that describes objects, events or other features with a location. It is most useful when it can be utilised in combination with traditional business data. It may sound esoteric to most of us right now, but we don't even realise how we are already an integral part of the geospatial data ecosystem.

We leave our readers this month with a variety of scientific information to read, enjoy, absorb, assimilate, and perhaps, make use of in the weeks and months to come, in the hopes that our science offering yet again matches the expectations of our esteemed readers.



Images Courtesy: Wikimedia Commons

# Recurrent Outbreak of Nipah Virus in Kerala

The understanding about Nipah virus (NiV) is abysmally low and there is no cure; but, there is no need to panic

■ **Science India Bureau**

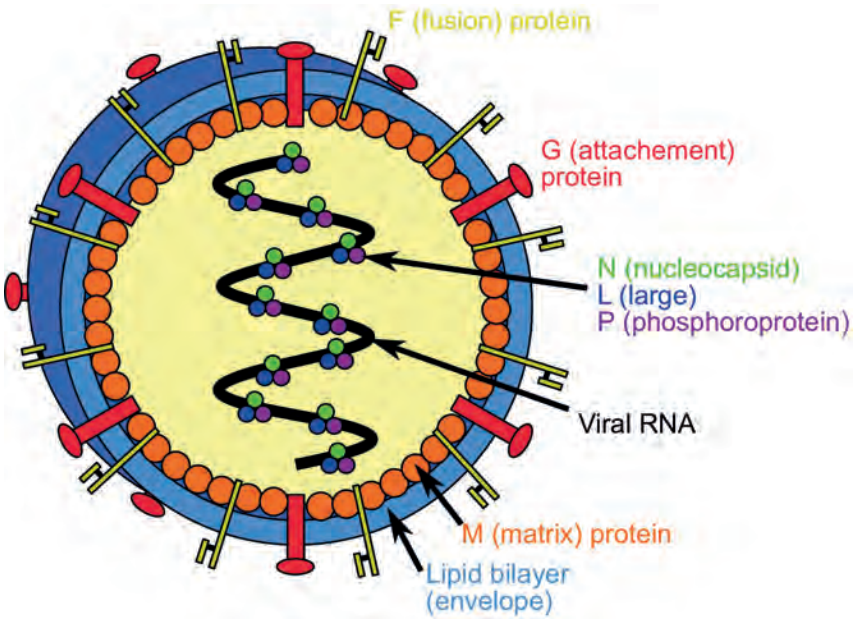
Kerala is currently experiencing a new outbreak of the deadly Nipah virus (NiV). This makes it the fourth outbreak of the virus in the state. The deadliest year was 2018, when 17 people died from 18 laboratory-confirmed cases and five suspicious cases.

By September, five people had contracted the virus, of whom two passed away. Schools in the Kozhikode district — the worst affected — were closed, and 'containment zones' established by the authorities. Sixty-six individuals, who had contact with the afflicted, were being closely watched for symptoms of the illness.

The Nipah is an RNA virus of the Paramyxoviridae family. In 1999, Malaysia saw the first known outbreak — among pig farmers — which resulted in 265 cases and 105 fatalities. Since then, there have been one or two outbreaks annually. More than half of those infected pass away. It took only a few months for the virus to reach Singapore through infected pigs. Over 100 fatalities and close to 300 cases were the result of this outbreak.

Since then, Malaysia has not experienced any other Nipah virus outbreak. However, the virus first appeared in Bangladesh and India in 2001, and outbreaks have continued to occur on occasions ever since. Studies have connected diseases with consuming fermented date-palm sap tainted with bat urine, where outbreaks occur virtually annually.

Since 2018, Nipah has recurred in Kerala four times, raising questions about the repeated occurrence of the infection in the state. In the current outbreak in Kerala, the trajectory of infection passing from bats to humans is not exactly known, and several possible reasons are being considered. The bat population in




**The Nipah virus (NiV) is a type of RNA virus in the genus Henipavirus (above)**

Kerala may have developed an endemic form of the Nipah virus. The practise of drinking fresh toddy or tree sap, which may become contaminated with diseased bats, may be another factor.

Despite having the potential to be fatal, the Nipah virus is less likely to cross international borders than other animal-borne illnesses because it is less contagious among humans. A 2019 analysis of approximately 250 Nipah virus cases in Bangladesh over a period of 14 years suggests that about one-third of human illnesses were spread to others.

According to Dr Puneet Misra, Professor of Community Medicine at the All India Institute of Medical Sciences, New Delhi, we should still be careful and watchful as it might spread to other parts (of the country) if we do not take adequate measures. "Though public health agencies are taking all the necessary steps, chances [of the spread] are very less and there is no reason to panic," added Dr Misra.

The percentage of asymptomatic Nipah virus infections fluctuates from one outbreak to another and ranges from 17% to 45%. Encephalitis (brain swelling) is the predominant symptom of the virus when it does produce sickness. Many patients also feel confusion, tiredness, and disorientation in addition to developing a fever and complaining of an excruciating headache. Additionally, some people get a chest infection.

But even after getting fully recovered, there may be certain long-term effects. "Long-term side effects in survivors of Nipah virus infection have been noted, including persistent convulsions and personality changes. Infections that lead to symptoms and sometimes death much later after exposure (known as dormant or latent infections) have also been reported months and even years after exposure," noted Dr Misra.

Since there are no particular medications to treat Nipah virus, medical care is only 'supportive', that is, it focuses on treating the patient's specific symptoms and ensuring their comfort while they wait to hopefully recover.

If administered early enough in the course of a Nipah virus infection, a targeted treatment known as monoclonal antibodies has been demonstrated to be successful at lowering death in green monkeys. However, no trials have yet demonstrated how well these medications work in Nipah virus-infected human patients.

To combat the present outbreak nonetheless, the Indian government is purchasing monoclonal antibodies from Australia.

Although an mRNA vaccine against the virus is being developed, there are no vaccinations available to protect against the Nipah virus.

All this leads to several questions regarding the spread of infection and ways to contain it, especially in the absence of any specific medication. Although there was no proof of person-to-person transmission during the initial outbreak in Malaysia more than twenty years ago, contact with pigs was the main risk factor. It was unclear then as to why pigs became the carriers of this virus.

We now know more about the virus and the dangers of human transmission than we did during the first outbreak. The Indian flying fox is now recognised as the main host for the Nipah virus in fruit bats. In Kerala, bats have already been found to carry the Nipah virus.

The Truenat test may now be used in Kerala to identify Nipah virus (NiV) infections, according to the Indian Council for Medical Research (ICMR). The test can now be performed in hospitals that have Biosafety Level 2 (BSL 2) laboratories, which is a significant development. The Truenat test would be conducted according to a standard operating procedure (SOP), Kerala's Health Minister Veena George has declared.

With the ICMR's permission, more labs in the state of Kerala will be able to use the Truenat test for NiV diagnosis. Inspected facilities, such as the Institute of Advanced Virology in Thiruvananthapuram, or the Kozhikode or Thiruvananthapuram Medical College hospitals, can do additional testing on samples that show positive results for NiV using the Truenat method.

According to the World Health Organisation (WHO), first symptoms of infection include fever, respiratory discomfort, headaches, and vomiting. In severe situations, encephalitis and seizures can also happen and result in coma.

The virus is on the WHO's research and development list of pathogens with epidemic potential.


**A postage stamp on Dr Shanti Swarup Bhatnagar, released by the Government of India in 1994**

Image courtesy: Wikimedia Commons

# Shanti Swarup Bhatnagar Awards: Top Honours to 12 Scientists

Outstanding scientists under the age of 45 have won the country's most prestigious science award in seven disciplines for the year 2022

■ **Science India Bureau**

The Council for Scientific and Industrial Research (CSIR) recently announced the winners of the 2022 Shanti Swarup Bhatnagar (SSB) awards. A total of 12 scientists from seven disciplines — biology; chemistry; mathematics; physics; medicine; engineering; and earth, atmospheric, ocean, and planetary sciences — have been selected for the most coveted honour in the field of science and technology in the country.

Dr N Kalaiselvi, director general of CSIR announced the names of the awardees for the year 2022 at an event in the presence of Dr Jitendra Singh, the Union Minister of State (independent charge) for Science and Technology. The award is named after Dr Shanti Swarup Bhatnagar (1894-1955), the renowned chemist and science administrator who was the first director general of CSIR.

Here's a brief introduction of all the 12 scientists who have been honoured with the Shanti Swarup Bhatnagar Prize for 2022:

## BIOLOGICAL SCIENCES

### Dr Ashwani Kumar

A Senior Scientist at Molecular Mycobacteriology Laboratory, CSIR – Institute of Microbial Technology, Chandigarh, Dr Kumar has won the prize for his research that has resulted in new understanding of the behaviour of Mycobacterium tuberculosis (Mtb), the bacteria that causes TB and claims millions of lives annually worldwide. His findings fundamentally alter TB biology and can pave the way for development of new drugs that can cure TB faster.

### Dr Maddika Subba Reddy

One of India's top cell biologists and director of the Laboratory of Cell Death and Cell Survival, Centre for DNA Fingerprinting

Diagnostics, Hyderabad, Dr Reddy has received recognition for his work that has made some fundamental contributions in understanding the communication between different proteins in cells. He has focused on identifying several protein complexes that ensure the internal environment within the cell remains stable even when there are changes to the external environment.

## CHEMICAL SCIENCES

### Dr AT Biju

An Associate Professor at the Indian Institute of Science, Bengaluru, Dr Biju has received the award for his work on using new environment-friendly methods to synthesise biologically important compounds that have implications in the development of new drug-like molecules. The new approach involves methods of carrying out chemical reactions that do not rely on transition metals as catalysts, and yet are more efficient and environment-friendly.

### Dr Debabrata Maiti

A professor at the Indian Institute of Technology Bombay, Dr Maiti has won the award for his work on identifying the right metal-ligand combination to make selective C-H (carbon-hydrogen bonds) activation super-efficient. He has been working on efficiently activating C-H bonds at specific locations so that they can be broken easily and substituted with other molecules. He has been using transition metals like palladium, cobalt or nickel as catalysts.

## EARTH, ATMOSPHERE, OCEAN AND PLANETARY SCIENCES

### Dr Vimal Mishra

Dr Mishra, who works at the Water and Climate Laboratory, Indian Institute of Technology Gandhinagar, has been awarded for his work on climate change solutions, particularly those related to water. His 2021 study found that groundwater pumping for irrigation, severe and frequent droughts (2009, 2014, 2015), and a roughly 11% drop in the summer monsoon (June-September) from 1951-2016, all led to groundwater depletion in the Ganga basin.

## ENGINEERING SCIENCES

### Dr Dipti Ranjan Sahoo

A professor of structural engineering at the department of civil engineering at the Indian Institute of Technology Delhi, Dr Sahoo has been recognised for his contributions to seismic design and the reduction of seismic effects on structures like bridges. His team has developed several energy-dissipating devices and high-strength construction materials, which are designed to minimise the possibilities of building collapse during an earthquake. He has worked on getting design solutions for concrete-filled steel tubular composite columns.

### Dr Rajnish Kumar

Dr Kumar of the Department of Chemical Engineering, Indian Institute of Technology Madras, has been awarded for his work on marine gas hydrates, exploring them as a source of energy. These ice-like solids found in deep oceans keep vast resources of potential energy trapped inside them. In collaboration with scientists from some other laboratories, Dr Kumar has developed a process of methane recovery from marine gas hydrates, which is ready for field trials.

## MATHEMATICAL SCIENCES

### Dr Apoorva Khare

A faculty member at the Indian Institute of Science, Bangalore, Dr Khare has carried out research in matrix analysis, and made new progress in a classical area with modern applications in big data problems, including statistical analysis of climate change and disease detection. His research has revealed new links between algebra and analysis. He also works in representation theory, a branch of algebra that finds applications in several areas of modern number theory.

### Dr Neeraj Kayal

Dr Kayal is a researcher in the Department of Mathematics and Computing at the Microsoft Research Lab India, Bengaluru. He works on complexity theory, number theory and algebra. Early in his career, he co-developed a famous method, called the AKS primality test, to find out whether a given very large prime number was prime or not. He has lately focused on improving the efficiency of computer algorithms. Earlier, he won the Infosys Prize for Mathematics 2021 for his contributions to computational complexity.

## MEDICAL SCIENCES

### Dr Dipyaman Ganguly

A researcher at the CSIR-Indian Institute of Chemical Biology's Translational Research Unit, Dr Ganguly has won the prestigious award for his research on autoimmunity and metaflammation, where the immune system starts targeting the body's own cells and tissues, resulting in autoimmune diseases. His group had carried out a number of studies during COVID-19 to understand the role of undue activation of the immune system in some patients with severe diseases.

## PHYSICAL SCIENCES

### Dr Anindya Das

A professor at the Department of Physics, Indian Institute of Science, Bengaluru, Dr Das has made immense contributions to our understanding of the electric and thermoelectrical properties of 2-D, atomically thin materials with strong interactions. His group is working with two-dimensional graphene (a one-atom thick sheet of carbon) and its hybrids to detect the presence of Anyons — a group of particles theorised to exist at very low temperatures and mostly in two-dimensional systems.

### Dr Basudeb Dasgupta

Working with the Department of Theoretical Physics, Tata Institute of Fundamental Research (TIFR), Mumbai, Dr Dasgupta has been awarded for his work on neutrinos, and on the nature and possible methods of detection of dark matter. Neutrinos are known to be the second most abundant particles in the universe, after photons or light particles. He has been researching on the properties of dark matter and the coherent interactions of neutrinos (which have no charge but some mass) in dense astrophysical environments.

COVER STORY

# REACHING FOR THE SUN

**India's debut solar mission has taken off triumphantly and is destined to add muscle and prestige to its position as a space-faring nation on the global stage**

■ Dr Biju Dharmapalan

The Sun has a very important place in the life of every organism on this planet Earth. The Sun is the star at the centre of our solar system. It is a massive, luminous ball of hot, glowing gas primarily composed of hydrogen (92.1%) and helium (7.9%). Trace amounts of other elements (0.1%), such as oxygen, carbon, nitrogen, silicon, magnesium, neon, iron, and sulfur are also present The Sun holds 99.8 percent of our solar system's mass, and its gravitational force is responsible for retaining all celestial bodies within it, including small Mercury, the gas giants, and the distant Oort Cloud, which is located 186 billion miles away. The Sun's gravitational pull holds the entire solar system, including planets, asteroids, and comets, in orbit around it.

In most civilizations, it has been revered as divine, because of its potential to sustain life. From


**Aditya-L1 was successfully launched by PSLV-C57 on 2nd September**

Image Courtesy: ISRO

photosynthesis which provides food for every living organism to meeting energy needs, we cannot think of a day without the illumination from the Sun. If the Sun were to stop emitting light and heat suddenly, it would have catastrophic consequences for life on Earth. The Sun's energy generation is based on nuclear fusion processes in its core, primarily converting hydrogen into helium, which is expected to continue for billions of years. This phase has lasted for about 4.6 billion years, and it is expected to continue for several billion more years before eventually evolving into a red giant and then a white dwarf. The uniqueness of the sun in sustaining life on our planet makes scientists focus their attention on studies on this star.

### ADITYA'S JOURNEY

The kingmakers of the next century will be those who make a presence in other celestial bodies in outer space. The successful launching of Chandrayaan 3 followed by the launch of Aditya-L1

**Aditya-L1 is projected to traverse a distance of 1.5 million kilometres from the Earth, ultimately arriving at the targeted Lagrange point (L1) after a duration of 135 days**

have made India a leading player in space research and exploration. The Aditya-L1 mission conceived in 2008 has undergone significant evolution as we stand in 2023. Initially conceived as a modest 880-pound (400 kilogram) satellite in low-Earth orbit, the mission has witnessed substantial growth over the past 15 years. For instance, the spacecraft was recently launched with a mass of nearly 3,300 pounds, and its revised mission profile now entails venturing well beyond low-Earth orbit. On September 2, 2023 Aditya-L1 lifted off on a PSLV-C57 (Polar Satellite Launch Vehicle) rocket from the launch pad at

Aditya-L1 carries seven payloads to observe the photosphere, chromosphere and the outermost layers of the Sun (the corona)

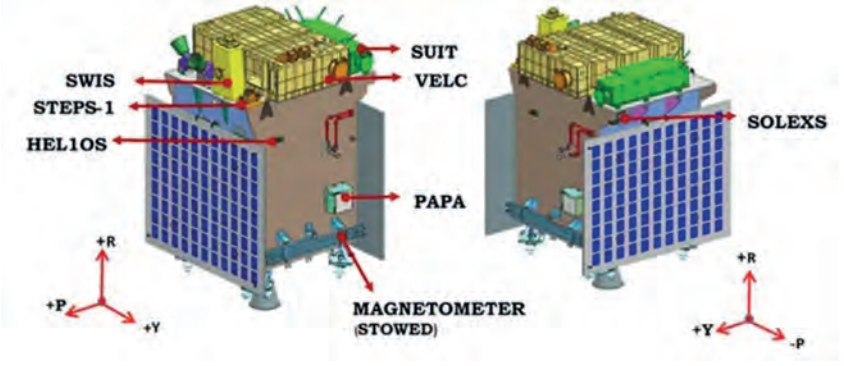



Image Courtesy: ISRO

**Remote Sensing (VELC, SUIT, SoLEXS, HEL1OS) and In-situ Payloads (ASPEX, PAPA) of Aditya L1 Mission**

Sriharikota at 11:50 IST. With this India is on the list of select countries that have made their scientific presence both in the moon and sun explorations.

After a flight duration of 63 minutes and 20 seconds, the Aditya-L1 spacecraft was successfully injected into an elliptical orbit of 235x19500 km around the Earth, according to ISRO (Indian Space Research Organisation). The spacecraft is projected to traverse a distance of 1.5 million kilometres (932,000 miles) from Earth, ultimately arriving at the targeted Lagrange point (L1) after a

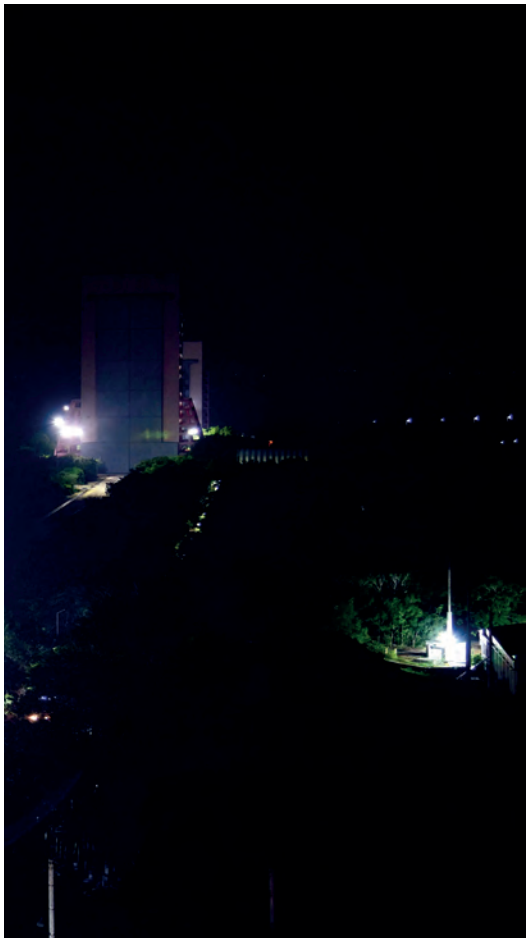


Image Courtesy: ISRO

duration of 135 days, assuming successful execution of the mission. The Aditya-L1 satellite will undergo a 16-day orbital period around the Earth in order to acquire the necessary velocity to successfully complete its mission. During this temporal interval, the satellite will be restricted to orbits that are bound to Earth and will undertake a total of five space manoeuvres. Spacecraft space manoeuvre refers to the alteration of the orbital trajectory by the utilisation of propulsion systems. Since the spacecraft started its journey on September 2, it has undertaken four manoeuvers till 15 September, shifting it to its new orbit at 256 km x 121973 km.

After successfully executing four orbital manoeuvres within the Earth's orbit, the Aditya-L1 mission will proceed to perform a Trans-Lagrangian insertion manoeuvre. This critical step signifies the commencement of its approximately 110-day journey towards its intended destination, which is the L1 Lagrange point. After reaching the L1 point, a subsequent manoeuvre is performed to establish Aditya-L1 in a stable orbit around L1.

There are five Lagrange points in the Earth-Sun system, among them L1 is close to Earth and allows for an unobstructed view of the Sun without being hindered by eclipses or occultation. This will allow scientists to study solar activities and their impact on space weather in real time. Once the Aditya spacecraft reaches the L1 parking area, it will be able to orbit the Sun at the same rate as the Earth. The Solar and Heliospheric Observatory (SOHO), a joint NASA-European Space Agency mission that launched in December 1995, is already positioned at L1. The Aditya-L1 is equipped with seven payloads, namely the Visible Emission Line Coronagraph, Solar Ultraviolet Imaging Telescope, Solar Low Energy X-ray Spectrometer, High Energy L1 Orbiting X-ray Spectrometer, Aditya Solar Wind Particle Experiment, Plasma Analyser Package for Aditya, and Advanced Tri-axial High-Resolution Digital Magnetometers. The seven scientific instruments carried in the orbiter will observe and study the dynamics of the crucial parts of the turbulent star, the photosphere, chromosphere and corona. Four of them will view the Sun directly, while the other three will carry out *in situ* measurements to explore the nature of the space weather that the Sun generates in interplanetary space.

ISRO's ingenuity shines through in the design of Aditya-L1. This cube-shaped spacecraft features a honeycomb sandwich structure, and its compact integrated GPS receiver provides real-time information on position, velocity, and time. When deployed, two solar panels will efficiently recharge Aditya-L1's lithium-ion battery, ensuring a consistent and reliable power source.

The payloads of Aditya-L1 are anticipated to offer vital data for comprehending the phenomenon of coronal heating, coronal mass ejection, pre-flare and flare activity, as well as their features. The solar flares and coronal mass ejections (CME) can affect our planet Earth. Intense CMEs that hit our planet, for example, trigger geomagnetic storms that can disrupt satellite navigation and power grids. India currently has more than 50 satellites in orbit, which provide a variety of important services to the country, including communication links, weather data, and forecasting pest infestations, droughts, and impending disasters. According to the United Nations Office for Outer Space Affairs

## MAJOR SCIENCE OBJECTIVES OF ADITYA-L1 MISSION

- Study of Solar upper atmospheric (chromosphere and corona) dynamics.
- Study of chromospheric and coronal heating, physics of the partially ionized plasma, initiation of the coronal mass ejections, and flares.
- Observe the in situ particle and plasma environment providing data for the study of particle dynamics from the Sun.
- Physics of solar corona and its heating mechanism.
- Diagnostics of the coronal and coronal loops plasma: Temperature, velocity and density.
- Development, dynamics and origin of CMEs.
- Identify the sequence of processes that occur at multiple layers (chromosphere, base and extended corona) which eventually leads to solar eruptive events.
- Magnetic field topology and magnetic field measurements in the solar corona.
- Drivers for space weather (origin, composition and dynamics of solar wind, their characteristics, dynamics of space weather, propagation of particles and fields, etc.).

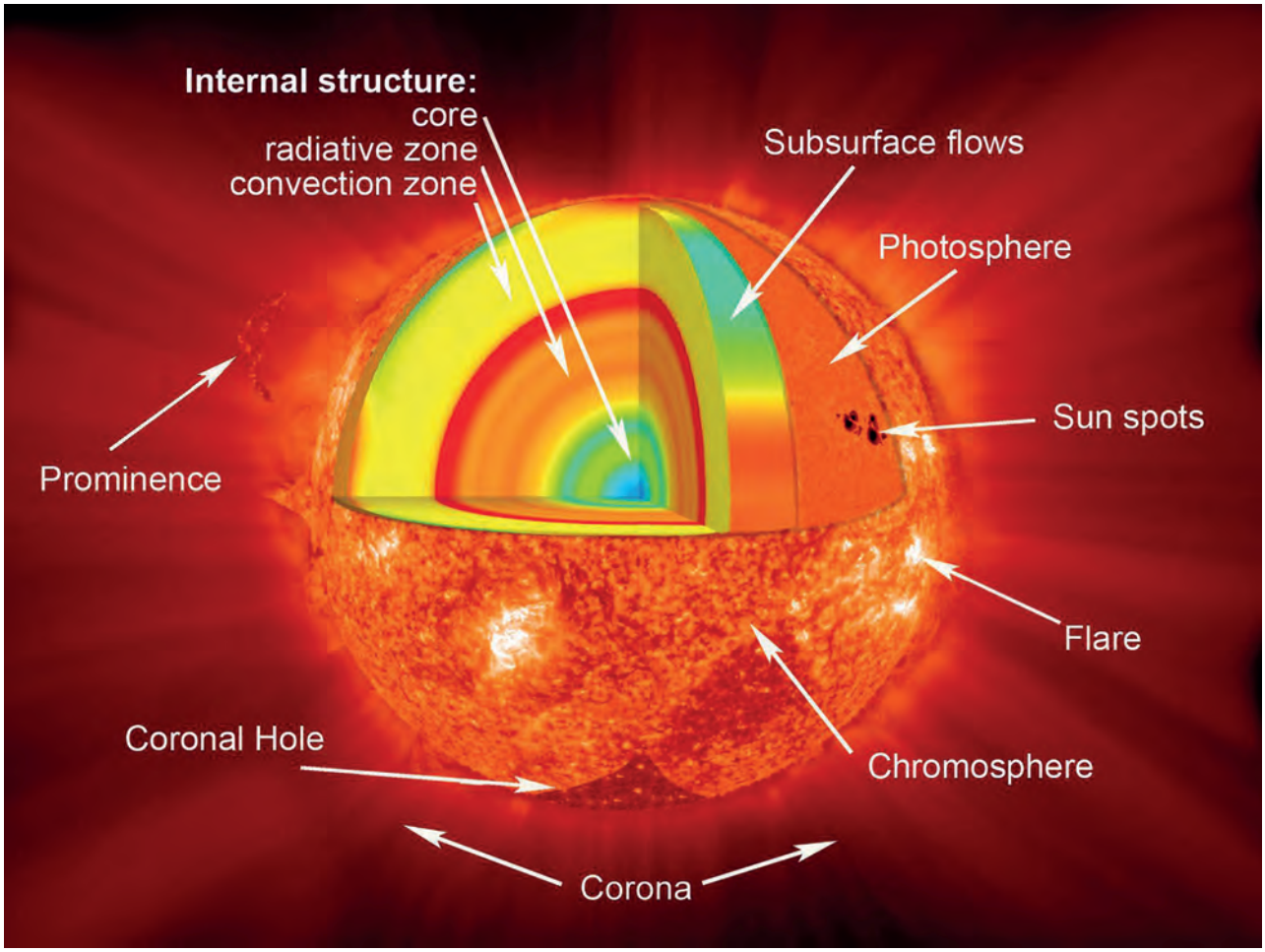



Image Courtesy: NASA

**The Sun and its atmosphere consist of several zones or layers**

(UNOOSA), approximately 10,290 satellites remain in the Earth's orbit, with nearly 7,800 of them functioning. Space weather has an impact on satellite performance affecting the GPS coordinates and radio transmissions on the Earth. Solar winds or storms can destroy satellite equipment and potentially bring power grids down. However, there are certain gaps in our knowledge of space weather. Knowing about the Sun's activities, such as solar wind or a solar eruption, a couple of days ahead of time will allow us to relocate our satellites. This will help to extend the life of our space satellites.

## SOLAR RESEARCH IN INDIA

Since times immemorial, Indian astronomers have developed systematic studies on various celestial bodies including the sun. Our first mention of the Sun and its importance in religious rituals was mentioned in Rigveda, which dates back to around 1500 BCE. The rigorous scientific inquiry into the Sun is evident in the contributions of eminent astronomers like Aryabhata, Brahmagupta, and Varahamihira, who thrived between the 5th and 7th centuries CE. They formulated mathematical models and methodologies for determining the positions of celestial bodies, including the Sun. Their treatises, such as Aryabhata's *Aryabhatiya* and Brahmagupta's *Brahmasphutasiddhanta*, encompassed intricate calculations and theories concerning the Sun's movement and eclipses. Bhaskara I, who lived around 629-688 CE and Bhaskara II (Bhaskaracharya), who lived around 1114-1185 CE, also made significant contributions to Indian astronomy. Their works such as the *Mahabhaskariya*, and *Siddhanta Shiromani*, contained calculations related to the Sun's position and the concept of time. The strong foundation provided by these early astronomers helped later Indian scientists focus on astronomical research. It is noteworthy to acknowledge that ancient astronomers lacked the advantages of contemporary technology, resulting in observations and calculations that were frequently less precise compared to present-day capabilities.

The first scientific observatory in pre-independent India specifically built to study the Sun was the Jantar Mantar astronomical observatory complex constructed by Maharaja Jai Singh II of Jaipur in the early 18th century. Jai Singh II was a keen astronomer, and he built several observatories in various cities in-

Image Courtesy: ISRO

**The suite of Aditya-L1 payloads is expected to provide most crucial information to understand the problem of coronal heating, coronal mass ejection, pre-flare and flare activities and their characteristics, dynamics of space weather, etc.**

cluding Delhi, Jaipur, Ujjain, Mathura, and Varanasi, known as Jantar Mantars, to carry out precise astronomical observations and calculations. These observatories were equipped with various instruments and structures designed for measuring the positions of celestial objects, including the Sun, Moon, and stars.

In post-independent India, several state-of-the-art modern observatories and astronomical facilities were established under various organisations like the Tata Institute of Fundamental Research (TIFR), Mumbai; Indian Institute of Astrophysics (IIA), Bengaluru; Indian Space Research Organisation (ISRO); Aryabhatta Research Institute of Observational Sciences (ARIES) at Manora Peak, Uttarakhand, and others, for the study of celestial objects, including the Sun.

But till now, all our observations and research about the Sun were from the Earth using sophisticated telescopes. However, despite the Sun's immense gravitational influence, travelling to the Sun is an astonishingly challenging endeavour, requiring 55 times more energy than a journey to Mars. Why is it such a formidable task? The reason is rooted in the same principle that prevents Earth from falling into the Sun: Our planet is hurtling through space at an astonishing speed of approximately 67,000 miles per hour, primarily in a sideways direction relative to the Sun. The only means to reach the Sun is to nullify this lateral movement.

## SOLAR MISSIONS

Solar missions, which are spacecraft and observatories specifically designed to study the Sun, have a range of objectives aimed at advancing our understanding of our closest star and its impact on the solar system. To study the sun, it's better to understand the structure of the sun and its atmosphere. From the inside out, the solar interior consists of:

**The Core:** The central region where nuclear reactions consume hydrogen to form helium. These reactions release the energy that ultimately leaves the surface as visible light.
**The Radiative Zone:** It extends outward from the outer edge of the core to base of the convection zone, characterised by the method of energy transport, i.e., radiation;
**and the Convection Zone:** The outermost layer of the solar interior extending from a depth of about 200,000 km to the visible surface where its motion is seen as granules and supergranules.

### The solar atmosphere is made up of:

**The Photosphere:** The visible surface of the Sun.
**The Chromosphere:** An irregular layer above the photosphere where the temperature rises from 6000°C to about 20,000°C.
**A Transition Region:** A thin and very irregular layer of the Sun's atmosphere that separates the hot corona from the much cooler chromosphere.
**and the Corona:** The Sun's outer atmosphere.

Beyond the corona is the solar wind, which is actually an outward flow of coronal gas. The sun's magnetic fields rise through the convection zone and erupt through the photosphere into the chromosphere and corona. The eruptions lead to solar activity, which includes such phenomena as sunspots, flares, prominences, and coronal mass ejections. Solar missions aim to study and understand the fundamental physical processes occurring in the Sun. This includes the process of nuclear fusion in the Sun's core, the generation of the solar magnetic field, and the transport of energy from the core to the surface. Solar missions continuously monitor and record the Sun's activity, including the appearance of sunspots, solar flares, prominences, and coronal mass ejections (CMEs). Understanding solar activity is crucial for space weather prediction and its impact on Earth and the solar system.

Solar missions do not physically land on or go to the surface of the Sun. Instead, they are designed to orbit the Sun at varying distances or fly closer to it to study the Sun and its surrounding environment. Usually, they study from areas known as Lagrange points, often referred to as L-points. These points were first described by the French mathematician Joseph-Louis Lagrange in the late 18th century and are specific locations in space where the gravitational forces of two massive objects, such as a planet and a moon or a planet and the Sun, create stable points of equilibrium for smaller objects.

Both our lunar and solar missions were carried out using indigenous technologies at a highly competitive rate showing our scientific strength in pushing forward space technologies for the benefit of humanity. The emergence of women inside India's space agency is seen in their significant contributions to interplanetary missions. Notably, Nigar Shaji has assumed the role of Project Director for Aditya-L1, India's ambitious mission to explore the Sun. Over the course of several years, she made significant contributions to a range of initiatives, assuming leadership of Aditya-L1 approximately eight years ago. As our Prime Minister Narendra Modi remarked, ".....without their contribution, this achievement was just not possible. They will inspire generations to come".

The expected duration of the Aditya-L1 mission is estimated to be around five years. As per the available information, all parameters of the Aditya-L1 spacecraft are working properly and the spacecraft has captured a selfie with the Earth and the moon from space on its way to its destination, Lagrange Point 1. The images show VELC (Visible Emission Line Coronagraph) and SUIT (Solar Ultraviolet Imager) instruments as seen by the camera on board Aditya-L1 on September 4, 2023.

If everything goes as planned, India will join select nations that have successfully conducted solar observatory missions to study the sun. The impetus given to space research in recent years, especially by our honourable Prime Minister Narendra Modi, needs appreciation, as it is the need for the next century. Only a visionary leader can direct our scientific community to work on areas that need attention in the next century. Of course, the government should see that overemphasis on space research should not deter the morale of researchers working in other areas of science. The current success in lunar and solar missions is the result of our exemplary strength in basic science we gained over the ages. Aditya-L1 is the shining face of Bharat that will take us to the zenith of global science.

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## LAGRANGE POINTS

There are five Lagrange points in the Earth-Sun system, known as L1 through L5. Here's a brief overview of each Lagrange point:

**1. L1 (Lagrange Point 1):** Located along the line connecting the centers of the two massive bodies, L1 is closer to the smaller body (in this case, Earth) than to the larger body (the Sun). Objects placed at L1 remain roughly stationary with respect to Earth's position and maintain a stable equilibrium between the gravitational pull of Earth and the Sun. L1 is commonly used for space observatories, such as the Solar and Heliospheric Observatory (SOHO), that study the Sun.


Image Courtesy: ISRO

**2. L2 (Lagrange Point 2):** L2 is located along the line connecting the centers of the two massive bodies but is on the opposite side of Earth from the Sun. Like L1, objects at L2 maintain a stable position relative to Earth. L2 is used for various astronomical observations and missions, including the James Webb Space Telescope (JWST), which studies the universe in infrared wavelengths.

**3. L3 (Lagrange Point 3):** L3 is located on the opposite side of the Sun from Earth, forming an equilateral triangle with Earth and the Sun. It is rarely used for missions, and its stability is not as favourable as that of L1, L2, or other Lagrange points.

**4. L4 (Lagrange Point 4):** L4 is located 60 degrees ahead of Earth in its orbit, forming an equilateral triangle with Earth and the Sun. It is also known as the 'leading Lagrange point' and is sometimes called the 'Trojan point'. L4 is associated with asteroids that share the Earth's orbit and remain relatively stable there.

**5. L5 (Lagrange Point 5):** L5 is located 60 degrees behind Earth in its orbit, forming an equilateral triangle with Earth and the Sun. Like L4, it is also referred to as the 'trailing Lagrange point' and is associated with groups of asteroids that remain relatively stable in that region.

# Matsya 6000: India's First Manned Submersible

From the sky to the oceans, India is vigorously pushing the envelope for science

■ **Science India Bureau**

Under the Samudrayaan project, the National Institute of Ocean Technology (NIOT), Chennai, is developing the Matsya 6000, India's first manned submersible, which will carry three people 6,000 metres below the surface of the ocean. It was recently revealed by the Union Minister for Earth Sciences Kiren Rijiju.

The Samudrayaan project, part of India's Rs 4,077-crore Deep Ocean Mission, aims for completion by 2026. Currently in the development stage, the Matsya 6000 is prepared to reveal the mysteries buried beneath the seas. This ground-breaking vessel features a titanium alloy sphere with 80mm thickness and a diameter of 2.1 metres, as well as a strong structure. This sphere was created to endure the extreme pressure found 6,000 metres below the sea surface, a place where few have ever gone.

This enormous project began on August 31, 2019, when Dr MA Atmanand, a former NIOT director, announced ideas for a submersible that could carry three people and explore depths of up to 6,000 metres. This innovative initiative, which takes its cue from ISRO's Gaganyaan mission, seeks to perform extensive study in the deep water, constituting an important milestone in India's quest of oceanic mineral exploitation.

The project was formally launched on October 29, 2021. A successful uncrewed trial of the 'personnel sphere' followed. The mild steel sphere, which was built for the trial, was buried in the Bay of Bengal, off the coast of Chennai, to an astonishing depth of 6,000 metres.

Safety is still a top priority in this innovative project, for which the scientists have undertaken extensive testing. At 500 metres below the surface, a steel pressure hull was put through rigorous tests. They also performed human tests at a depth of seven metres to assess the efficiency of the life support systems.


**Minister for Earth Sciences Kiren Rijiju (above) recently shared details about submersible Matsya 6000 (right)**

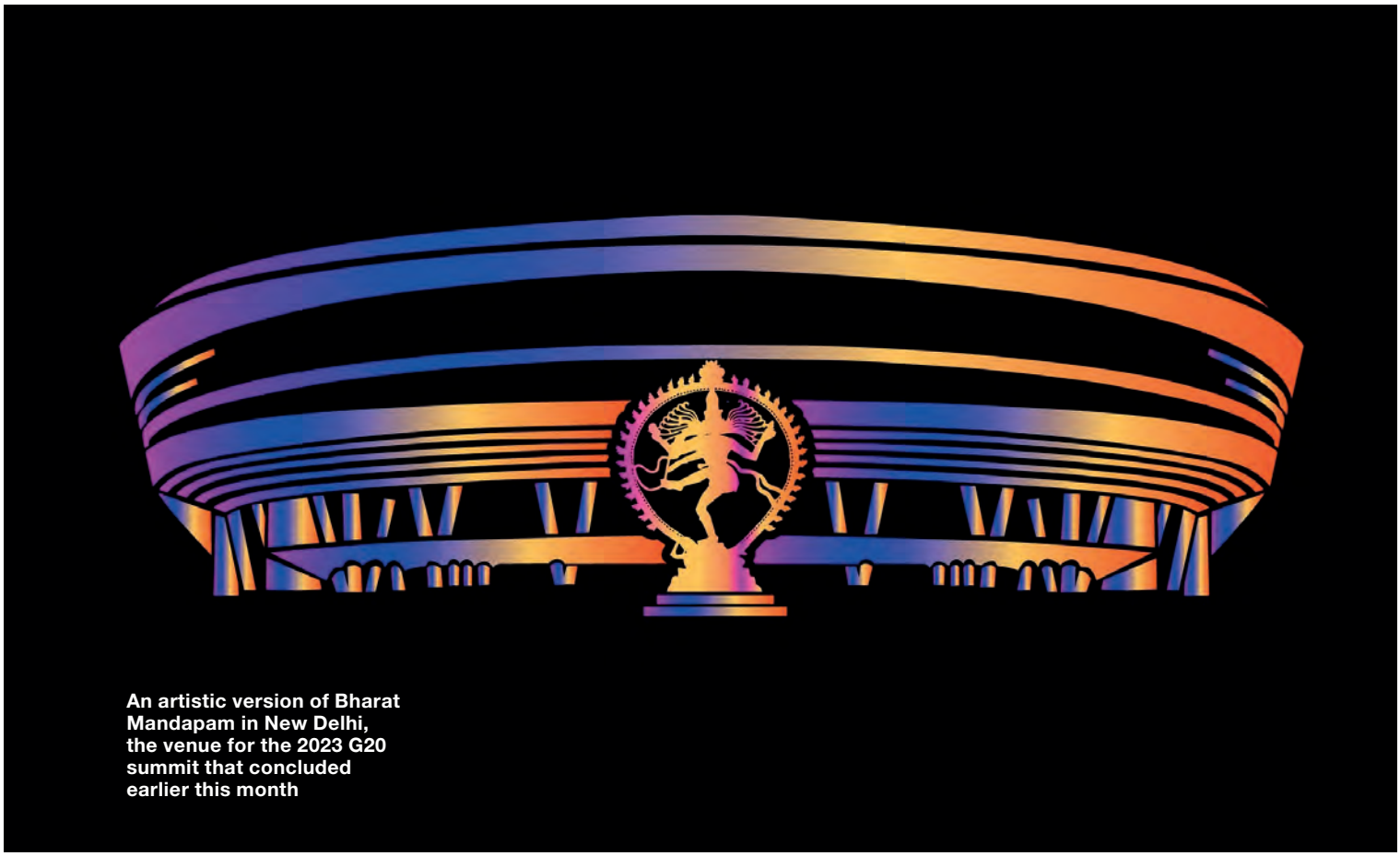
According to the Ministry of Earth Sciences, the Matsya 6000 manned submersible has a proportional personnel sphere with a 2.1-meter diameter. This vessel, made of sturdy mild steel, maintains structural integrity despite intense pressure that the deep-sea environment places on it. The sphere has shown promise in early tests in the Bay of Bengal, where it has proven itself at depths of up to 600 metres.

Once it is running, the submersible will provide a lifeline for deep-ocean scientific study. It promises to alter our understanding of the deep-sea ecosystem. It can operate for 12 hours and last an astounding 96 hours in an emergency.

The submersible will act as a mobile laboratory and will be outfitted with a variety of cutting-edge scientific tools to enable direct observation and action in hitherto uncharted areas. Along with a variety of underwater devices like the Autonomous Coring System (ACS), Autonomous Underwater Vehicle (AUV), and Deep Sea Mining System (DSM), this consists of a remotely operated vehicle (ROV) with a depth rating of 6000 metres.

The government's dedication to expanding deep-sea exploration is demonstrated by a sizeable allocation of Rs 4,077 crore over a five-year period. Trials for Matsya 6000 are likely to occur in early 2024 in the Bay of Bengal. With Matsya 6000, India will make outstanding contributions to marine science and technology, consolidating its position as a leader in ocean exploration on the international scene.

Images Courtesy: Twitter



An artistic version of Bharat Mandapam in New Delhi, the venue for the 2023 G20 summit that concluded earlier this month

Uday Kumar Varma

SCIENCE DIPLOMACY

# India's Ascendancy in Global Diplomacy

What distinguishes India's triumph in science diplomacy is not only its brilliance of conception but also its masterful execution, as the country's successful space missions, stellar G20 presidency, and other global collaborations have shown

India, steeped in rich history and tradition, has forged a new identity as a global powerhouse, a prominent player in diplomacy, technology, and sustainability. Noteworthy achievements in space exploration, leadership within the G-20, and collaborative ventures such as IMEC (India-Middle East-Europe Economic Corridor) and the GBA (Global Biofuel Alliance) underscore India's growing global influence. This article delves into the significance of Chandrayan III, Aditya-L1, G-20 Presidency, and international partner-

Image Courtesy: Shutterstock

ships, highlighting India's unwavering commitment to global progress.

## CHANDRAYAN III: A MONUMENTAL LEAP IN INDIA'S SPACE ODYSSEY

Throughout history, certain moments transcend time and leave an indelible mark on a nation's collective memory. On August 23, 2023, India bore witness to such an extraordinary moment. As the lunar lander Vikram executed a flawless touchdown on the moon's surface and the rover Pragyan gracefully rolled out, a wave of jubilation and pride swept across the nation. India had achieved the seemingly impossible: A successful landing on the treacherous terrain of the moon's southern polar region. This remarkable feat positioned India as the fourth nation to reach the lunar surface and the first to conquer the challenging south pole. Beyond its astronomical significance, this achievement underscored India's increasing influence and prominence in global diplomacy, especially in the realm of science diplomacy.

## ADITYA-L1: ILLUMINATING INDIA'S SPACE ODYSSEY

Following the triumphant launch and landing of Chandrayan III on the moon's surface, the launch of Aditya-L1 marked yet another milestone in India's space journey, brimming with enthusiasm and optimism.

Aditya-L1 represents India's inaugural space mission dedicated to studying the Sun. This spacecraft will be positioned in a halo orbit around Lagrange point 1 (L1) of the Sun-Earth system, approximately 1.5 million kilometres from the Earth. The strategic placement in the L1 halo orbit allows uninterrupted observations of the Sun, free from eclipses or occultation, providing real-time insights into solar activities and their impact on space weather. The spacecraft carries seven advanced payloads designed to study the photosphere, chromosphere, and the outermost layers of the Sun (the corona) using electromagnetic, particle, and magnetic field detectors. With four payloads directly observing the Sun and three conducting in-situ studies at Lagrange point L1, the mission promises invaluable scientific insights into the propagation of solar dynamics in the interplanetary medium.


Image Courtesy: Sonam Singh Subhedar

**The G20 New Delhi Summit succeeded with the formation of IMEC (India-Middle East-Europe Economic Corridor) and GBA (Global Biofuel Alliance)**

## G-20 GLOBAL SUMMIT: INDIA'S DIPLOMATIC TRIUMPH

Following these remarkable space achievements, India hosted the G-20 summit in New Delhi, an unprecedented success that underscored India's prowess in diplomacy and statecraft. Notably, the summit's unanimous declaration garnered widespread acclaim, and India's adept handling of the Ukraine crisis showcased its diplomatic finesse. However, the summit's more transformative outcomes included the introduction of the India-Middle East-Europe Economic Corridor (IMEC) and the launch of the Global Biofuel Alliance (GBA).

## IMEC: A PARADIGM SHIFT IN INTERNATIONAL COOPERATION

One of the most significant outcomes of the G-20 summit was the announcement of IMEC, the India-Middle East-Europe Economic Corridor. Equally ground-breaking was the formation of the Global Biofuel Alliance. Within the global commitment to reducing Greenhouse Gas emissions, these initiatives stand out as trailblazing and inspiring.

IMEC has earned unanimous praise for its well-conceived and strategically potent approach to international cooperation, distinguishing itself from China's older and flawed Belt and Road Initiative (BRI). IMEC's design surpasses its predecessor in every aspect, offering a more finely tuned approach.

India successfully garnered the support of the US, UAE, Saudi Arabia, European Union (EU), Italy, France, and

Germany for the economic corridor during the G20 Summit in New Delhi. This project aims to enhance connectivity and economic integration across South Asia, the Arabian Gulf, and Europe. It positions itself as a credible alternative to China's Belt and Road Initiative (BRI), which has encountered numerous challenges, including concerns about debt sustainability. Notably, Italy has expressed intentions to withdraw from the BRI.

Ashwini Vaishnaw, India's Railway Minister, emphasised the distinctiveness of IMEC in comparison to the BRI, asserting that it will be economically viable and avoid the debt traps that some host nations have experienced under the Chinese project. Vaishnaw stated confidently that IMEC would be so financially viable that several multilateral institutions are eager to fund it, emphasising its potential to generate revenue independently.

## DIVERGENT APPROACHES: IMEC VS BRI

While the Belt and Road Initiative comprises six corridors, IMEC stands as a two-pronged initiative, consisting of an eastern corridor linking India to the Arabian peninsula and a northern corridor connecting the Arabian peninsula to Europe. The inclusion of a railway network for cost-effective cross-border ship-to-rail transportation distinguishes IMEC. It seeks to boost economic efficiency, reduce costs, and promote economic unity among participating nations, all the while aligning with sustainable development goals.

BRI, associated with China's expanding sphere of influence, has faced criticism for its economic consequences on participating countries. American President Joe Biden has referred to it as the "debt and noose" project due to concerns about lending practices. In contrast, he staunchly supports IMEC, recognising the manifold opportunities it offers in terms of trade, clean energy export, and infrastructure development.

European Commission President Ursula von der Leyen described IMEC as a historic project, emphasising its role as a green and digital bridge between continents and civilizations. The proposed rail link is expected to accelerate trade between India and Europe by 40%.

## GLOBAL BIOFUEL ALLIANCE: PIONEERING ENVIRONMENTAL SUSTAINABILITY

The G20 summit also marked the launch of the Global Biofuel Alliance (GBA), a momentous event signalling a new era of environmental sustainability and a resolute commitment to mitigating Greenhouse Gas emissions. Prime Minister Narendra Modi inaugurated this initiative in the presence of prominent leaders, including US President Joe Biden, Brazilian President Luiz Inacio Lula da Silva, Argentinian President Alberto Angel Fernández, Italian Prime Minister Giorgia Meloni, and Bangladesh Prime Minister Sheikh Hasina. Notably, this alliance comprises 19 participating nations, with India, Brazil, and the US at its core. The G20 partners include Argentina, Canada, Italy, and South Africa, while Bangladesh, Singapore, Mauritius, and the UAE participate as G20 invitee countries.

Moreover, several nations, including Iceland, Kenya, Guyana, Paraguay, Seychelles, Sri Lanka, Uganda, and Finland, expressed keen interest in joining the alliance. Influential international and multilateral organisations, such as the World Bank, Asian Development Bank, World Economic Forum, World LPG Organisation, UN Energy for All, UNIDO, Biofutures Platform, International Civil Aviation Organisation, International Energy Agency, International Energy Forum, International Renewable Energy Agency, and World Biogas Association, have also expressed their intent to participate.

The alliance's founding triumvirate, consisting of the US, India, and Brazil, commands a significant 85% share of global biofuel production and an impressive 81% share of consumption, underscoring their pivotal roles in this initiative. Prime Minister Modi aptly lauded the launch of the Global Biofuel Alliance as a watershed moment in the pursuit of sustainability and clean energy, thanking the member nations for their participation.

**The founding triumvirate of GBA — India, Brazil and the US — command 85% of global biofuel production, underscoring their pivotal roles in this initiative**

Chandrayaan III Integrated Module during the testing stage

Notably absent from the alliance are China, as well as major oil producers Saudi Arabia and Russia. IMEC, conceived by India, seeks to position itself as a global forum for fostering demand growth, technology transfer for biofuel production, and trade enhancement, potentially influencing the Organization of the Petroleum Exporting Countries (OPEC)-plus grouping, of which Saudi Arabia and Russia are members.

The G20 Leaders' Declaration on that momentous day emphasised the significance of sustainable biofuels in zero and low-emission development strate-

Image Courtesy: ISRO

gies, acknowledging the establishment of the Global Biofuel Alliance. According to the International Energy Agency (IEA), the world must triple its biofuel production by 2030 to align with the net-zero emissions goal by 2050.

India, on its ambitious path to cleaner energy, has committed to achieving carbon neutrality by 2070 and has set forth an ambitious biofuel roadmap. The government aims for a 20% ethanol blending in petrol by 2025-26, a remarkable acceleration considering the original target was set for 2030. India's progress aligns with the growth of the global ethanol market, projected to reach $162.12 billion by 2032. Much like the International Solar Alliance, the Global Biofuel Alliance's central focus revolves around accelerating the adoption of biofuels, promoting innovation in biofuel technologies, establishing universally accepted standards, identifying global best practices, and encouraging active industry engagement. This alliance represents a formidable catalyst for positive change on the global stage, propelling us toward a more sustainable and environmentally conscious future.

## INTERNATIONAL SOLAR ALLIANCE: ILLUMINATING THE GLOBE WITH SOLAR ENERGY

Launched in conjunction with COP21, the International Solar Alliance (ISA), an India-led international coalition, exemplifies India's collaborative approach to global solar proliferation. Born from a partnership between India and France, this alliance transcends technology; it embodies a shared vision. The ISA underscores India's global commitment to unite nations under the banner of solar energy, transcending borders.

The 'Towards 1000' strategy envisions a solar-powered revolution, mobilising $1 trillion in investments, providing energy access to a billion people, and installing 1,000 GW of solar capacity by 2030. The ISA is more than just numbers; it's about transforming lives and shaping a sustainable tomorrow.

As of November 2022, India proudly ranked as the fourth-largest global solar PV deployer, boasting an impressive installed capacity of around 61.97 GW. Achieving grid parity, where solar tariffs rival conventional sources, has positioned solar energy as a formidable contender in the energy landscape.

## THE FUTURE: DEDICATED TO GLOBAL GOOD

In recent years, India has made astonishing strides in global diplomacy, a testament to its remarkable achievements and boundless potential, particularly in the realm of science and technology. These accomplishments have catapulted India to the forefront of nations poised to shape and influence the course of world events in profound ways.

What distinguishes India's triumph in science diplomacy is not only its brilliance of conception but also its masterful execution. Unlike some other nations, India harbours no territorial ambitions. Its economic growth is primarily fuelled by its own abundant resources, both tangible and intangible.

This is the era of Indian leadership and a global vision that transcends boundaries. These developments position India uniquely, perched on a precipice of distinction, as an emerging global power with an entirely altruistic agenda, devoid of narrow self-interest and propelled by a spirit of global welfare. It promises to be a force that fosters creativity and cooperation, contributing significantly to the collective betterment of humanity. The future beckons India warmly, inviting it to assume the role of a 'Vishwabandhu' not by chance, but by the sheer merit and magnificence of its intentions.

**The writer, a Harvard educated civil servant, is a former Secretary to the Government of India. He also served on the Central Administrative Tribunal and as Secretary General of ASSOCHAM. He commands extensive expertise in the fields including Media and Information, Industrial and Labour Reforms, and Public Policy.*

# Harnessing Solar Energy for the Common Man

**Richly endowed with sunlight for a major part of the year, India has an easily accessible source of energy for multifarious use; only if it could become more economical for the last citizen standing**

Image Courtesy: Shutterstock

Udaipur City railway station with Photovoltaic solar panel installed on top of platform sheds as green energy initiative of renewable energy source

■ Dr Biju Dharmapalan

Energy is the primary need for human life. For living, we need cellular energy that we gather through various metabolic processes. The first form of this chemical energy, though, comes from photosynthesis taking place in green plants and algae. Even to carry out our day-to-day activities, we depend on various forms of energy. These energies primarily come from fossil fuels. Fossil fuels are formed by millions of years of geological processes. Since our consumption of these fuels is higher, it will be difficult to replenish fossil fuels during the life span of a human being. Apart from their dwindling resources, fossil fuels also cause severe environmental impacts due to burning. There is a growing push and adoption of renewable, cleaner alternate energy resources.

## CAPTURING THE SUN GOD'S POWER

Ever since humans evolved on this planet, we have been looking at the sun as a divine superpower. All civilisations across continents have revered the sun and utilised its energy for lighting and heating purposes. The Greeks and Romans, for example, designed their homes to capture the sun's warmth during the day, using materials like stone and glass to enhance this effect. The earliest documented use of a solar oven dates back to the 18th century. Swiss physicist Horace-Bénédict de Saussure built a solar hot box in 1767, which was essentially an insulated box with a glass cover to trap solar heat.

However, scientific studies on utilising solar power started only during the 19th century. In 1839, French physicist Alexandre Edmond Becquerel discovered the photovoltaic effect, which describes the generation of an electric current when certain materials are exposed to light. This laid the foundation for modern solar cells. The first practical solar cell was constructed by Charles Fritts in 1883 using selenium and gold. It had an energy conversion efficiency of about 1%. In 1887, a

significant scientific breakthrough occurred when Heinrich Hertz, a German scientist, made a pioneering discovery of the photoelectric phenomenon. As a result of these developments, a pioneering solar cell was devised by Aleksandr Stoletov, a prominent Russian scientist, utilising the principles of the photoelectric effect.

Following the elucidation of the photovoltaic effect and the photoelectric effect, researchers worldwide persisted in their endeavours to develop solar cell models and designs. However, none of these endeavours yielded commercially feasible outcomes. The 1950s marked a significant turning point in the field of solar energy as physicists at Bell Laboratories in New Jersey, United States, recognised the superior efficiency of semiconducting materials, particularly silicon, compared to selenium. This discovery paved the way for the development of the first commercially viable solar cell, which achieved an energy conversion rate of 6 per cent. The main people credited with the development of the initial silicon solar cell were Daryl Chapin, Calvin Fuller, and Gerald Pearson of Bell Labs.

## STRUCTURE OF SOLAR CELL

A solar cell, also known as a photovoltaic cell, is a semiconductor device that converts sunlight into electrical energy. It has a specific structure that allows it to harness the energy of photons from sunlight. Here's a basic outline of the structure of a typical silicon-based solar cell:

1. Top Contact/Grid Electrode (Front Surface): The top layer of the solar cell is a metal grid or a transparent conducting oxide (TCO) layer. This grid or layer allows sunlight to pass through and reach the semiconductor material while also providing electrical contact to collect the generated electrons.
2. Antireflection Coating (Optional): Some solar cells have an antireflection coating on the front surface. This coating helps reduce the reflection of sunlight, allowing more photons to be absorbed by the cell.
3. Emitter Layer: Beneath the top contact, there is an emitter layer. This layer is typically made of a thin layer of a different semiconductor material (such as boron-doped silicon). It helps create an electric field within the cell and assists in the separation of electrons and holes.
4. Base Layer (P-N Junction): Below the emitter layer, there is the base layer. It is made of a different type of semiconductor material (often phosphorous-doped silicon) and forms a junction with the emitter layer. This is called the P-N junction. It's a critical part of the solar cell where electron-hole pairs are generated.
5. Back Surface Field (Optional): Some solar cells have an additional layer at the back surface, called the back surface field. It is designed to further improve the collection of electrons.
6. Back Contact (Back Surface): The back contact is usually a metal layer that covers the entire back surface of the solar cell. It provides a path for the electrons to be collected and sent out of the cell.
7. Anti-Reflective Coating (Back Surface, Optional): Similar to the front surface, some solar cells may have an antireflection coating on the back surface as well.
8. Encapsulation (Front and Back): Solar cells are typically encapsulated to protect them from environmental factors like moisture, dust, and physical damage. This encapsulation is done using materials like glass and special polymers.

It is important to note that there are different types of solar cells (e.g., monocrystalline, polycrystalline, thin-film), and their internal structures may vary. However, the basic principles of generating electricity from sunlight through the photovoltaic effect remain the same. The arrangement and characteristics of the layers may be tailored to optimise performance for specific applications or to make use of different semiconductor materials.

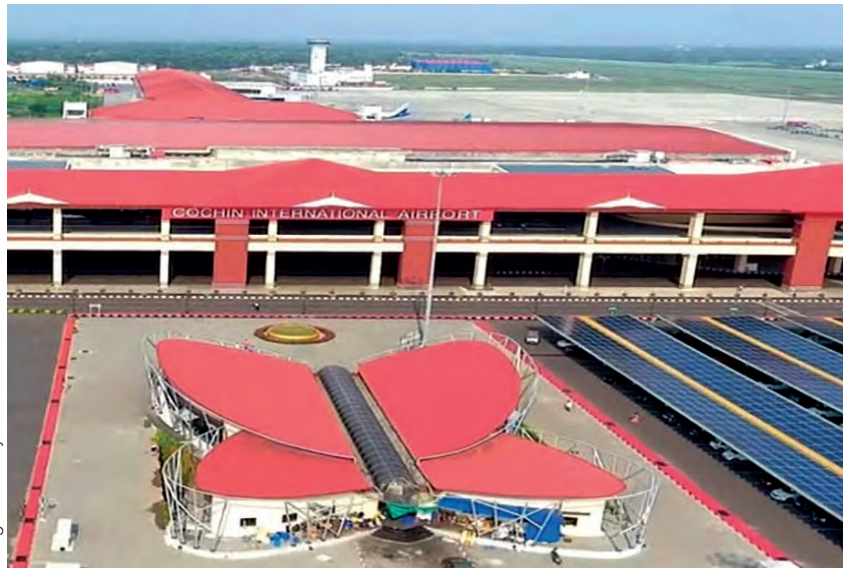



Image Courtesy: Twitter

**More than 46,000 solar panels installed at Cochin International Airport**

## SOLAR ENERGY IN INDIA

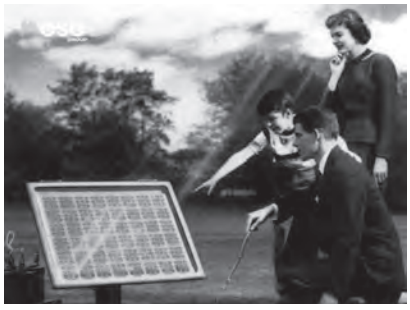
India possesses a significant capacity for harnessing solar energy. The country's annual incident energy amounts to around 5,000 trillion kilowatt-hours (kWh), with the majority of regions receiving a daily average of 4-7 kWh per square metre. The potential for scalability of solar photovoltaic power in India is substantial. India's interest in solar energy began in the 1970s, largely in response to the global oil crises during that decade. This led to the establishment of the Department of Non-Conventional Energy Sources (DNES) in 1982, which

later became the Ministry of New and Renewable Energy (MNRE).

Central Electronics Limited, a government-owned enterprise, developed and produced the country's first solar photovoltaic cell in 1977 and the first solar photovoltaic panel in 1978 as well as the installation and commissioning of India's first solar power plant in 1992. Subsequently, in the 1990s, numerous other companies entered the solar manufacturing sector. This included two state-owned entities, BEL and BHEL, which also manufactured solar cells primarily for space applications. Additionally, Tata BP Solar, a private joint venture, focused on addressing the emerging terrestrial solar applications. During the 2000s, there was notable growth in the solar sector with the emergence of many other companies including Moser Baer, Indosolar, and Websol.

The government of India initiated various schemes for promoting solar energy. The National Solar Mission was initiated by India in 2010, aiming to achieve a solar power capacity of 20 GW by 2020. However, in 2015, this target was revised and extended to 100 GW by 2022. The rate of solar installations had significant growth inside the country throughout the 2010 decade. As of 2021, the installed capacity of solar photovoltaic (PV) systems in India amounted to 49 gigawatts (GW). As a result, India has achieved a prominent position among the top five nations globally in terms of both yearly deployment and cumulative deployment.

In the year 2020, the government of India declared a commendable objective pertaining to renewable energy, aiming to achieve a capacity of 450 gigawatts (GW) by the year 2030. It is anticipated that a significant portion, ranging from 280 to 300 GW, will be derived from solar energy sources. During the 2021



**Above: In 1884, Charles Fritts installed the world's first rooftop photovoltaic solar array on a New York City roof; Left: French physicist Edmond Becquerel, who discovered the photovoltaic effect**

United Nations Climate Change Conference, commonly known as COP-26, our Prime Minister Narendra Modi made a declaration regarding India's energy goals, stating that the country aims to achieve a capacity of 500 GW of renewable energy sources by the year 2030, while also striving for carbon neutrality by the year 2070.

## GRASSROOTS APPLICATIONS OF SOLAR POWER

These technological developments have resulted in significant social and economic benefits for society. The advances in solar energy production have helped people in remote areas, where there is a lack of proper electric infrastructure. Even in remote forest areas, villagers and forest officials can enjoy the benefits of solar power in lighting their spaces and running appliances like radio or television sets. The biggest beneficiaries are the women folk of the community. Previously, they were using Kerosene or firewood for lighting and cooking purposes. Apart from the physical strains, the smoke emanated from it causes respiratory illness in many women. Appliances working using solar power like solar lanterns, solar cookers, and solar water heating systems have made life easy for these people. The public sector company, Indian Oil's novel Indoor Solar Cooking System called the 'Surya Nutan', can cook enough for a family of four during the day and night using the daily captured sunlight. The device is capable of harnessing solar energy and transforming it into heat using a specifically engineered heating component. It then proceeds to store this thermal energy within a scientifically validated thermal battery, which can then be utilised for indoor cooking purposes. Even though we have developed every appliance that works with solar power, from calculators to aircraft, it has not received the acceptance from the public as it should have. The primary reason is the high cost involved with technology compared to other cheaper technologies available today. Many groups are working on technologies that can be made affordable to the common man. A Shimla-based NGO, Himalayan Research Group (HRG), has developed low-cost solar water heaters for people in the hills.

Our farmers have to rely on the energy from the grid or diesel generators to run the pump when they are pumping water for irrigation, which causes enormous delays and economic strain. They would benefit tremendously from having access to an efficient watering system like the Solar Water Pump. It

***The public sector company, Indian Oil's novel Indoor Solar Cooking System called the 'Surya Nutan', can cook enough for a family of four during the day and night using the daily captured sunlight. The device can harness solar energy and transform it into heat***

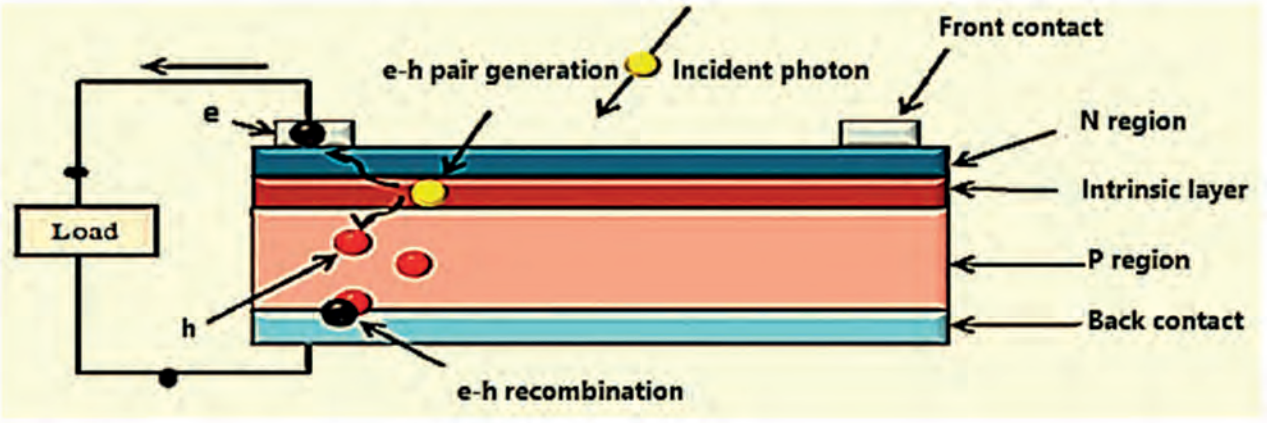



Image Courtesy: encyclopedia.pub

**The solar cell is a p-n junction device where n-type refers to the negatively charged electrons donated by donor impurity atoms and p-type refers to the positively charged holes created by acceptor impurity atoms**

does this by guaranteeing that their fields have a steady and unending supply of water, which in turn boosts crop production. The Ministry of New and Renewable Energy (MNRE) has initiated the PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan) Scheme to facilitate the installation of subsidised solar pumps and distributed solar power plants across the nation. More than 3.5 million farmers across India will benefit from this effort, which is one of the largest clean energy distribution programmes ever undertaken anywhere in the world.

But in future, when we meet a situation where currently available technologies become inoperational, we will not have any other alternative, but to use solar technologies. Solar is the energy for the future. The development in the field is so exhaustive that scientists have developed solar cars, planes and space crafts, thereby reducing our dependence on fossil fuels. Even in spacecraft of our Chandrayaan 3 and Aditya-L1 missions, solar panels have been installed.

## SOLAR ENERGY PRODUCTION IN INDIA

India has emerged as a global leader in solar energy production, having developed technology to harness solar energy to the maximum in every available free space. We have been successful in operating our airports on solar power. Cochin International Airport in Kerala is the world's first fully solar-powered airport; many others have followed suit. India's largest floating solar power project having a capacity of 100MW was commissioned in Ramagundam, Telangana, on July 1, 2022. The historic city of Sanchi in Madhya Pradesh was declared the first solar city in the country on 7 September 2023, generating 3 MW of electricity.

Furthermore, the solar energy industry in India has emerged as a significant contributor to the capacity of power generation connected to the grid, in line with the government's commitment for sustainable development. The incorporation of this element has become an essential aspect in addressing the country's energy needs and ensuring stability and reliability of its energy supply. This has resulted in an overall improvement in living conditions and economic prospects at the local level.

As a global leader in solar technologies, the country's Prime Minister Narendra Modi has initiated the 'One Sun, One World, One Grid' concept that envisions the development of a connected grid infrastructure that spans different continents, allowing for the efficient sharing and distribution of solar power globally. The goal is to optimise the utilisation of solar resources, enhance energy security, and reduce greenhouse gas emissions. He introduced this concept during the first assembly of the International Solar Alliance (ISA) held in New Delhi in October 2018. The International Solar Alliance is an intergovernmental organisation co-founded by India and France, aimed at promoting solar energy and increasing cooperation among solar-rich countries. It is important to note that 'One Sun, One World, One Grid' is a visionary concept that faces various technical, logistical, and geopolitical challenges. Implementing such a global grid would require extensive coordination, investment, and the development of advanced grid management technologies. However, if successful, it could revolutionise the way renewable energy is harnessed and distributed on a worldwide scale. We cannot rely on fossil fuels for a longer period, as they will soon exhaust. Even today, the cost of fossil fuels has become so high that it has become unaffordable for the common man. We need to shift to cleaner, greener alternative sources of energy like solar, hydrogen, etc. Being a country located in the tropics, India has the advantage of reaping solar energy to the maximum and can effectively provide continuous electricity at a cheaper cost in every corner of the country.

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# Bridging Gap Between Agriculture and Technology

The WINDS portal, designed to help farmers make informed choices with weather forecast, gets a manual for its easy understanding

■ **Science India Bureau**

A series of initiatives to digitally arm the agricultural sector further were launched by the Union Finance Minister Nirmala Sitharaman recently. These included a manual for the WINDS portal, which stands for Weather Information Network Data Systems.

Along with the WINDS manual, the finance minister also launched the Kisan Rin portal and the Ghar Ghar KCC (Kisan Credit Card) campaign.

The WINDS portal, launched in July by the Ministry of Agriculture and Farmers' Welfare, leverages advanced weather data analytics to provide actionable insights into weather patterns, which can help farmers take suitable and well-informed decisions.

According to reports, the WINDS initiative aims to set up a strong network of weather stations, including stations at the block and gram panchayat level. This implies that the critical weather-related information will be easily accessible to farmers, enabling accurate monitoring of weather patterns, effective planning, risk assessment and timely response to climatic challenges and emergencies.

By bringing information closer to the stakeholders, the portal aims to bridge the gap in weather data availability.

The manual will serve as an important link in the journey of the stakeholders to become integrated with the digital revolution taking place in different sectors. The comprehensive manual will provide an in-depth understanding of the portal's functionalities, data interpretation, and effective utilization, empowering not just farmers but even policymakers and various other agricultural entities to make informed choices.


Image Courtesy: Wikimedia Commons

**Left: Launch of the manual for WINDS portal**

The portal also addresses the need of parametric crop insurance scheme of the government, in addition to non-scheme parametric insurance programmes for crop risk mitigation and disaster risk reduction and mitigation being run by the insurance industry.

The need for accelerating digitalisation of Indian agriculture has for long been emphasized by the experts as it can prove to be a game changer for the sector. It involves integrating cutting-edge digital technology into the farm production system, including artificial intelligence (AI), robotics, uncrewed aviation systems such as drones, sensors and communication systems. As per the Food and Agricultural Organization (FAO), India is already the second largest food producer in the world but continues to have immense potential to improve and increase production with the intervention of technology.

The government has been proactively pushing for digital initiatives in the agricultural sector, an important part of which is the Digital Agriculture Mission 2021-25, launched in September 2021 by the Union Minister of Agriculture and Farmers Welfare, Narendra Singh Tomar. The aim of this mission is to encourage and speed up agricultural projects through cutting-edge technologies. A key highlight of this mission's objectives is to create a crop production forecast model for which NITI Aayog has teamed up with International Business Machine (IBM) to deliver data on crop output, soil quality, agricultural input control, and early disease outbreak warning.

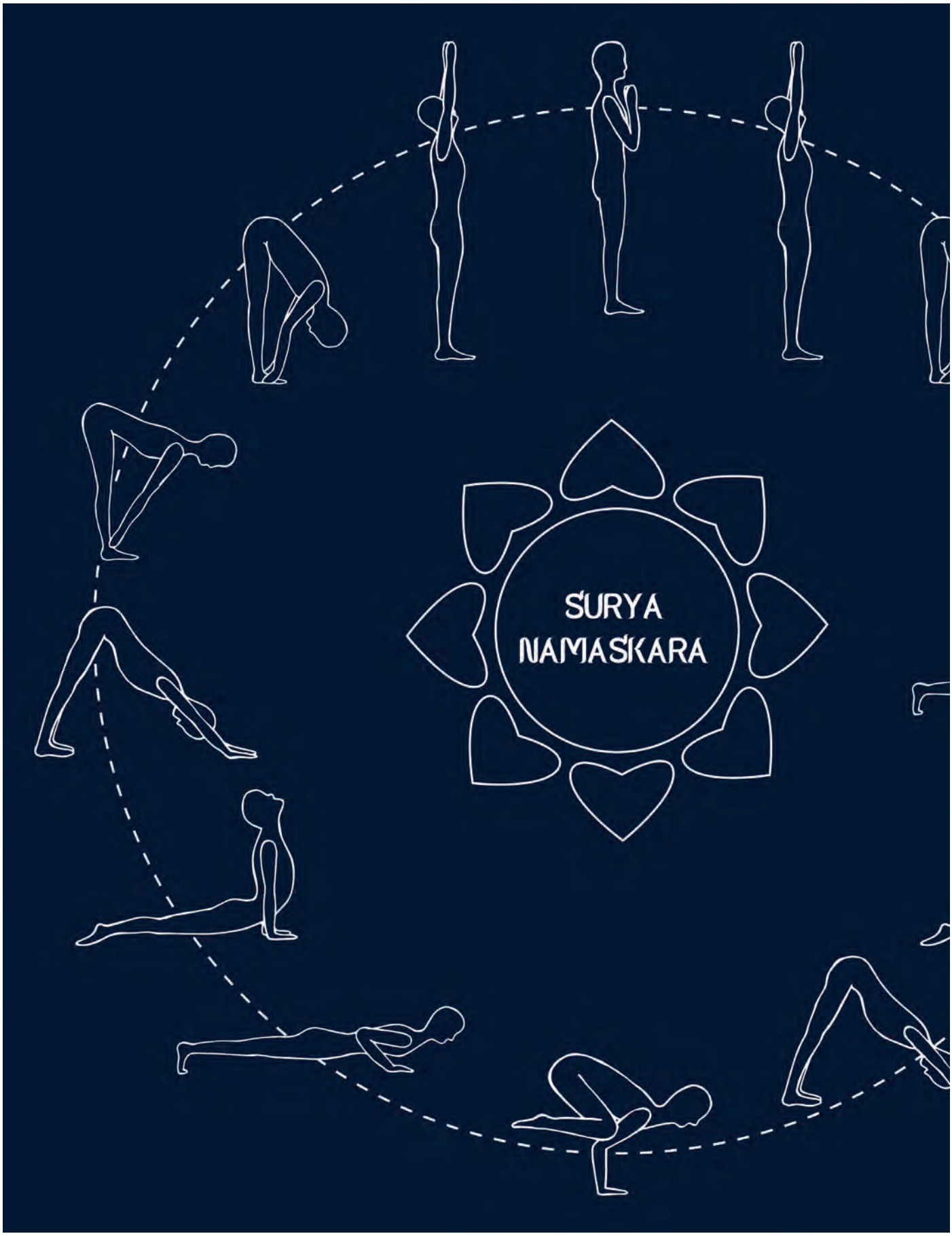
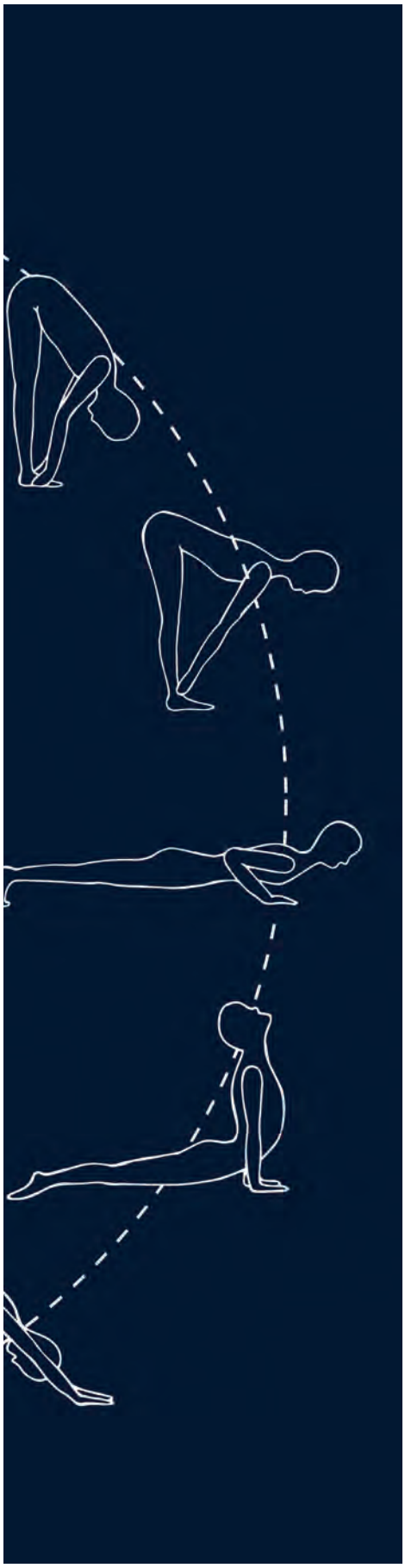



Image Courtesy: Shutterstock



# Sun: The Sustainer of Life

The Sun has enjoyed a place of supreme importance in the Indian way of life since ancient times, and most notably celebrated through the elaborate Surya Namaskar in Yoga

■ **Dr Rajiv Rastogi**

The Sun has always attracted humans as a powerful source of energy. Many races and civilisations have worshipped the Sun as a God. These were most practised by Vedic Indians, Persians, Greeks, and Romans which were the most advanced civilisations of their times. Scientists always wanted to know more and more about the Sun and other planets. For that, different missions were initiated by the leading countries of the world but only few succeeded. The distance of the Sun from the earth was a limiting factor behind the mission towards the Sun. But people are curious to know about the intensity of the Sun's heat, its atmosphere and about any existence of life there, as on the moon and Mars.

India's successful launch of its Aditya-L1 mission recently, soon following the successful landing of Chandrayan 3 on the southern part of the moon was a big surprise for the developed nations as India's calibre was always underestimated by them.

The importance of the Sun in our daily life cannot be overstated, and India's mission to this celestial body is but a tiny step towards understanding the life-giver of this universe.

In fact, no life is possible on the earth without the Sun. It is believed that this whole universe has been made from the five great elements, viz. earth, water, sun, air, and ether, also known as Panchamahabhutas. Our body has all these five elements in it. So, it can be said that we have a close relationship with these Panchamahabhutas, which not only affect our body in different ways but also help in keeping us healthy and fit.

## IMPORTANCE OF SUN IN INDIAN LIFE

If we see the ancient references, it can be said that the Rishis of the Vedic period had clear concepts about the therapeutic values of earth, water, air, and sun. There are a good number of descriptions in Atharvaveda and Yajurveda which narrate the qualities and therapeutic potentials of these elements. Earth is narrated as 'Mother', water is considered as 'Amrita'(panacea) and Sun is equated to 'Brahma' (the creator). There is extensive mention of Vayu (air) in Rigveda and is considered to be the divine force of all activities, sensations, and peace. Perhaps these considerations had led to different cults which worshipped trees, rivers, Sun, God of rain (Indra), God of

air (Varuna), etc.

The Sun is the creator. It is the source of energy. A lot of references can be seen in our ancient literature worshiping the Sun. In India, references are found of many Sun temples. Sun temple is a structure used for religious or spiritual activities and dedicated to the Sun or solar deity. We can see the references of Konark Sun Temple in Puri (Odisha) built by the emperor Narasingha Deva I (1238-1264 CE) of the Eastern Ganga dynasty; Katarmal Sun Temple in Almora (Uttarakhand) built by the Katyuri kings in the ninth century CE; Sun Temple in Modhera in Mehsana district (Gujarat) situated on the banks of river Pushpavati and built by Bhima I of Chalukya dynasty in 1026 CE; the Martand Sun Temple Lalitaditya Muktapida of the Karkota dynasty in Anantnag district, Jammu and Kashmir, built in the eighth century CE (the oldest in the country); Surya Mandir in Gwalior (Madhya Pradesh) and Sidhgora Sun Temple, in Jamshedpur (Jharkhand), etc.

Not only in India, but references are also available regarding sun temples in other countries. One such temple in Beijing, China, was built in 1530 during the Ming dynasty by the emperor Jiajing. The temple of the Sun was used by the imperial court for elaborate acts of worship involving fasting, prayers, dancing, etc., as a part of year-long ceremonies involving all the temples. In ancient Egypt also, there were several sun temples.

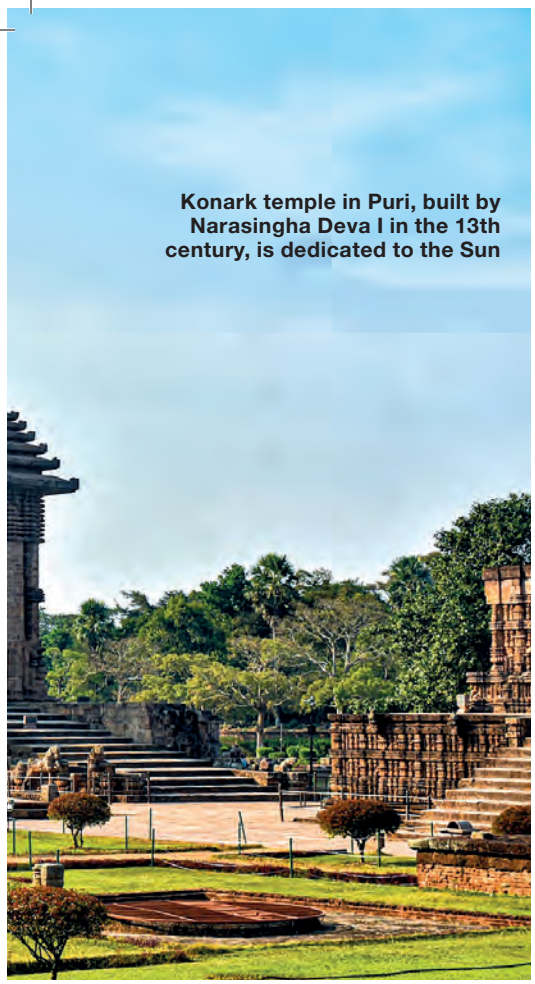
In the recently organised G20 Summit at New Delhi on 9-10th September, 2023, with the theme 'Vasudhaiva Kutumbakam – One Earth-One Family-One Future', Konark Sun temple which is a UNESCO heritage, was displayed in the background of morning programme as a symbol of ancient Indian knowledge, developed civilization, and excellence in architecture.

## SUN: THE PURIFIER, THE HEALER

The practices of Surya Namaskar (Sun Salute), Dugdhakalpa (mono diet on milk), Upvas (fasting), Ushapanm (drinking water in the morning) and Sandhya (Hindu ritual in the morn-


Image Courtesy: Internet

**According to ancient Indian thought, human body as well as the entire universe are made up of Panchamahabhutas or the five basic elements**



Konark temple in Puri, built by Narasingha Deva I in the 13th century, is dedicated to the Sun

Image Courtesy: Wikimedia Commons

ing when holy water is offered to the Sun, the Creator) were widely practiced in early days for health and healing. Every Hindu was advised to do Sandhya preferably standing in the water of a running river or a brook or in a lake or pond to offer Arghya to Lord Sun.

Arghya to Sun is ablutions of water to the Sun. The first part of Arghya consisted of hymns addressed to water and its benefits while the sprinkling of water on the face and head as well as touching the different organs with wetted fingers are meant to purify these parts and invoke the respective deities on them. This also stimulates the various nerve centres and wakes up the dormant powers of the body. Arghya is meant to drive the demons that obstruct the path of the rising sun. While the sun is the intellect, the demons are the evils of lust, anger, and greed. It is said that we pray to the Sun and offer Arghya for our peaceful life.

Rigveda says that the Sun is a great physician. It is believed that health and ill-health are under his control. He is prayed to for the cure of heart disease and jaundice. He is the greatest purifier. The Sun rays are also recognised as effective destroyers of disease germs — 'the rising sun kills with his rays, the germs that pervade the world; the setting sun does the same'.

Sun is very deeply connected to our lifestyle. From ancient times, the Sun worship has been in existence in some form or the other. It can be said that the traditional Indian lifestyle revolves around the Sun. From waking up early in the morning before the sunrise, i.e., in *brahmamuhurta,* till night at the time of sleep, the pattern of biological clock is followed. Sun is the representative of Agni in the body. Hence, taking food in coordination with the Sun is always beneficial. Physicians usually advise to take lunch preferably around 12.00 noon as that time the Sun is at the peak and our Jatharagni (gastric fire) is at maximum capacity. Similarly, in the evening it is advised to take light food preferably at the time of the sunset considering the gastric fire at low level. It is also advised to take fruits ripened in sunshine instead of artificially ripened with the help of chemicals. Sunshine keeps them fresh, alive, vibrant, and natural.

**Sun is the representative of Agni in the body. Hence, taking food in coordination with the Sun is always beneficial. Physicians usually advise lunch around 12 noon as then, the Sun is at its peak and gastric fire at maximum capacity**

## SURYA NAMASKARA: THE ULTIMATE YOGASANA

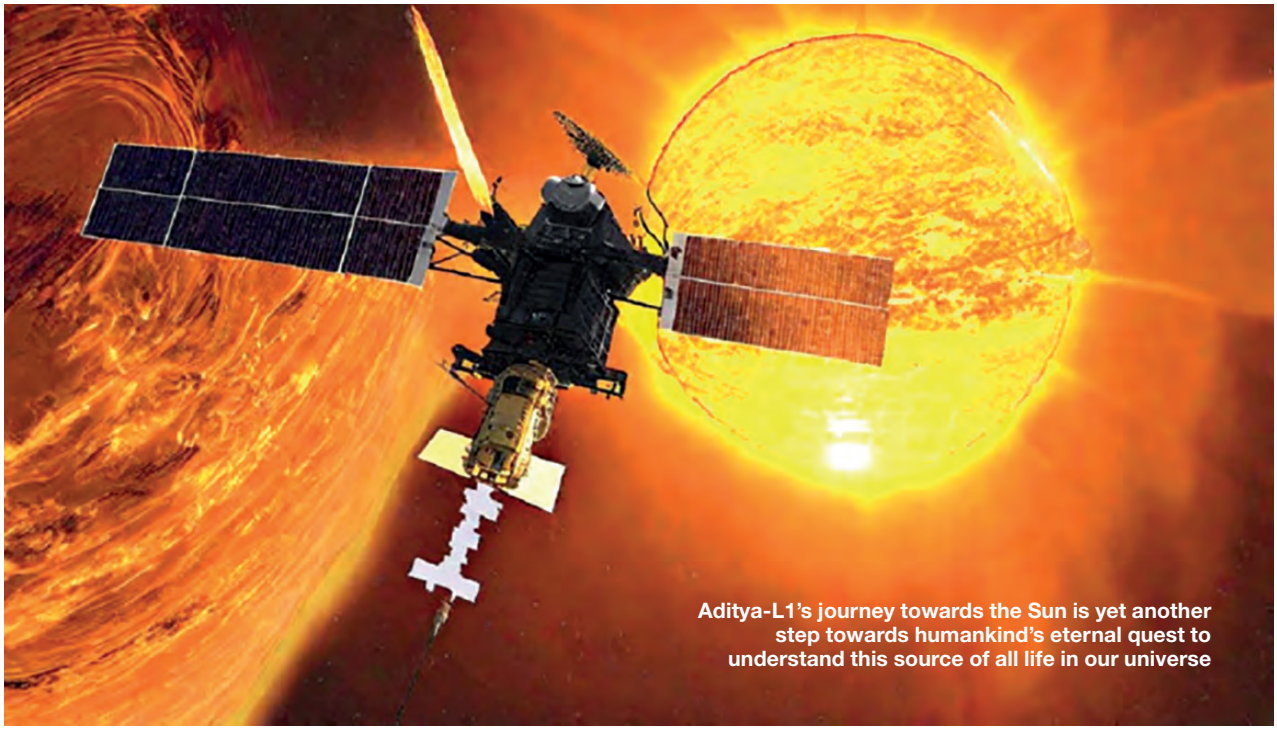
Surya Namaskara (Sun Salutation) is a classic example from Yoga which is very much relevant to our health. Thanks to celebrations of the International Day of Yoga which propagated the science of Yoga to the whole world, millions of people the world over are now daily practising Surya Namaskara. In Surya Namaskara, we salute the Sun with 12 names of the solar body. Surya Namaskara consists of a series of 12 postures which are performed early in the morning facing the rising Sun. The 12 postures make a complete round of one Surya Namaskara. There are 12 Surya Mantras which are to be recited with the practice of Surya Namaskara. So, this is a way of acknowledging and appreciating the Sun god. When we practise Surya Namaskara, we offer our gratitude to Lord Sun and pray to him to give us wisdom, energy, and patience. Surya Namaskar is the most useful and popular mode of Yogic exercises which briefly bestows the benefits of Asanas, Pranayama and Mudras altogether. Surya Namaskara energises the entire neuro-muscular system of the body. Its regular practice ensures a balanced supply of oxygenated blood and perfect harmony to all the systems of the body, thus invigorating the entire psychosomatic system of human constitution. Apart from the practice of Surya Namaskara, morning walk is preferred in sunshine along with the practice of Yogasanas and Pranayama.

Surya Namaskara is beneficial for physical as well as mental health. It awakens the vital force (*prana shakti*); each position of Surya Namaskara influences the endocrine glands, increases immunity, is highly beneficial for adolescents, removes the stiffness of the body and gives freshness, stretches the muscles of the entire body which develop body strength, is highly beneficial for the health of spinal cord, and provides physical balance leading to a balanced personality.

## SUNLIGHT FOR WELLNESS

Besides this, the Sun has a lot of other impacts on our health and life. Sun bath, colour therapy (treatment of disease through different rays of the sun), oil massage to the whole body and exposing the body to sun's rays all are practices that have been used in India for a long time for a wholesome healthy routine.

The sunlight has healing powers. It is a combination of seven visible colours of the rainbow. Sunlight has been in use



Aditya-L1's journey towards the Sun is yet another step towards humankind's eternal quest to understand this source of all life in our universe

Image Courtesy: ISRO

for healing since ages. Water solarised in colourless transparent glass bottles acts as a tonic for aged people. It is a very good remedy for the dentition diarrhoea among children. It makes up for the deficiency of calcium in children. We get vitamin D directly from the rays of the sun.

The sun's rays also influence our health. Seven colours of the rays, i.e., violet, indigo, blue, green, yellow, orange, and red have different therapeutic effects. These colours work effectively in treatment of different illnesses. It is believed that these colours affect the human personality and influence various stages like mood, concentration, etc.

One of the stalwarts of Naturopathy, Dr JM Jussawalla has mentioned in his book, *Heal Your Mind Heal Your Body* that 'colours have a direct effect on our health and personality hence colours in dress, furnishing and the walls of the rooms should be chosen and combined carefully with reference to the needs and personality of the individuals involved'. For example, in a sitting room, orange colour would evoke brightness of mood and cheerfulness. In the bedroom, green or blue give a sedative and cooling effect. In the dining room, yellow will be for appetite and digestion, or orange for well-being and stimulation.

Sunbath is a popular mode of treatment globally. In India, most of the Naturopathy Centres have facilities for sunbath. It is an application of natural sunlight directly to the exposed body surface. It is believed that sunlight is one of the best promoters of health, which also reduces the chances of disease. Sunlight not only kills the germs but vitalizes and energises the body and increases its immunity at the same time. The practice of sunbathing with banana leaves known as Atapasnana is prevalent in Naturopathy Centres, especially in the southern part of India. It is an excellent way of sunbathing where the body is covered with banana leaves during sunbathing.

**Water solarised in colourless transparent glass bottles acts as a tonic for aged people. It is a very good remedy for dentition diarrhoea among children. It makes up for the deficiency of calcium in children**

Sunbathing is a wonderful technique in which either the whole or a part of the body is exposed to the direct rays of the sun. Sunbathing has a lot of benefits. It is useful in the cases of malnutrition, anaemia, sluggishness or inactivity of the skin, chronic dyspepsia, neurasthenia, indigestion, rheumatism, diabetes as well as obesity.

In fact, the Sun is deeply amalgamated in our lifestyle. Sun provides us energy, boosts our stamina, removes vitamin D deficiency, removes darkness and enhances immunity. Sun is essential for the environment, plants, and so many other activities necessary for living beings. Sun is life and darkness is death. That is why the Sun is called the ultimate source of energy and the greatest friend of humanity.

The Sun is the source of continuous energy. Sunshine makes us refreshed, shining, motivating, and vibrant, and develops a sense of aliveness when we are in contact with the Sun. Our traditional lifestyle always insists upon open houses full of air and sunshine to make abundance of these items and to eliminate all kinds of disease-causing germs. Unfortunately, in our so-called modern living or modern lifestyle, we give least attention to the Panchamahabhutas or it can be said that we are drifting away from these five basic elements. This is not at all good for our health. These Panchamahabhutas give us a kind of positivity which transforms our whole thought process. Sun teaches us to live a disciplined lifestyle and with regularity in each step of life for success.

**The writer is former Assistant Director (Naturopathy), CCRYN, Ministry of AYUSH, New Delhi, and has authored several books on Yoga and Naturopathy. He can be reached at rajivrastogi2018@gmail.com.*

Image Courtesy: Pixabay

■ Dr Indranill Basu-Ray

HEALTH

# Embracing the Sun: The Golden Key to our Well-being

Despite bathed in sunlight for a better part of the year, India reports a staggering Vitamin D deficiency

The sun, a celestial body that has been revered and celebrated across cultures and millennia, offers more than just poetic inspiration. It is a beacon of health, providing a myriad of benefits that go beyond warmth and light. From the synthesis of essential vitamins to the enhancement of our mood, the sun truly is nature's pharmacy.

In modern times, science has validated many of these ancient beliefs. We now understand the sun's role in producing vitamin D, a nutrient essential for bone health, immune function, and mood regulation. When our skin is exposed to sunlight, it synthesizes vitamin D, often referred to as the 'sunshine vitamin'. This natural process underscores the symbiotic relationship between humans and the sun.

However, despite the sun's abundant gifts, there's an irony that's hard to ignore, especially in countries known for their sunny climes. Take India, for instance. A land of diverse landscapes and cultures, India is blessed with plenty of sunlight throughout the year. From the golden beaches of Goa to the vast Thar Desert, the sun casts its glow generously. Yet, beneath this sunny facade lies a concerning health anomaly.

According to a 2020 study published in the *Journal of Clinical and Diagnostic Research*, a staggering 70.2% of the Indian population is deficient in vitamin D. This means that more than 7 out of 10 people in India, a country bathed in sunlight, are not getting enough of this essential vitamin. The statistics delve deeper into this paradox. Women, often the pillars of Indian households, show a higher deficiency rate at 77.6%, com-

pared to men at 62.8%. Furthermore, one might assume that urban areas, with their high-rise buildings and pollution, might be the primary culprits. However, the study reveals that rural areas, often associated with open fields and outdoor activities, have a higher prevalence of vitamin D deficiency at 74.5%, compared to urban locales at 65.9%.

These figures prompt several questions. Why, in a country graced with abundant sunlight, is vitamin D deficiency so rampant? Is it cultural practices, dietary habits, or simply a lack of awareness?

## THE MULTIFACETED BENEFITS OF VITAMIN D

The sun's rays, gentle and warm on our skin, are not just a source of comfort but also a natural provider of Vitamin D. *Medical News Today* emphasizes the sun's role in this synthesis. Delving deeper into the science behind it, *JSTOR Daily* explains that our skin contains a molecule called 7-dehydrocholesterol (7-DHC). When kissed by the sun's UVB radiation, this molecule transforms into preD3, which eventually matures into vitamin D3, a vital nutrient for our health. This synthesis is overseen by the Vitamin D binding protein, ensuring its efficiency.

*Verywell Health* further underscores Vitamin D3's role in aiding our body to absorb calcium, essential for robust bones. While sunlight is a primary source, our diet, including foods like fatty fish, beef liver, eggs, and cheese, also contribute. *1MD* highlights Vitamin D3's broader protective role, especially in bolstering our immune system. The NHS (National Health Service of the UK) points out its importance in balancing calcium and phosphate, crucial for bones, teeth, and muscles. Both Mayo Clinic and Healthline reiterate its diverse functions, from supporting muscle activity to enhancing our immune defences.

## SUNLIGHT, VITAMIN D, AND CARDIOVASCULAR HEALTH

The heart, often described as the engine of our body, plays a pivotal role in our overall health. Its rhythmic beats ensure that every cell receives the oxygen and nutrients it needs. But like any engine, the heart requires proper maintenance and care. Interestingly, sunlight, with its myriad benefits, emerges as a significant factor in cardiovascular health.

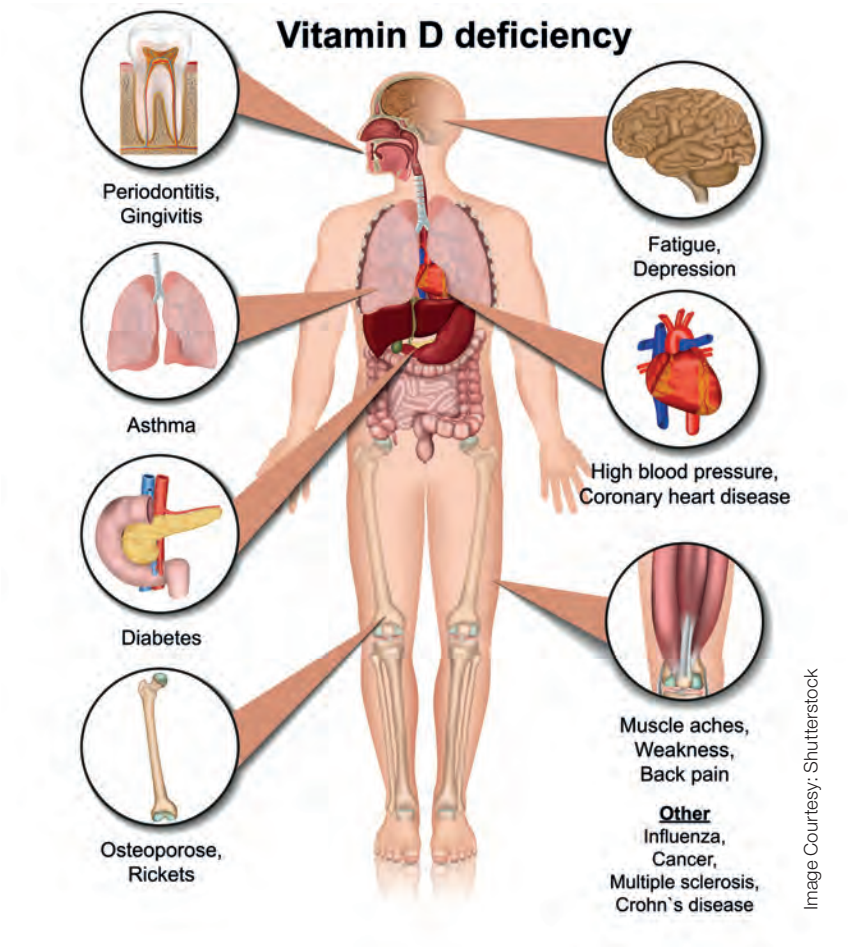


Image Courtesy: Shutterstock

A study in the *European Heart Journal* paints a somewhat alarming picture. It reveals that individuals deficient in vitamin D are at a heightened risk for heart diseases and elevated blood pressure. This connection between vitamin D and heart health isn't entirely surprising. Vitamin D plays a role in regulating inflammation, a known factor in many heart-related issues. Inflammation of the heart's arteries can lead to blockages, which in turn can cause heart attacks. By helping to manage inflammation, vitamin D indirectly supports heart health.

However, the relationship between vitamin D and heart health is complex. As *Medical News Today* points out, while there isn't conclusive evidence from clinical trials linking vitamin D supplementation directly to improved heart health, observational studies have shown some promising correlations. These studies suggest that individuals with higher levels of vitamin D in their system tend to have reduced rates of heart diseases. It's a reminder that while supplements can be beneficial, they are not a replacement for natural sunlight exposure and a balanced diet.

But the sun's benefits for our heart might not be solely tied to vitamin D. An intriguing article in *Karger* introduces a fresh perspective. It posits that sunlight, independent of its role in vitamin D synthesis, offers cardiovascular benefits. Sunlight exposure can lead to the release of nitric oxide stored in the skin, which can then enter the bloodstream. Nitric

oxide is a molecule that dilates blood vessels, reducing blood pressure. This process can enhance blood flow, ensuring that the heart receives the oxygen it needs and reducing the strain on this vital organ.

## SUNLIGHT AND MENTAL HEALTH

Beyond the physical, the sun also nourishes our minds. Its radiant beams have a profound impact on our mental well-being, influencing our emotions, energy levels, and even our thought processes. The interplay between sunlight and our psyche is a dance as old as time, deeply rooted in our evolutionary history.

Our brains produce a neurotransmitter called serotonin, often dubbed the 'feel-good' hormone. Sunlight stimulates the production of serotonin, leading to elevated moods and a feeling of calm and focus. On darker days, serotonin production can dip, leading to feelings of sadness or even depression in some individuals.

*Harvard Health* delves into a specific condition influenced by sunlight: Seasonal Affective Disorder (SAD). SAD is a type of depression that typically occurs during the colder months when daylight is scarce. Symptoms can range from mild lethargy to more severe depressive episodes. One of the recommended treatments for SAD is light therapy, which mimics natural sunlight. This therapy underscores the sun's role in regulating our mental health.

Moreover, sunlight also influences our sleep patterns. Exposure to natural light during the day helps regulate our body's internal clock, or circadian rhythm. This rhythm affects our sleep-wake cycle, hormone release, and other bodily functions. A regulated circadian rhythm ensures better sleep quality, which is crucial for mental health. Poor sleep can lead to irritability, mood swings, and cognitive impairment.

## ADDITIONAL HEALTH BENEFITS OF SUNLIGHT

The sun, in its vast expanse across the sky, is more than just a luminous body that brightens our day. Its rays, while bathing the Earth in light, also bring forth a treasure trove of health benefits that are both direct and indirect.

Image Courtesy: Shutterstock

*Medical News Today* highlights the multifaceted advantages of sunlight exposure. Beyond the synthesis of vitamin D and its cardiovascular benefits, the sun plays a role in several other health aspects that might not be immediately obvious.

One of the most immediate effects of sunlight is its ability to lower blood pressure. When our skin is exposed to the sun's UV rays, it releases a compound called nitric oxide into our bloodstream. This compound helps dilate blood vessels, leading to a decrease in blood pressure. This effect is not only beneficial for heart health but also reduces the risk of stroke and other vascular complications.

The sun's protective role extends to several chronic diseases. For instance, consistent sunlight exposure has been linked to a reduced risk of type 1 diabetes. While the exact mechanisms are still under study, some researchers believe that vitamin D might play a role in regulating the immune system and preventing the onset of this autoimmune condition.

Multiple sclerosis (MS) is another condition where sunlight seems to have a protective effect. MS is less common in regions closer to the equator, where sunlight exposure is more consistent year-round. The sun's UV rays may help modulate the immune system and reduce inflammation, both of which are crucial in managing and preventing MS.

When it comes to cancer, the sun's role is multifaceted. While excessive sun exposure is linked to skin cancers, moderate sunlight exposure can have protective effects against certain internal cancers. Colon, breast, and prostate cancer rates are lower in regions with higher sunlight exposure. The mechanisms are still being explored, but vitamin D's role in cell growth regulation and its anti-inflammatory properties might contribute to these protective effects.

## WHERE DO WE GO FROM HERE?

In the dance of life, the sun plays a rhythm that's both timeless and essential. Yet, as we've seen, even in sun-drenched lands like India, there's a gap between its abundant offerings and our reception of its gifts.

It's a gentle reminder that nature's blessings, no matter how generous, require our active participation. Whether it's adjusting our daily routines, rethinking cultural practices, or simply spreading awareness, the onus is on us to bridge the divide. Let's cherish its warmth, harness its energy, and most importantly, share its benefits with our communities. For in doing so, we not only honour nature's pharmacy but also pave the way for a healthier, brighter future for all.

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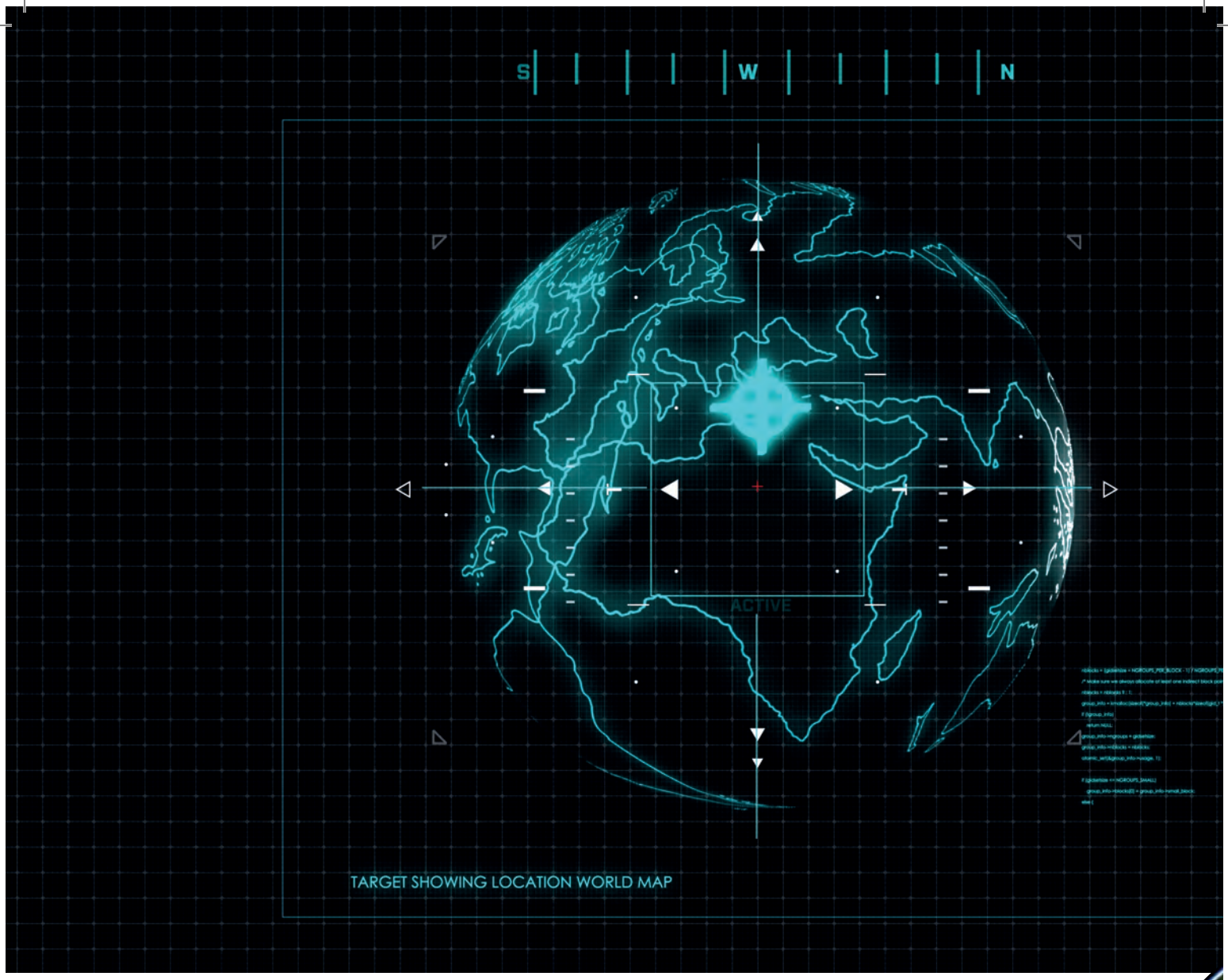
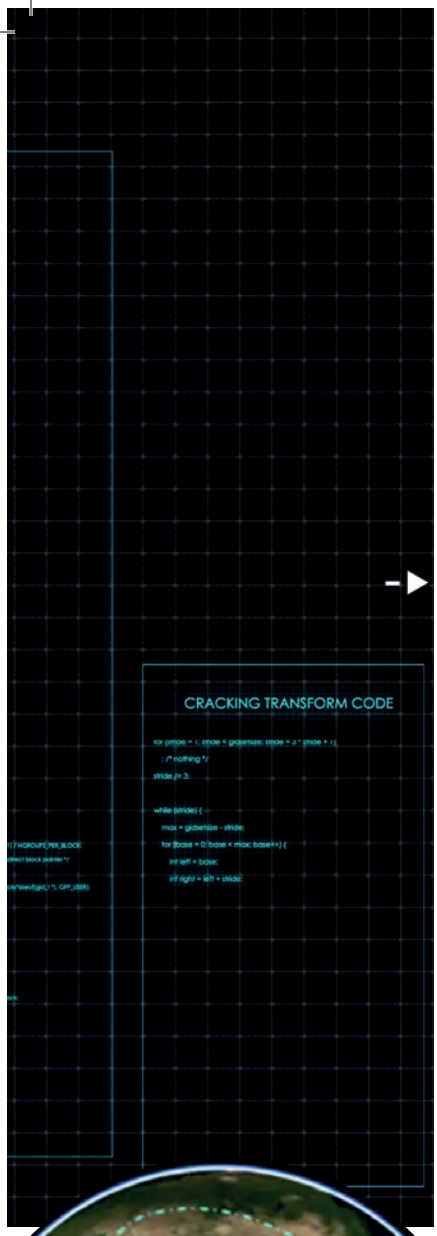
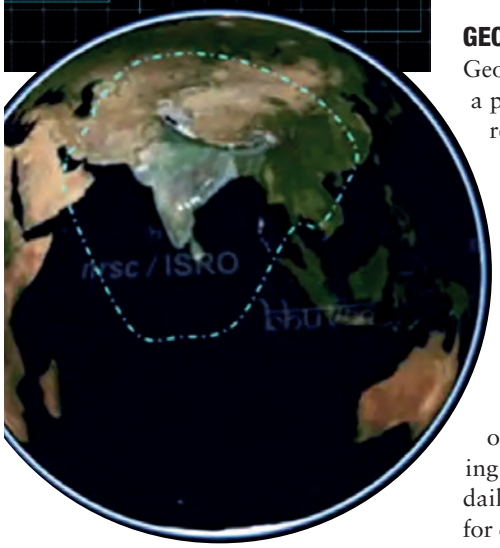



# Revolutionising India's Geospatial Landscape

Image Courtesy: Shutterstock

**The National Geospatial Policy aims to strengthen the location-centric industry, which is veritably at the core of almost everything these days**




**To meet the positioning, navigation and timing requirements of the nation, ISRO has established a regional navigation satellite system called Navigation with Indian Constellation (NavIC)**

■ **Aswin S**

In an era where technology is reshaping the way we perceive and interact with the world, geospatial information has emerged as a pivotal tool for governments, businesses, and individuals alike. Geospatial data, which encompasses location-based information, satellite imagery, maps, and more, plays a critical role in diverse sectors such as agriculture, urban planning, disaster management, and national security. Recognising the immense potential of geospatial data, India took a pioneering step by introducing the National Geospatial Policy in 2022, a visionary framework that is poised to transform the country's geospatial landscape. Before jumping into an in-depth review of the framework, let us see what geospatial technology is.

## GEOSPATIAL TECHNOLOGY: WHAT IS IT?

Geospatial data refers to data associated with a particular location. This means that the records in the data set are associated with geographical location information in the form of coordinates, addresses, cities, or pin codes. Geospatial technology refers to the remarkable digital toolkit, which is an amalgamation of scientific and geographic knowledge and techniques to map, analyse, or visualise geospatial data for Earth's surface changes, and human societies and to help us navigate our world with precision, therefore making it an essential tool for everything from daily navigation to scientific exploration and for conservation efforts, which is pivotal for operational needs of the government, the private sector, science, and the individuals. The world has come a long way from the days of using paper maps for finding places to adopting spatial intelligence in everyday decisions. The story of our country is also not different, even though the adoption rate here is much slower than desired.

## GENESIS OF NATIONAL GEOSPATIAL POLICY (NGP)

India's geospatial industry has been growing remarkably. This industry is expected to cross Rs 63,000 crore by 2025 at a growth rate of 12.8% and to provide employment to more than 10 lakh people. In India, various levels of governance are democratic, which makes the need for data for better governance — whether national, state, or local level — indispensable. The geospatial data and the aided applications fulfill the data requirement with an additional hand of location information associated with the conventional data giving multiple dimensions to the data. Geospatial technologies like Global Positioning System (GPS), Global Navigation Satellite System (GNSS), India's own Navigation using Indian Constellation (NavIC), Light Detection and ranging (LiDAR), Location Based Services (LBS) are being widely used in our day-to-day life. Many government departments and services use geospatial data and technologies for governance. Governments' flagship development programmes like Gati Shakti, Swachh Bharat, Namami Gange, etc. have substantial geospatial data and technology components. It is visible that the Government of India is interested in measures to link space and location technology with development and governance. This initiative altered the geospatial ecosystem of the country and recognised the technology as an effective and efficient tool for planning, management, and decision-making, not only at the local level but also at the global level. This eventually paved the way for the launch of the strategic National Geospatial Policy.

## DEEP DIVE INTO INDIA'S NATIONAL GEOSPATIAL POLICY

India's journey towards establishing a comprehensive geospatial policy began with the realisation of the strategic importance of geospatial data in fostering sustainable development. Notified on December 28, 2022, the National Geospatial Policy (NGP) was formulated under the auspices of the Department of Science and Technology (DST) and the Ministry of Electronics and Information Technology (MEITY). This policy represents a strategic shift from the previous regime, which imposed restrictions on the dissemination and use of geospatial data. NGP is a

citizen-centric policy that liberalises the geospatial sector and democratises the datasets generated by the use of public funds.

Until a decade ago, in India, the early adopters of geospatial data and technologies were the national mapping agencies like the Survey of India (SoI), Geological Survey of India (GSI), National Atlas and Thematic Mapping Organization (NATMO), Indian Space Research Organisation (ISRO), etc., having built-in capacity to create geospatial data and products. These agencies completed several projects in different domains to demonstrate the potential of spatial data and aided technologies. With the government departments doing a good amount of significant work, there were minimal efforts for the enhancement of private participation in this sector. This affected the adoption rate of newer technological advancement in this rapidly evolving sector in the country at a much slower pace than desired.

NGP brought deregulation in the geospatial domain by liberalising the collection, production, and access of geospatial data, which goes further by establishing an overarching framework for the comprehensive development of the geospatial ecosystem in India. NGP enabled the enhancement of private participation in the sector more than ever before and it spells vision and goals of the geospatial domain, describing strategies for achieving them. NGP aims to develop geospatial infrastructure, geospatial skills and knowledge, standards, geospatial enterprises, foster innovation, and strengthen national/ sub-national agreements, and create and manage geospatial information. The collection, production, and access of geospatial data will continue to be governed by the guidelines in its current form or regulated by DST from time to time, to promote private sector participation through continuous improvements to facilitate business in the sector.

Image Courtesy: Lockheed Martin Corporation

**Global Positioning System is a space-based radio-navigation system that broadcasts highly accurate navigation pulses to users on or near Earth**

## MAPPING INDIA'S FUTURE

In the intricate web of progress, the National Geospatial Policy of 2022 (NGP 2022) emerges as a guiding star, illuminating India's journey towards technological excellence. This policy, born from the heart of the Indian government, holds the key to unlocking a multitude of benefits for the nation, making it accessible and understandable for everyone.

### Pioneering the Geospatial Frontier

At its core, NGP 2022 recognises the transformative potential of geospatial technology and data in shaping India's destiny. Geospatial technology, like a trusty compass, guides us through a multitude of applications: urban planning, natural resource management, disaster management, agriculture, transportation, security, and climate change adaptation.

### Seeding Innovation and Entrepreneurship

NGP 2022 is more than just a recognition; it is a nurturing embrace for India's geospatial sector. It is the launchpad for innovation, an open field where entrepreneurial spirits can flourish. Think of it as a well-tended garden, where regulatory hurdles are cleared away, innovation sprouts, and financial support waters the seeds of progress.

### Guardian of Data Security and Privacy

In the digital age, safeguarding data is paramount. NGP 2022 takes on the role of a vigilant guardian, ensuring that while data flows freely, it remains securely protected. Picture it as an unbreakable vault, shielding national interests and individual privacy alike.

### Sustainability as a Compass

Beyond mere development, NGP 2022 champions sustainable growth. It's a compass guiding India through the challenges of climate change, responsible resource management, and equal access for all. This is the policy's pledge to protect our environment, foster resilience, and ensure that no one is left behind.

## REALISING BENEFITS FOR ALL

The benefits of NGP 2022 are far-reaching and will touch the lives of every Indian. Geospatial technology enhances business efficiency, attracting investments and stimulating economic growth. It aids in planning and managing infrastructure projects, from roads to power plants, resulting in improved connectivity. Geospatial tech helps monitor and respond to natural disasters, safeguarding lives and property. It monitors and preserves natural resources like forests and water bodies, contributing to environmental protection. Geospatial technology improves access to essential services, like education and healthcare, reducing poverty and inequality.

## THE POWER AND RESPONSIBILITY OF GEOSPATIAL DATA

The NGP ushers in a new era, one that promises to revolutionise how India utilizes geospatial data. In a world dominated by satellites, drones, and location-based services, this data has become the lifeblood of modern civilisation, influencing diverse sectors, from urban planning to agriculture, disaster management to national defence. The NGP champions this democratisation of data by mandating the sharing of geospatial data produced with public funds, fostering innovation and development across the nation.

However, the policy acknowledges that with great power comes great responsibility. India, like many nations, grapples with the challenge of preventing geospatial data misuse. To address this, the NGP establishes several measures aimed at safeguarding India's interests.

Image Courtesy: Pixabay

## BALANCING INNOVATION AND SECURITY

A cornerstone of the NGP is the prohibition on exporting geospatial data that could be exploited for military purposes. This crucial provision ensures that sensitive information remains out of reach for potential adversaries.

Furthermore, to ensure a responsible and effective implementation of the NGP, a Geospatial Data Promotion and Development Committee (GDPDC) is established. This committee is entrusted with the task of balancing the imperatives of innovation and security, offering guidance that will keep India's geospatial journey on the right course.

### Securing India's Geospatial Frontier

The NGP demonstrates a keen understanding of the potential misuse of geospatial data. It recognises that threats such as terrorist attacks and espionage are not mere conjectures but tangible and imminent dangers. The policy, therefore, meticulously outlines a comprehensive set of measures designed to safeguard India's geospatial frontiers.

One noteworthy provision is the introduction of a list of negative attributes that cannot be included in geospatial data without prior government approval. This measure acts as a bulwark against the dissemination of information that could be maliciously exploited. Furthermore, geospatial data providers are compelled to implement robust security measures, ensuring that the first line of defence remains steadfast. NGP goes a step further by imposing stringent penalties for unauthorised access or use of geospatial data. This serves as a stark deterrent, emphasizing the nation's unwavering commitment to protecting its geospatial assets.

### Addressing Critical Security Issues

The NGP is not merely a policy framework but a shield against grave security concerns. It acknowledges the potential for geospatial data to be used in planning terrorist attacks, espionage, or even to violate India's sovereignty.

Terrorist groups could exploit geospatial data to identify targets, plot attack routes, or monitor the movements of security forces. With the NGP in place, India reinforces its defences, making it considerably more challenging for malevolent actors to exploit geospatial information.

Likewise, the NGP recognises the risk of espionage, where foreign intelligence agencies may gather information about India's military capabilities, infrastructure, or economic assets. Through rigorous regulation of geospatial data acquisition and dissemination, the NGP

heightens defences against unwarranted espionage attempts.

Furthermore, the policy safeguards India's sovereignty by imposing strict controls on the publication and distribution of geospatial data. This bolsters protection against potential encroachments by foreign governments.

### Charting a Secure Geospatial Future

The NGP stands as a testament to India's forward-looking approach to striking a harmonious balance between innovation and security. It not only embraces the boundless possibilities of geospatial data but also equips the nation with robust defences against potential threats.

While the NGP is still in its nascent stages, its influence is already palpable across India's geospatial landscape. It is not merely a policy; it represents India's unwavering intent. With the Geospatial Data Promotion and Development Committee as its guardian, India is poised to unlock a realm of opportunities while ensuring that its geospatial assets remain fortified. As time progresses, the NGP will undoubtedly emerge as a significant milestone in India's journey toward a secure and prosperous geospatial future.


Image Courtesy: Internet

**Unlike GPS, which is dependent only on L-band, NavIC has dual frequencies (S and L bands)**

### THE PROMISE AND THE PERIL

At its heart, NGP 2022 is a promise. A promise to unlock the immense potential of geospatial data and welcome greater private-sector engagement. It's an open invitation to innovation and investment that could redefine the landscape of Indian development. Yet, as with any path into uncharted territory, there are whispers of peril.

One of the policy's linchpins is the democratisation of geospatial data. It declares that all such data, even the once-guarded secrets, shall be accessible to the public, albeit with strings attached. While this move symbolises transparency and accessibility, it casts a shadow of concern over the potential for misuse.

### WALKING THE TIGHTROPE OF PRIVACY

Privacy is the jewel in the crown of personal freedoms, and it is this jewel that is at stake in the NGP 2022 debate. The worry is that the unrestricted availability of geospatial data may be akin to handing a double-edged sword to society. On one hand, it empowers us with knowledge; on the other, it raises the spectre of stalking, harassment, or even terrorism.

Consider this: An individual, armed with geospatial data could potentially track every move of another person or group. Worse, they might pinpoint sensitive infrastructure locations. It's a chilling thought, one that underscores the importance of robust privacy safeguards.

### PRIVACY PARADOX

The government assures us that safeguards will be in place, such as requiring consent before utilising geospatial data for specific purposes. However, not everyone is convinced that these safeguards are sufficiently robust. Concerns abound about the vagueness of key terms, like 'sensitive' data. Without clear definitions, the risk remains that non-sensitive data could be wielded for malicious intent.

Moreover, the policy lacks a requirement for users to obtain consent from individuals before using their geospatial data. This raises the unsettling prospect of individuals being tracked without their knowledge or consent. The spectre of unchecked surveillance looms.

### THE ROAD AHEAD

As we venture into this new geospatial frontier, a delicate balance must be struck between progress and privacy. Clarity is needed regarding what constitutes sensitive data, stronger consent requirements, and effective mechanisms for enforcement.

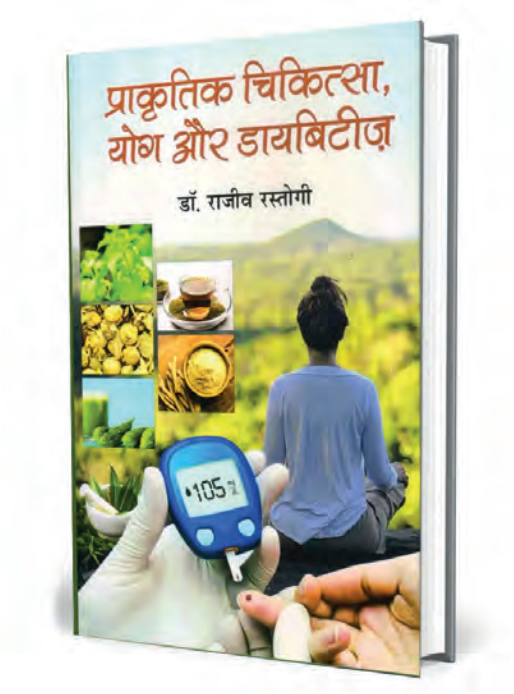
The government's commitment to protecting privacy is reassuring, but vigilance and accountability are the watchwords of our age. It falls upon us all, as a society, to ensure that the NGP 2022 unfolds as a testament to progress and protection. We must tread carefully, navigating the geospatial frontier with an unwavering commitment to safeguarding individual privacy.

**The writer is a Geoinformatics and Remote Sensing enthusiast holding Master of Science in Geoinformatics from TERI School of Advanced Studies, New Delhi. He has published several articles in peer-reviewed international journals and continuously contributes to the field of geospatial science. He can be contacted at: mail2aswinsunil@gmail.com.*

BOOK REVIEW

# Resetting Modern Lifestyles to Keep Diabetes at Bay

Labelled as the diabetes capital of the world, India faces an unprecedented health burden, which, however, can be tackled to a great extent, as this handy book shows




**PRAKRITIK CHIKITSA, YOG AUR DIABETES**
**Dr Rajiv Rastogi**
Shivank Prakashan, 2023
Rs 295

■ **Debobrat Ghose**

Long years ago, people in India led far simpler lives than what is the norm in the country today. They ate simpler foods, their lifestyles were more in tune with the circadian rhythm, and 'lifestyle disorder' was a term that had not yet been applied to India.

And then, economic liberalisation took place, and the rest, as they say, is history.

Of course, pinning every ill of the society today — including lifestyle disorders — on economic reforms of 1991 and their consequences, would not only be simplistic but outright wrong. Yet, the fact remains that India has earned the rather unfortunate epithet of being the diabetes capital of the world, which is a disorder concomitant with generic lifestyle of a fast progressing capitalist economy.

According to a recent study published in June this year, by Madras Diabetes Research Foundation and the Indian Council of Medical Research (ICMR), India has around 101 million people living with diabetes and another 136 million in pre-diabetes stages. This is the biggest such study on diabetes in India conducted on a sample of over 113,000 people across 31 states and union territories in the country. Its finding — that 11.4% of India's population is diabetic and another 15.3% is pre-diabetic — is alarming.

It is worth mentioning that Indians suffer from Type 2 Diabetes Mellitus. Type 2 diabetes, the most common type of diabetes, is a disease that occurs when your blood glucose, also called blood sugar, is too high. The body doesn't make enough insulin or doesn't use insulin well.

As diabetes is so widespread in our country, one cannot expect the population to simply wait to be diagnosed and begin a lifelong quest to control it, which, often times, deteriorates with co-morbidity resulting in serious complications. So, would it not be better if every individual took the challenge in his or her own hands and tackled the disease at the individual level, thereby setting up precedent for a healthy lifestyle for society at large?

It is possible, as the new book *Prakritik Chikitsa, Yog aur Diabetes* (Naturopathy, Yoga and Diabetes) by Dr Rajiv Rastogi, shows. Published by New Delhi's Shivank Prakashan, it's a handy guide on how this serious national health scare can be tackled.

At the outset I would like to clarify that the book has been published in Hindi. That cannot be a deterrent for

gaining vital information on health, especially when it is a national scare, and therefore, I thought it prudent to review it in this essentially English magazine.

The author is former Assistant Director (Naturopathy), CCRYN, Ministry of AYUSH, and has written several books on health, naturopathy and yoga, making him perfectly placed to write a handy book that individuals can consult right from the time they think they have become vulnerable to diabetes.

He writes that one of the biggest challenges facing the treatment of diabetes is the fact that there is no harmony between various systems of medicine, all of which have something to contribute towards prevention and cure of this disease. He writes, "The material presented in the book has not been complicated, a lot of references have been given to ongoing experiments [on this disease]… It lists the difficulties faced by diabetes patients as well as gives suggestions to policy makers. I can assert that whatever programme is created to help diabetics, it will have to incorporate Yoga and Naturopathy as these two branches of medicine not only help in containing diabetes but teach many other things on maintaining general health which is not the case with other systems of healthcare and medicine."

The author has quoted latest data regarding the burden of diabetes in our country and the urgent need to take care of the burgeoning problem. Through easy to read and concise chapters, he establishes the situation of the condition in different groups of people — women, children, people suffering from obesity, and so on. He has also presented brief discussions on the impact of diabetes on other health conditions such as cancer, cardiac issues, glaucoma, and vitamin D deficiency, among others.

Keeping various aspects in mind like the apprehensions and fear that the patients face due to diabetes, multiple queries that appear in the mind related to the disease, technical details related to diabetes for medical practitioners, etc., too have been addressed by the author in different chapters in an incisive manner.


Image Courtesy: Pixabay

**One of the biggest challenges facing the treatment of diabetes is the absence of harmony between various systems of medicine though all have something to offer**

The part of the book that every reader would most eagerly wait for deals with the treatment of the condition, which the author presents through succinct notes, diagrams and other illustrated material. With the emphasis that Yoga deserves in containing diabetes, the author has dedicated multiple pages to this section. He writes: "According to a research paper published in *Clinical Research Cardiology Journal* (SC Manchanda, Kushal Madan, 2014), Yoga has been found to be useful and economical in the incidental treatment of Type 2 diabetes." The highlight of the chapter on Yogasanas for treating diabetes is the detailed protocol that the author gives for a guided programme of Yoga, including 30 minutes of Pranayam, which must be followed at least five times a week. He lays special emphasis on Surya Namaskar, giving precautions and other advice.

The intervention of naturopathy for treating diabetes has been dealt with in equal detail by the author. He writes: "In reality, diabetes is a lifestyle disorder. To control it, it is imperative to correct the disturbed lifestyle of the patient. Lifestyle refers to the way of life, food habits, thought process and attitude, and daily routine. In effect, the chief aim of naturopathy is to correct an individual's lifestyle."

Last but not the least is the due emphasis given by the author to the importance of a right diet in preventing and controlling diabetes. In fact, the importance of correct dietary habits cannot be overstated in tackling any lifestyle disorder. He has given a detailed analysis of types of food and their impact on our health — such as Sattvik, Rajsik and Tamsik diet, and the effect each one of these has on our short-term and long-term health. The most important point that the author makes in this section is the importance of eating food at a particular time. As sages and *rishi*s of ancient India emphasised centuries ago, there is no substitute to good eating habits and the modern world's lifestyle disorders are proving them right in a back-handed manner. The more we remain active after sunset, the more we push our dinner time to middle of the night, the graver the danger of getting afflicted with multiple disorders.

Just getting a few basics right is likely to bring a course-correction in our lifestyle, as Dr Rastogi underscores throughout his book, leading to not just a healthier world but a world with lesser incidences of diabetes. Now only if the book could be made available in other Indian languages.

**The writer is Editor, Science India.*

# Merging of Biotechnology and Social Entrepreneurship

BIRAC aims to cultivate social entrepreneurs under the Sparsh programme for affordable biotechnological interventions in critical social needs

■ **Science India Bureau**

By the end of last year, India ranked third globally in terms of start-ups with the number of registered startups growing to a little more than 72,000. This is, in part, also due to the constant government push that the startup ecosystem is receiving in India.

Recently, BIRAC, the Biotechnology Industry Research Assistance Council (BIRAC) under the Department of Biotechnology (DBT) announced its aim to cultivate about 60-70 social entrepreneurs during each of its cohort workshops under 'Sparsh' programme, to develop affordable biotechnological interventions to address critical societal challenges. According to an official release published in *The Hindu*, this information was shared by BIRAC MD Jitendra Kumar, while participating in a three-day 'Ventura Design Workshop' at the Sparsh centre, held at the Atal Incubation Centre – Centre for Cellular and Molecular Biology (AIC-CCMB) in Hyderabad, in collaboration with the Tata Institute of Social Sciences (TISS).

Sparsh programme, initiated by the central government, provides fellowship spanning 19 months, which includes a kick-start grant of Rs 5 lakh, enabling chosen fellows to demonstrate the viability of their ideas. It also guides them toward building entrepreneurship in social innovation space through biotechnology-based interventions.

According to reports, the workshop was meant to mentor and evaluate fellows under Sparsh, which aims to encourage aspiring entrepreneurs with special focus on addressing challenges in various areas such as maternal and child health, ageing and health, food and nutrition, waste to value, agri-tech, and combating environmental pollution.

**Atal Incubation Centre – Centre for Cellular and Molecular Biology (AIC-CCMB) in Hyderabad**

Image Courtesy: aic.ccmb.res.in

According to the report in *The Hindu*, the CSIR-CCMB director Vinay Kumar Nandicoori commended the programme and pointed out that BIRAC had successfully merged the fields of biology and social entrepreneurship by providing a supportive ecosystem for innovators. Such initiatives positively contributed to the growth of biotechnology sector in India and encouraged the translation of scientific research into practical applications that benefited society and economy, he said.

Other luminaries gracing the occasion included AIC-CCMB CEO N Madhusudhana Rao, BIRAC Director (Operations) Subhra R Chakrabarti and TISS's Satyajit Majumdar.

The space for biotech startups in India is highly exciting right now with the country clocking approximately 6,000 startups in this sector alone, as revealed by Jitendra Singh, Minister of State (Independent Charge) for Science & Technology, at an earlier event in July in New Delhi. Speaking on the exponential growth in the sector, Singh had said, "We had just about 50 biotech startups eight-nine years back, now we have around 6,000." The country's bio-economy, too, has grown from $8 billion in 2014 to $100 billion currently.

Last year, the government launched a single-window national portal for startups and researchers seeking regulatory clearance for biological research. Aimed at making it easy to do science and science research in the country, this portal, called BioRRAP (Biological Research Regulatory Approval Portal), serves as a single window clearance platform for startups and researchers. In August 2022, the government also announced 75 Amrit grants for collaborative biotech initiatives involving startups and academia. Besides, BIRAC also offers grants of up to Rs 50 lakhs, under the BIG scheme, for budding biotech startups to validate their ideas, develop prototypes and establish proof of concept.

National Power Training Institute, Faridabad

**IN FOCUS: NATIONAL POWER TRAINING INSTITUTE, FARIDABAD**

# Skilling India's Power Sector

The National Power Training Institute, with its headquarters in Faridabad and 11 institutes in different corners of India, has remained at the forefront of equipping professionals with state-of-the-art skills for handling the nation's quest for energy self-reliance

The National Power Training Institute (NPTI) stands as a beacon of excellence in the realm of power sector training. Under the aegis of the Ministry of Power, Government of India, NPTI has earned global recognition as a pioneer in power training. With its headquarters in Faridabad, NPTI operates through a network of eleven institutes, each contributing to the nation's quest for energy self-reliance and sustainability.

## INCEPTION AND EVOLUTION

Established in 1965, NPTI emerged as a response to the acute shortage of skilled manpower in the burgeoning Indian power sector. It marked the nation's commitment to self-reliance in energy generation and distribution. Over the years, NPTI has grown into a formidable institution, spanning the entire country and offering diverse training programmes.

## GEOGRAPHICAL SPREAD

NPTI operates on an all-India basis with manpower strength of 149 including 78 officers through its 11 institutes, covering:

**Northern region:** NPTI-Corporate Office, Faridabad; NPTI-Badarpur, New Delhi, and NPTI-Hydro Power Training Centre, Nangal

**Southern region:** NPTI-Power System Training Institute, Bengaluru; NPTI - Hot Line Training Centre, Bengaluru; NPTI-Neyveli; and NPTI-Alappuzha

**Eastern & North-Eastern region:** NPTI-Durgapur and NPTI-Guwahati

**Western Region:** NPTI-Nagpur and NPTI-Shivpuri

With eleven institutes strategically located, NPTI ensures accessibility to

All Images Courtesy: NPTI

quality power sector training for professionals nationwide.

## TRAINING MILESTONES AND RESEARCH & INNOVATION

Having imparted knowledge to more than 4,50,000 power professionals in various programmes over five decades, NPTI boasts a rich history of achievements and contributions to the power sector's growth. NPTI's legacy is rooted in its unwavering commitment to delivering world-class training and extends to pioneering research and development in the power sector. Its research initiatives have catalysed technological advancements and the adoption of best practices across the industry. Its faculty, trainers, and state-of-the-art laboratories have consistently set industry standards.

NPTI's alumni network spans the globe, with graduates holding influential positions in both public and private sectors. They have played pivotal roles in shaping India's energy landscape, driving innovations, and advocating for sustainable practices.

## ADVANCED TRAINING INITIATIVES

NPTI's vision for the future involves expanding its training portfolio to encompass cutting-edge courses in renewable energy, grid management, and smart grid technologies. These programmes will equip professionals with the expertise required to navigate the evolving energy landscape. Recognising the global demand for skilled power professionals, NPTI is actively forging partnerships with international institutions. These collaborations will facilitate knowledge exchange, technology transfer, and global expansion of NPTI's training programmes. The institute is committed to modernising its infrastructure, including advanced laboratories, simulation facilities, and research centres. This investment ensures NPTI remains at the forefront of power sector training.

## SUSTAINABILITY INTEGRATION

NPTI acknowledges the paramount importance of sustainability in the power sector. It is integrating sustainability principles into its training modules to cultivate environmentally conscious power professionals.

NPTI conducts an array of comprehensive training programmes designed to meet the evolving needs of the power sector. These programmes cater to engineers, supervisors, technicians, and other professionals in various technical and managerial domains of the Renewable Energy & Power Sector. The programmes offered include:

**Thermal Power Programmes:** Covering both supercritical and subcritical technologies.

**Hydro Power Training:** Focused on hydroelectric power generation.

**Renewable Energy Training:** Encompassing solar, wind, and other renewable energy sources.

**Transmission and Distribution:** Addressing the intricacies of power distribution networks.

**Management Programmes:** Equipping professionals with managerial skills.

**Regulatory Affairs:** Providing insights into the regulatory framework of the power sector.

These training programmes, offered across all NPTI institutes, can be customised to suit the specific needs of client organisations. They are conducted year-round and are complemented by workshops and seminars that cover the latest developments in the sector.

NPTI also offers specialised industry-interfaced programmes and postgraduate diploma courses in various areas, including Power Plant Engineering, Renewable Energy, Smart Grid Technologies, and Power System Operation. These programmes prepare graduates for leadership roles in the dynamic power sector.

NPTI is at the forefront of several ongoing initiatives that contribute to the power sector's growth and resilience:

**Induction Training Programmes:** NPTI imparts induction training to fresh graduate engineers and executives from various power sector organisations, ensuring a strong foundation for their careers.

**On-job Training:** On-job training supplements formal education, providing real-world experience and essential skills in specific areas of power sector operations.

**Online Training Courses:** NPTI conducts online training programmes, adapting to the digital age and providing accessible learning opportunities.

NPTI is recognised as Cadre Training Institute for Central Power Engineering Services. NPTI is functioning as the Apex Cadre Training Institute for the engineers/officers of Central Power Engineering Services.

**Energy Efficiency:** NPTI collaborates with financial institutions to provide training on energy efficiency financing, promoting sustainable practices.

**Protection of Consumer Interest:** The institute organises training programs for ombudsmen and officials from consumer grievance redressal forums, fostering consumer protection in the power sector.

**Distribution Lineman Training:** NPTI has pioneered training programs like 'Urja Sarathi' and 'Uttam Urja Sarathi' to equip distribution linemen with the knowledge and skills needed for safe and efficient operations.

**Power System Operation Certification:** NPTI has been conducting Certification of Power System Operators since 2011. Training Courses at NPTI, Corporate Office, Faridabad, Power System Training Institute (PSTI), Bengaluru and NPTI (NER), Guwahati are equipped with necessary inputs to take up the various System Operation Certification Examinations.

**Simulator Training:** Simulators at various locations are housed in an existing Simulator Training Centre with classrooms and other infrastructure facilities for a full-fledged training activity. The simulator design includes equipment, instrumentation and controls that enable the operator to function in all modules with optimal specified operation conditions including normal, abnormal or emergency operating conditions.

**Skill Development:** NPTI plays a vital role in the National Skills Qualification Framework (NSQF), providing training programs aligned with industry needs.

**Foundation Programme:** NPTI offers a unique three-week foundation programme that imparts interdisciplinary

knowledge of power generation, transmission, distribution, renewable energy, and energy transition.

**Revamped Distribution Sector Scheme (RDSS):** NPTI collaborates with RDSS to enhance operational efficiency and sustainability in the distribution sector through training programmes.

**Mission SAMARTH:** NPTI has conducted more than 32 training programmes for farmers, pellet manufacturers and thermal power plant officials and have trained more than 3,500 personnel under National Mission on use of Biomass in Thermal Power Plants (SAMARTH).

**Cyber Security:** As per Article-8 of the CEA (Cyber Security in Power Sector) Guidelines, 2021, National Power Training Institute in consultation with CEA has identified and designed domain specific courses on Cyber Security for different target groups in Power Industry. NPTI is organising classroom training programmes along with Hands-On Training programmes for personnel having authorised cyber or authorised physical access (unescorted or escorted) to their critical systems.

As cyberattacks are growing in volume and complexity, preparing young professionals to protect systems, networks and programs from digital attacks has become all the more important. National Power Training Institute along with Whizhack is also running India's First Experiential Post Graduate Diploma in Cyber Security (PGDCS) Program, which is of six-months; duration. A course worth 480 hours of content with access to virtual labs with cyber attack and defence simulated projects has been prepared. The course is well designed and experienced faculty will address the participants in live classes scheduled during the weekends.

**Mid-career Training Programme for IAS Officers:** The Phase III programme, introduced by the Government of India is the first in the series of the Mid-career Training Programme for IAS Officers. It is the first major training programme which officers attend after induction level training. It marks a key inflection point when an IAS officer makes a transition from field administration to higher level responsibilities as the Head of Department at the State level and Deputy Secretary / Director in the Government of India with the mandate to ensure qualitative improvement in delivery of services in the larger context.

**Multi-functional stimulator at National Power Training Institute, Faridabad**

NPTI conducted the 'ENERGY' module of one week duration, out of the total four weeks' training programme. A wide range of topics covering the generation, transmission and distribution sectors were presented to the participants. New and emerging technologies in the power sector were also introduced.

## UPCOMING INITIATIVES AT NPTI

### LEARNING MANAGEMENT SYSTEM (LMS)

As part of the Digital India programme initiated by the Government of India, NPTI is getting its own Learning Management System developed. LMS provides access to information anytime, anywhere, so that trainees can get access to study material from anywhere and at any time as centralised information consolidated in one location, online and blended learning solutions which facilitate and improve upon traditional educational methods.

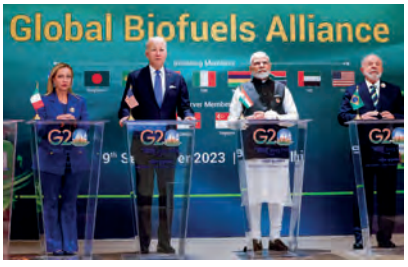
LMS can also save organisation's time and money by allowing easy administration of information in a user-friendly, web-based environment and also automate administration, tracking and reporting of training events. Initially NPTI is planning to float courses on Basic Course on Cyber Security, Specialised Course on Cyber Security, SCADA & Substation Automation, and Regulatory Issues in Power Sector on the LMS which later on will have more courses on newer technologies in the Power Sector.

### NATIONAL SCADA RESOURCE CENTRE (NSRC)

The Ministry of Power (MoP) launched the Distribution Sector Scheme (RDSS) in July 2021. Apart from its twin objectives related to distribution infrastructure and institutional capacity building for DISCOMS, the scheme also envisages the establishment of SCADA/DMS in 100 towns and basic SCADA in 3,875 towns. Accordingly, a state-of-the-art National SCADA Resource Centre (NSRC) is being established at NPTI in association with Power Finance Corporation Limited (PFC) to provide hands-on training on vendor-neutral platforms on upcoming distribution SCADA in various DISCOMS across India. NSRC will do the handholding of DISCOMS for the adoption of new technologies and it will also serve as a platform for knowledge exchange and peer-to-peer learning.

## PM Modi announces Global Biofuel Alliance at G20 Summit

Both G20 members and non-member nations have consented to join the Global Biofuel Alliance, making a total of 19 nations and 12 international bodies. The alliance's original members are the US, Brazil and India. Argentina, Canada, Italy, South Africa, and Brazil are the additional G20 members who are backing the proposal. About 85% of the world's production and 81% of its consumption of ethanol is contributed by the three founding members of the alliance. Oil producers such as Saudi Arabia, Russia and China have chosen not to join the alliance, though.




**From right: Leaders of Brazil, India and the US, the original members of Global Biofuel Alliance**

## Samudrayaan: Three-member team to explore ocean

Following the Chandrayaan mission, India is currently getting ready for the Samudrayaan project, which would send three people in a submersible to a depth of 6,000 metres, to explore the deep oceans and their riches. Union Minister of Earth Sciences Kiren Rijiju provided information about the Samudrayaan mission in a written response to a question in the Rajya Sabha. Samudrayaan is intended to research deep ocean resources and carry out biodiversity analyses. The submersible project will only be used to investigate biodiversity while preserving the health of the marine ecosystem.

**The Samudrayaan submersible**

## How Earth helped Moon in getting water

According to a recent study performed by planetary scientist Shuai Li of the University of Hawaii at Manoa, Earth may have assisted the Moon in obtaining water. High energy electrons in the Earth's plasma sheet may be helping to produce water on the Moon's surface, according to data from India's Chandrayaan-1 spacecraft. The study may offer essential details on how the Moon formed and evolved as well as prospective resources for further human exploration. High energy electrons are known to exist in the Earth's plasma sheet, a region of the magnetosphere loaded with trapped charged particles.

**A study by the University of Hawaii suggests source of moon's water**

## South Korea's Danuri captures ISRO's Vikram on Moon

The South Korean lunar orbiter Danuri has successfully captured ISRO's Vikram lander, while sleeping on the Moon's surface. Images depict the Shiv Shakti point, the landing site of India's Chandrayaan-3 lunar lander. The pictures were taken from an orbit about 100 km above the moon's surface and released by the South Korean space agency, the Korea Aerospace Research Institute (KARI). South Korea's ministry of science announced that the iamges were taken on August 27. This comes days after NASA too released an image of Vikram on the moon taken by its orbiter.

## First test vehicle mission for Gaganyaan in two months

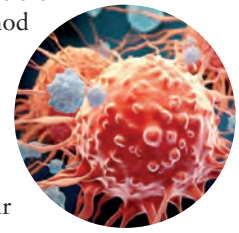
Gaganyaan, India's ambitious first human spaceflight project, will fly its first test vehicle trip to verify the crew escape system in about two months.

**Preparations for India's first human spaceflight project are in full swing**

It would be the first of the Gaganyaan programme's four abort missions. The second test vehicle mission, TV-D2, and the first unmanned mission of Gaganyaan (LVM3-G1) would come after the first test vehicle flight, TV-D1. The next missions are the LVM3-G2 mission with a robotic payload and the second set of test vehicle missions (TV-D3 and D4). The successful test vehicle and uncrewed missions have served as the basis for the crewed mission's planning.

## New approach to detect, kill cancer cells

Researchers at the Indian Institute of Science (IISc) have created a novel method that may be used to identify and eradicate cancer cells, particularly those that form solid tumour masses. IISc has developed hybrid copper sulphide and gold nanoparticles that may heat-kill cancer cells and enable their detection using sound waves. The IISc, situated in Bengaluru, stated in a statement that early detection and treatment are essential in the fight against cancer.



**A study by IISc has created a method to tackle cancer cells**

All Images Courtesy: Internet

## Pig kidney works 2 months in donated body

Media sources state that a pig's kidney that was implanted into a brain-dead individual functioned normally for two months. The NYU Langone Health trial has raised hope for human-animal transplants. The research team removed the pig's kidney

All Images Courtesy: Internet

**Pig kidney was implanted at NYU Langone Health in New York city**

to conclude their work under the direction of transplant surgeon Dr Robert Montgomery. In terms of how long a modified pig kidney has ever operated within a human body, this experiment set a record. The team has gained some very important insights, and they are hopeful that one day they will be able to conduct tests on living patients.

## $2.7 tn annually for net zero emissions by 2050

A recent analysis stated that in order to reach net zero emissions by 2050 and keep global temperatures from increasing above 1.5 degrees Celsius this century, an annual global investment of $2.7 trillion is needed. This

**Annual global investment of $2.7 tn is required to reach net zero emissions**

is despite the fact that the globe is still dealing with the effects of extreme weather events and climate change. The current $1.9 trillion per year investment required to decarbonise the energy sector is increased by 150% in this calculation. It is believed that limiting global warming to 1.5°C will be essential to preventing catastrophic climate change effects.

## Mysterious non-human-like fossils spark debate

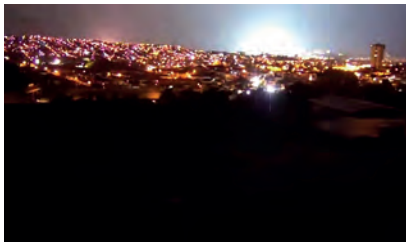
Do aliens exist? Authorities allegedly released the bodies of two 'non-human' people for exhibit during a congressional session in Mexico City, reigniting the question. Journalist

**1000-year-old bodies of two 'non-humans' were recently revealed in Mexico City**

Jaime Maussan revealed the remains. According to media reports, the 'alien' bodies were 1,000 years old. These specimens are not a part of our earthly evolution, Maussan said. These creatures weren't discovered following a UFO wreckage. They were discovered in diatom mines and later fossilised.

## Mysterious lights in sky before Morocco quake

On September 8, a terrible 6.8-magnitude earthquake that shook the High Atlas Mountains in Eastern Morocco killed at least 2,900 people and injured almost 5,500 more. But both experts and the general people are interested in a fascinating phenomenon that happened before the earthquake. Videos



**On September 8, a 6.8 magnitude earthquake shook eastern Morocco**

that have gone viral on social media purport to show bright lights shooting across the sky before the earthquake, which are thought to be strange aerial phenomena called 'earthquake lights'.

## NASA astronaut breaks US record for longest spaceflight

Frank Rubio, a NASA astronaut, has achieved history by establishing a new mark for the lengthiest US spaceflight. On September 11, 2023, Rubio broke the previous US record for space endurance, which stood at 355 days. He did this while travelling on the International Space Station (ISS). In September 2022, Rubio and two Russian cosmonauts arrived aboard the International Space Station (ISS) for

**NASA astronaut Frank Rubio has spent 370 days in space**

what was first intended to be a routine six-month assignment. When their Soyuz capsule experienced a coolant leak while parked at the space station, their time there was unexpectedly prolonged.

## Golden ball at the bottom of sea

A fascinating golden orb was discovered by marine biologists during a recent excursion off the Pacific coast of Alaska, piquing the interest of the scientific community. The discovery was made during the current Seascape Alaska 5 mission of the National Oceanic and Atmospheric Administration (NOAA). Due to its unusual properties, the golden orb, which was discovered about three kilometres beneath the ocean's surface, has baffled scientists. The object is smooth and rounded, and it resembles something biological.

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# Early Detection of Hepatitis C Infections

The HCV DUO test can detect Hepatitis C infections up to 22 days earlier compared to traditional antibody tests

■ **Science India Bureau**

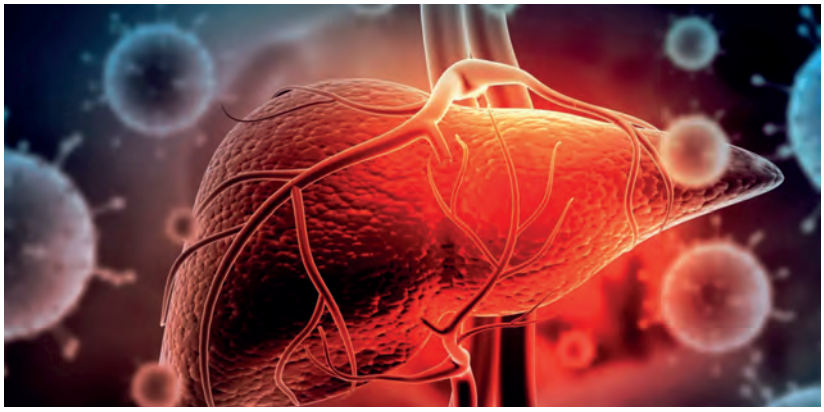

Image Courtesy: IISER Bhopal

The hepatitis C virus (HCV) is a bloodborne pathogen, and the majority of infections result through contact with blood from unsafe injection techniques, hazardous medical procedures, unscreened blood transfusions, injectable drug usage, and sexual behaviours that expose one to blood.

Around 1.5 million new HCV cases are reported each year globally, with an estimated 58 million people worldwide carrying the infection. According to estimates, 3.2 million children and adolescents worldwide have chronic hepatitis C infection. According to the WHO, 2,90,000 people died from hepatitis C in 2019 in the world, primarily due to cirrhosis and hepatocellular carcinoma (primary liver cancer).

By 2030, WHO hopes to eliminate hepatitis C as a danger to public health by reducing new infections by 90% and fatalities by 65%. Nevertheless, despite advancements, only 21% of people with chronic HCV infection are aware of their condition. According to an evaluation, almost 70% of those with HCV infection will experience chronic HCV infection, which, if ignored, can result in liver cirrhosis and malignancy.

For prompt therapy and to lower the risk of HCV transmission through body fluids, early and accurate HCV identification is crucial.

Dr Dangs Lab has announced the introduction of the cutting-edge HCV DUO test, marking a significant advancement in the fight against Hepatitis C in India. This innovative diagnostic method, according to a statement by the lab, can identify hepatitis C infections up to three weeks sooner than conventional HCV antibody testing.

The HCV DUO test was developed by Dr Arjun Dang, CEO and a partner at Dr Dangs Lab and a specialist in GI and Liver Pathology.

"Our goal has always been to introduce cutting-edge diagnostic tools to empower physicians and add value to our patients' care continuum. The introduction of the HCV DUO test in India is a step in that direction, enabling timely detection and preventing transmission of Hepatitis C," said Dr Dang.

More people will be able to benefit from earlier diagnoses after the availability of the HCV DUO test across Delhi-NCR. This ground-breaking test will also empower patients and doctors in the fight against hepatitis C by enabling prompt management and treatment decisions.

Additionally, this diagnostic instrument combines the simultaneous detection of hepatitis C antibodies (Ab) and antigen (Ag) from a patient's blood sample, according to the press release.

In contrast to existing combination assays that only display a combined result, the HCV Duo immunoassay is the first test to provide parallel but distinct read-outs of HCV-Ag and HCV-Ab findings.

The statement went on to say that the assay has potential as a first-line diagnostic and screening test for HCV infection in clinical laboratories and as a screening tool for blood products in blood donation centres. Additionally, a final HCV Duo result is calculated equal to the highest cut-off index value of the sub-results (HCV-Ag & HCV-Ab), it added.

In particular for at-risk individuals, an early detection of the illness is essential for effectively preventing virus transmission and enabling quick and efficient treatment. However, due to the lack of distinct clinical signs, acute HCV infections are difficult to detect.

Additionally, the diagnostic window period, during which antibodies are not yet detectable, is sometimes longer for conventional screening techniques that simply rely on testing for antiviral antibodies. Early diagnosis and action are hampered by this constraint.

According to the press release, the HCV DUO test can identify hepatitis C infections up to 22 days sooner than conventional antibody testing.

# QUIZ

**1. When does India celebrate the National Engineers' Day?**
A. 5 September
B. 15 September
C. 25 September
D. 30 September

**2. India celebrates National Engineers' Day to commemorate the birth anniversary of which of the following personalities?**
A. Dr Homi J Bhabha
B. Dr Vikram Sarabhai
C. Sir Mokshgundam Visvesvaraya
D. Dr APJ Abdul Kalam

**3. The World Engineering Day for Sustainable Development (WED) is an official international day proclaimed in 2019 by the United Nations Educational Scientific and Cultural Organisation (UNESCO). When is it celebrated?**
A. 4 March
B. 14 April
C. 10 May
D. 5 June

**4. On which river, M Visvesvaraya contributed to the building of the famous Krishnaraja Sagar (KRS) Dam?**
A. Kaveri
B. Godavari
C. Krishna
D. Yamuna

**5. Besides being a civil engineer of great repute, M Visvesvaraya was also the Diwan of which state in pre-independent India?**
A. Hyderabad
B. Travancore
C. Kapurthala
D. Mysore

**6. What is the distance that the spacecraft of the Aditya-L1 mission travels from the Earth to reach its destination?**
A. 3.5 million kms
B. 4.5 million kms
C. 2.1 million kms
D. 1.5 million kms

**7. ECG Sudarshan, born on September 16, challenged an established global scientist's theory that nothing with mass can travel faster than light. Name him.**
A. Ernest Rutherford
B. Albert Einstein
C. Max Planck
D. J. Robert Oppenheimer

**8. The longest bridge over water in India, named after Dr Bhupen Hazarika, measures 9.15 kms in length. It is also known as:**
A. Bogibeel Bridge
B. Digha-Sonpur Bridge
C. Dhola-Sadiya Bridge
D. Dibang River Bridge

**9. The first vaccine was developed in 1796 by Edward Jenner against which of the following diseases?**
A. Cowpox
B. Smallpox
C. Chickenpox
D. All of the above

**10. At present, there are 9 countries in the world with nuclear weapons. Which of the following is not one of them?**
A. Israel
B. North Korea
C. France
D. Japan

# Solar Space Missions The World Over

**Parker Solar Probe (USA):** Launched by NASA in 2018, this mission studies the outer corona of the Sun.
**Solar and Heliospheric Observatory (SOHO, USA/European Space Agency):** Launched in 1995, this joint mission by NASA and the European Space Agency observes the Sun from a unique vantage point, studying its activity and its impact on space weather.
**STEREO (Solar Terrestrial Relations Observatory, USA):** Launched in 2006, this mission uses twin spacecrafts to provide a three-dimensional view of the Sun and its solar phenomena.
**Solar Orbiter (ESA/NASA):** Launched in 2020, this joint mission by the European Space Agency and NASA studies the Sun's polar regions and understand its magnetic field.
**Hinode (Japan/USA/UK):** Launched in 2006, this mission by the Japan Aerospace Exploration Agency (JAXA), NASA and the UK Space Agency studies the Sun's magnetic fields.
**Yohkoh (Japan/USA/UK):** Launched in 1991 by ISAS (now part of JAXA) in collaboration with NASA and the UK's Particle Physics and Astronomy Research Council (PPARC), this mission observed the Sun in X-rays.
**Proba-2 (Belgium):** Launched by ESA in 2009, this satellite studies the Sun's atmosphere and surface.
**Coronas-Photon (Russia):** Launched by the Russian Federal Space Agency (Roscosmos) in 2009.
**SMILE (Solar wind Magnetosphere Ionosphere Link Explorer) (China/European Space Agency):** An upcoming collaborative mission between the Chinese Academy of Sciences and ESA, it is focuses on interaction between solar wind and Earth's magnetosphere.
**Helios-A and Helios-B** (after launch renamed Helios 1 and Helios 2) are a pair of probes that were launched as a joint venture between German Aerospace Center (DLR) and NASA, on December 10, 1974, and January 15, 1976, respectively.

**Answers**: 1 (B); 2 (C); 3 (A); 4 (A); 5 (D); 6 (D); 7 (B); 8 (C); 9 (B); 10 (D)

# Satish Dhawan

## (25 September 1920 – 3 January 2002)


Image Courtesy: ISRO

***"When I failed, Satish Dhawan did the press conference and when I succeeded, he asked me do it. When the failure occured, the leader took it up and when the success came, he gave it to his team."***

***— Dr APJ Abdul Kalam,***
***former President of India***
***and renowned scientist,***
***also known as 'Missile Man of India'***

September
2023

# Celebrating Science This Month

**SEPTEMBER 1**
National Nutrition Week is observed from 1-7 September to spread knowledge about the importance of nutrition for human body.

Shankar Purushottam Agharkar, the founder and first director of the Maharashtra Association for the Cultivation of Science (MACS), passed away in 1960.

**SEPTEMBER 3**
Rajeshwari Chatterjee, Indian scientist, academic, and first woman engineer from Karnataka, passed away in 2010.

**SEPTEMBER 4**
Balu Sankaran, orthopaedic surgeon, professor and scientist, was born in 1926. He helped establish the Artificial Limbs Manufacturing Corporation of India, Kanpur.

**SEPTEMBER 5**
Celebrated as Teacher's Day since 1962, marking the birth anniversary of India's second president, Dr Sarvepalli Radhakrishnan.

The University of Madras was established in 1857.

**SEPTEMBER 8**
International Literacy Day and World Physical Therapy Day.

**SEPTEMBER 10**
The Institute of Palaeobotany was established in 1946 with Prof Birbal Sahni as its first director in honorary capacity.

**SEPTEMBER 12**
KALPANA-1, the first dedicated meteorological satellite launched by ISRO using PSLV, was launched in 2002.

**SEPTEMBER 14**
Hakim Abdul Hameed, a renowned physician of the Unani system of traditional medicine and founder chancellor of Jamia Hamdard, was born in 1908.

In 2012, Jagadis Chandra Bose's experimental work in millimetre-band radio, and work of Sir CV Raman on scattering of photons, were awarded the IEEE Milestone in Electrical and Computer Engineering.

Benjamin Peary Pal, the first DG of Indian Council of Agricultural Research and the director of Indian Agricultural Research Institute, passed away in 1989.

**SEPTEMBER 15**
Sir Mokshagundam Visvesvaraya was born in 1860. He was the Chief Engineer of Krishna Raja Sagara dam in Mysore. In his memory, this day is celebrated as Engineers' Day.

**SEPTEMBER 16**
International Day for the Preservation of the Ozone Layer is observed every year since 2000.

**SEPTEMBER 20**
The first dedicated 'Educational Satellite', GSAT-3, also known as EDUSAT, was launched by GSLV-F01 in 2004. .

Indian nuclear scientist Sekhar Basu was born in 1952. He served as Director of Bhabha Atomic Research Centre (BARC) and Project Director of Nuclear Submarine Programme.

**SEPTEMBER 21**
World Alzheimer's Day.

**SEPTEMBER 23**
Asima Chatterjee, the first Indian woman to receive a Doctorate of Science from an Indian University, was born in 1917.

**SEPTEMBER 24**
Raja Ramanna, known for operations Smiling Buddha and Shakti (nuclear tests of 1974 and 1998 respectively), passed away in 2004.

Nuclear scientist Sekhar Basu passed away in 2020.

**SEPTEMBER 25**
Girjesh Govil, molecular biophysicist known for his researches on semi-empirical quantum chemical theories, was born in 1940.

Satish Dhawan, mathematician and aerospace engineer, regarded as the father of experimental fluid dynamics research in India, was born in 1920. He was the third chairman of ISRO.

**SEPTEMBER 26**
The Council of Scientific and Industrial Research (CSIR) was established in 1942 as an autonomous body.

**SEPTEMBER 27**
Shiyali Ramamrita Ranganathan, the father of library science, documentation and information science in India, passed away in 1972. His birthday, August 12, is celebrated as the National Library Day every year.

TR Seshadri, chemist, academic, writer and the Head of the Department of Chemistry at Delhi University, passed away in 1975.

**SEPTEMBER 28**
ISRO's latest communication satellite, INSAT-3E was launched by Ariane5-V162 in 2003 from French Guyana.

Sunil Kumar Verma, biologist and principal scientist at the Centre for Cellular and Molecular Biology, Hyderabad, was born in 1974.

World Rabies Day.

**SEPTEMBER 29**
World Heart Day.

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WORLD AYURVEDA FOUNDATION
AN INITIATIVE OF VIJNANA BHARATI

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EAGA European Ayurveda Graduates Association

GLOBAL AYUSH FORUM

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GHF Global Homeopathy Foundation

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- Environmental impact assessment
- CFD/DEM modelling and simulation

Constructed wetland for waste water treatment

XPS

Particle Size Analyzer

## INDUSTRY INTERFACE

- Technology development for mineral, material, metallurgical and chemical industries
- Contract research and consultancy for process optimization
- TEFR and Basic engineering packages in core area
- Testing of water quality and components in ores, rocks, soils, slags, and processed products
- Skill development

High Concentration Slurry Transportation

CNC Turning & Milling Machines

## FACILITIES

- Mineral processing pilot plant
- SOPs for extraction of materials from industrial wastes
- Coal characterization
- Processing of natural gemstones for value addition
- State-of-the art analytical equipments for characterization of ores, minerals & materials
- Commercial scale production facility for fly ash and red mud building materials
- Mechanical workshop for design and fabrication
- Biomass operated cook stoves and testing lab
- Technology validation

Fly Ash & Red Mud Bricks

EPMA

XRD

Plasma Spray Coating

Column Flotation Unit

Hydrogen Plasma Reactor

TEM

X-ray Micro CT

Microwave Plasma Reactor

Scanning Electron Microscope

## CONTACT US

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