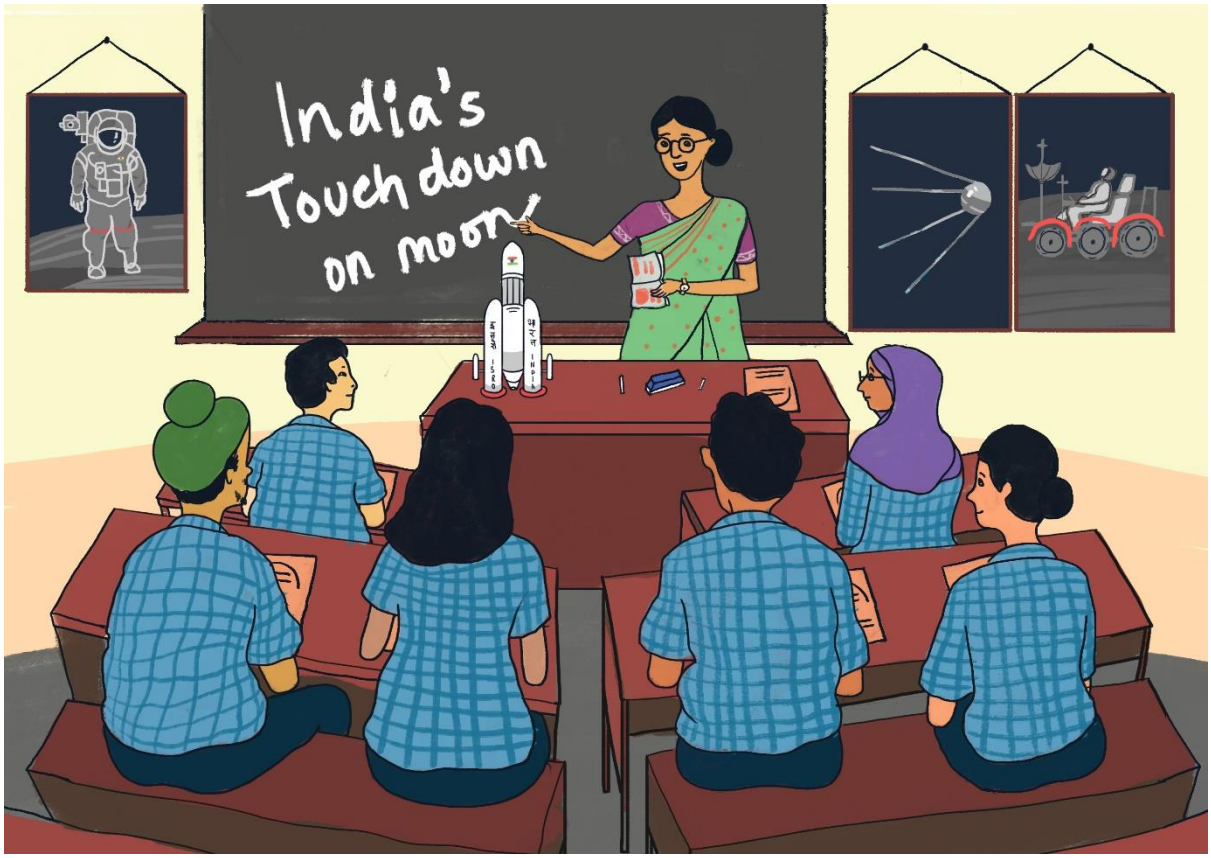
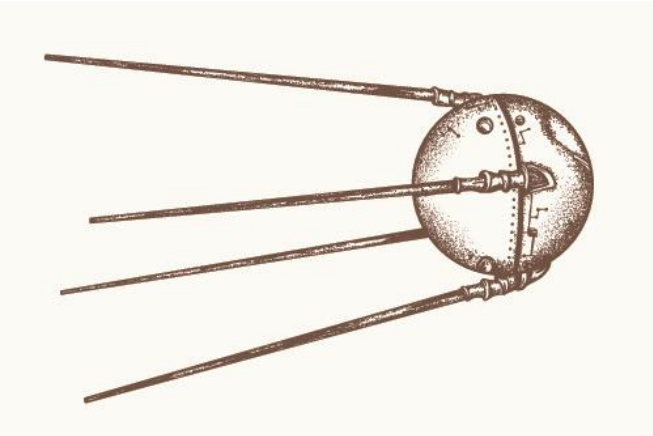
India's Touchdown on Moon – Chandrayaan 2

~ Sujata C



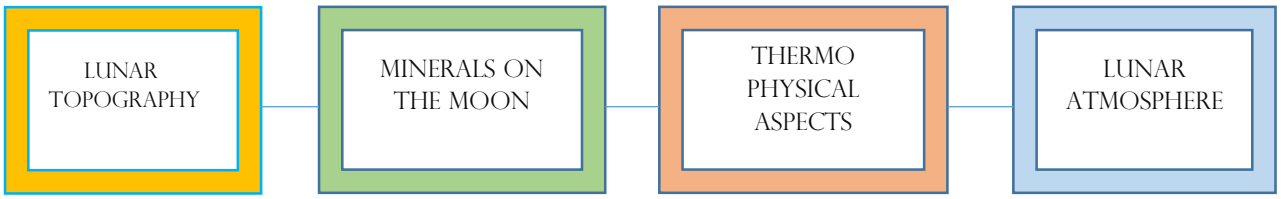
Technology for space exploration has developed by leaps and bounds since the launch of the first satellite, Sputnik in 1957. July 22, 2019 was a historic day for India as Chandrayaan 2, India's first unmanned moon lander mission, was launched. This was 11 years after Chandrayaan 1 which sent a lunar probe in October 2008 to search for water on the surface of the moon using radars.



Chandrayaan 2 mission carried a lunar orbiter, a lander – Vikram, and a robotic lunar rover – Pragyan. The orbiter has a life of seven and half years and will orbit the moon while taking pictures and mapping its surface. The rover is a six wheeled vehicle that can move on the lunar surface. It is equipped to carry

out on-site chemical analysis and send data to earth via orbiter. The third mission, Chandrayaan 3 is tentatively scheduled for 2024.

Study Tasks for Chandrayaan 2



The mission of Chandrayaan 2 was to expand scientific knowledge of the lunar surface and its atmosphere. The South Pole of the moon is permanently on the shadow side of the moon and has been little explored till date. Indian Space Research Organisation (ISRO) had planned for a soft landing on the moon but a last minute communication breakdown led to a hard landing of the lander and the mission had to be aborted at the last moment. Despite the setback faced by Chandrayaan 2, it is a historic feat in its own right and makes for a wonderful project for school children.

When asked what they want to be when they grow up children often say they want to go to the moon or fly in a rocket or be an astronaut. Besides firing their ambition and igniting a spark in their imagination, a project such as this will keep the students well versed with the current affairs and recent updates on space exploration and research. 60 students were selected from a space quiz conducted by ISRO to watch the launch of the mission from the command centre in Bengaluru along with the Prime Minister and scientists of ISRO.

Extraordinary Moment: September 7, 2019 was the D-day when Vikram would touchdown on the moon after performing some complex maneuvers and rough and fine braking. India was about to script history and set to become the fourth nation to land on moon. A sense of nationhood had gripped the country as millions eagerly awaited the news of touchdown. But history had something

else in store, and a pall of gloom descended as the news of the loss of communication with Vikram was announced.

Vikram's life was one moon day, which is equal to fourteen earth days. Vikram was supposed to complete its tasks in that time period. On September 20-21, fourteen days after the landing, night descended on the moon and all efforts to reestablish communication with Vikram were lost. Moon nights are unimaginably cold with temperatures plummeting to minus 180 degrees Celsius, and the darkness is impenetrable, leaving no scope for any orbiter to spot Vikram.

The entire world too was following the mission closely because ISRO missions are well known to be frugal. Once again, touchdown or not, ISRO proved to the world that space exploration is not a preoccupation of wealthy industrialized nations. Developing nations too can have an equal role to play in it.

Many reasons to smile: ISRO has set many world records in its eventful life of fifty years. It has put into orbit major satellite systems, including communication satellites, Indian remote sensing satellite to monitor the country's natural resources, earth observation satellites that were historic milestones for the country. In 2017, ISRO set a world record by carrying 104 satellites in a single mission. It is indeed a matter of pride that both Chandrayaan 1 and 2 have been developed with indigenous technology.

ISRO completed the Mars Orbiter Mission successfully in its first attempt in 2014. Once again this was done on a shoestring budget of $74 million compared to NASA's Mars orbiter project which cost $671 million. Mangalyaan is

equipped to measure the methane content on Mars, an important research topic in the field of space science.

The benefits of space exploration are many. The vision of scientists in India was to use space exploration to benefit mankind. For Vikram Sarabhai[1], popularly known as the 'Father of the Indian space programme', a nation struggling to get four square meals a day would leverage space technology only to improve the lot of its people. Expeditions on remote sensing, satellite communication, earth observations, etc., have made several things possible including telecommunications, long distance calls, weather predictions, early warning systems, etc., that help to prevent natural disasters, tracking climate change as well as provide medical and education solutions.

Chandrayaan 2 showed the world that it is possible to accomplish a mission to the moon in less than ₹1000 crores, which is less than half the cost of the costliest Hollywood movie. It has strengthened ISRO's position among the leading nations involved in space studies, and created the foundation for future missions. More than anything else this mission was a live lesson on how to deal with a setback. It has shown that failure does not mean you stop what you are doing but keep at it till one gets better at it. Any project of this proportion is the result of successful teamwork and collaboration that is necessary to surmount several challenges that are inevitably a part of this journey.

ISRO has lined up even more ambitious plans for the future and work is in progress on Gaganyaan (an Indian crewed orbital spacecraft for the Human Spaceflight Programme) in the years to come. Chandrayaan 2 has helped India join the international space club, considered an exclusive guild of space explorers from developed countries. It has added to the stature of India and enabled it to be better prepared to meet future challenges.

Sujata C is a writer and editor with more than thirty years of experience. She writes on children, environment, society as well as technology. She has also been a copywriter with advertising agencies for over fifteen years.

[1] Vikram Ambalal Sarabhai was an Indian physicist and astronomer who initiated space research. He is known for his contribution to the development of nuclear power in India. Know more about him from here: https://www.isro.gov.in/about-isro/dr-vikram-ambalal-sarabhai-1963-1971

Lesson Plan:

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A classroom project on outer space is likely to inspire students and get them interested in space science and technology. It will help to lay the foundation for a scientific bent of mind to solve everyday problems and improve life on Earth. Teachers may plan the lesson to suit the age of their class. Many activities can be planned around Chandrayaan 2 and India's contribution in space research.

Posters, charts, powerpoint presentations, debates, quizzes, storytelling, writing, etc., to cover the following questions:

- What is Chandrayaan 1? What did it do?
- What was the main aim of Chandrayaan 2
- What are the main parts of Chandrayaan 2 and what are their names?
- Where was Chaandrayaan 2 planning to land and what is special about that?
- What is the weight of the satellite?
- How many days did it take for Chandrayaan 2 to reach the moon?
- What distance did it travel?
- How many experiments was it supposed to carry out?
- What is the life of the Lander?
- How is moon day different from an earth day?
- What is the distance between the earth and the moon?
- What is the current status of Vikram? Read the newspapers to find out.
- Do we see only one side of the moon?

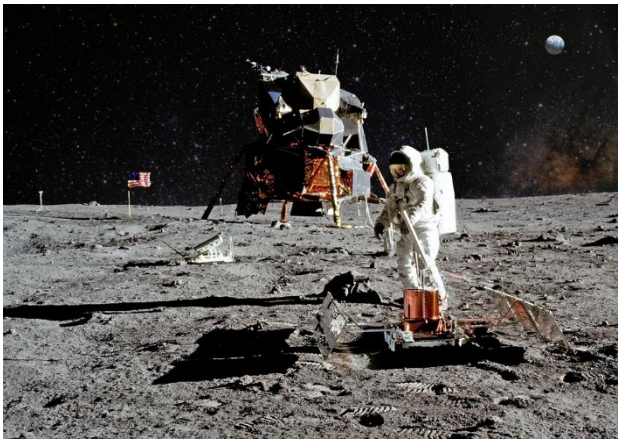
Raise the following questions and encourage students to find out about ISRO:

- What were the past successes of ISRO?
- Who is the current Chairman of ISRO? What do you know about him?

- How old is ISRO?
- Where is ISRO located?
- What is the name of India's first satellite? When was it launched?
- How many Chairmen have served ISRO? Name them.
- What is INSAT? When was it launched?
- What do you know of the team of women scientists who were involved as project directors on the moon mission?

Encourage students to find out about the moon by asking these questions:

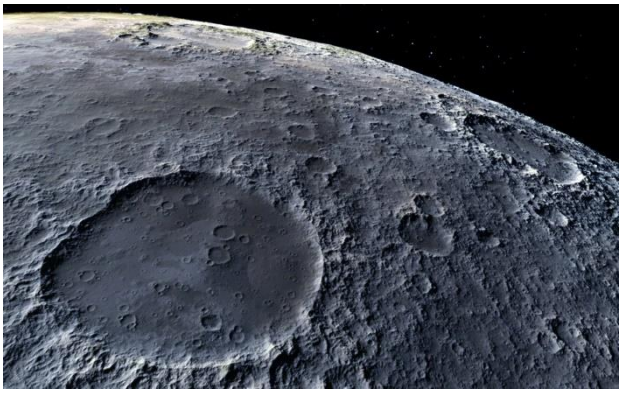
- Which ancient astronomer was the first to make lunar observations?
- Which countries were involved in the space race or the race to the moon?
- Which country was the first to explore the moon? Which year was it?
- What keeps the moon spinning round the earth?
- What causes the waxing and waning of the moon?
- How does the moon affect the tides on earth?
- Do you know that every full moon has special significance and name? Find out about them and share with others in the form of a chart.
- How are the patterns on the moon formed?
- What do you know about the first manned mission to moon?
- What was the first manned mission to moon called? Who were the men who walked on the moon?



Engage students in storytelling, reading and writing activities

Every culture and civilization has myths and legends that revolve around the moon. Here are some examples:

- The patterns on a full moon are interpreted in many ways, most popular among them is the man on the moon. Was this the inspiration for man to fly to the moon in the first place? Write a story about the man on the moon.



- Read about the mythological story when the moon laughed at Lord Ganesha.
- The moon is often romanticized in popular cinema: identify some songs about moon in Hindi or your vernacular language.
- Watch the movie **First Man** which narrates the story of the life of Neil Armstrong and write a review.
- What is understood as 'moonwalk' in popular culture, and which famous artist made it popular?

Space technology

Suggest students to watch videos that explain

- How satellites work? https://www.youtube.com/watch?v=ror4P1UAv_g
- How satellite changed telecommunications? https://www.euronews.com/2017/03/16/remembering-early-bird-the-satellite-that-changed-how-we-communicate, https://theageofaerospace.co.uk/articles/satellites-are-what-makes-todays-super-connected-world-possible.html

- What kind of work is carried out on a space station? https://www.youtube.com/watch?v=SGP6Y0Pnhe4
- How astronauts live, eat and sleep in space? https://www.youtube.com/watch?v=cj1Htik95_M
- What keeps the moon spinning round the earth? https://www.youtube.com/watch?v=OKXVRu6JL54

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Pleiades (noun)

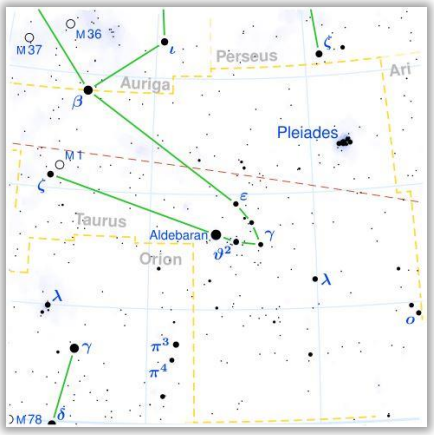
Pronunciation: /ˈplʌɪədiːz/

Meaning: It is a well-known open cluster of stars in the constellation Taurus that is considered closest to the Earth. Six (or more) stars in this constellation are visible to the naked eye, which in stellar terms were formed quite recently.

Origin and additional information: The word has a Greek origin and has made its way into English via Latin. It probably derived from the word *plein* (meaning ‘to sail’) because of the cluster’s importance in delimiting the sailing season in the Mediterranean Sea. Its association with Greek mythology is also well-known where it stands for the seven daughters of the Titan Atlas and the Oceanid Pleione. They were pursued by the hunter Orion until Zeus changed them into a cluster of stars. Galileo was the first astronomer to view the Pleiades and thereby discovered that the cluster contains many stars which are too dim to be spotted by the naked eye. The word has acquired a meaning of ‘multitude’, inspiring the name of the French literary movement, La Pléiade.

Word section: Pleiades are a common sight during winters in the Northern Hemisphere. While Gaileo's observation first found them documented in his treatise **Sidereus Nuncius** (1610), the Pleiades have been known since antiquity to cultures across the globe including the Celts, Maoris, Aboriginals, Persians, Arabs, Quechuas, Mayans, Aztecs and several others. Indeed, the Pleiades are known as *Krittika* in Hinduism and are associated with Kartikeya, the God of War. The Bible too mentions them more than once. The distance to the Pleiades can be said to be the first step towards calibrating the cosmic distance ladder[1], though controversies or debates surrounding it are aplenty.

Source: *By History of Science Collections, University of Oklahoma Libraries - http://hos.ou.edu/galleries/17thCentury/Galileo/1610/Galileo-1610-016c-r%20-%20Version%202-image/, CC BY 1.0, https://commons.wikimedia.org/w/index.php?curid=29540215*



Source: *Wikimedia Commons*

Usage:

1. *On precisely the same day each year the star cluster Pleiades also first became visible in the dawn sky.*
   (Source: "Religion and agriculture in Mesoamerica", *New Scientist*, Reed Business Information, pp. 291: 1983)

2. *Like all open clusters, the Hyades and Pleiades each contain a few hundred stars, which astronomers feel sure all formed together and are only slowly drifting apart.*
   (Source: "Mapping the Milky Way" by Donald Goldsmith in **Einstein's Greatest Blunder?: The Cosmological Constant and Other Fudge Factors in the Physics of the Universe**)

3. *And the Pleiades continued, within historical memory, to be the first asterism of the lunar zodiac.*
   (Source: **Les Origines De L'Histoire** by Francois Lenormant)

Content sourced majorly from Oxford Advanced Learner's Dictionary.

[1] The succession of methods by which astronomers determine the distances to celestial objects. The ladder analogy arises because no other single technique can measure distances at all ranges encountered in astronomy.