WEEKLY FOCUS
#37 WEEK 3, APRIL 2021

VISIONIAS
INSPIRING INNOVATION

SPACE EXPLORATION

Changing Dynamics & Pathway To The Future

Introduction

Outer space has been considered as a part of **global commons since the 1960s.** With the **growing dependence** on outer space assets **for socioeconomic, developmental and military purposes,** the number of **players in outer space is growing rapidly.** Also, developments

such as anti-satellite weapons and offensive use of space assets have raised concerns about potential weaponization and militarization of space. Such developments may impact peaceful space exploration especially for nations like India, which has emerged as a major space-faring nation with notable accomplishments in its space programmes in domains of launch vehicles, space exploration, satellites etc.

In this backdrop, it becomes crucial to understand how the evolution of space exploration activities took place, Why is outer space considered a global common and why does it matter, How are outer space activities regulated, What are the emerging challenges in space exploration activities and their regulation, What are India's achievements and major concerns, How can India play a leadership role in shaping norms for outer space activities and What can be done to ensure that in future, humanity's development of space is less a race and more a peaceful march.

What is space exploration and how the evolution of space exploration activities took place?

Space exploration is the **use of astronomy** (using optical and radio telescopes to observe planetary phenomena) **and space technology** (unmanned robotic space probes such as satellites as well as manned missions such as human spaceflights) **to explore outer space.**

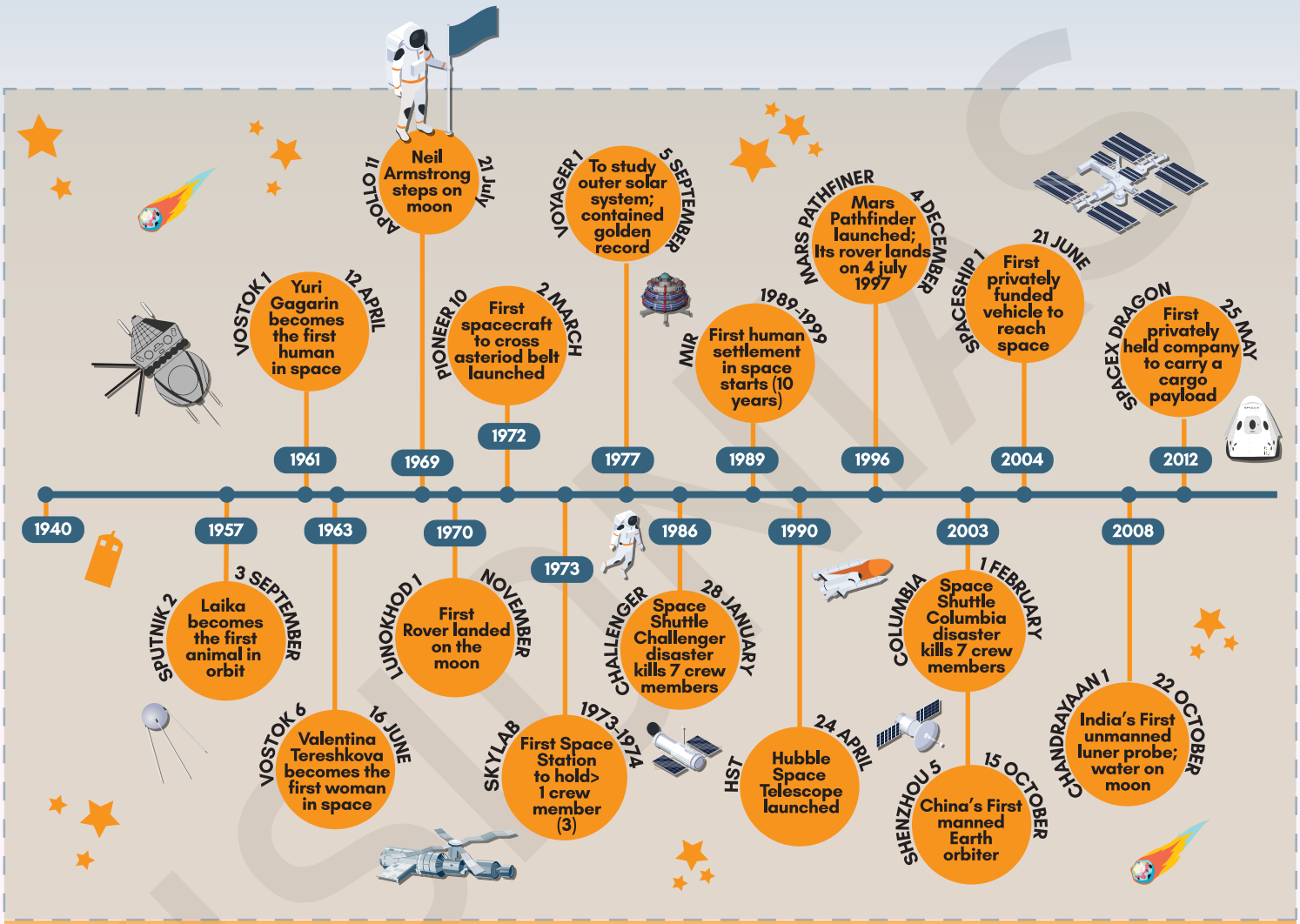
Space was explored as early as the 4th century BCE, through ancient astronomy when **Eudoxus,** an ancient Greek astronomer, designed his model of the universe. But it was only in the **twentieth-century that man sent out probes and himself to explore space.** Since then, it has traversed on following lines:

- **Space Race Era:**
  The early era of space exploration was driven by a Space Race (competition between the USSR and the US, to achieve superior spaceflight capability).
  - The launch of the first human-made object to orbit Earth, the **Soviet Union's Sputnik 1**, in 1957, and the first Moon landing by the **American Apollo 11 mission** in 1969 are often taken as **landmarks for this initial period.**
- **Entry of Other Players:**
  Later, **other developed countries** like **China, Japan, Canada,** some **European countries** and **India** too jumped in with high ambitions and expenditure.
- **Early Signs of Outer Space Being Treated as a Global Common:**
  After the first 20 years of exploration, focus shifted from one-off flights to renewable hardware, such as the **Space Shuttle program** (routine transportation of Earth-to-orbit crew and cargo), and from competition to cooperation.
- **Involvement of Private Sector:**
  Through majority of the 20th century, outer space was the sole preserve of national space programmes. However, with entry of private sector, the last decades of the 20th century, witnessed the emergence of new, **Second Space Age (Space 2.0)** based on the merger of cyber and physical systems.
  - Space 2.0 is witnessing a heightened interest in space exploration based on the canon of

commercialisation-industrialisation-democratisation.

- The **global space business is now estimated to be around $ 400 billion** and is expected to rise to at least a trillion dollars by 2040.

A BRIEF HISTORY OF SPACE EXPLORATION



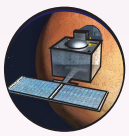
Man has already dreamed about space and whats out there. With the launch of the V2 Rocket in 1942, Man finally penetrated into 'Outer' Space. Eventually this led to the space race and finally an international space station.

India and Outer Space Exploration

- India's space programme started with formation of INCOSPAR (Indian National Committee for Space Research) under the leadership of Dr. Sarabhai and Dr. Ramanathan in 1962 and subsequent establishment of Indian Space Research Organisation (ISRO) in 1969 and Department of Space (DOS) in 1972.
- Since its inception, it has been orchestrated well and had three distinct elements, namely, **satellites for communication and remote sensing, the space transportation system and application programmes.**
- As per industry sources, the **space sector in India accounts for 3% in the rising $400-billion**

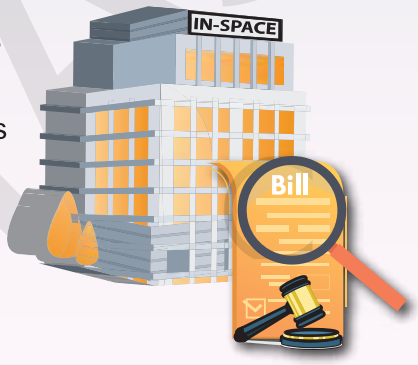
global space market.

- The **Indian Space Research Organisation** has till now carried out **111 spacecraft missions,** 79 launch missions with a **remarkable feat of launching 104 satellites into orbit in one go.**
- Major missions that are successfully completed and/or planned are:

	Mission Name	Details
 **Lunar Missions**	**Chandrayaan-1 (2008-09)**	India's first lunar probe, **orbiting around the Moon for chemical, mineralogical and photo-geologic mapping** of the Moon. The mission included a lunar orbiter and an impactor.
	Chandrayaan-2 (2019)	It consists of a lunar orbiter, lander and rover, all developed in India. The main scientific objective is to **map the location and abundance of lunar water.**
 **Interplane-tary Missions**	**Mars Orbiter Mission (MOM) (2014)**	Also called Mangalyaan, it was India's first inter-planetary mission and ISRO has become the fourth space agency to reach Mars. India is the first Asian nation to reach Mars orbit, and the **first nation in the world to do so in its first attempt.** The mission was comparably cost-efficient (NASA's MAVEN cost close to 9 times the cost of MOM).
 **Astronomy**	**Astrosat (2015)**	It enabled **multi-wavelength observations of the celestial bodies** and cosmic sources in X-ray and UV spectral bands simultaneously.
 **Planned Missions**	**Chandrayaan-3 (2022)**	**Mission repeat of Chandrayaan-2** with lander, rover and a propulsion module to **attempt soft landing of lunar surface.**
	Gaganyaan (2022)	Gaganyaan ("**Orbital Vehicle**") is an Indian crewed orbital spacecraft (jointly made by ISRO and HAL) to **carry three people,** and a planned upgraded version will be equipped with rendezvous and docking capability.
	Lunar Polar Explor-ation Mission (2024)	A concept mission by Japan and ISRO to **explore the south pole region of the Moon.**
	Aditya-L1 (2022)	First Indian Solar Coronagraph spacecraft mission to **study solar corona in visible and near Infra-red bands.**
	RISAT-1A (2021)	RISAT-1A is a radar-imaging satellite with primary application in terrain mapping and analysis of land, ocean and water surface for soil moisture.

	NISAR (NASA-ISRO Synthetic Aperture Radar) (2022)	**A dual-frequency synthetic aperture radar satellite to be used for remote sensing.** It is notable for being the **first dual-band radar imaging satellite.**
	Shukrayaan-1 (2024)	**The Indian Venusian orbiter mission** is a planned orbiter to Venus by the ISRO to **study the atmosphere of Venus.**

Governmental Efforts to Encourage Space Exploration

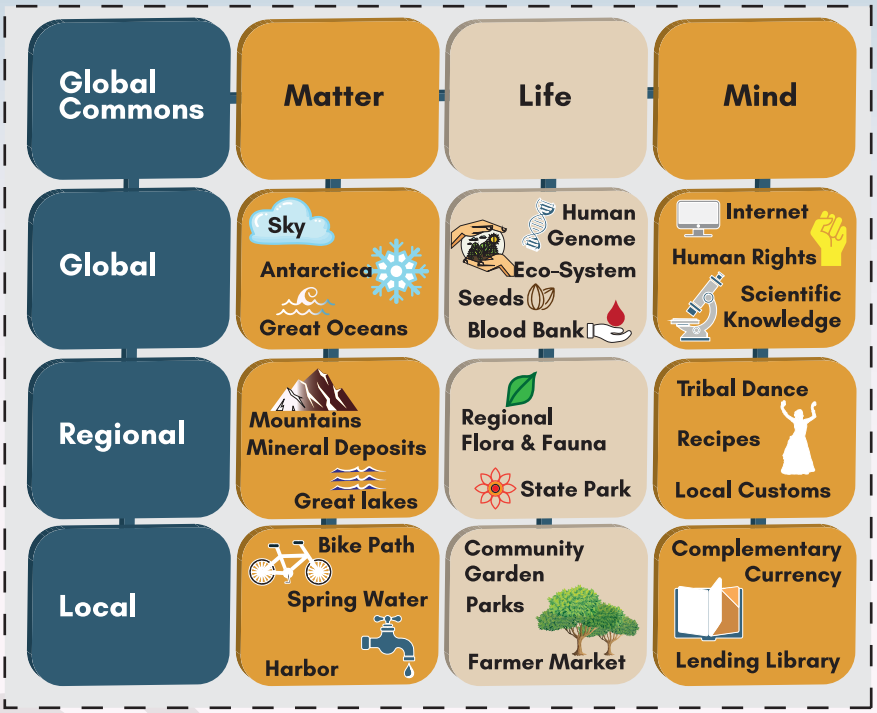


- **Indian National Space, Promotion & Authorization Centre (IN-SPACE):**
  It was established under the Department of Science to assess the need and demand of private players, including educational and research institutions, and explore ways to accommodate these requirements in consultation with ISRO in order to **boost private participation in space activities.**
- **Space Activities Bill, 2017:**
  To **support the overall growth of space activities** in India the government is going to introduce the Space activities Bill, 2017 with the aim of promoting and regulating the space activities of India and to encourage the participation of private business entities in space activities.

Changing Dynamics of India's Space Exploration Activities

- **Predominance of Security Concerns:**
  Today, **India's approach to space policy is driven much more by national security worries** than by morality and sovereignty considerations that prevailed in the 1980s and 1990s. As a result, it has been observed that **India's space programme has been developing a military profile.**
  - For instance, China's first successful ASAT test in January 2007 became a wake-up call for India of the kind of space security threats that India will need to address. Subsequently, India tested its own anti-satellite (ASAT) capability during Mission Shakti in 2019.
- **Raising the Profile of the Indian Space Programme through Space Exploration and Crewed Space Missions:**
  Although, many questions have been raised on the need of such missions, but with India's space progress gaining strength and sophistication, these appear to be next logical steps in its developmental trajectory with simultaneous spin-off technological benefits.
  - For instance, India's deep space communication capabilities are so much more significant today that it does not have to possibly rely on space agencies of other countries for this purpose.

Why is outer space considered a global common and why does it matter?



Global commons are **physical or virtual areas,** where resources are shared at the international level. Examples include the Antarctic, the high seas, and more recently cyber-space. These areas **do not fall under any national jurisdiction** and are regulated by international law.

The Outer Space Treaty, 1967, reflected the determination of states to make outer space a common for all humankind. More than fifty years of **human activity in space have produced** both tangible and intangible benefits for humanity thus improving the quality of life on Earth. These benefits can be categorized into three fundamental areas:

- **Research and Innovation:**
  - **Applications in Everyday Life:** Space exploration has contributed to many diverse aspects of everyday life, ranging from solar panels, implantable heart monitors, water-purification systems, improved computing systems to a global search-and-rescue system.
  - **Public Health and Safety:** One of the experiments conducted on the International Space Station (ISS), for example, involved testing innovative materials designed to prevent bacterial growth. The current COVID-19 pandemic brings the importance of this kind of research into sharp focus.
    - Also, studies of the human body's response to extended periods in the microgravity environment of the ISS are improving our understanding of the aging process.
  - **Space Mining:**
    The mining of asteroids and other celestial bodies could also provide a near-infinite supply of the precious and scarce resources such as lithium, cobalt, gold, nickel etc.
    At the same time, **water is abundant in outer space, in some or the other form, it could be extracted and electrolysed to make rocket propellants.** Thus, asteroids could serve as extra-terrestrial/orbital "gas stations" for fuelling future deep space missions.
  - **Understanding Climate Change:** Scientific studies of the Martian environment, its evolution and current state represent important benchmarks of terrestrial planetary evolution, and hence, provide a model that some scientists believe will aid our growing understanding of climate change processes on Earth.

- **Capacity Building:** The excitement generated by space exploration attracts young people to careers in science, technology, engineering and mathematics, helping to build global capacity for scientific and technological innovation.

- **Culture and Inspiration:**
  - Space exploration missions **fulfil people's curiosity,** that brings us closer to answering profound questions like What is the nature of the Universe? Is the destiny of humankind bound to Earth? Are we and our planet unique? Is there life elsewhere in the Universe?
  - Discovery of signs of past or present life in the solar system (or beyond) affect **humanity's appreciation of life's uniqueness on Earth** in unpredictable ways.
- **New Means to Address Global Challenges:**
  - Partnerships and capabilities developed through space exploration **contribute to trust and diplomacy between nations.**
    - For instance, human missions to the Moon, asteroids, and Mars require more extensive international cooperation, and this creates opportunities to strengthen the capacity for peaceful, globally-coordinated activities in space and on Earth.
  - Enhanced global partnerships and exploration capabilities may help advance **international preparedness for protecting the Earth from catastrophic events** such as some asteroid strikes, advancing collaborative research on space weather and protecting spacecraft by developing new means for space debris removal.
  - Knowledge derived from space exploration may also **contribute to implementing policies for environmentally sustainable development.** For instance, we can **gain insight into Circular Economy** based on recycling and waste management of manned space missions where Astronauts have to survive on limited food, raw materials, sunlight, energy, water and oxygen.

Case Study: International Space Station (ISS) and Global Partnerships

- The ISS was **launched in 1998** and has five participatory space agencies: NASA (United States), Roscosmos (Russia), JAXA (Japan), ESA (Europe), and CSA (Canada).
  It is the **pre-eminent example of successful, continuing international cooperation in space exploration.**
- Fifteen nations signed the intergovernmental agreement that established the partnership framework, and cooperation has expanded over the years, resulting in 68 nations to date that have participated in ISS activities.
  The ISS partnership demonstrates-
  - **Functional Aspect of International Cooperation** in space as it enables partners with different levels of investments to gain access to this unique laboratory, not affordable for any partner alone, and thereby share into the benefits.
  - **Political Aspect of Exploration:** To achieve its core mission, the ISS partnership has overcome political and economic strains and demonstrated the diplomatic value of international cooperation in space.
- **However, there is now a palpable shift towards individualism resulting in competition in this domain.** For instance-
  - **Recently, Russia has planned to pull out of the ISS amid rising tensions between Russia and the US** with the two powers also accusing each other of militarising space. With this, Russian space industry has also announced launching its own Space

Station named Russian Orbital Service Station (ROSS).

- China is also developing its own space station – **Tiangong** which could be completed by the end of 2022.
- In 2019, Indian Space Research Organisation (ISRO) had announced India's plan to launch its own space station as an extension of its Gaganyaan or human spaceflight program.

How are outer space activities governed and regulated?

'Space law' (body of law governing space-related activities) comprises a variety of international agreements, treaties, conventions, and United Nations General Assembly resolutions as well as rules and regulations of international organizations.

- **The United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS)**, along with its Legal, Scientific and Technical Subcommittees, are responsible for debating issues of international space law and policy.
  - The **United Nations Office for Outer Space Affairs (UNOOSA)** serves as the secretariat of the Committee and is promoting Access to Space for All through a wide range of conferences and capacity-building programs.
- There are **five international treaties underpinning space law**, overseen by the UNCOPUOS:

SPACE TREATIES

The Outer Space Treaty, 1967	The Rescue Agreement, 1968	The Liability Convention, 1972	The Registration Convention, 1975	The Moon Agreement, 1979
The treaty presents principles for space exploration and operation: - Any country is free to explore orbit and beyond. - There is **no claim for sovereignty in space;** no nation can "own" space, the Moon or any other body. - Weapons of mass destruction are forbidden in orbit and beyond, and celestial bodies can only be used for peaceful purposes.	- Signatories agree to take all possible actions to help or rescue astronauts in need. - Countries must return any space objects that land on Earth to the sponsoring nation.	Signatory states are fully liable for any damage caused by their space objects and agree to standard procedures for adjudicating damage claims.	Requires signatory states to register all space objects with the UN.	- Agreement states that celestial bodies can only be used for peaceful purposes and should not be contaminated. - An international regime must be established to govern how the resources mined from the moon are obtained

✦ Signatory states are responsible for their space activities, including private commercial endeavours, and must provide authorization and continuing supervision. ✦ Nations are responsible for damage caused by their space objects and must avoid contaminating space and celestial bodies. India ratified the treaty in 1982.	India ratified the Agreement in 1979.	India acceded to the Convention.	India acceded to the Convention.	and used. ✦ The United States is not a signatory of the Moon Agreement. India signed the Agreement.

What are the emerging challenges in exploration and regulation of space?

✦ **Militarisation and Weaponization of Space:** Space has become the new frontier with several countries organising specific commands in their armed forces to deal with both the defensive and offensive aspects of protecting their essential space-based systems. For instance, the recent creation of the **US Space force** to conduct military operations in space to protect U.S. assets and interests.

✦ Similarly countries like Russia, the US, China and India - have demonstrated an **anti-satellite weapon capability** over the past decades, heightening the insecurities in outer space.

Space Militarisation:

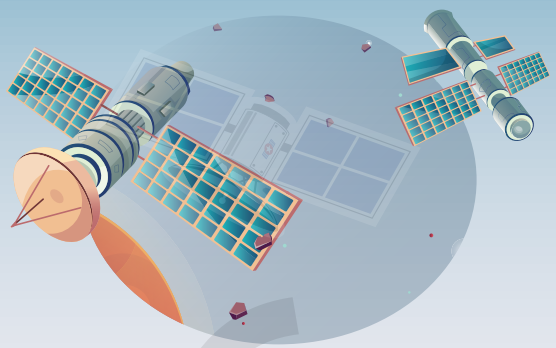
Despite concerns about military activity in outer space for long, **not much progress has been made in addressing them.** The desire to establish military supremacy in outer space emerges due to reasons such as:

✦ Deployment of weapons in space can help countries to **strengthen their present missile defence system and gain supremacy in the conduct of war.**

✦ **Ensuring Protection of Space Assets:** Assets such as communication and navigation satellite act as critical components within a state's national infrastructure.

✦ **Geopolitical competition** may also fuel the militarization of space, which heightens state incentives to devise cyber espionage, interference, and attack strategies against rivals' space operations.

✦ **Space Arms Race:** Since most space technologies have military applications, countries may find it difficult not to participate in an ongoing arms race in space. For example, satellite constellations are commercial but governments could acquire their data to monitor military movements.



- **Cybersecurity Challenges:** Satellites and other space-based assets are vulnerable to cyberattacks which can threaten ground-based critical infrastructure as well. If not contained, these threats could interfere with global economic development and, by extension, international security.
  - For example, false information could be given by Earth-based attackers to a satellite to force it to collide with another.
- **Dual-Use Technology:** "Dual-use" nature of satellites meaning where civilian and military purposes are blurred into a single observational system and can be adapted for different functions when necessary. The rise of dual use technology is blurring the boundaries between military and civilian observations, **raising serious ethical concerns over space based data collection.**
- **Space Privatisation:** Privatisation of space exploration has had many benefits for the space industry such as greater degree of autonomy, cost effectiveness, employment generation, innovation, and generation of public interest in space through opportunities like space tourism.
  - However, privatisation **might result in the polarisation of space reach and formation of an oligopoly** in the space. Instead of being industry-wide, growth can become lopsided and biased.
  - Also, **loss of government control,** which provides a firm sense of accountability to space projects, might be detrimental to the process.
- **Ecocide in Outer Space:** Ecocide is defined as the mass damage and destruction of ecosystems, constituting harm to nature which is widespread, severe or systematic. There are two ways in which crimes against the environment may occur in outer space.
  - **Deliberate Release of Space Debris:** The increased risk of collisions between space debris and with human spaceflight vehicles will eventually make LEO unsafe to traverse, threatening the future sustainability and viability of human activities and communities in space.
  - **Human Activities Surrounding Space Mining:** The inherent nature of space mining activities and infrastructure poses a heightened risk of **environmental pollution and contamination in outer space;** and an **elevated hazard to the principle of planetary protection,** particularly concerning radioactive debris and extra-terrestrial material.
- **Increased Space Traffic & Debris:** Presently, several constellations and mega-constellations projects are being organized to provide more and more efficient communications technologies. For instance, Starlink (by SpaceX) aims to provide high-speed internet access throughout the planet through mega-constellations.
  - However, an increase in the number of objects in orbit increases the chances of collisions between spacecrafts and repeated collisions could lead to **Kessler's scenario:** an exponential increase in debris and impact probabilities that would make space exploration impossible.
  - According to NASA, there are more than 23,000 orbital debris larger than 10 cm and an estimated number of approximately 500,000 particles between 1 and 10 cm in diameter.

- **Irresponsible Manufacturing of Space Objects:** Recently, a 22.5 metric ton rocket by China named Long March 5B was expected to make an uncontrolled re-entry into Earth's atmosphere, with some of its debris possibly landing on inhabited areas. Rocket manufacturers are required to account for the free-fall of rocket debris using practices like built-in booster, stabilization system and a re-startable engine, but China's Long March 5B was not built with either of those options.
- **Uneven Distribution of Benefits:** Benefits of space exploration and development have accrued mainly to those countries that have financed space activities. The contributions of space to the economic and social development of large regions of Earth have been limited.
- **Policy and Legal Challenges:** As outer space becomes democratised, commercialised and crowded, the multilateral framework for its governance is becoming obsolete, due to reasons such as-
  - **Lack of Provisions Regarding Emerging Issues:** including the prohibition of non-nuclear weapons tests in space and the creation of risky debris from the destruction of old satellites. For instance, the OST prohibits the placement of weapons of mass destruction (WMD) in space - but it makes no mention of conventional weapons.
  - **Lack of Dispute Settlement Mechanism:** This heightens the potential for conflict in the emerging space era. Also, with the continuous technological advancements, the business opportunities in outer space are increasing and they might involve Intellectual Property releted issues.
  - **State-Centric Nature:** The existing law places responsibility on states alone. However, non-state entities are now in the fray for commercial space exploration and utilisation. Unregulated growth of non-state actors can generate a damaging free-for-all competition for celestial resources.

What needs to be the road ahead ?

Space is no more a safe and secure sanctuary. Given that dependence on space spans from economic and social sectors to military and security domains, unless there are effective rules of the road governing outer space activities, sustainable use of space is in serious danger. Steps that need to be taken include:

- **Devising New Norms and Rules for Space:**
  Issues such as cleaning up space debris, the principle of non-interference, efficient management of radio spectrum,proximity rules (how close satellites can manoeuvre to each other), and stricter rules to regulate the manufacturing of rockets need to be agreed as a set of international norms for space behaviour.
  - A cross-regional group of like-minded countries should link up with UN bodies - including UNOOSA, COPUOS and International Telecommunication Union (ITU) - and key private-sector companies to kick-start a new process for developing a global code of conduct.
- **Fostering International Cooperation on Potential Instruments:**
  - **International Code of Conduct for Outer Space Activities (ICoC):** Initiated by the EU, the proposed draft is a non-legally binding, voluntary international instrument aimed

at building norms of responsible behaviour in space activities

- **Prevention of Arms Race in Outer Space (PAROS):** It is a UN resolution conceived of during the Cold-war era that advocates for a ban on the weaponization of space. However, US opposition has thwarted treaty negotiations in the UN General Assembly. It is currently being discussed in the Conference on Disarmament.
- **Space2030 Agenda:** As a response to the growing concerns, the agenda was proposed by the Outer Space Committee in 2018 to strengthen the role of the space sector as a major driver of sustainable development, to advance the societal benefits of space-related activities and ensure that all countries have access and can benefit socioeconomically from space science, technology and information.

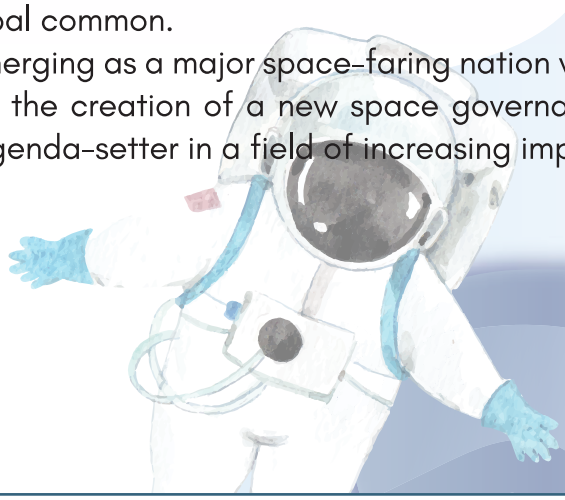
- **Leadership Role Must be Played by India:** India has stakes in a peaceful outer space both for economic and security reasons. India can promote the creation of a more comprehensive regime for the use of outer space in a variety of ways such as starting discussions within organizations like the BRICS, Shanghai Cooperation Organization (SCO) etc. and by actively engaging with existing forums, such as the UN Committee on the Peaceful Uses of Outer Space and ongoing deliberations like ICoC and PAROS.
- **Recognising Intellectual Property (IP) in Space:** There is an urgent requirement for an internationally accepted legal framework governing intellectual property in outer space activities which can also ensure active participation of private business entities in the development of space technology.
- **More Rational Approach is Needed in the Space Research:** The ways and means on spending less and achieving more on space missions and space research must be explored, taking an example from India's mission to Mars. Accordingly, a much more calculated, organized and rational approach must be adopted when dealing with the subject of space research that make an optimal use of limited financial resources while facilitating human development.

Conclusion

Space systems and activities are vital to national and international security, and underpin the daily activities necessary for our economies to function. The growth of orbital debris, crowding of critical orbits and of the radiofrequency spectrum, and the lack of consensus on defining responsible behaviour in space threaten these essential services.

Given the centrality of space for the future of our civilization, we need to have policies and practices in place, which are shared by all spacefaring nations that will allow and encourage them to use and explore space for peaceful purposes. We thus need to recognize, encourage, and enable space as a global common.

At the same time, India that is emerging as a major space-faring nation with notable accomplishments must engage itself in the creation of a new space governance framework that would also project India as an agenda-setter in a field of increasing importance for international relations.



TOPIC AT A GLANCE

Evolution of Space Exploration Journey

(1957-1977) Space Race Era competition between the USSR and US, to achieve superior spaceflight capabilty.

(1960 Onwards) Entry of Other Players like China, Japan, Canada, some European Countries and India.

(1977 Onwards) Outer Space being Treated as a Global Common focus shifted to renewable hardware, and cooperation among countries.

(1990 Onwards) Involvement of Private Sector emergence of Space 2.0 based on the canon of commercialisation industri-alisation democratisation.

India as a Major Space Faring Nation

- Indian Space Research Organisation has till now carried out **111 spacecraft missions, 79 launch missions** with a **remarkable feat of launching 104 satellites into orbit in one go.**
- **Efforts have been taken to encourage Space Exploration** like Indian National Space, Promotion & Authorization Centre (IN-SPACE) and Space Activities Bill.
- **Changing approach of India's space exploration activities** to factor in predominance of security concerns from countries like China and to raise India's international profile.

Benefits of Space Exploration

Research & Innovation

- **Applications in everyday life** ranging from solar panels to a global search-and-rescue system.
- Experiments conducted over International Space Station helps in **betterment of public health and safety.**
- **Space mining** provides a near-infinite supply of the precious and scarce resources such as lithium, cobalt etc.
- Studies of the Martian environment helps in **understanding Climate change over Earth.**
- **Attracts young people** to careers in science, technology, engineering and mathematics.

Culture & Inspiration

- **Fulfil people's curiosity** about Universe
- Affect humanity's **appreciation of life's uniqueness on Earth.**

Means to Address Global Challenges

- Contribute to **trust building and diplomacy between nations.**
- International preparedness for **protecting the Earth from catastrophic events.**
- **Insight on Circular Economy** based on recycling and waste management of manned space missions.

Regulation of Outer Space Activities

- **United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS)** for debating issues of international space law and policy.
- **Five international treaties under UNCOPUOS forms the basis of space law:**
  - The Outer Space Treaty, 1967
  - The Rescue Agreement, 1968
  - The Liability Convention,1972
  - The Registration Convention, 1975
  - The Moon Agreement, 1979

Emerging Challenges

- **Militarisation and Weaponization of space**
- **Cyberattacks on space assets**
- **Increased Space Traffic & Debris**
- **Ethical concerns over space based data collection** due to the dual use nature of satellites.
- **Polarisation of space reach and formation of oligop-oly** due to increasing Space Privatisation.
- **Ecocide** i.e. mass damage and destruction of space ecosystem.
- **Irresponsible manufacturing of space objects**
- **Uneven distribution of benefits** of space exploration
- **Obsolete space laws** with lack of dispute settlement mechanism and state centric nature.

Way ahead

- **Devising new norms and rules for space** to address emerging issues.
- **Fostering International Cooperation on** International Code of Conduct for Outer Space Activities, Prevention of Arms Race in Outer Space and Space2030 Agenda.
- **Leadership role must be played by India** in forming a comprehensive regime for use of outer space and by actively engaging with existing forums and deliberations over peaceful use of outer space.
- **Recognising Intellectual Property (IP) in space to** ensure active participation of private entities.
- **More rational and organised approach is needed** in the space research.