Group

September 2023 Edition

SECTOR SPECIFIC REPORT

(Space Science)

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01

India's Quantum Leap in Space Research through Chandrayaan Mission

India's most awaited **Chandrayaan-3 mission by ISRO (Indian Space Research Organisation) successfully made a soft landing on the surface of the south pole of the moon on 23 August 2023** and made the history in global space landscape. It has two of its predecessors Chandrayaan 1, a successful Orbiter mission, and Chandrayaan 2, comprised of a lander and a rover which crashed on its final leap but has provided incremental steps for the success of Chandrayaan 3 mission.

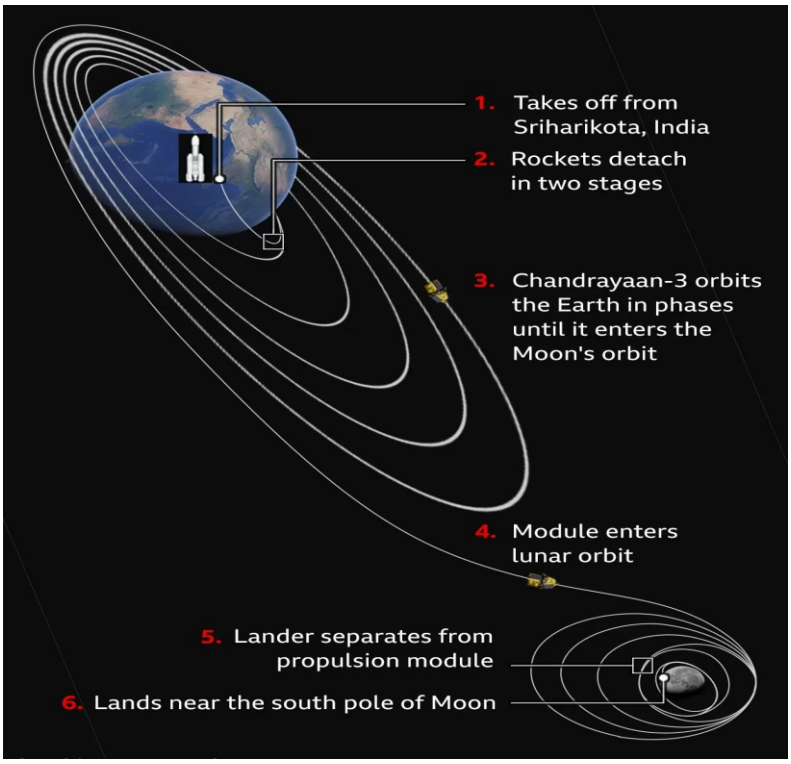
Chandrayaan-3 Mission

Source: https://newsonair.gov.in/Main-News-Details.aspx?id=464145

This success showcased India's caliber to handle complex space missions on its own and attract global interests to join India's space projects and gain benefits and space knowledge together. The skills and technology used in Chandrayaan-3 will not be limited to space but can also be used in other areas to welcome new inventions and services in various fields of life. This will bring economic benefits along with creating new jobs majorly in the space and communication sector where immense potential still needs to be unearthed.

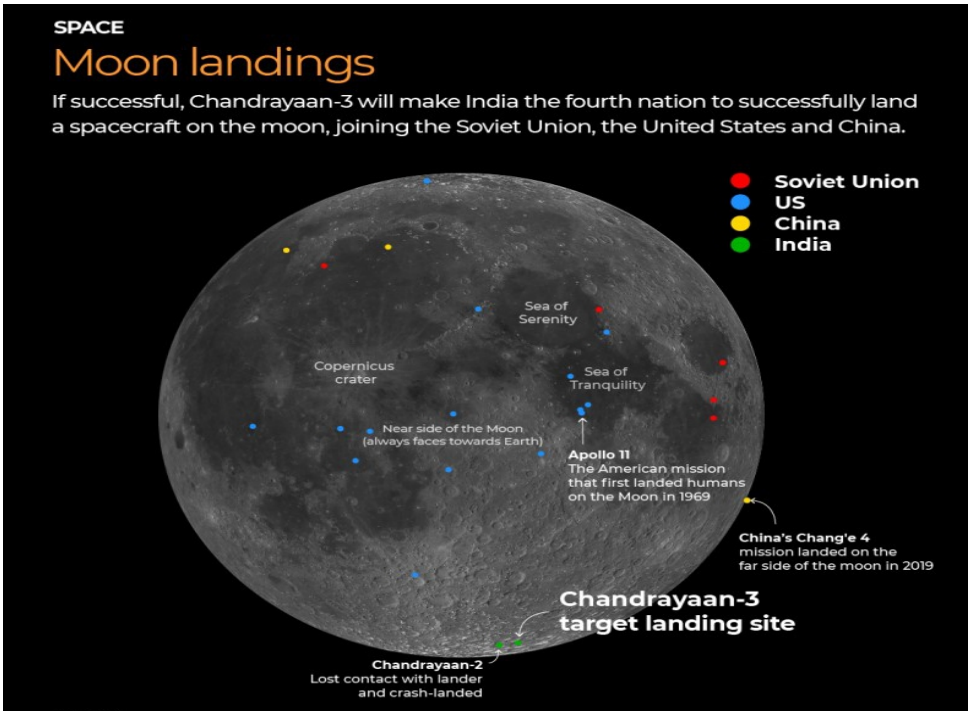
Following the USA, Russia, and China, India has become only the fourth nation on the moon and the first to land near its south pole. Chandrayaan-3 has proved India's capability enabling India to take a quantum leap in space research to benefit humanity at large.

Journey of Chandrayaan-3 toward Moon



Source: https://www.bbc.com/news/world-asia-india-66185565

Moon Landings by India & other Space Agencies



The successful launch of Chandrayaan-3 was a collaborative effort of India's major space tech companies including some of India's PSUs such as BHEL, HAL, etc. The space missions pioneered by ISRO used smart Indian skills and cost-effective technologies like sensors, navigation, and engines. Most of these technologies were self-made and a testimony to the successful journey towards Atmanirbhar Bharat.

Source: https://www.aljazeera.com/news/2023/7/14/chandrayaan-3-india-launches-rocket-to-land-spacecraft-on-moon

Companies behind the Successful Launch of Chandrayaan-3

Source: https://www.livemint.com/companies/news/these-are-the-listed-companies-behind-the-successful-launch-of-chandrayaan-3-mission-do-you-own-any-11689501374695.html

This successful mission has gained a global presence inviting friendship with the rest of the world and working together on space projects. It will give rise to the mutual sharing of new leaning, knowledge, resources, and hidden discoveries, the **joint mission of ISRO and the Japanese Space Agency (JAXA) is such an example where entities are collaborating to launch Chandrayaan-4 in 2026** with which the whole world will gain the hidden facts of an infinite universe beyond earth.

02 India Signed 'Artemis Accord' to Deep Dive in Civil Space Exploration

On 21st June 2023, **India became the 27th country to sign the US-led Artemis Accords** in Washington, in the presence of NASA Administrator Bill Nelson & Taranjit Singh Sandhu, India's ambassador to the United States. It will benefit India to unite with the other member countries for the peaceful exploration of deep space to nurture possibilities of civil space exploration

The Artemis Accord and its Members

Source: https://www.nasa.gov/specials/artemis-accords/index.html

The objective of this program is to have a common vision for deep space exploration by having practical guidelines, and a set of principles, for developing best practices to make sure it advances the use and exploration of outer space. With intentions to advance sustainable & beneficial use of outer space, it also aims to improve the safety of operations and reduce uncertainty for mankind regarding the unknown universe.

Principles of Artemis Accords

01	02	03	04	05
Peaceful Exploration	Transparency	Interoperability	Emergency Assistance	Registration of Space Objects
Release of Scientific Data	Preserving Heritage	Space Resources	Deconfliction of Activities	Orbital Debris

India's ISRO is joining US-led NASA's Artemis Accords is a big leap in the field of civil space exploration. **This is an unbinding agreement among member countries with no financial commitments to fulfill**.

ISRO AND NASA: Collaboration

Source: https://www.linkedin.com/posts/peeyush-singh-a475401a_future-innovation-opportunities-activity-7079341556075233280-tgU-?trk=public_profile_like_view

India under this program will participate in moon exploration and other space objects with NASA and member state space agencies under common protocols set. The agreement will ease the restrictions on the sourcing of space technology for peaceful space exploration

Artemis Accords and other Associated Agencies

Source: https://www.nasa.gov/press-release/nasa-international-partners-advance-cooperation-with-first-signings-of-artemis-accords

In the 21st century, India has increased its presence in Space exploration, and proven its worth in Deep Space Missions. This Accord will benefit Indian companies dealing in Space research & development including other space tech entities to develop systems and have innovations, especially in the field of electronics for US markets. This will facilitate **India's participation in scientific programs, and access to long-term engagements like spaceflight programs, micro-electronics, space security, and quantum under common vision standards** that will lead to close cooperation for acquiring more knowledge to peacefully explore deep space for a safe future of mankind.

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03

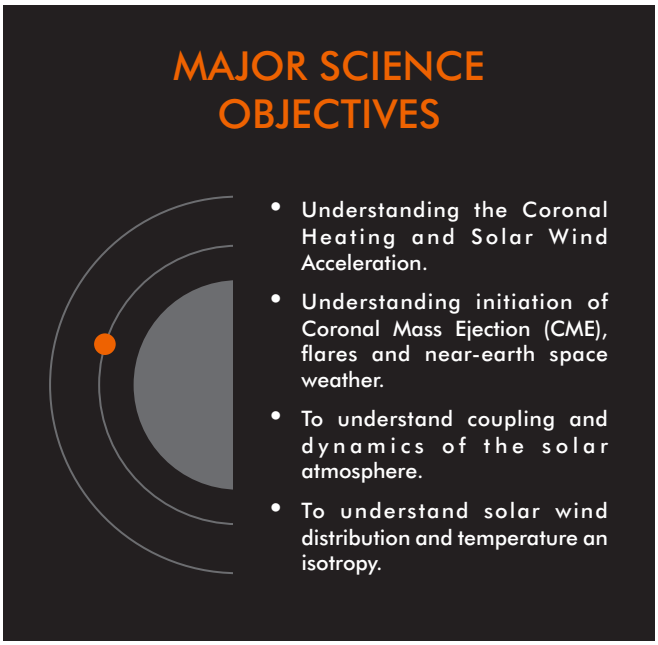
Aditya L1 Mission: Launch of India's Space Laboratory to Study the Sun

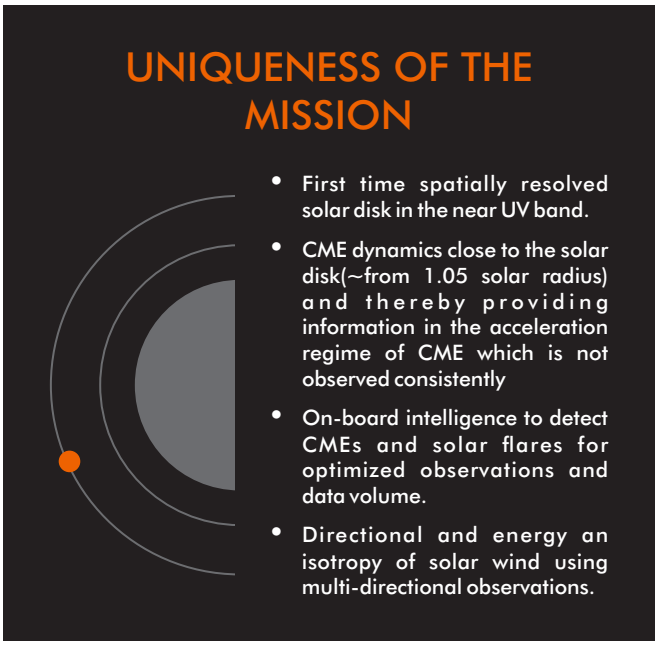
The Indian Space Agency, ISRO (Indian Space Research Organisation) has launched Aditya-L1 from Satish Dhawan Space Centre in Sriharikota, Andhra Pradesh, India on 2nd September 2023 via PSLV (Polar Satellite Launch Vehicle). It is **India's first space-based mission to study the sun and its atmosphere.**

The spacecraft carrying Aditya-L1 will be positioned in a halo orbit around the L1 point (Lagrange point). This point is situated at a distance of about 1.5 million km from Earth. Thus, this advanced space-based observatory will continuously view the sun without any occultation/eclipses, to notice solar activities and their effects on the space atmosphere in real-time and will bring exciting facts to lead future missions.

Launch of Aditya-L1 Mission

Source: https://www.ndtv.com/india-news/isro-successfully-performs-first-earth-bound-manoeuvre-of-aditya-l1-4355231

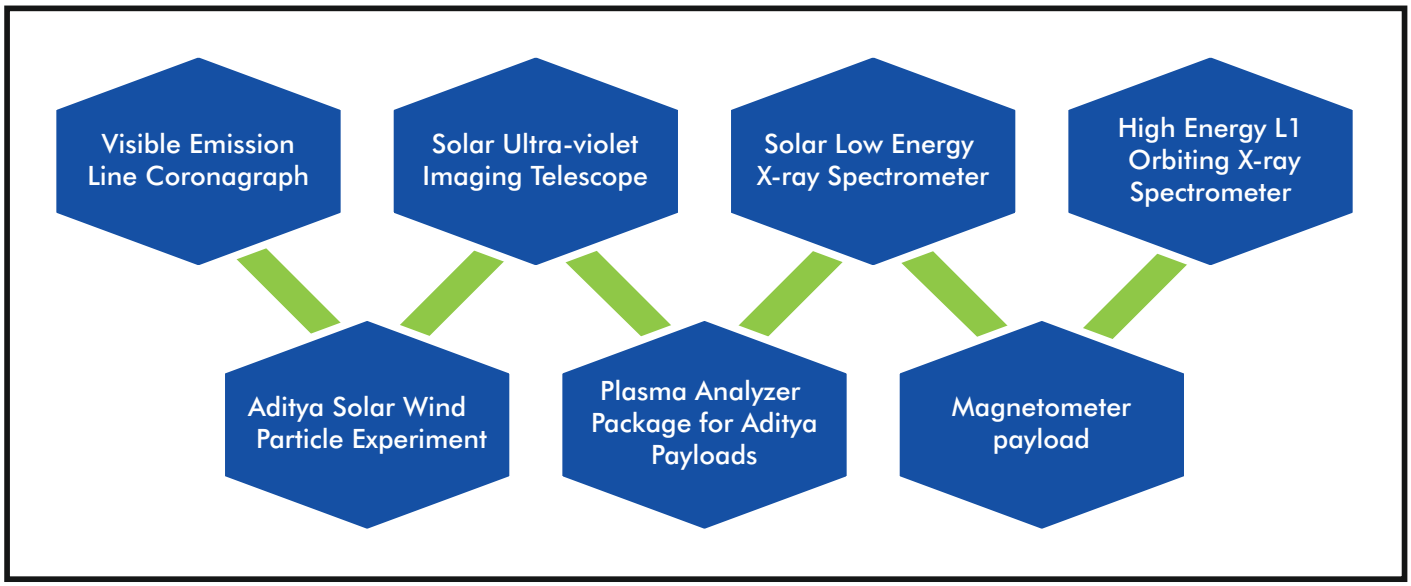




Source: https://www.isro.gov.in/media_isro/pdf/Aditya_L1_Booklet.pdf

This **spacecraft carries seven payloads to observe the outermost layer of the Sun (the corona), chromosphere, and photo sphere using electromagnetic particle, and magnetic field detectors**.

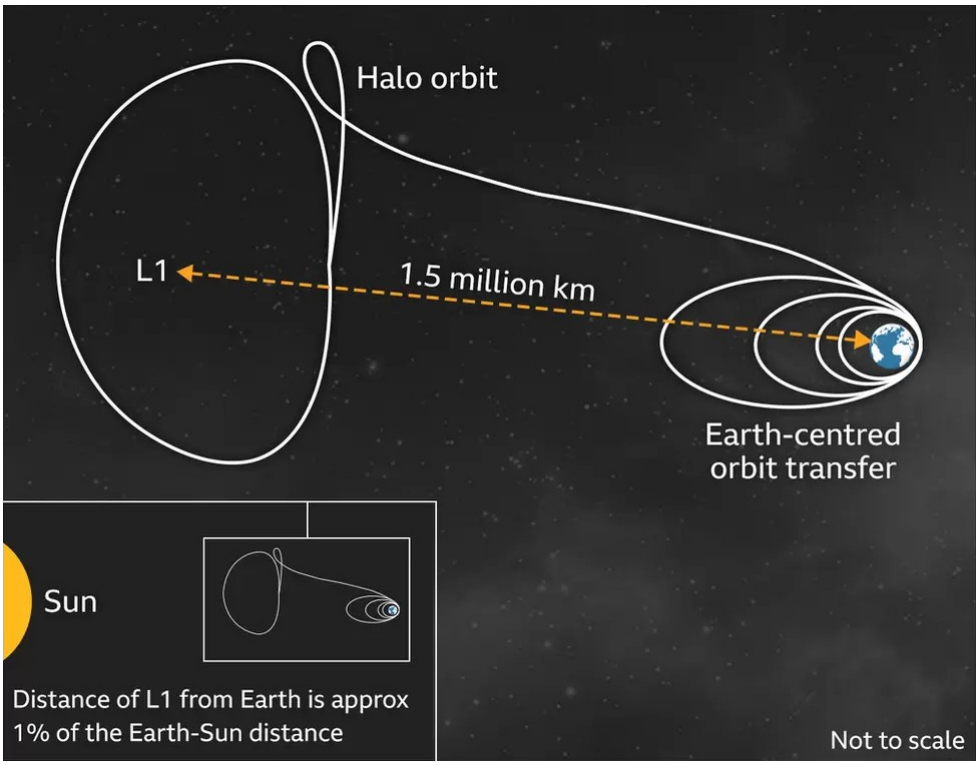
Aditya-L1 & the Seven Payloads



Having the advantage of the L1 point, out of seven, four payloads will directly view the Sun and the other three will be engaged for in-situ studies of particles and fields at this point. **Aditya-L1 mission is designed to study the Sun and its solar system phenomenon for 5.2 years around the Earth**, during this period the spacecraft will never come closer to the Sun than 1% of the total distance between the Sun and the Earth.

India's first solar mission will mark a global presence of the country by relishing abundant information on obstacles of the upper atmosphere (coronal heating & mass ejection), dynamics of space weather, flare as well as Pre-flare activities, propagation of particles and fields as a part of space science exploration. This is expected to bring unexplored hidden truths about the Sun to the Earth and enrich the world space community at large.

Aditya-L1: Trajectory path to L1 point



Source: https://www.bbc.com/news/world-asia-india-66738230

04 Indian Space Policy 2023 to Give Boost to the Space Economy of India

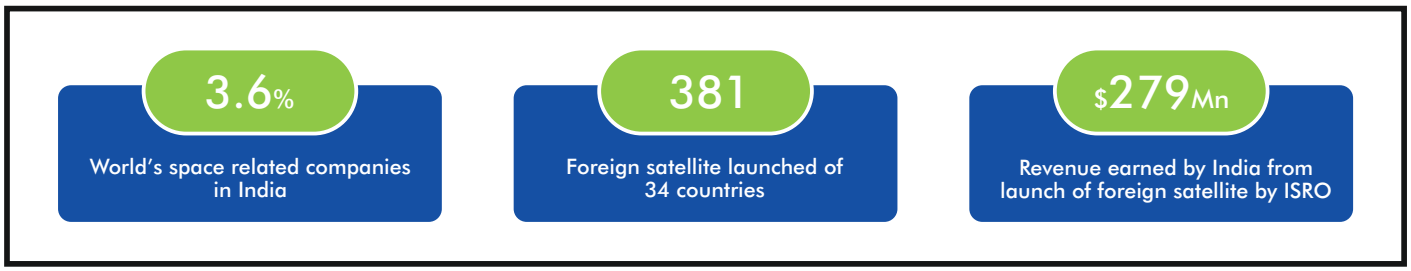
The Indian Space Policy 2023 was approved by the Union Cabinet on 20 April 2023. The new policy **explicitly talked about the roles and responsibilities of various organizations like ISRO (Indian Space Research Organisation), NSIL (NewSpace India Ltd), and IN-SPACe (Indian National Space Promotion and Authorization Center)**. The policy welcomes **private players in the space sector recognized as critical stakeholders** to boost the Indian space economy.

Indian Space Policy 2023: Focus Area

Source: https://www.linkedin.com/pulse/indian-space-policy-2023-paving-way/

The **space economy of the world is mostly occupied by the West with almost 47% market share**. **ISRO being the sixth largest space agency** and the leading entity for the Indian space sector with the recent successful mission of Chandrayaan 3 and Aditya L1 mission, occupies **around 2-3% global space market share**. Such a comprehensive policy document to bring private stakeholders as an active asset to fulfill India's quest to explore the whole of the universe will **enhance future possibilities of expanding this market share to over 10% by 2030** and promise greater contribution to the global space community to explore possibilities of unknown horizons.

Quick Facts from the Indian Space Sector



Source: https://www.investindia.gov.in/sector/space

The new policy opens the Indian space sector for private players enabling them to play an active role in the development and competitiveness of the Indian space programs that **will allow ISRO to focus on space R&D**. **This knowledge will be leveraged for commercial purposes by NSIL, IN-SPACe.** The policy allows NGE (non-government entities) to provide space-based communication services at the national and international levels based on self-owned, leased, or procured GSO (Geostationary orbit) & NGSO (Non-geostationary orbit) settings.

Indian Space Policy 2023: Supporting Agencies

Source: https://socialgraphika.com/can-indias-space-policy-make-india-a-superpower/

Further, this move will boost the role of DoS (Department of Space) and enable ISRO to focus its entire energy on the research and development of advanced space technology. Hence opening new avenues for space tech startups to get major benefits from this policy rollout.

Various Indian Space Tech Startups

Source: https://socialgraphika.com/can-indias-space-policy-make-india-a-superpower/

This policy offers much-awaited clarity in space reforms and private sector participation to enhance the space economy in India. It is designed to increase the contribution in terms of knowledge and market share by attracting more funds and investments at the global level. It will invite private players, startups, and other stakeholders for future Indian space missions and civil space exploration in the time to come by working on various facets of space exploration simultaneously.

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05

First Test Vehicle Mission Planned for India's First Maiden Human Space Flight Mission Gaganyaan

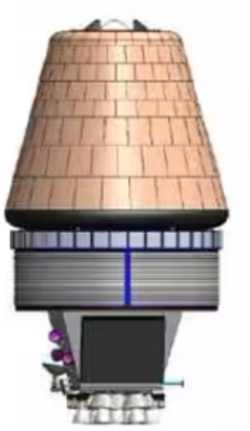
ISRO's (Indian Space Research Organisation) Gaganyaan mission envisions a display of human spaceflight capability and is expected to be launched at the earliest by April 2024 for which a key test is expected to be scheduled in October 2023. The mission will take Indian astronauts to space on an Indian platform with an approximate cost of Rs.9023 crores.

GAGANYAAN: OBJECTIVE & BENEFITS

Statement of Honourable Prime Minister

" A son or a daughter of India will go to Space from Indian Soil by an Indian Vehicle by 2022 (75th Year of India's Independence) or earlier"

Benefits

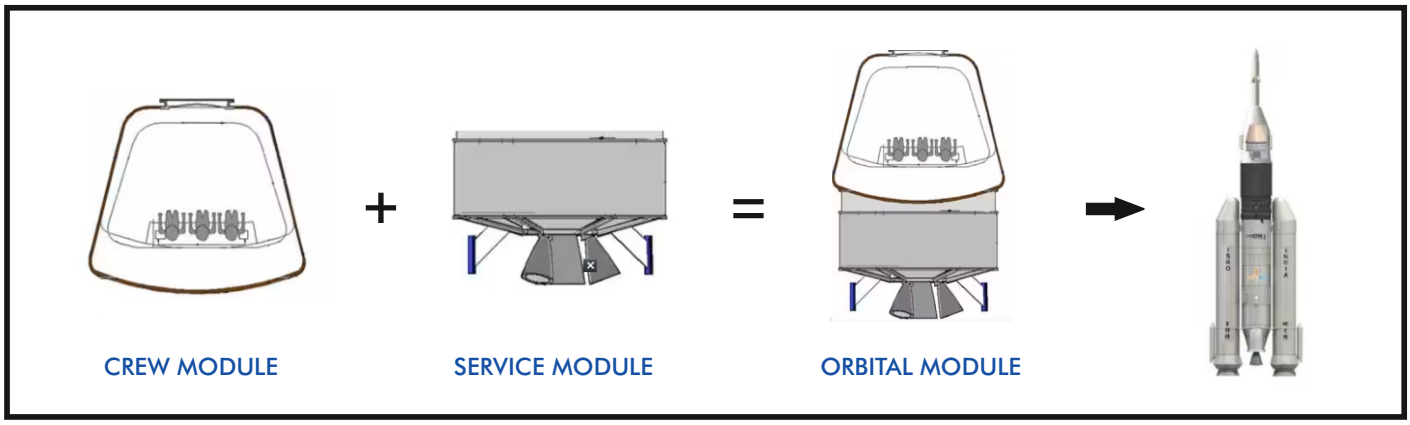


- Enhance Science & Technology Levels of the Country
- National project involving other Institutes, Academia and industry
- Improves Industrial Growth
- Inspires Youth to take challenges in Science & Technology
- Technologies developed for societal benefits
- Additional Human Resource Development
- Provides way for the International Collaboration & Policies

Source: https://english.cdn.zeenews.com/sites/default/files/2018/08/28/715838-gaganyaan.jpg

It will carry three crew members for a 3-day mission to an orbit of 400 km. The orbital module which will orbit the Earth will carry a crew module and a service module. ISRO has identified the LVM3 rocket (Launch Vehicle Mark) as the launch vehicle for the mission and is reconfigured to meet human standards and thus, labelled as a human-rated LVM3 (HLVM3). HLVM3 consists of a Crew Escape System (CES) which ensures that crew members & crew modules will be taken to a safe distance in case of emergency.

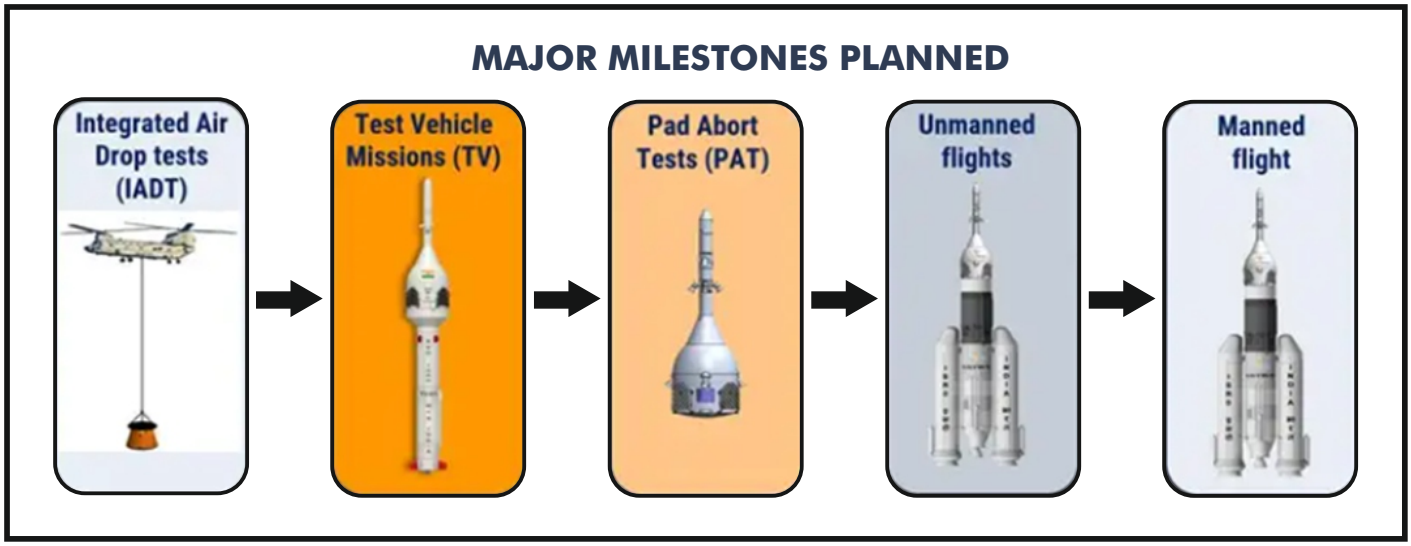
Gaganyaan System



Source: https://zeenews.india.com/photos/india/photo-gallery-know-all-about-gaganyaan-isros-mission-to-send-indian-astronaut-to-space-by-2022-2136815/2136819

ISRO planned many missions to demonstrate the technology preparedness level before launching actual human spacecraft like the Integrated Airdrop Test (IADT), Pad Abort Test (PAT), and Test Vehicle (TV) flights. **This manned mission will be preceded by two unmanned missions including a female robot named Vyommitra a humanoid**.

Gaganyaan: Planned Phases In the Mission



Source: https://www.isro.gov.in/Gaganyaan.html#:~:text=Gaganyaan%20project%20envisages%20demonstration%20of,landing%20in%20Indian%20sea%20waters.

To accomplish this mission, ISRO will use international technologies and in-house industry experience, expertise, and academia & research capabilities. Further, the development of many essential technologies, like life support systems to provide an earth-like environment to crew members, launch vehicles for carrying them safely to space, crew escape provision during emergencies, and training, recovery & rehabilitation of crew members will be required to make this mission a great success and add one more feather to India's space exploration capabilities soon.

06

Eminent's Insight

We proudly stand among the nations with immense potential for further expansion. Our relentless pursuit of growth, innovation, and collaboration positions us on the list of frontrunners, ready to embrace new horizons and shape a future filled with endless possibilities.

S. Somnath
Chairman
Indian Space Research Organization (ISRO)

07 Resources

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