ACHIEVEMENTS OF CONTEMPORARY BHARAT

सत्यमेव जयते
MINISTRY OF EDUCATION
Government of India

CHANDRAYAAN UTSAV

CODE 1.9HS

SPECIAL MODULE

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Published at the Publication Division, by the Secretary, National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi 110 016 and printed by Gita Offset Printers (P.) Ltd., C-90 & C-86, Okhla Industrial Area, Phase-I, New Delhi 110 020

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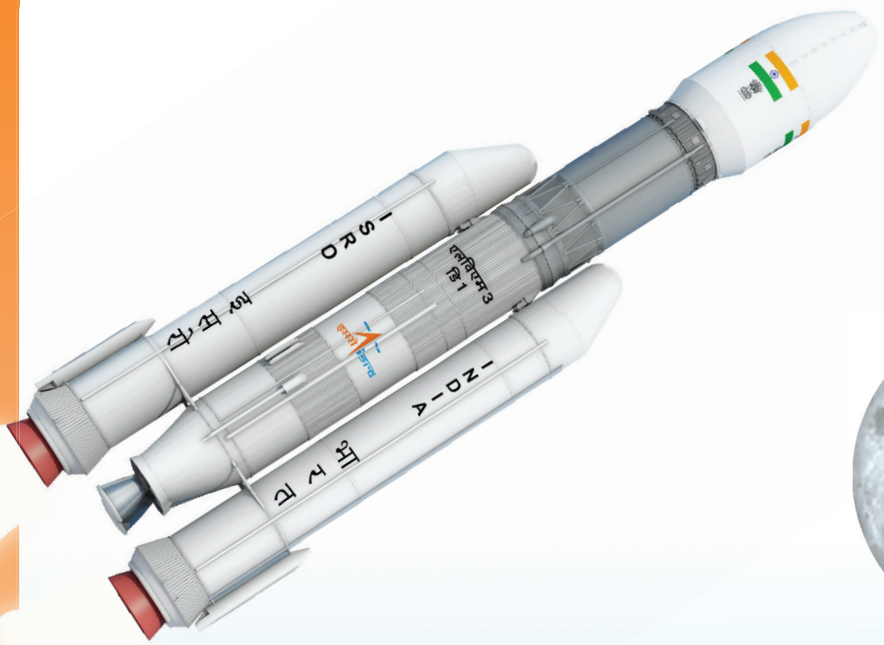

Bharat Space Mission
The Chandrayaan Mission

Higher Secondary Stage

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Space Mission: The Chandrayaan

One day, after having seen and listened so much about the space missions of our country everywhere in newspapers, magazines, television, social media, etc., the whole class was eager to learn more about the space missions of our country in general, and about the Chandrayaan in particular. The teacher also got anxious and enthusiastic to begin the elaborative discussions among the students.

Space Programme

India's space programme started 61 years ago when the Indian National Committee for Space Research (INCOSPAR) was set up in 1962 under the able leadership of Dr. Vikram A. Sarabhai. Thumba Equatorial Rocket Launching Station was also installed near Thiruvananthapuram in the same year. India's space programme is among the oldest in the world, and has played a crucial role in national development.

India has so far successfully accomplished 125 spacecraft missions, including three nanosatellites and one microsatellite; 94 launch missions; two re-entry missions; 431 foreign satellites belonging to 34 countries; 15 students' satellites; and three satellites realised by Indian private players.

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These include 53 Indian satellites in different Low Earth Orbits (LEO) and Geosynchronous Earth Orbits (GEO). India has also launched missions to Mars and the Moon. Very recently, India has successfully launched Chandrayaan-3 and has become the fourth country in the world to land on the moon, and the first to land *Vikram* lander and *Pragyan* rover near the Moon's South Pole. Further, on September 2, 2023, India launched the Aditya-L1 mission to study the Sun. It is expected that this satellite will reach its designated place, Lagrange 1 (L1), to remain stable between the Sun and Earth sometime in January 2024. India also plans to send an Indian citizen to LEO soon, maybe in late 2023 or early 2024. This mission is known as Gaganyaan. The Indian Space Programme is also well known for its expertise in launching missions at very low prices.

ISRO and its Units

Now, having learned about the status of space exploration and research, students are further curious to learn about the space agency of our nation, ISRO, and its constituent units and their respective locations. The class started exploring it and has prepared the following:

The Indian Space Research Organisation (ISRO) was established on August 15, 1969. It superseded INCOSPAR with an expanded role to harness space technology. Later in 1972, the Government of India

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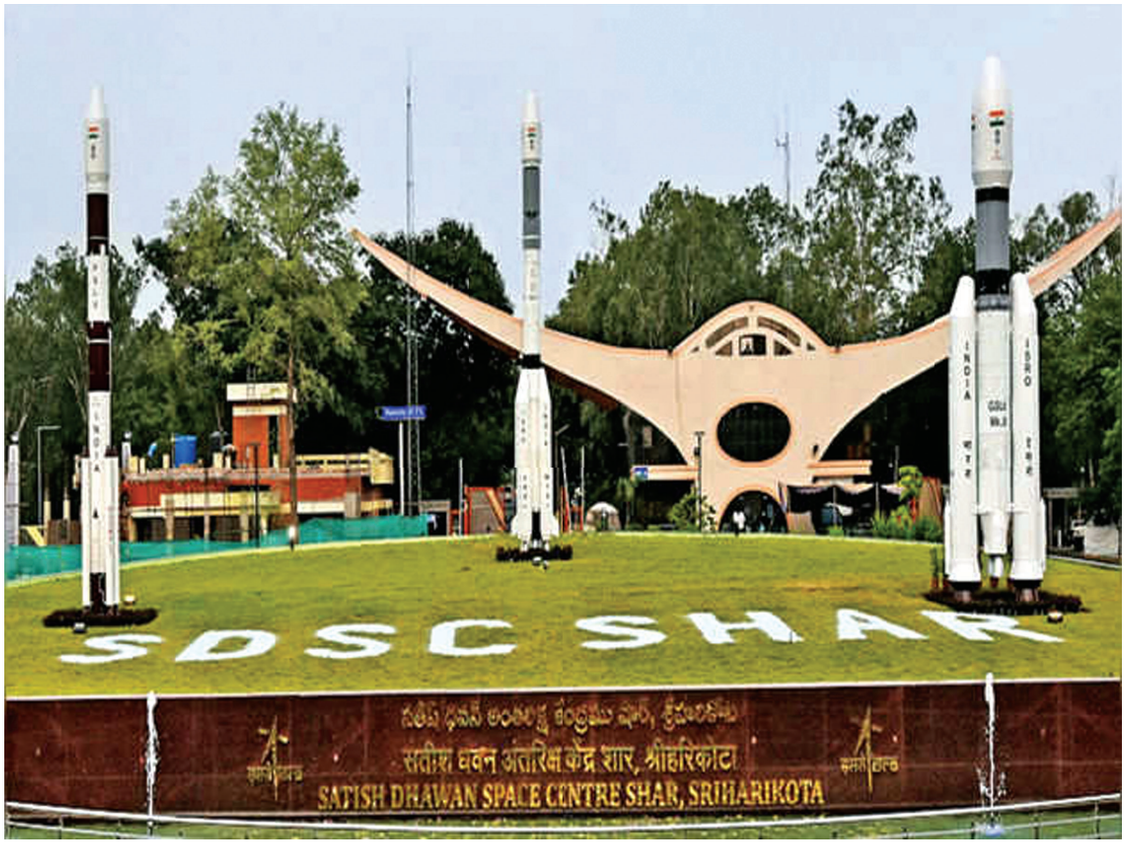
constituted the Space Commission and established the Department of Space, under which the ISRO was instituted. ISRO is now known as the space agency of India. The Space Commission formulates the policies and oversees the implementation of the Indian Space Programme to promote the development and applications of space science and technology for various national needs including socio-economic, communication, television broadcasting, and meteorological services, resource monitoring and management, space-based navigation services, technological and planetary exploration, etc. The Department of Space implements these programmes mainly through ISRO and its constituent units.



ISRO has its headquarters in Bengaluru. Its activities are spread across various centres and units. Each unit has a specific and given mandate to work upon. Launch vehicles are built at Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram; satellites are designed and developed at U R Rao Satellite Centre (URSC), Bengaluru; integration and launching of satellites and launch vehicles are carried out from Satish Dhawan Space Centre (SDSC) Sriharikota (SHAR); development of liquid stages including

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cryogenic stage is carried out at Liquid Propulsion Systems Centre (LPSC), Valiamala and Bengaluru; sensors for communication and remote sensing satellites and application aspects of the space technology are taken up at Space Applications Centre (SAC), Ahmedabad, and remote sensing satellite data reception processing and dissemination is entrusted to National Remote Sensing Centre (NRSC), Hyderabad. There are several other ISRO centres and units. These include the Department of Space and the ISRO HQ Human Space Flight Centre (HSFC), the Indian Institute of Remote Sensing (IIRS), the ISRO Inertial Systems Unit (IISU), the ISRO Propulsion Complex (IPRC), the ISRO Telemetry, Tracking and Command Network (ISTRAC), the Laboratory for Electro-Optics Systems (LEOS), the Liquid Propulsion Systems Centre (LPSC), and the Master Control Facility (MCF).

ISRO also has its supporting wings, viz., the Indian National Space Promotion and Authorisation Centre (IN-SPACe) and Central Public Sector Enterprises (CPSEs). These include Antrix Corporation Limited and New Space India Limited (NSIL). There are four autonomous bodies working under the aegis of ISRO. These are: Indian Institute of Space Science and Technology (IIST), Thiruvananthapuram; National Atmospheric Research Laboratory (NARL), Tirupati; North Eastern Space Applications Centre (NE-SAC), Ri Bhoi, Meghalaya, and Physical Research Laboratory (PRL), Ahmedabad.

Indian Space Programme and its Journey so far

Students are now anxious to learn about the ISRO's progress so far and what it has done so far. How are ISRO and other agencies planning to pursue this further? How about MoM and Aditya L1?

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The core of the Indian Space Programme lies in nationalism, entrepreneurship, and national security. Nationalism necessarily includes nation-building, regime legitimacy, internal national development and external status. Space has always been viewed as a major tool for developing the scientific temper for nation-building. All governments in independent India have viewed the development of space capacity as a priority. Space has continued to play a critical role in the shaping of the achievements of current Prime Minister Narendra Modi. He has always highlighted the importance of space for India's national development. He has personally been watching the progress in space reforms and developing India's commercial space sector. Under the present leadership, India is hailed as being able to develop low-cost launch systems, be it the Mars mission, Lunar missions—Chandrayaan, or the Solar mission—Aditya-L1. It is worthy to note that India has played an entrepreneurial role in space capacity.

Presently, the ISRO's commercial arm, Antrix Corporation Limited, and the establishment of New Space India Limited (NSIL) in a public-private partnership are striving not only to build a global customer base for Indian space technology, but also to develop freedom of innovation in the private sector. As per the vision of the present government, the role of government should be as an enabler, identifying the space sector as a resource for progress. Thus, the space sector would mean better mapping, imaging, and connectivity facilities for the countrymen. The space sector also envisages better forecasts of natural calamities, better speed from shipment to delivery for entrepreneurs, better navigation and security. Indian space entrepreneurship programmes are expected to become a major profit-earning agency for the global space industry. The need to explore space technology in national security, such as in nuclear command, control, and communication; military command and control; global positioning systems; navigation; intelligence; surveillance, and reconnaissance, etc., has been increasing tremendously over the last two decades. The development of an 'eye in the sky' or satellite surveillance adds to strategic forecasting and mapping of any intrusions and/or the building of military infrastructure across border areas.

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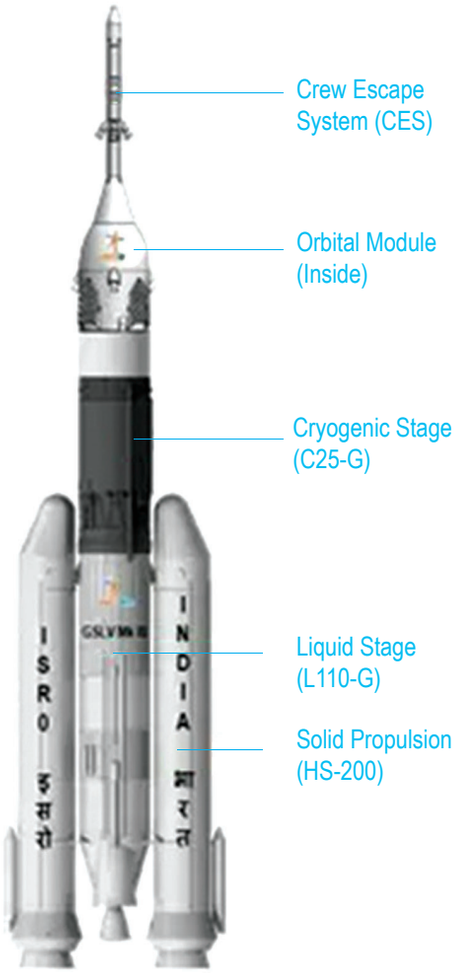
The 2025 vision for India's Space Programme envisages: (i) to develop satellite-based communication and navigation systems for rural connectivity, security needs, and mobile services; (ii) to enhance imaging capability for the management of natural resources, weather, and assist in climate change studies; (iii) to further develop 'space science' missions to enhance understanding of the solar system and the universe; (iv) to develop a heavy lift launcher capability; (v) to develop reusable launch vehicles; and (vi) to develop a human flight programme.

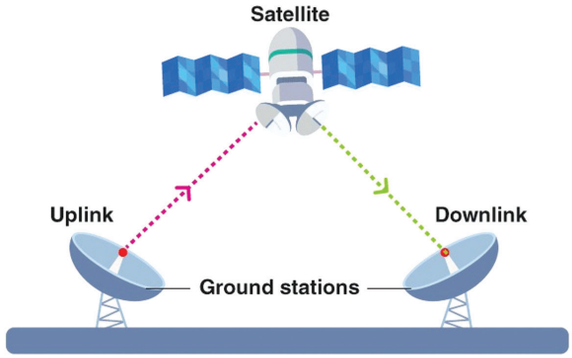


Activity 1

Well, after having learned about space missions, the space agency of our country, ISRO, and its journey so far, we need to focus on the present activities of our endeavours in space research. Let's see.

Gaganyaan

The Gaganyaan project envisages a demonstration of human spaceflight capability by launching a crew of three members into an orbit of 400 km for a 3-day mission, and bringing them back safely to earth by landing in Indian sea waters. Before carrying out the actual Human Space Flight mission, ISRO plans to demonstrate the level of technology preparedness. These demonstrator missions include Integrated Air Drop Test (IADT), Pad Abort Test (PAT), and Test Vehicle (TV) flights. The safety and reliability of all systems will be proven in unmanned missions preceding manned missions. For effective



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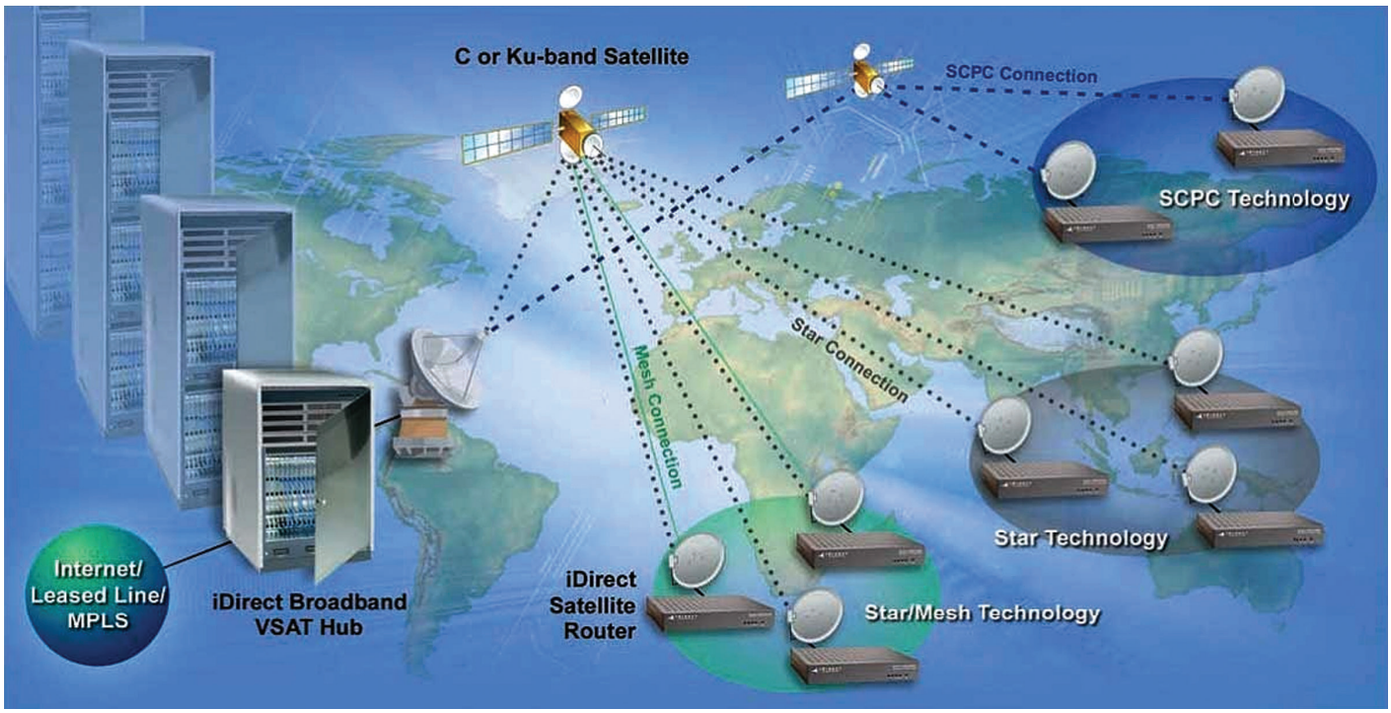
monitoring and implementing the programme, a new ISRO Human Spaceflight Centre (HSFC) has been formed.

Communication

Above the Indian skies, a fleet of 17 communication satellites plays a pivotal role in supporting an array of vital services, including television broadcasting, Direct-to-Home (DTH) television services, telecommunications, very small aperture terminals, radio networking, strategic communication, and applications serving society at large. Notable users of these transponders encompass government and strategic entities, Prasar Bharati, DTH and television service providers, public sector organisations such as BSNL, ONGC, AAI, ECIL, private VSAT operators, as well as banking and financial institutions, among others. These communication satellites are equipped with transponders spanning various frequency bands, including C-band, extended C-band, Ku-band, Ka/Ku band, and S-band.



The Department of Space and ISRO also support customised societal endeavours in need-based telemedicine, teleeducation, and disaster management activities.

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Space Transportation System

The Indian Space Programme has successfully evolved in terms of technology acquisition and the development of launch vehicles. The Polar Satellite Launch Vehicle (PSLV) has gained popularity as a reliable and cost-effective choice for launching satellites from various countries and fostering unprecedented international collaboration. Furthermore, the Geosynchronous Satellite Launch Vehicle (GSLV), equipped with an indigenous cryogenic stage, has transitioned into an operational vehicle primarily used for communication satellites. This accomplishment has led India towards self-sufficiency in space transportation, enabling the launch of satellites for purposes such as earth observation, communication, navigation, and space exploration using the PSLV and GSLV.

Planetary Research

The image of the shadow of the Phobos (circled in red, a satellite of mars) on the surface of mars. Image taken by India's Mangalyaan.

AstroSat—India's first astronomical space observatory, facilitates the concurrent, multi-wavelength observation of diverse celestial entities using a single satellite. Some noteworthy discoveries made with AstroSat are: (i) the detection of ultraviolet emissions emanating from remote galaxies; (ii) the capture of high-resolution images depicting extended ultraviolet emissions from star clusters and nearby galaxies; (iii) the identification of significant spectral attributes within X-ray sources within our galaxy, comprehensive multi-wavelength coverage of activities in extragalactic realms; and (iv) the polarisation of X-rays in proximate supernova remnants.

The Mars Orbiter Mission (MOM), an interplanetary spacecraft endeavour, has triumphantly completed its sixth year in orbit around Mars. Ongoing scientific analyses of data received from the spacecraft span various aspects of the red planet.

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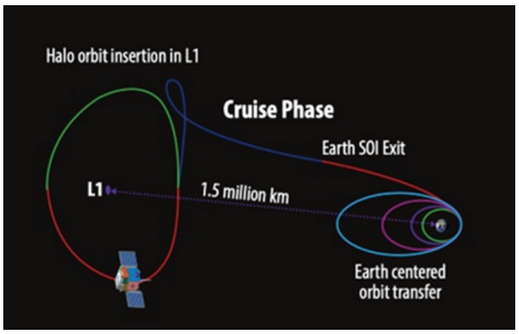
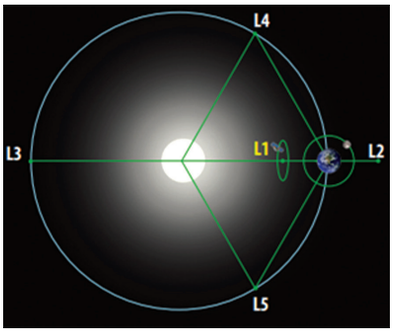
In the realm of lunar exploration, the next section deals in with the Chandrayaan missions.

Study of the Sun—Aditya L1 Mission

The sun is the largest and heaviest object in our solar system, and is approximately 15 crore kilometers from the Earth. It is a hot, glowing sphere of hydrogen and helium gases. At the core of the Sun the temperatures are estimated to be as high as 1.5 crore kelvin. However, the visible surface of the sun, the photosphere, is relatively cool at about 5,500 K. Though its estimated age is around 4.5 arab (billion) years, it is a very dynamic star. To study the Sun, India has launched its first space-based observatory, Aditya-L1 mission, on September 2, 2023, from the Satish Dhawan Space Centre (SDSC), Sriharikota. The spacecraft was initially placed in LEO. Subsequently, it was successfully maneuvered four-time on September 15, 2023, to obtain the orbit at 256 x 1,219,73 km. On 19th September, 2023, the spacecraft took an exit from the earth's gravitational sphere of influence and started traveling to Lagrange point L1. It is expected that the spacecraft will reach the L1 in January 2024, which is 15 lakh km from the earth. In the Sun-Earth system, there are five Lagrange points: L1, L2, L3, L4, and L5. At these points, the gravitational pull of the Sun and Earth on the spacecraft would be equal to the necessary centripetal force required for the spacecraft to move with the Sun and Earth. Notice that L1, L2, and L3 are in the same line, with L1 and L2 being equidistant from the Earth, as shown, whereas L4 and L5 constitute equilateral triangles. The observatory is to be placed in a halo orbit around L1 to enable it to continuously view the Sun without any eclipse. It will ensure Aditya-L1 to observes solar activities continuously.



The journey of Observatory Aditya-L1: SDSC, Sriharikota to halo orbit around the Lagrange point L1 in Sun-Earth system.



The Lagrange points L1, L2, L3, L4 and L5 in the Sun-Earth system. The orbit shown in green is halo orbit around L1

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Study of the Earth

Observations from space-based facilities and other sources are used to assess resources such as land cover, vegetation, surface and groundwater, snow (or glaciers), soil, wetlands, minerals (or hydrocarbons), etc. Additionally, the study extends to renewable (inexhaustible) energy sources like solar, hydro, offshore wind, and wave energy, as well as monitoring wastelands and land degradation. Advanced techniques have been developed to forecast crop production, identify potential fishing zones (PFZ), assess horticulture, and manage crop insurance programs that involve yield modeling and damage assessment. Moreover, space-based data is pivotal for evaluating irrigation potential utilisation and reservoir capacity.

Within the context of disaster management, the Disaster Management Support (DMS) Programme by ISRO plays a pivotal role in providing space-based inputs for effective disaster management within India.

ISRO's commitment to disaster management also extends internationally, as it is a signatory to the International Charter for Space and Major Disasters. ISRO supports this initiative by planning satellite data acquisition from various Indian remote sensing satellites and actively participating in disaster scenarios across countries by providing sets of Indian remote sensing data. Furthermore, ISRO also conducted a comprehensive scientific study to analyse the impact of lockdown measures on environmental parameters in India.

Capacity Building and Global Collaboration

Great! We are also inclined to learn how we can be a part of such initiatives, as many of the class students exclaimed. How can students be a part of it? Let us explore to some extent. We are also curious to learn the commercial (or economic) implications! The class further echos.

Space programmes are exclusive and are at high risk. The cost of failure is of multiple orders compared to conventional areas. The space missions are therefore conceived with almost zero defects. The achievements of the Indian Space Programme have been primarily due to the well-established quality standards and review system and completing the activities with commitment and dedication with professionalism. Recognising the

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Indian Institute of Space Sience and Technology (IIST), Thiruvananthpuram

importance of nurturing such unique talents and motivating principles, the department has always emphasised capacity-building-related aspects. Capacity building encompasses multiple areas of development to ensure that the department achieves its goals as envisioned.

In order to enhance the capacity of human resources and address the increasing requirements of the Indian Space Programme, the Indian Institute of Space Science and Technology (IIST) was founded in Thiruvananthapuram in 2007. This institution stands as a pioneer in the nation, offering top-tier education across various levels, including undergraduate, postgraduate, doctoral, and post-doctoral, with a distinct emphasis on disciplines related to space sciences, space technology, and space applications.

ISRO also conducts various activities for school students and faculty members. The details of all such capacity-building programmes can be seen on the ISRO website: www.isro.gov.in.

International collaboration constitutes an integral component of India's space endeavours, and ISRO continues to prioritise bilateral and multilateral relationships with space agencies and related organisations. The objective is to address novel scientific and technological challenges, establish international frameworks for the peaceful utilisation of outer space, refine space policies, and strengthen existing ties between nations.

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Commercial Wing

New Space India Limited (NSIL) was established in 2019, as a central public sector enterprise under the administrative purview of the Department of Space, Government of India. This initiative was conceived with the overarching goal of offering products and services derived from the Indian Space Programme to both domestic and global customers. Additionally, NSIL was created to stimulate the growth of the Indian industry, encouraging it to take on complex technological challenges within the field of space-related activities.

The NSIL is majorly involved in the construction and in-orbit delivery of various types and classes of satellites, the ownership and operation of satellites for providing space-based communication and earth observation services, the development of launch vehicles in collaboration with the Indian industry to meet customer demands, the provision of launch services to both Indian and international clients, and facilitating technology transfer to the Indian industry, among other tasks. NSIL actively engages in the construction and in-orbit delivery of diverse satellite types and their subsystems, serving both domestic and international clientele. Furthermore, it extends space launch services to its customers by leveraging the proven launch vehicles of the Indian Space Research Organisation (ISRO). NSIL's overarching objective is to bring space technology and its applications to the grassroots level through space-based services.

The NSIL company assumes a pivotal role in delivering space-based services through communication satellites, catering to applications such as television broadcasting, direct-to-home (DTH) services, very-small-aperture terminal (VSAT) connectivity, broadband services, communication backhaul, in-flight connectivity services, and services for digital satellite news gathering (DSNG) operators. Additionally, NSIL leverages earth observation satellites for applications related to the management of natural resources, urban planning, and overall socio-economic development.

Chandrayaan

We are all well versed in the ISRO's activities. Nowadays, Chandrayaan has brought in much awareness and excitement—students sound in resonance. How many such missions have been explored so far? Looking into the students' excitement, the teacher encourages them further.

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Chandrayaan-1: India's First Lunar Mission

Chandrayyan-1 is credited for reviving interest about presence of water on the Moon

Chandrayaan-1, the first Indian lunar probe, was launched successfully on October 22, 2008, from the Satish Dhawan Space Centre, Sriharikota. This spacecraft orbited the moon in an orbit at an altitude of 100 km, conducting crucial tasks like chemical, mineralogical, and photo-geologic mapping of the lunar surface. The spacecraft was equipped with 11 scientific instruments, contributed by nations including India, the USA, the UK, Germany, Sweden, and Bulgaria. The Moon Impact Probe (MIP) used in this mission provided signatures of the presence of water around the south pole of the moon. This research led India to pursue lunar missions further. The mission achieved most of its goals within a year. Its orbit was then raised to 200 km in May 2009. The mission was considered concluded after losing communication with the spacecraft on August 29, 2009.

Chandrayaan-2: A Technological Leap

After the remarkable success of Mission Chandrayaan-1, India moved further into lunar exploration. Chandrayaan-2, launched in 2019, represented a significant technological leap compared to previous ISRO and international space agency missions in the sense that it aimed to demonstrate

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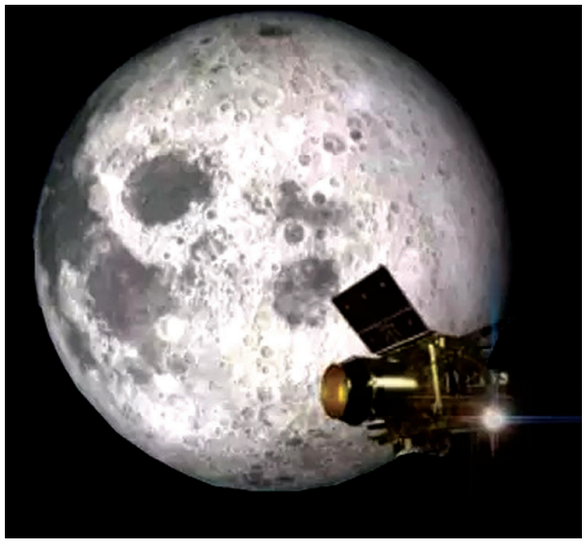
the soft landing on the South Pole of the Moon and scientific exploration capabilities. It brought together an orbiter, lander *Vikram,* and rover *Pragyan* with the goal of exploring not just one area of the moon but all areas, combining the exosphere, surface, and sub-surface of the moon as well as studying the lunar south pole through in-vitro observations in a single mission. Extensive mapping of the lunar surface was essential to trace back the origin and evolution of the moon. Additionally, evidence for water molecules discovered by Chandrayaan-1 required further studies on the extent of water molecule distribution on the surface, below the surface, and in the thinner lunar atmosphere.



Chandrayaan-2 orbiter maps Moon for minerals

On July 22, 2019, ISRO employed its most powerful launch vehicle rocket, GSLV-MK III-M1, to inject the Chandrayaan-2 into its initial earth's orbit. Following it, a series of maneuvers were executed to elevate its trajectory. On August 14, 2019, after the Trans Lunar Insertion (TLI) maneuver, the spacecraft broke free from earth's orbit and embarked on a trajectory that would take it towards the moon. By August 20, 2019, Chandrayaan-2 had been successfully inserted into lunar orbit, where it circled the Moon at an altitude of 100 km. In preparation for its lunar soft landing, on September 2, 2019, the *Vikram* Lander was detached from the orbiter. Subsequently, two de-orbit maneuvers were carried out for the *Vikram* lander to adjust its orbit and position it in a circular path around the moon, maintaining an altitude ranging from 100 kilometers to 35 kilometers.

The descent of the *Vikram* lander went as planned, landing on September 7, 2019, early in the morning. The whole nation was waiting for this historic event. Our Prime Minister, Shri Narendra Modi, and many other dignitaries from space science and research were all waiting in the ISRO Telemetry, Tracking, and Command Network (ISTRAC) Centre in

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Bengaluru. The lander, *Vikram*, was performing normally until it reached an altitude of 2.1 km. Unfortunately, communication between the lander and ground stations in Bengaluru was lost at this point. And a hard landing of lander was assumed. It was a historic point in India's space programme, as the Prime Minister still congratulated and encouraged the ISRO scientists for their endeavours in the mission and extended full support from the Government of India, to opt for the launch of lunar soft landings and other missions again.

Meanwhile, the orbiter, which had been placed in its intended lunar orbit, played a crucial role in expanding our knowledge of the Moon's history and mapping the distribution of minerals and water molecules in the lunar polar regions. Equipped with eight advanced scientific instruments, the orbiter's camera stands out as the highest-resolution camera (with a resolution of 0.3 m) of any lunar mission to date. This camera's high-resolution images are expected to be invaluable to the global scientific community. The orbiter was originally planned for a one-year mission. Thanks to ISRO's precise launch and mission management, the orbiter is still in operation (September 2023), and in-fact, its operational lifespan is now extended until 2026.

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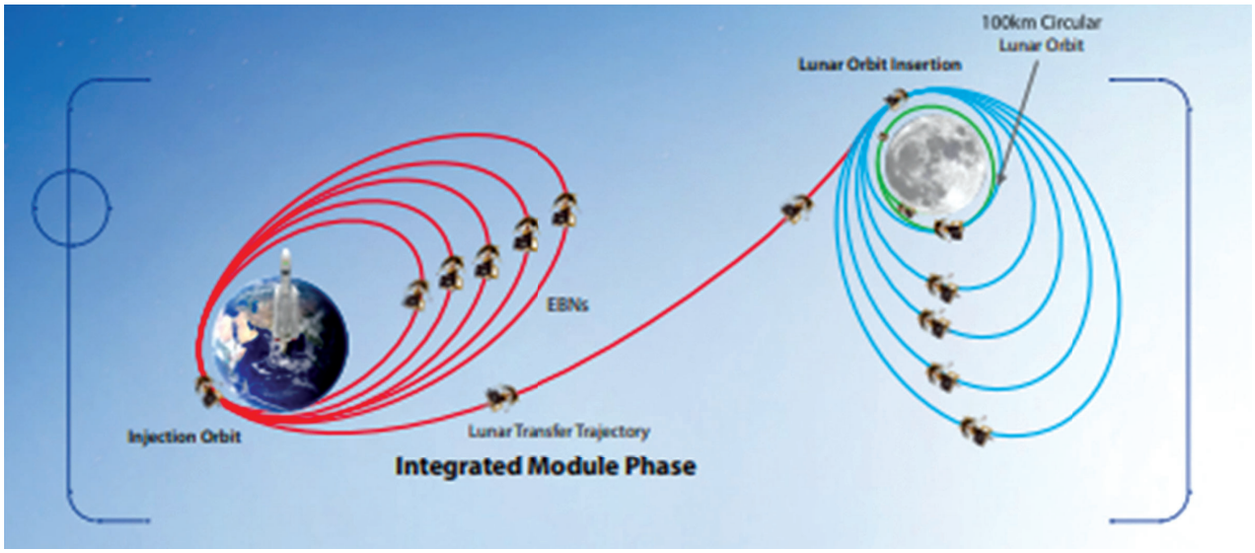
Chandrayaan-3: Advancing Lunar Exploration

Following the setback of the Chandrayaan-2 mission, ISRO has now become successful in demonstrating its end-to-end capability for safe landing and roving on the lunar surface. This spacecraft was launched aboard India's heaviest rocket, the LV Mark-III M4, on July 14, 2023, from the SDSC-SHAR. Learning from the predecessor mission, this mission was designed with a focus on failure-based strategies to enhance mission success. As the orbiter of Chandrayaan-2 is still in operation, this mission did not have any orbiters; instead, it used the data received from the predecessor's orbiter. It only had a lander to soft-land on the South Pole and a rover to study the moon's surface. The landing area was expanded, allowing the lander to touch down safely within a region of 4 km x 2 km, unlike in the predecessor's case, where it was 500 m x 500 m.



Chandrayaan-3: Payloads

Chandrayaan-3 consisted of an indigenous propulsion module, a lander module, and a rover, with the objective of developing and demonstrating new technologies required for interplanetary missions. The propulsion module carried the lander and rover configuration to the lunar orbit of 153 km x 163 km. It is a box-like structure with a large solar panel and an intermodular adapter cone that worked as a mounting structure for the lander. In addition, the propulsion module also carried a SHAPE payload.

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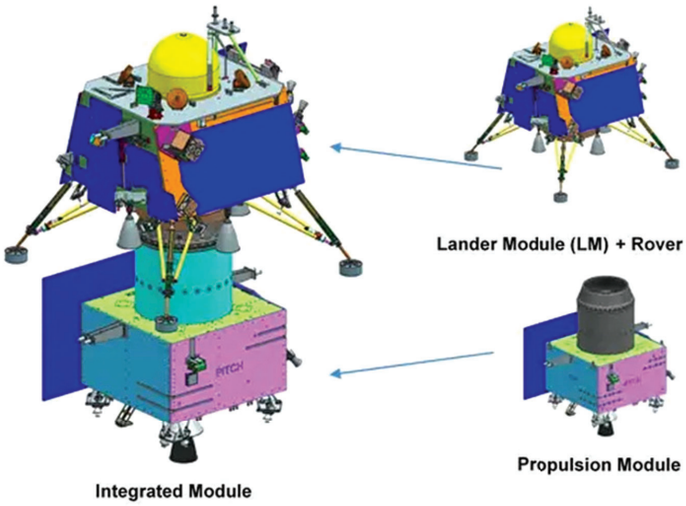
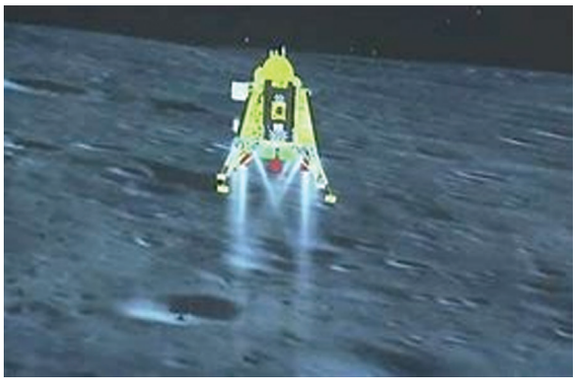
The *Vikram* lander module was designed to soft-land on the lunar surface. It also had a box-like structure with four landing legs and four landing thrusters. It carried the *Pragyan* rover and various scientific instruments for in-site analysis.



Chandrayaan-3 has three main components: Propulsion Module, Vikram Lander and Pragyan Rover

Chandrayaan-3 first communicated with the ground station at ISTRAC, Bengaluru and sent the picture of moon as viewed during lunar orbit insertion on August 6, 2023.



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Timeline and Launch Details of Chandrayaan-3

July 6	The launch scheduled for July 14, 2023 at 2.35 PM (IST) from the second launch pad at SDSC, Sriharikota.
July 7	All electrical vehicle tests are completed.
July 11	The launch rehearsal was successfully completed.
July 14	Using the LVMIII-M4, the Chandrayaan-3 was precisely and successfully launched in earth's orbit.
July 15	The first orbit-raising maneuver was performed at ISTRAC on July 15 in 41762 km x 173 km earth's orbit.

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July 17	The second maneuver was performed in 41603 km x 226 km orbit.
July 22	The third orbit-raising maneuvers took place in 71351 km x 233 km earth's orbit.
July 25	Additional orbit-raising maneuver was performed.
August 1	The spacecraft was inserted into the translunar orbit 288 km x 369328 km
August 5	The spacecraft was inserted into the lunar orbit (164 km x 18074 km)
August 6	Chandrayaan-3 communicated with the ground station at ISTRAC and sent the pictures of the moon as viewed during lunar orbit insertion and the spacecraft reached nearer to moon in 170 km x 4313 km orbit.
August 9	Spacecraft's orbit was reduced to lower lunar orbit at 174 km x 1437 km.
August 14	The spacecraft's orbit became nearly circular (151 km x 179 km).
August 16	Chandrayaan-3 was inserted to a further lower lunar orbit at 153 km x 163 km.
August 17	The lander module got separate from the propulsion rocket module in 153 km x 163 km lunar orbit.
August 19	The lander module reduced its orbit at 113 km x 157 km.
August 20	The lander module further reduced its orbit at 25 km x 134 km.
August 23	The lander soft-landed on the lunar surface at 6.04 PM (IST). India became the fourth country to reach moon and first to soft-land at the lunar south pole.
August 24	The rover Pragyan ramped down from the lander and thus India took a walk on the moon.
August 27	The first observations from the ChaSTE payload onboard Vikram lander was received at ISTRAC.
August 28	LIBS confirmed presence of sulphur on the lunar surface through unambiguous in-situ experiments.

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August 30	APXS onboard Pragyan rover detects the presence of minor elements
August 31	ILSA listens to the movements around the landing site; and RAMBHA-LP onboard Chandrayaan-3 measures near surface plasma content.
September 4	The lander and rover are in sleep mode. The solar power-driven batteries are fully charged with an expectation that it will awake on September 22, but it could not yet.

On August 23, 2023, the whole world witnessed the soft landing of the Vikram lander on the south pole of the moon at 6.04 PM (IST). The event was so startling that its telecast and live streaming were viewed by a record number of audiences. Our Honurable Prime Minister, Shri Narendra Modi also witnessed the event, though he was participating at the BRICS meetings in South Africa. On the successful soft landing of the lander on the Moon, he inspired and congratulated the ISRO. Later, on the same day, *Vikram* sent a message to the ground station: "I reached my destination and you too!"

Why August 23, 2023?

Learners' have learned about the Chandrayaan missions. Equally now, they are anxious to understand the timing! Why August 23, etc.? Let us try and understand!

On Earth, we have a day of 24 hours. It is because the Earth completes one rotation in 24 hours. However, the situation is not the same. It takes nearly 14 Earth days to complete one rotation. The date, August 23, 2023, marked the commencement of the lunar day (equivalent to 14 earth days). Therefore, Chandrayaan-3 was programmed to land on August 23, 2023, because that's when the Moon's daytime starts towards its South Pole. This timing would help the spacecraft use sunlight to charge its batteries and perform the designated tasks. The South Pole of the Moon had the darkest time from September 7 to September 22. The next sunrise on the South Pole was on September 22, 2023. Scientists were expecting that the *Vikram* and *Pragyan* would then come out of their sleeps and start communicating with the ground station again. It, however, could not happen. The mission is not yet closed!

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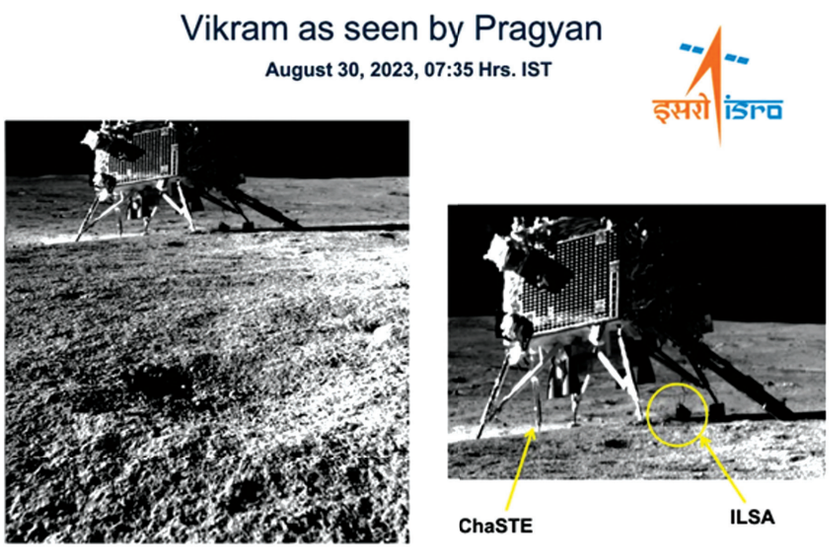
National Space Day

Excited with India's success and ISRO's achievements in the Chandrayaan-3 mission, while returning home after the two-nation visit from South Africa and Greece, Prime Minister Narendra Modi decided to first visit Bengaluru to personally meet ISRO scientists. He congratulated all the scientists involved with the Chandrayaan mission and gave full support to the government for the forthcoming Solar Aditya-L1 and Gaganyaan



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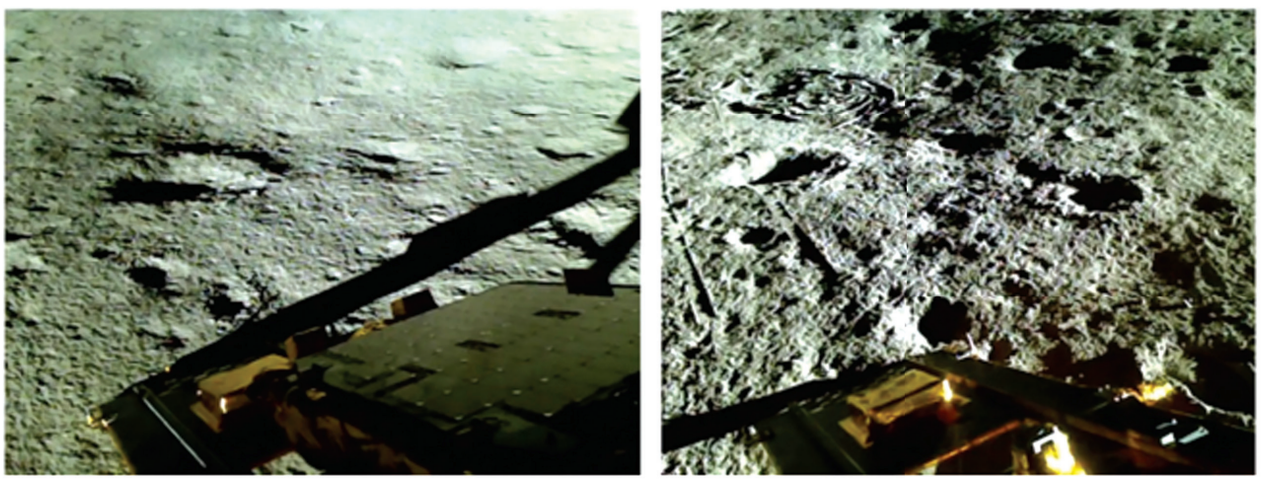
missions. During his meeting with the ISRO scientists, the Prime Minister announced August 23 as 'National Space Day'. It will be celebrated every year to commemorate the successful soft landing of the *Vikram* lander on the South Pole of the Moon. During his visit to ISTRAC, the Prime Minister designated the sites where the *Vikram* lander (Chandrayaan-3 mission) touched the lunar surface after its soft landing on August 23, 2023, as "Shivshakti Point". He also mentioned that the area where the Chandrayaan-2 lander unfortunately crashed on September 6, 2019, will now be referred to as "Tiranga Point".

Pre and Post Hop Ramp images captured by Lander Imager–1 Camera

Ramp Deployed Position Captured on 25-08-2023

Ramp Deployed Position Captured on 03-09-2023 after post Hopping



(Picture source: www.isro.gov.in)

Ha! It has been a long time since I learned about space missions in general and Chandrayaan in particular. It has been so engaging that we never realised the time it took. One of the students, Sunita, exclaimed—I will pursue further scientific research. The whole class echoed in resonance.

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Activity 2

MAKE YOUR OWN ROCKET

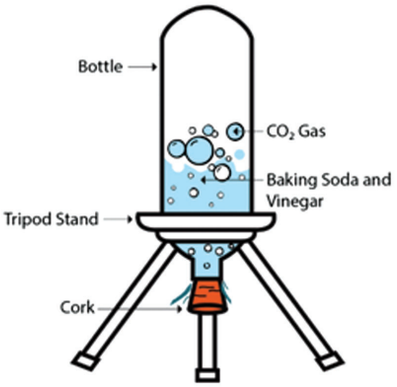
Requirements:

A 1.5 L/2 L narrow neck empty bottle, vinegar (100 – 200 mL), baking soda (1 – 2 table spoons), a funnel, a cork, a few tissue papers, and a tripod stand.

Procedure:

- Take an empty bottle and pour 100 – 200 mL of vinegar into it with the help of a funnel.
- Pour 1 – 2 table spoons of baking soda into the bottle and quickly close (tighten) the opening with the help of a cork and tissue paper.
- Switch the bottle upside down (opening towards the ground) and place it on the tripod stand.

Caution: Move yourself a few distances away from the setup and let the acid-base reaction take place. As a result of the reaction, carbon dioxide (CO_2) gas is produced. This gas exerts an upward pressure on the bottle and generates enough thrust to launch it into the air.



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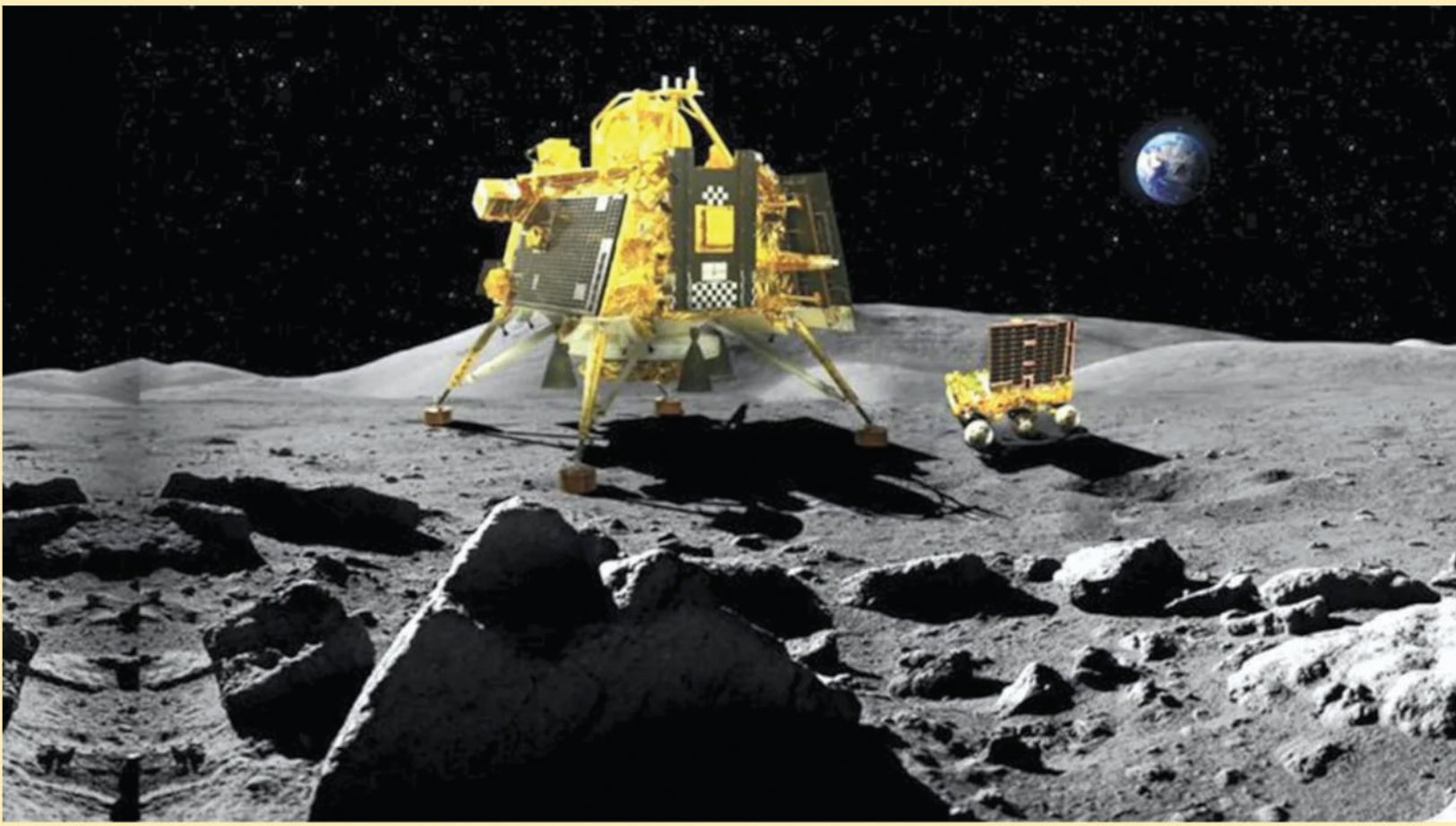
Theme 1.0 Chandrayaan Utsav

1.1	F	हमारा चंद्रयान Our Chandrayaan
1.2	P	*Mera Pyara Chanda: Rani ki Khoj*
1.3	M	Chandrayaan Mission: Bharat's Expedition to the Moon
1.4	S	Chandrayaan: Journey Towards the Moon
1.5	S	Exploring the Moon Mission of Bharat
1.6	S	Towards Moon and Beyond
1.7	S	Exploring Chandrayaan-3: Bharat's Lunar Mission
1.8	HS	Bharat on the Moon
1.9	HS	Bharat Space Mission: The Chandrayaan Mission
1.10	HS	Physics of Chandrayaan-3

For participation in the activities related to Apna Chandrayaan:
Visit : www.bharatonthemoon.ncert.gov.in

For more information:
Email: dceta.ncert@nic.in
PMeVIDYA IVRS: 8800440559



An image of Rover *Pragyan* with Lander *Vikram*

विद्यया ऽ मृतमश्नुते

एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
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