



GOA BOARD OF SECONDARY AND HIGHER SECONDARY EDUCATION

(A Corporate Statutory Body constituted by an Act of the State Legislature)

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CIRCULAR NO. 61

To,
The Heads of all recognized
Secondary and Higher Secondary Schools
within the jurisdiction of this Board.

Sub: - Observation of National Space Day on 23rd August 2024.

Sir/Madam,

1. Goa Board of Secondary and Higher Secondary Education is pleased to inform you that 23rd August 2024 will be observed as National Space Day across India. This day is dedicated to fostering awareness and appreciation for the remarkable achievements in the field of space exploration and science, as well as inspiring students to explore the infinite possibilities that space science offers.
2. As part of the celebrations, it is encourage to all schools to organize special activities such as workshops, exhibitions, and interactive sessions that highlight India's contributions to space science. These activities will help students understand the significance of space exploration in advancing scientific knowledge and technological innovation.
3. Additionally, it is excited to inform you that a special quiz on space science has been made available on the MyGov platform. This quiz aims to engage students in a fun and educational manner, testing their knowledge about space and igniting their curiosity about the cosmos. It is to request you to actively promote participation in this quiz among students. The link to the quiz is provided below:
Quiz Link: [<https://quiz.mygov.in/quiz/national-space-day-quiz/>]
4. Goa Board of Secondary and Higher Secondary Education hope that you will encourage your students to participate in the quiz wholeheartedly, making the most of this opportunity to learn and explore.

Your cooperation in observing National Space Day and supporting these initiatives will contribute to nurturing a generation of future scientists, engineers, and space enthusiasts.

The Heads of Institutions are hereby requested to inform the concerned and the copy of the Circular be displayed on the Notice Board at a prominent place for information and needful action.


(Vichyadatta B. Naik)
Secretary

Enclosed: Article on summarising 25 achievements of ISRO from Moon Missions by Dr. Nandkumar M. Kamat former member of the Board.

Copy to:-

1. The Director of Education, Porvorim-Goa.
2. The Director of SCERT, Alto Betim-Goa.
3. Heads of Sections of this Office.
4. P.A. to Chairman.

What did ISRO achieve from the moon missions?

NANDKUMAR M. KAMAT

The Government of India has declared August 23 as National Space Day to celebrate the remarkable success of the Chandrayaan-3 Mission, which accomplished the safe and soft landing of the Vikram Lander and deployed the Pragyan Rover on the lunar surface near the South Pole. This mission solidified India's position as a formidable space-faring nation, particularly in the context of lunar exploration. Chandrayaan-3 was conceived following the partial success of Chandrayaan-2 in 2019. The mission aimed to demonstrate India's capability to safely land on the lunar surface and conduct in-situ scientific experiments.

It is often noticed that many science teachers in higher educational institutions talk vaguely about the outcome of Chandrayaan missions instead of informing the students what India achieved through these missions. Therefore, specific information is given in this article, which identifies 25 achievements from ISRO's moon missions after going through several important research papers.

The first achievement worth noting was the discovery of water molecules on the moon (2009) by Chandrayaan-1's Moon Mineralogy Mapper (M3), which provided definitive evidence of hydroxyl and water molecules on the moon's surface, revolutionising our understanding of the lunar environment. This was published in *Science*, 2009. Then, the Chandrayaan-1 mission mapped water and ice distribution, particularly in permanently shadowed craters at the lunar poles. This was published in *Geophysical Research Letters* in 2009.

Another achievement was the high-resolution 3D mapping of the lunar surface (2008). Chandrayaan-1 used the Terrain Mapping Camera (TMC) to produce detailed 3D maps of the moon's surface, aiding in selecting landing sites for future missions. Many journals carried the results. ISRO got support for the Magma Ocean Hypothesis (2010) in Chandrayaan-1 which detected elements indicative of an ancient global magma ocean, contributing to the understanding of the moon's thermal history. This was published in *Nature Geoscience* in 2010.

Lunar exosphere and sodium emission (2009) were studied by the Chandrayaan-1 mission from the tenuous lunar exosphere, focusing on sodium emissions, helping to understand the moon's interaction with solar radiation. This was published in *Planetary and Space Science*, 2009. Another win was the detection of solar wind interaction with the moon (2009). Chandrayaan-1 detected the formation of a mini-magnetosphere caused by solar-wind interaction, providing insights into lunar magnetic anomalies. The results were published in *Science*, 2009.



Identifying volatiles in the lunar interior (2019) by Chandrayaan-2 was an important finding. Detailed spectroscopic studies identified volatiles such as sulfur, suggesting volcanic activity in the moon's past and these results were published in *Icarus*, 2019. Chandrayaan-2 carried out thermal imaging of the lunar surface (2019), and the high-resolution thermal images provided insights into the temperature variations and thermal properties of the lunar regolith. *Journal of Geophysical Research: Planets* published these results in 2019.

Mapping the lunar south pole-Aitken Basin (2019) was accomplished by Chandrayaan-2 which provided new data on the mineral composition and topography of this large impact basin, deepening our understanding of lunar geology. These findings were also published in *Icarus*, 2019.

Understanding the lunar water cycle (2009) was done by Chandrayaan-1 which contributed to the understanding of the migration of water molecules across the moon's surface. *Science Advances*, 2009 published these results. The Chandrayaan-2 mission did a study of lunar highlands and surface brightness variations (2019). It analysed the composition and age of the lunar highlands using imaging systems. Results were published in *Planetary and Space Science*, 2019.

Chandrayaan-2 performed detection of thermal anomalies in lunar soil (2019). The mission identified thermal anomalies around lunar craters, offering clues about subsurface structures and

volatile materials, and results were published in the *Journal of Geophysical Research: Planets*, 2019. The study of lunar magnetic field anomalies (2019) was done by Chandrayaan-2 which explored localised magnetic anomalies on the moon, helping to understand its weak magnetic field. *Geophysical Research Letters*, 2019 published these findings.

A detailed analysis of the lunar impact craters (2008 and 2019) was conducted on two missions - Chandrayaan-1 and Chandrayaan-2. Both provided high-resolution imagery and topographical data for lunar crater morphology studies. Reputed journal *Icarus* published these papers in 2008 and 2019. Chandrayaan-1 obtained insights into lunar surface weathering (2009) and contributed to understanding space weathering processes on the moon, particularly due to solar wind and micrometeorite impacts. These results were published in *Meteoritics & Planetary Science*, 2009.

Chandrayaan-2 in 2019 identified rare minerals such as spinel and anorthosite, which are remnants of the moon's early crust. *Nature Geoscience* 2019 published the results. Study of lunar dust properties (2019) was done by Chandrayaan-2 mission. It investigated the electrostatic properties and behaviour of lunar dust under solar radiation, crucial for future exploration missions. These results were published in *Acta Astronautica*, 2019. Improved lunar gravity field models (2019) was another achievement by Chandrayaan-2. These refined models of the moon's gravity field, particularly in the South

Pole region, would aid precise landing and orbital maneuvers. *Geophysical Research Letters* published the results in 2019.

Identification of hydrogen signatures (2008) was an ambitious objective of the Chandrayaan-1 mission which successfully detected hydrogen signatures at the lunar poles, suggesting the presence of water ice below the surface. These results were published in *Geophysical Research Letters*, 2008. The Chandrayaan-2 mission (2019) conducted detailed studies of the moon's permanently shadowed regions, providing surface and subsurface composition data and results were published in *Icarus*, 2019.

Another achievement was from the polarisation studies of the lunar surface (2009) by Chandrayaan-1 mission which undertook these studies to understand the roughness and composition of the lunar surface at microscopic levels. The results appeared in the *Journal of Geophysical Research: Planets*, 2009. The development of lunar surface composition maps (2008) was done by Chandrayaan-1. This mission created comprehensive maps of the lunar surface's mineralogical composition, aiding global lunar studies and the results were published in *Science*, 2008. Moonquakes are a curiosity on Earth. So, detection of tectonic activity on the moon (2019) was done successfully by Chandrayaan-2 suggesting that the moon may still be geologically active. *Nature Geoscience*, 2019 published these findings. Measurement of the lunar surface plasma environment (2019) was an important objective of the Chandrayaan-2 mission. It analysed the lunar surface's plasma environment, helping to understand its interaction with solar wind and its effect on surface properties. These results were published in *Planetary and Space Science* in 2019.

Enhanced understanding of lunar volcanism (2019) was another achievement of the Chandrayaan-2 mission, which provided new data on lunar volcanism, particularly focusing on lava flow characteristics and distribution. These results were published in *Icarus*, 2019. Chandrayaan-3 mission also yielded several important results. The mission provided further evidence of the presence of water ice in the moon's south pole region. This discovery is crucial for future lunar exploration and potential human settlements, as water can be used for drinking, fuel, and oxygen production.

The analysis of lunar soil by the Pragyan Rover added to our understanding of the moon's composition, revealing the presence of several elements that could have implications for both scientific research and future resource utilisation. Based on publications from this mission, a separate article will be written. On National Space Day, this article would be useful for educational institutions.