



**KCSA**



# **Kalpana Chawla Space Academy**

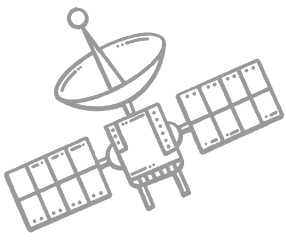
## **SPACE SPECTRUM**



**e-newsletter**

December 2024





# Foreword

Greetings to everyone reading the KCSA Space Spectrum,

It brings us immense pleasure to announce the launch of the first edition of KCSA's e-newsletter in November 2024. We aim to present a collection of scientific articles that explore diverse dimensions of science, technology, and space science.

*\*The views expressed by the authors in their articles are solely their own.*



# Aim

To theorize, sight see, augment knowledge baskets with literary work on science, technology and space science in form of e-newsletter among budding scientists, parents, researchers, academicians and industrial practitioners.



# Purpose

- To provide engaging content that educates readers about current space science topics, discoveries, and innovations, fostering a greater understanding of the universe.
- To inspire and equip readers for careers in space science, helping them navigate educational and professional pathways.
- To foster connections among KCSA members and the wider community by sharing stories, events, and achievements, while inspiring engagement in space-related activities and discussions.



# Space Spectrum




The KCSA e-newsletter, Space Spectrum, serves as a vibrant hub for all things related to space science. Designed to educate and inspire, it delivers the latest updates, discoveries, and research from the cosmos. Each issue offers in-depth articles that break down complex topics into digestible insights, making the wonders of the universe accessible to everyone.

Space Spectrum fosters a strong sense of community among KCSA members, spotlighting individual achievements and collaborative projects. Readers can share their stories, engage in discussions, and contribute their own articles, enhancing the collective knowledge and experience.

In addition to educational content, the newsletter highlights upcoming events, from workshops and lectures to hands-on activities. Members are encouraged to participate, fostering connections and promoting a culture of learning and exploration.

The newsletter also features a dedicated section for career opportunities, offering guidance for aspiring space scientists. With profiles of professionals in the field, readers gain valuable insights into potential career paths and networking tips.

Overall, Space Spectrum is not just an e-newsletter; it's a dynamic platform that nurtures curiosity among young minds, builds community, and celebrates the endless possibilities of space science. Join us in exploring the universe, one edition at a time!



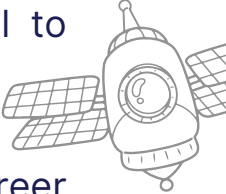
# Editorial Desk




Welcome to the inaugural edition of Space Spectrum, KCSA's e-newsletter created to connect our community with the fascinating world of space science. Our mission is to inform, engage, and inspire by sharing the latest advancements in science, technology, and space exploration.

Each edition will cover a wide range of topics, from groundbreaking discoveries to insights from leading scientists, simplifying complex ideas for everyone to enjoy. We believe that exploring the universe should be accessible to all, and this newsletter is designed to ignite that curiosity.

Space Spectrum is also a platform for our community. We encourage you to share your experiences, projects, and questions, fostering vibrant discussions among members. Your contributions are vital to shaping our content.



Additionally, we'll feature updates on events, workshops, and career opportunities to keep you connected and informed. This newsletter aims to be a hub for growth, learning, and collaboration.



Join us in celebrating the wonders of space science and the remarkable efforts within KCSA. Together, let's explore, learn, and inspire the next generation of space enthusiasts.

Thank you for being part of our journey. We look forward to your insights and contributions in future editions of Space Spectrum. Happy reading!

**Editor**  
**Dr. Pushpendu Rakshit**  
**Program Director, KCSA**



# There's Law Up There?

**P.J. Blount, J.D., Ph.D.**

**Assistant Professor of Space Law**

**Durham University, London Executive Secretary,**

**International Institute of Space Law**



When people are first presented with the notion of space law, often, their immediate response is one of revelation. It has not occurred to most people that a legal framework governs activities in space. Most people soon realize that it is quite natural that the law would extend into a space as a place of human interaction. Indeed, Earth orbit is full of high valued, multinational corporate assets and operators want the predictability provided by law to manage risk to these assets.

Nevertheless, a repeated trope about space is that it is like the “Wild West,” a reference to the notoriously lawless American West and the cowboy gangs led by mythic figures like Billy the Kid. Space as a Wild West is intended to frame space as an anarchic anything goes domain.

Space has law. In the 1960s and 1970s, the international community adopted a series of treaties to guide states in their activities and the activities of their non-governmental actors. In addition, numerous nations have adopted a wide variety of national space laws, many of which govern the authorization of private actors in space. Notably, India has not yet joined these ranks. Space is full of laws and regulations.

Yet there might be some truth to the Wild West analogy. The American West was not truly lawless, but it was a lot easier to be a bad guy there when sheriffs were in short supply. As a patchwork of settlements, there were severe enforcement problems in the West. Space may be similar, international law often lacks clear enforcement mechanisms and is notoriously incomplete. Like space, space law is full of voids.

Despite this, the space law framework has been able to provide stability to the space domain for approaching 70 years. As technology changes there will be a need for the law to continue to develop and fill gaps and adapt to new situations, but there is a strong legal framework for any such project to build on.

# Space Miners: The Quest for Cosmic Riches



**Dr. Sonam V. Sancheti Advanced Scientist,  
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Space is one of the most mesmerizing, full of resources, and mysterious fields human beings have ever explored. Can precious materials/metals be found in space beyond Earth? This very question sparked the development of projects aimed at extracting valuable materials from space. It was this quest that gave rise to the concept of space mining. Space mining is quickly emerging as an exciting opportunity for resource extraction and economic development beyond our planet. It is well known that many asteroids are residues or remnants of early-solar systems and some of them are reservoirs of high amounts of valuable metals. Metallic asteroids are rich in Nickel, Iron, and precious metals. NASA's OSIRIS-REx mission focuses on exploring asteroids like Bennu, while companies such as Planetary Resources and Asteroid Mining Corporation are also advancing efforts in asteroid mining. With private companies driving the next phase of space exploration, SpaceX is at the forefront of this expanding industry. The company's cutting-edge technology and reusable rockets make it a strong contender to lead future space mining efforts. Other space mining companies include; Karman+ with developing technology in mining water from the asteroids near the earth; AstroForge goals to minerals from asteroids; Origin Space developed a robot for asteroid mining and removal of space garbage and companies such as TransAstra, Asteroid Mining Corporation, among others.

It is estimated that the resources from a single asteroid could be worth nearly \$200 billion. In addition, some asteroids and the Moon contain water, while the Moon holds both water and a valuable isotope called Helium-3 ( $^3\text{He}$ ), which could potentially fuel nuclear fusion reactors. Helium has nine isotopes, out of which only  $^3\text{He}$  and  $^4\text{He}$  are stable. Nuclear fusion powered by helium-3 has long been considered a promising potential energy source for the future. In this context, one of the emerging space mining companies has prioritized helium-3 extraction from the Moon as a key goal.

In conclusion, a quest for cosmic riches by space mining is an exciting new frontier with the potential to transform resource extraction, support future space exploration, and address Earth's increasing resource needs. As technology evolves and both private companies and space agencies continue to push the limits of what's achievable, mining asteroids and the Moon could mark a new era of innovation, economic opportunity, and sustainability for humanity beyond our planet.

# The Need for STEAM Education in India: Empowering Future Generations

**Dr. Pushpendu Rakshit**  
**Program Director, KCSA**  
**Mumbai, India**



India, a country with a rich history of intellectual contributions and cultural diversity, is now at a crossroads where the educational system needs to adapt to the demands of the modern world. The global job market is increasingly relying on skills in science, technology, engineering, arts/architecture, and mathematics (STEAM). Yet, despite India's impressive strides in fields such as information technology and space exploration, the country faces significant challenges in fully integrating STEAM education into its school curricula.

STEAM education is a powerful tool for fostering creativity, critical thinking, and problem-solving abilities. This article explores why STEAM education is vital for India's future in space education and how it can address the nation's evolving educational and economic needs.

## Bridging the Skills Gap

India has one of the youngest populations in the world, with nearly 50% of its population under the age of 25. This demographic offers a significant opportunity for growth if equipped with the right skills. However, there is a widening gap between the skills that the current education system imparts and the ones required by modern industries. According to reports, a large portion of India's youth remains unemployable due to a lack of critical thinking, creativity, and practical skills.

KCSA addresses this gap by offering an interdisciplinary framework that promotes problem-solving, experiential and hands-on learning. By introducing students to real-world challenges through STEAM in space education, India can create a workforce ready to tackle the problems of tomorrow, whether it's in science, technology, space science and social innovation.





# Encouraging Innovation and Creativity


While STEM education (Science, Technology, Engineering, and Mathematics) focuses on technical knowledge and skills, STEAM goes a step further by integrating the arts/architecture. This inclusion of the arts is crucial for developing well-rounded individuals who can think creatively and approach challenges from multiple perspectives. In a rapidly changing world, innovation often stems from the intersection of technical expertise and creative thinking.

STEAM fosters curiosity, imagination, and the ability to think outside the box—qualities essential for breakthroughs in various fields. Whether it's designing user-friendly software, creating sustainable infrastructure, or developing cutting-edge medical solutions, the marriage of technical skills with creativity can lead to transformative solutions. For instance, India's burgeoning start up ecosystem thrives on the innovative fusion of technology and creativity. At KCSA we recognize the importance of these cross-disciplinary skills to nurture the next generation of space entrepreneurs, space engineers, and space scientists.

## Preparing for the Future Job Market

The future of work is already here, and it's changing rapidly. Automation, artificial intelligence (AI), robotics, sensors and data science are just a few of the areas where the job market is expanding. According to a report by the World Economic Forum, automation could displace millions of jobs in India by 2030, but it will also create new opportunities in sectors like space sciences, space engineering, renewable energy and space technology.

STEAM education equips students with the skills needed to excel in these emerging fields. By incorporating technology and engineering alongside traditional subjects, students are better prepared to understand and work with new technologies. Furthermore, STEAM promotes adaptability and a growth mind set—traits that are indispensable in an era of constant technological disruption.





# Integrating Local and Global Perspectives

By connecting local traditions with global advancements, STEAM education can create solutions that are contextually relevant, culturally sensitive, and globally competitive. It can also encourage students to think globally and act locally, fostering a sense of responsibility and awareness towards pressing global challenges like climate change and inequality.


## Policy and Infrastructure Support

For India to fully embrace STEAM education, there needs to be a concerted effort to reform the educational system. The Indian government has already taken steps in this direction, such as the introduction of initiatives like Atal Tinkering Labs and PM eVIDYA for digital learning, which aim to promote innovation and creativity among young minds.

To further accelerate the adoption of STEAM education, there should be a focus on training teachers, upgrading educational resources, and fostering industry-academia collaborations.

The need for STEAM education in India is clear. As the country stands on the threshold of technological and economic transformation, it is imperative that the next generation is not only well-versed in technical subjects but also capable of thinking creatively and innovatively. The integration of the arts with STEM education will create individuals who are not only skilled professionals but also well-rounded problem-solvers capable of addressing the complex challenges of the future.

For India to maintain its position as a global leader, it must prioritize STEAM education across all levels of learning. By empowering young minds with the skills, knowledge, and creativity to succeed in an ever-evolving world, India can unlock its full potential, driving innovation and progress for generations to come.



# Another Indonesian Volcano is awake

**Kusala Rajendran**

**Professor (retired) Centre for Earth Sciences;  
Indian Institute of Science, Bengaluru, India**



Lewotobi Laki-laki, a volcano on the Indonesian island of Flores, erupted violently on November 4 this year, damaging more than 2000 houses, affecting around 10,000 residents and killing ten people. The explosion sent hot ash to about 2 km into the sky and spread in areas of over 6 kilometres from the volcano. It disrupted air travel for many days. The volcano, quiet for twenty years, had been active since December 2023. Since January 2024, it erupted nearly 900 times, according to Indonesia's Center for Volcanology and Geological Disaster Mitigation. This level of activity enabled an early warning and evacuation that minimized the impact of the larger explosion.



**Mount Lewotobi Laki Laki is seen unleashing large clouds of smoke in Indonesia on November 7, 2024 (AP Photo).**

Eruptions are not new to Indonesia, one of the most volcanically active nations in the world, with around 130 active volcanoes. Volcanoes occur in certain regions of the earth because of plate tectonics. According to this theory, the top 100-km-thick layer of the earth known as the lithosphere form plates that are moving at a very slow rate of a few centimetres each year. The plates collide with one another or move apart, and their boundaries are the most geologically active regions on the earth. These boundaries form mountain chains and rift valleys, and also form conduits through which hot, molten rocks from below to rise to the surface forming volcanoes. Thus, we find most volcanoes on the earth along the 'ring of fire', the boundary that the Pacific plate forms with countries like the Americas, Japan and Indonesia. It is interesting that the same plate boundaries are responsible for some of the largest earthquakes as well. With advances in science and technology, volcanic eruptions are predicted, and warnings are issued. This is because the processes leading to the final eruption can be monitored at the surface. But when it comes to earthquakes, the processes leading to the final event happens tens or even hundreds of kilometres below the surface, outside the realm of our direct observation. They lead to an earthquake without giving any characteristic warnings. On the other hand, the volcano emits smokes and gases create several earthquakes and sometimes even show a bulge as the magma starts to build up. There is only one active volcano on the Indian continent- it is the Barren Island that forms a part of the Andaman and Nicobar Islands. It was sleeping for a longtime, and most of us were not aware of its existence. It woke up after the great 2004 Indonesian earthquake, but the explosion was very small.

# Planetary conquest and Space exploration

**Dr. Prasenjit Ghose**  
**Professor, Indian Institute of Science (IISc),**  
**Bengaluru, India**



Gone are those days when we dream of reaching celestial bodies. Human pursuit to conquer space and space-bound objects attained considerable impetus with the advent of modern technology and scientific curiosity. The Habitability and settlement on celestial bodies and the search for exoplanets to host us in future are a new dimension of scientific endeavours. From Chandrayaan to Mangalyaan, Indian Space research made all plans to navigate the planetary world with both manned and unmanned. Indian researchers and technologists are at the forefront of space exploration, competing with giants like NASA, ESA and JAXA. ISRO has many successful stories and tales for young talents and aspirants. Landing and surveillance of the crater on the moon, discoveries of water, and the adventure to explore space are now a reality, not a dream.



# Space Science Education

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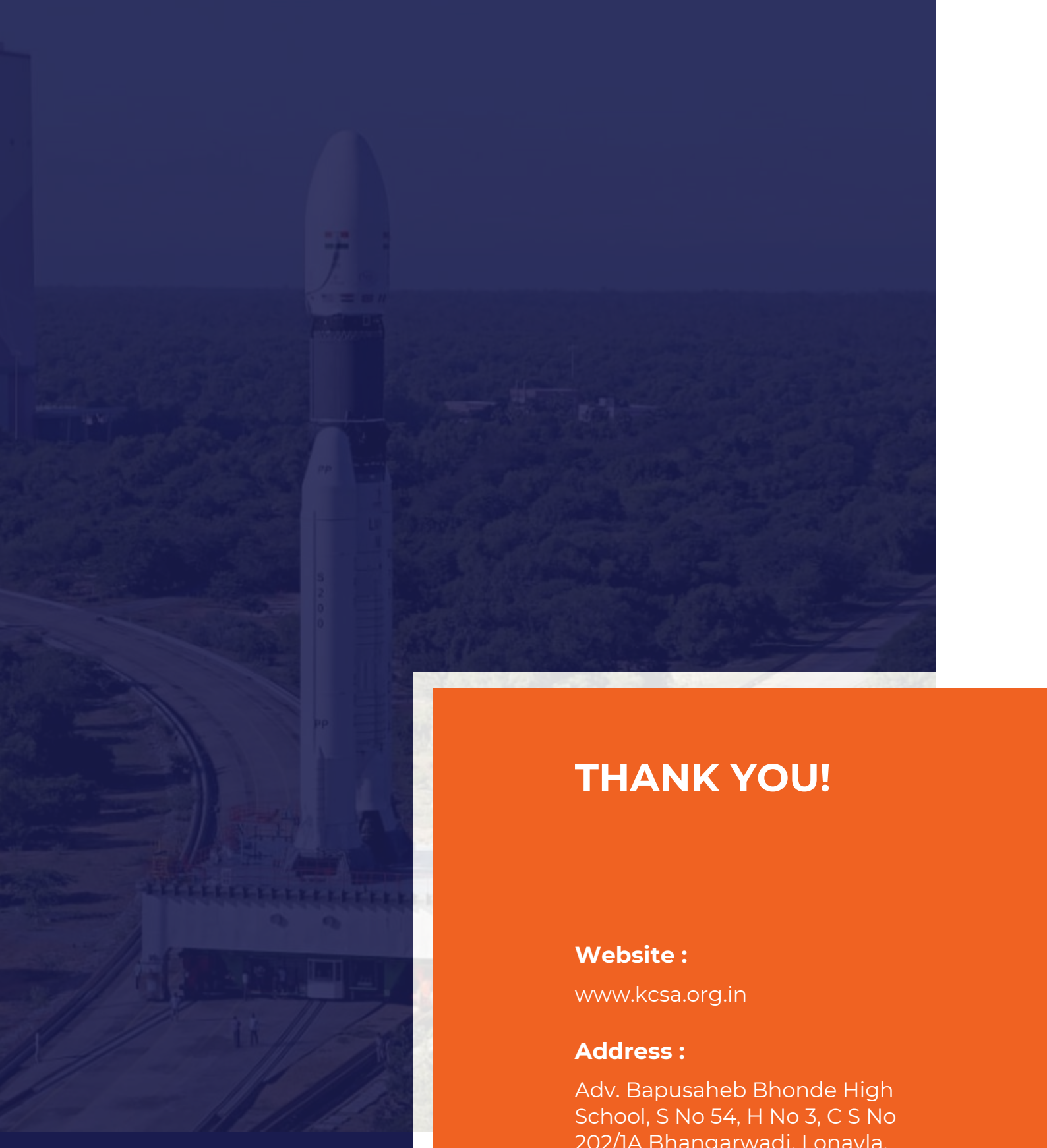
**Dr. Pushpendu Rakshit**  
**Program Director**  
**Kalpana Chawla Space Academy**



Space science education plays a crucial role in fostering a deeper understanding of the universe and humanity's place within it. From an early age, students are introduced to fundamental concepts through engaging curricula that explore topics such as astronomy, astrophysics, and planetary science. Hands-on activities, like building model rockets or simulating planetary orbits, spark curiosity and encourage critical thinking. Additionally, the integration of technology, such as virtual reality and simulations, enhances learning by allowing students to explore distant planets and galaxies.

The growing accessibility of online resources and educational platforms has made space science more approachable, enabling learners from diverse backgrounds to engage with cutting-edge research. Collaborative projects, such as citizen science initiatives, allow students to contribute to real scientific studies, fostering a sense of community and purpose. Interdisciplinary approaches further enrich space science education by integrating physics, mathematics, and even art to create a holistic learning environment.

Public outreach initiatives, such as science fairs and community workshops, demystify space science and make it accessible to everyone. In addressing global challenges like climate change and resource sustainability, understanding space science becomes vital. Ultimately, a robust space science education empowers students to think critically, innovate, and contribute to our collective knowledge of the universe. By nurturing curiosity and a passion for the cosmos, we can inspire the next generation of explorers and scientists to push the boundaries of human understanding.



**THANK YOU!**

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