

ACHIEVEMENTS OF CONTEMPORARY BHARAT



सत्यमेव जयते

MINISTRY  
OF EDUCATION  
Government of India

# CHANDRAYAAN UTSAV

CODE  
1.5S



SPECIAL MODULE

विद्यया ऽ मृतमश्नुते



एन सी ई आर टी  
NCERT

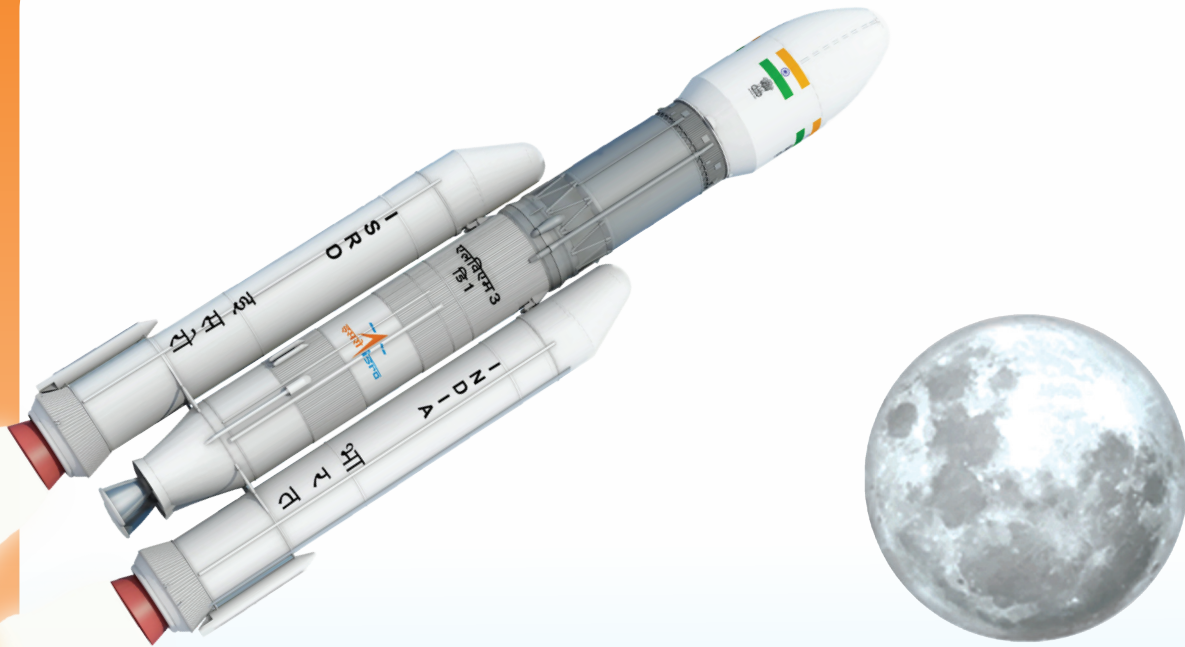
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# Exploring the Moon Mission of Bharat

Secondary Stage



Let us moon knows about Bharat's lunar exploration program and its significance in the global context. Bharat's lunar exploration program which began in 2008 with the launch of Chandrayaan-1 exemplifies Bharat's commitment to lunar exploration. This module will explain the journey of Bharat's moon mission from Chandrayaan-1 to Chandrayaan-3 which is exhilarating and showcases success and resilience to learn from setbacks. You will learn about the Indian values and traditions related to the Moon. The Moon provides an unspoiled setting for researching a variety of astronomical occurrences, acting as a priceless celestial laboratory. Due to its proximity to the Earth, geological processes, surface characteristics, and lunar geography can all be carefully examined. Some activities related to the Moon can be taken up by you, which will promote observational astronomy and in turn help understand the Bharat's Moon mission.

Do you know that The Moon has been an integral part of Indian culture, faiths and tradition for centuries. It has been a source of inspiration for poets, artists, and writers alike. In the Indian tradition, the Moon is personified as a divine figure *Chandra*, who is believed to be the ruler of the night sky. The Moon is also associated with various festivals and rituals in Bharat. The Moon holds immense cultural significance in Indian culture, literature, and art, making it a natural focal point for scientific exploration. Understanding this connection will provide a deeper appreciation for Bharat's Chandrayaan missions.

Bharat's Lunar Exploration Program began with Chandrayaan-1 in 2008, which was aimed at mapping the lunar surface and studying its mineral composition. Chandrayaan-2 was launched in 2019 and consisted of an orbiter, a lander named *Vikram*, and a rover named *Pragyan*. Although *Vikram*'s soft-landing attempt could not achieve complete success, the orbiter continues to orbit the Moon and collect valuable data. Chandrayaan-3 is Bharat's third Lunar Exploration Mission, which was launched in July 2023. The mission also consists of a lander named *Vikram* and a rover named *Pragyan*, similar to those launched aboard Chandrayaan-2. The mission aims to explore the unexplored South Pole of the Moon and demonstrate end-to-end landing and roving capabilities.

It is important for all of us to develop an understanding of Bharat's Lunar Exploration Program and its significance in the global context. The module will also help students appreciate Indian values and traditions related to the Moon.

## **Indian Values and Traditions Related to the Moon**

Bharat's cultural landscape is intricately woven with references to the Moon, shaping beliefs, art, literature, and festivities for centuries. In the Bhartiya tradition, the Moon is personified as *Chandra*, a benevolent deity who exudes serenity and grace. *Chandra* is often depicted holding a lotus, symbolizing purity and enlightenment, further emphasising the spiritual connection between the Moon and Indian ethos. Literature, both classical and contemporary, frequently draws upon the Moon as a metaphor for beauty, tranquillity, and unrequited love. The verses of Kalidasa, a renowned Sanskrit poet, in his epic poem 'Meghdoot' vividly describe the Moon's ethereal glow, likening it to the smile of separated lovers. In modern Indian literature, the Moon remains a potent symbol, evoking nostalgia, yearning, and introspection. Artistic representations of the Moon adorn countless Indian paintings and sculptures. In ancient cave art at places like Ajanta and Ellora, the Moon is depicted in various forms, reflecting the spiritual reverence accorded to it. Miniature paintings from Rajasthan and Madhubani art from Bihar feature the Moon as a central motif, celebrating its luminous beauty.

The Moon has been an indispensable part of the time calculation in the traditional ancient calendrical system of luni-solar calendars of Bharat. The lunar months, called *chandramāsa*, of the Indian year derive their names from the occurrence of full Moon in a particular *nakshatra* (lunar mansion). For instance, *Chaitra* month is named after *Chitrā nakshatra* transiting the Moon during the period. Similar logic follows for the rest of the months like *Vaishakha*, *Jyeshtha*, etc. Even the concept of *Tithi* meaning lunar day directly follows from the period of time during which the angle between the Sun and the Moon increases by 12 degrees. This tithi concept is central to the lunar month of the Indian calendrical system. Even the two fortnights of the month referred to as *paksh* are based on the waning and waxing cycle of the Moon and are called as *krishna paksh* and *shukla paksh* (Vajpayee, 2022).

You may have observed in your family or in your neighbourhood that festivals like Karvā Chauth and Sharad Pūrṇimā hold special significance in Bharat's cultural calendar, reinforcing the Moon's place in tradition. Karvā Chauth is a celebrated fasting ritual observed by married Hindu women, who abstain from food and water from sunrise until moonrise, praying for the longevity and well-being of their husbands. The sighting of the Moon on this day holds great importance, symbolising the fulfilment of their prayers. On Sharad Pūrṇimā, an auspicious night in Hinduism, devotees partake in a night-long vigil under the silver glow of the full moon. Folklore narrates that on this night, the Moon's rays possess healing properties, bestowing health and vitality upon those who bask in its luminance. Families gather on rooftops, courtyards, and open spaces, enjoying delectable sweets made from freshly harvested rice, revelling in the moonlit serenity. The Islamic festival of Eid-ul-Fitr too, is associated with the Moon, after a month's fasting by the followers of the faith during the holy month of Ramzan.

### Let's Learn Together

Participate in group discussions exploring the diverse cultural interpretations and beliefs associated with the Moon in different societies around the world. You can research and present on how various cultures, including Indian, Chinese, Native American, and others, have integrated the Moon into their traditions, folklore, and religious practices. You can search for mythological reference or anecdotes related to Moon in different cultures. This activity encourages critical thinking and cross-cultural understanding.

## A Look at Bharat's Chandrayaan Missions

The pursuit of lunar exploration has been a universal endeavour, transcending national boundaries. From the early observations of Galileo Galilei in the seventeenth century to the iconic Apollo 11 mission led by NASA in 1969, humanity's fascination with the Moon has driven relentless scientific inquiry. Bharat, a nation known for its ancient scientific acumen, recognised the importance of contributing to lunar exploration in the modern era. Bharat's lunar exploration program is an ongoing series of space missions by the Indian Space Research Organisation (ISRO) for the exploration of the Moon. The program includes a lunar orbiter, propulsion module, a soft lander, and a rover spacecraft. The program's strategic goals include developing Bharat's space technology and infrastructure, exploring the Moon's surface, and conducting scientific experiments. Lunar exploration worldwide has been conducted by several countries and organisations, including the Soviet Union, the United States, Japan, the European Space Agency, China, Israel, etc.

The Chandrayaan missions were conceived not only as a testament to Bharat's technological prowess but also as a means to unearth vital scientific knowledge about Earth's celestial companion. The goals extended beyond national pride, encompassing a shared quest for unravelling the mysteries of the Moon and its potential implications for humanity.

The strategic objectives of Bharat's Lunar Missions encompassed several key facets. Firstly, Chandrayaan aimed to comprehensively map the Moon's surface, utilising advanced imaging technology to gain unprecedented insights into its topography, mineral composition, and geological formations. This data would not only advance scientific knowledge, but also hold implications for potential resource utilisation in the future. Secondly,

### Activity 1

In small groups explore the Moon using two powerful tools: naked eyes and mobile phones. The session will commence with a brief introduction to lunar phases, followed by a hands-on demonstration of how to identify and observe various lunar features using only our eyes. You will learn about the significance of different phases and how they relate to the Moon's position in its orbit. Take pictures of the moon from waxing to the waning phase and make a collage. Alternatively, you can also draw pictures of the moon how it changes from waxing to waning phase. A STEAM (Science, Technology, Engineering, Arts and Mathematics) project can be planned as part of the observations of the Moon.

Chandrayaan sought to investigate the presence of water on the Moon, a discovery that could revolutionise our understanding of the Moon's history and its potential as a platform for future space exploration. The possibility of water ice existing in lunar Polar Regions held immense significance for sustaining future lunar habitats and missions. Lastly, Bharat's Chandrayaan missions were designed to bolster the nation's technological capabilities in space exploration. By successfully executing lunar missions, Bharat demonstrated its proficiency in spacecraft design, propulsion and autonomous navigation, guidance and control, positioning itself as a formidable player in the global space race.

### Activity 2

Make a short video or a collage showcasing all the important dates and events of Chandrayaan-1, 2 and 3. The video can be uploaded on the school website and the collage can be placed on the school notice board.

## Chandrayaan-1: Pioneering Lunar Exploration

Chandrayaan-1 marked a monumental milestone in Bharat's foray into space exploration. Launched on 22 October 2008, this mission, consisting of an orbiter and an impactor, was a testament to Bharat's determination to make significant contributions to lunar science. The spacecraft was equipped with 11 scientific instruments, each meticulously designed to fulfil specific objectives (Figure 1). Among these, the Moon Impact Probe (MIP) was a standout feature, designed to separate from the orbiter and make a controlled descent to the lunar surface once the orbiter reaches the final 100 km of the orbit to impact at a pre-selected location. The data transmitted by MIP provided crucial insights into the lunar atmosphere.

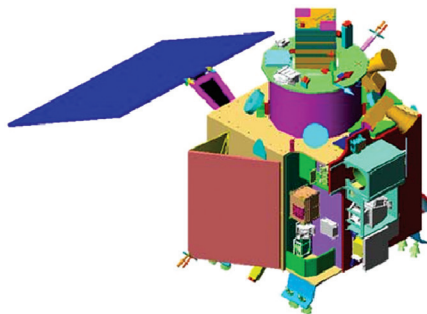


Figure 1: Integrated module of Chandrayaan-1

Source: Visual may be taken from ISRO website.



Chandrayaan-1's greatest achievement was the discovery of hydroxyl and water molecules on the lunar surface, a revelation that fundamentally altered our understanding of the Moon's composition (Figure 2). The Moon, long perceived as a barren and desolate world, now emerged as a potential repository of invaluable resources. Additionally, Chandrayaan-1 produced high-resolution images and maps of the lunar surface, enabling scientists to scrutinise geological features with unprecedented clarity. These images continue to serve as an invaluable resource for researchers worldwide.

A payload is the equipment, either scientific or technological, that is carried by a satellite for a given mission.

Do you know that Chandrayaan-1 carried several scientific payloads, viz., (source: [https://www.isro.gov.in/Chandrayaan\\_1.html](https://www.isro.gov.in/Chandrayaan_1.html)) Let us learn more.

### **Scientific Payloads from Bharat**

- Terrain Mapping Camera (TMC)
- Hyper Spectral Imager (HySI)
- Lunar Laser Ranging Instrument (LLRI)
- High Energy X-ray Spectrometer (HEX)
- Moon Impact Probe(MIP)

### **Scientific Payloads from Abroad**

- Chandrayaan-1 X-ray Spectrometer (CIXS)
- Near Infrared Spectrometer (SIR - 2)
- Sub keV Atom Reflecting Analyzer (SARA)
- Miniature Synthetic Aperature Radar (Mini SAR)
- Moon Mineralogy Mapper (M3)
- Radiation Dose Monitor (RADOM)



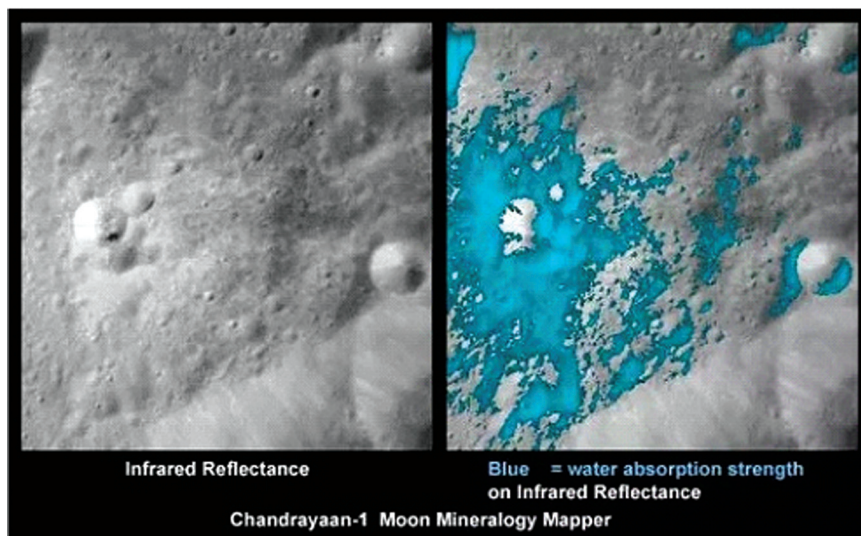


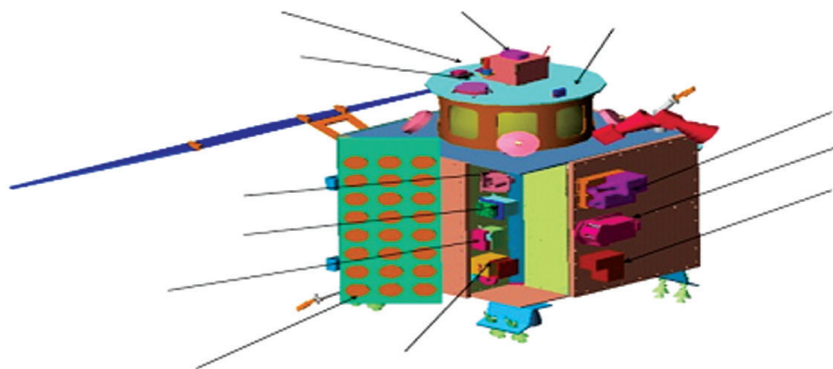
Figure 2: Moon Mineralogy Mapper onboard Chandrayaan-1 found the existence of water molecules on lunar surface.

Source: <https://chandrayaan.com/chandrayaan-1>

While the mission ended prematurely due to communication issues, Chandrayaan-1's contributions to lunar science remain enduring and continue to inspire subsequent lunar missions globally.

### Activity 3

In the sketch (Courtesy: ISRO, Bangalore) given below mark the different payloads and impact probe on board Chandrayaan-1. Also identify the objective of each payload.



Source: <https://issdc.gov.in/docs/ch1/chandrayaan-1.pdf>

## Chandrayaan-2: Advancing Lunar Research

Launched on 22 July 2019, Chandrayaan-2 was a testament to Bharat's commitment to pushing the boundaries of lunar exploration. Building upon the success of Chandrayaan-1, this mission was characterised by a multifaceted approach, comprising an orbiter, a lander (Vikram), and a rover (Pragyan). The mission aimed to study the south polar region of the Moon and conduct scientific experiments. The soft-landing attempt of Chandrayaan-2, though unsuccessful, was a significant leap forward in Bharat's space exploration endeavours. While the lander, Vikram, encountered challenges during its descent, it nevertheless demonstrated Bharat's capability to execute complex manoeuvres in the harsh lunar environment. The orbiter, with its suite of advanced instruments, continues to orbit the Moon, providing a wealth of data on its composition and topography.

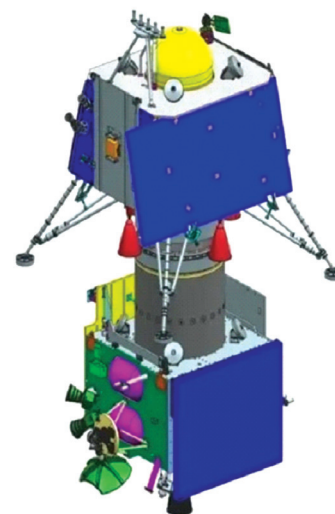


Figure 3: Integrated module of Chandrayaan-2.

Source: [https://www.isro.gov.in/Chandrayaan\\_2.html](https://www.isro.gov.in/Chandrayaan_2.html)

One of the mission's notable achievements was the detection of water ice on the lunar surface, particularly in the Polar Regions. This discovery further substantiated the presence of water molecules, corroborating Chandrayaan-1's ground breaking findings. The revelation holds profound implications for future lunar exploration and potential resource utilization. Chandrayaan-2's orbiter, equipped with high-resolution cameras and spectroscopic instruments, has provided detailed maps of the lunar surface, aiding in the identification of key geological features and potential landing sites for future missions. It found the presence of Argon 40—a noble gas in the lunar exosphere during the observations of the micro flares occurring outside active region as well as elemental abundances in the quiet Sun corona. Its continued operation ensures a sustained stream of data that continues to enrich our understanding of the Moon.

Chandrayaan-2 had an array of eight experiment payload on board, viz, (source: [https://www.isro.gov.in/Chandrayaan2\\_science.html](https://www.isro.gov.in/Chandrayaan2_science.html))

- Chandrayaan-2 Large Area Soft X-ray Spectrometer (CLASS)
- Solar X-ray Monitor (XSM)

- Chandra's Atmospheric Compositional Explorer 2 (CHACE 2). It is a Quadrupole Mass Spectrometer (QMA)
- Dual Frequency Synthetic Aperture Radar (DFSAR)
- Imaging Infra-Red Spectrometer (IIRS)
- Terrain Mapping Camera (TMC 2)
- Orbiter High Resolution Camera (OHRC)
- Dual Frequency Radio Science (DFRS) Experiment

#### **Activity 4**

According to ISRO, on 30th July 2020, Terrain Mapping Camera – 2 (TMC-2) onboard ISRO's Chandrayaan -2 captured the Sarabhai Crater on Mare Serenitatis in the north east quadrant of the Moon. Mare Serenitatis, which host the Sarabhai crater is one of the lunar mare region on the Moon, with vast lava plains creating a near flat surface. To the east and ~250-300 km of Sarabhai crater is the landing site of Apollo 17 and Luna 21 missions. In this activity, the secondary level students embark on an exciting journey to uncover the secrets of our celestial neighbour, the Moon. Download an enlarged Moon mosaic image (from an authentic observatory source like: <https://www.schoolsobservatory.org/things-to-do/explore-moons-surface> so that scaling can be done during the activity). Mark the historic landing spots of various Apollo missions, Luna Missions and Chandrayaan Missions. Identify your favourite crater on the Moon and measure its size using the moonsaic image.

### **Chandrayaan-3: A Triumph in Lunar Technology**

Chandrayaan-3, representing Bharat's resolute commitment to lunar exploration, stands as a crowning achievement in the nation's space endeavours. Chandrayaan-3 was launched on 14 July 2023. It successfully landed on the Moon's South Pole on 23 August 2023. The mission aims to explore and study the Moon's South Pole that is rich in water resources and permanently shadowed craters. The successful soft landing of Chandrayaan-3 is a significant achievement for the country as it makes Bharat the first nation to successfully land a spacecraft in the Lunar South Pole region and only the fourth country to land on the Moon after the Soviet Union, the United States, and China. This mission exemplifies Bharat's growing expertise in lunar technology. The successful landing of Chandrayaan-3 on the lunar surface marked a historic milestone, solidifying

Bharat's position as a formidable contender in the global space race. The lander, designed with enhanced precision and capabilities, executed a flawless descent, demonstrating Bharat's mastery over the intricacies of lunar landings.

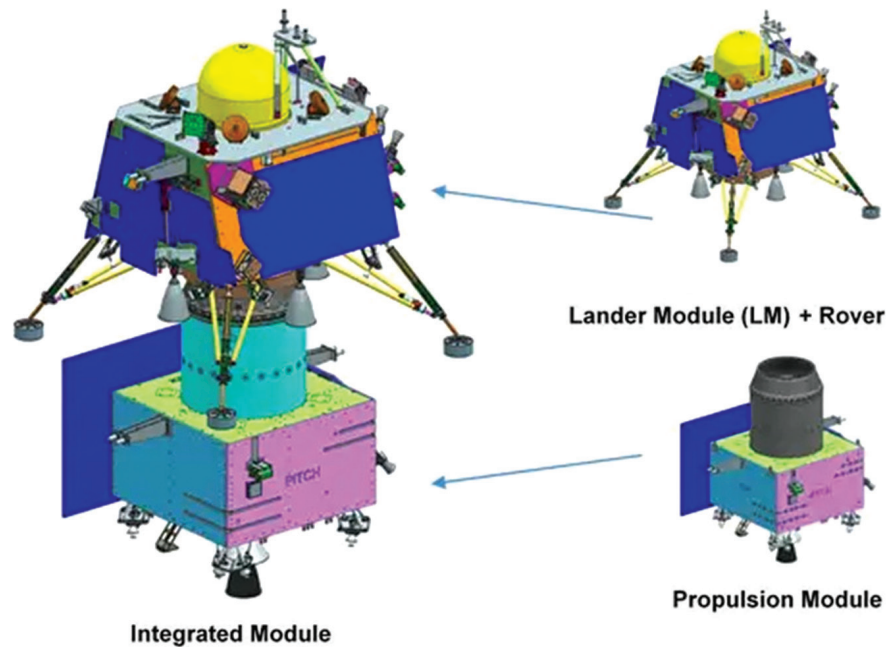


Figure 4: Chandrayaan-3 elements

Source: [https://www.isro.gov.in/Chandrayaan3\\_Details.html](https://www.isro.gov.in/Chandrayaan3_Details.html)

Upon touchdown, Chandrayaan-3 commenced a series of experiments and data collection activities. The sophisticated scientific instruments on board meticulously analysed the lunar soil, mapping its composition and conducting experiments to unearth crucial insights into the Moon's geological history. This feat could significantly extend the range and effectiveness of data transmission, enabling a more comprehensive understanding of the lunar environment. Chandrayaan-3's successful data collection and experiments have enriched global lunar research, advancing our comprehension of the Moon's formation and evolution. The mission's triumphs stand as a testament to Bharat's technological prowess and its indomitable spirit in the pursuit of scientific knowledge. The soft-landing point of the Chandrayaan-3 mission has been named as the 'Shiv Shakti Point' by the Government of Bharat.

As for Chandrayaan-3, the mission is still in progress. The payloads include

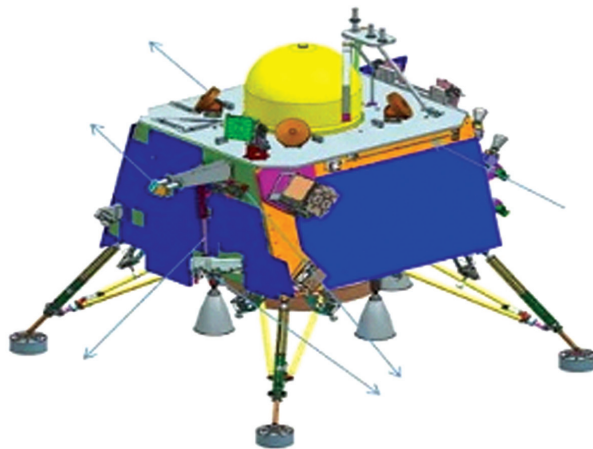
[source: [https://www.isro.gov.in/Chandrayaan3\\_Details.html](https://www.isro.gov.in/Chandrayaan3_Details.html)]

### Lander

- Radio Anatomy of Moon Bound Hypersensitive ionosphere and Atmosphere (RAMBHA)
- Chandra's Surface Thermo physical Experiment (ChaSTE)
- Instrument for Lunar Seismic Activity (ILSA)
- Laser Retro reflector Array (LRA)

### Reflective Exercise

In the sketch (Source: ISRO) given below mark the different payloads onboard the lander of Chandrayaan 3. Also identify the objective of each payload.



### Rover

- Alpha Particle X-Ray Spectrometer (APXS)
- Laser Induced Breakdown Spectroscope (LIBS)

### Propulsion Module

- Spectro-polarimetry of Habitable Planet Earth (SHAPE)
- Indian Contributions to Lunar Science

The Chandrayaan missions have indelibly imprinted Bharat's mark on the global landscape of lunar science. The discovery of water molecules on the lunar surface by Chandrayaan-1 revolutionised our understanding of the Moon's composition and potential resource utilisation. This revelation has far-reaching implications for future space exploration, offering the tantalising prospect of sustained human presence on the Moon. Furthermore, Chandrayaan-2's detection of water ice in the polar regions has reinforced the significance of lunar polar regions as potential reservoirs of water resources. This finding opens up new avenues for research on the Moon's geological history and its potential as a springboard for future missions to deeper space. The high-resolution imagery and detailed mapping of the lunar surface provided by Chandrayaan-1, 2 and 3 continue to be invaluable resources for lunar researchers globally. These data sets have facilitated ground-breaking studies on the Moon's geological features, impact craters, and potential landing sites for future missions. In addition to its scientific contributions, Bharat's success in executing complex lunar missions has solidified its position as a key player in the international space community. The Chandrayaan missions have not only advanced our understanding of the Moon but have also underscored Bharat's capabilities in spacecraft design, propulsion, and navigation.

You have read about an overview of Bharat's lunar exploration programme with a focus on Chandrayaan-1, 2, and 3 missions. The got to know Indian values and traditions related to the Moon and includes interactive learning activities related to the Indian Mission and group discussions on cultural significance of the Moon. Explore the historical context, objectives, and achievements of Chandrayaan-1, 2, and 3, with special emphasis on the remarkable success of Chandrayaan-3.

**Let us find out what you have learnt.**

1. What is the name given to the site at which Chandrayaan 2 Lander crash landed?
  - a) Tiranga Point
  - b) Vijay point
  - c) Jawahar Point
  - d) Vikram Point

2. What is the focus of Chandrayaan-3?
  - a) primarily focused on achieving a successful soft landing on the Sun.
  - b) primarily focused on achieving a successful hard landing on the Moon
  - c) primarily focused on achieving a successful soft landing on Venus.
  - d) primarily focused on achieving a successful soft landing on the Moon
3. Which region of the Moon is the primary target for Chandrayaan-3's landing site?
  - a) Lunar North Pole
  - b) Lunar South Pole
  - c) Lunar Equator
  - d) Celestial Equator
4. What is the name given to the soft landing site of Chandrayaan 3 Vikram Lander?
  - a) Jawahar Point
  - b) Vijay Point
  - c) Tiranga Point
  - d) Shiv Shakti Point
5. What is the name given to August 23 by the Government of Bharat to commemorate the Chandrayaan 3 landing?
  - a) National Victory Day
  - b) National Space Day
  - c) Moon Mission Day
  - d) Triumph Day
6. What is the meaning of the word 'Pragyan' given to the Moon lander module?
  - a) 'Pragyan' means 'satellite'
  - b) 'Pragyan' means 'wisdom'



- c) 'Pragyan' means 'moon satellite'
  - d) 'Pragyan' means 'power'
7. Which instrument aboard Chandrayaan-3 will measure the thermal properties of the lunar surface?
- a) Alpha Particle X-ray Spectrometer (APXS)
  - b) Chandra's Surface Thermo physical Experiment (ChaSTE)
  - c) Laser Retroreflector Array (LRA) Rover
  - d) Spectro-polarimetry of Habitable Planet Earth (SHAPE)
8. What are the names of the mission of ISRO to study the Sun ?
- a) Mission Aditya L1
  - b) Mission Solar face
  - c) Mission Parker
  - d) Mission ACE

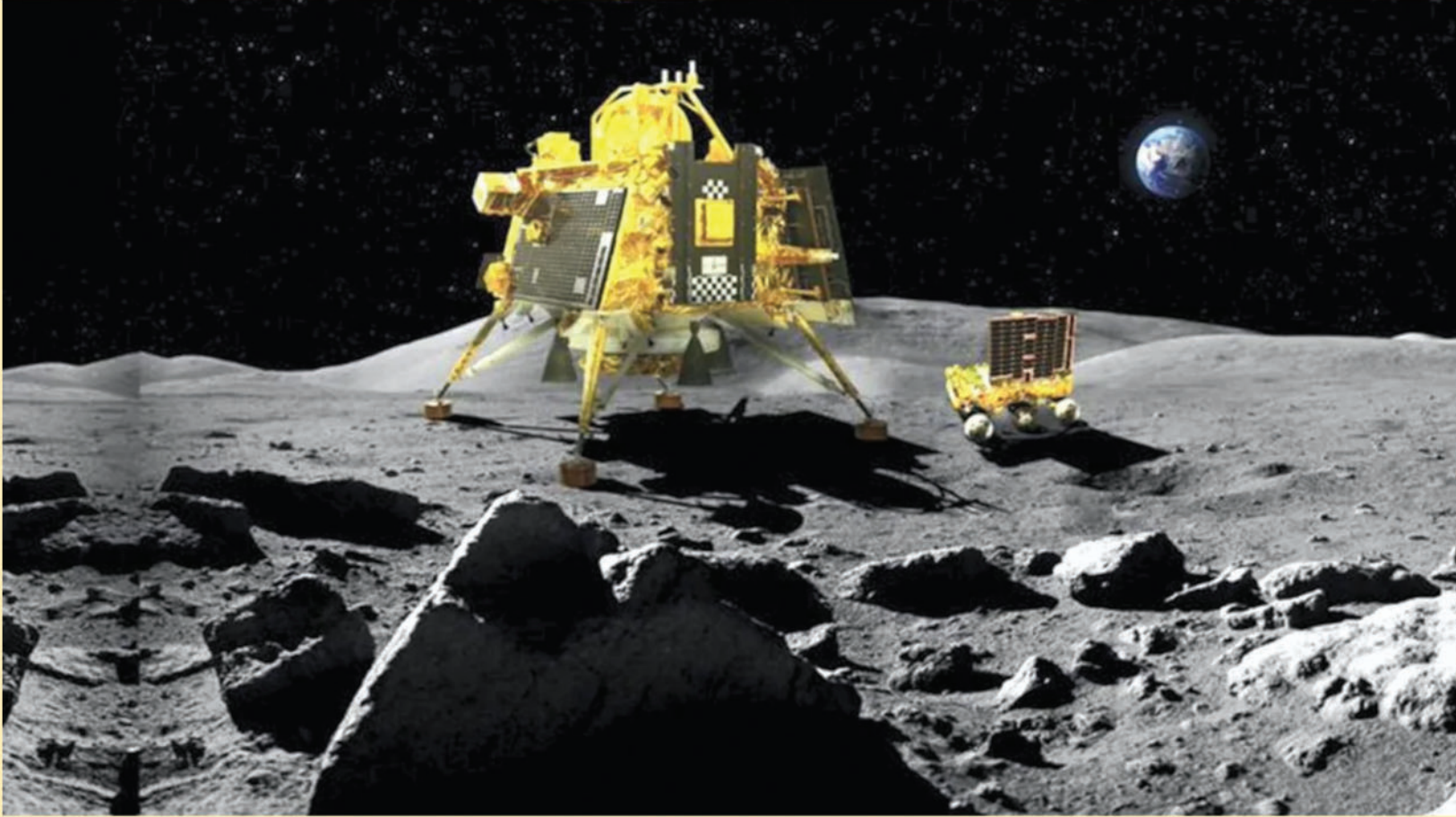


## Theme 1.0 Chandrayaan Utsav

- |      |    |  |
|------|----|--|
| 1.1  | F  | हमारा चंद्रयान<br>Our Chandrayaan                    |
| 1.2  | P  | <i>Mera Pyara Chanda: Rani ki Khoj</i>               |
| 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](http://www.bharatonthemoon.ncert.gov.in)

For more information:  
Email: [dceta.ncert@nic.in](mailto:dceta.ncert@nic.in)  
PMeVIDYA IVRS: 8800440559



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

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एन सी ई आर टी  
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्  
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