CHANDRAYAAN 3 MISSION: SCIENCE & TECHNOLOGY

NEWS: Chandrayaan-3 data says water ice easier to find on moon than believed

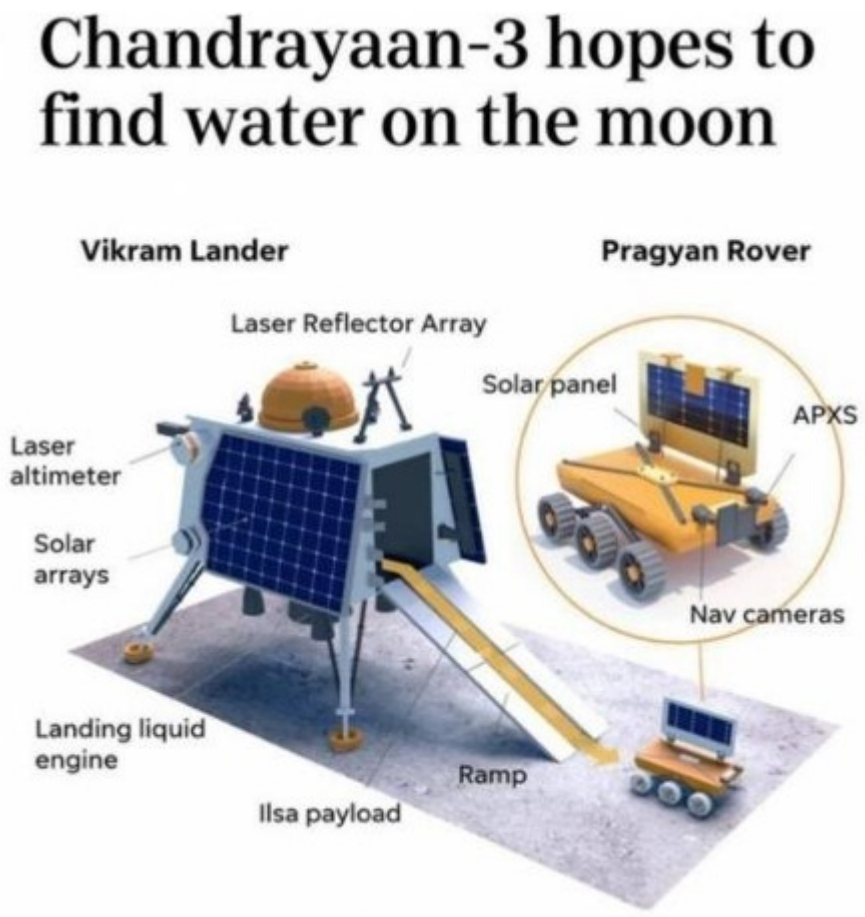
WHAT'S IN THE NEWS?

Chandrayaan-3's successful landing near the Moon's south pole revealed critical data on temperature variations, suggesting that water ice may be more accessible than previously believed. The mission's findings could support future lunar habitation, resource utilization, and fuel generation for long-term human missions.

Key Findings from Chandrayaan-3 Mission:

- **Temperature Variations**:
    - The **Vikram lander** of Chandrayaan-3 recorded a significant **peak surface temperature** of 82°C at **Shiv Shakti Point**, which is the landing site.
    - A **location just a meter away** from the Shiv Shakti Point showed a **temperature of 58.85°C**, highlighting the **local variations** in surface temperatures.
    - At **nighttime**, the temperatures dropped drastically to approximately **-181°C**, showcasing extreme fluctuations between day and night temperatures.
    - These **temperature variations** occur on a **meter scale**, which is crucial because such fluctuations play a key role in the **stability of water ice** on the Moon's surface.
- **Presence and Accessibility of Water Ice**:
    - The findings suggest that **water ice may be more accessible** on the Moon than previously believed. The temperature differences on the Moon's surface are important because they directly influence the **conditions for water ice stability**.
    - **Water ice** on the Moon is critical for supporting **long-term lunar missions**. Water ice could be used for **drinking**, **sanitation**, and **fuel generation** (as it can be converted into hydrogen and oxygen to fuel rockets).
    - **Water ice** also plays an important role in **lunar habitation and resource utilization**, enabling sustainable missions and potential human settlements on the Moon.
- **Chandrayaan-3 Objectives**:
    - The primary objective of **Chandrayaan-3** was to **demonstrate India's end-to-end capabilities** in **safe landing** and **roving** on the lunar surface.
    - The mission included two key components:

        - A **Lander Module** (**Vikram**).
        - A **Rover** (**Pragyan**).
    - The **launch vehicle** for the mission was **India's LVM3 rocket**, which is capable of placing up to **8 metric tons into low-Earth orbit**.
    - The spacecraft was launched from the **Satish Dhawan Space Centre** in **Sriharikota**.
    - The **soft landing** of **Chandrayaan-3** on the Moon took place on **August 23, 2023**, making India the **first country** to land a spacecraft near the **Moon's south pole**.
- **Scientific Findings by the Pragyan Rover**:
    - The **Pragyan rover** conducted a detailed analysis of **soil samples** near the south pole of the Moon, leading to the detection of **ferrous anorthosite**, a mineral that supports theories about the Moon's **early molten state**.
    - This discovery helps understand the **formation and evolution** of the Moon's surface and provides further insights into the **lunar geology**.
- **India's Achievement**:
    - With the successful soft landing near the **south pole**, India became the **fourth country** to achieve a soft landing on the Moon, joining the ranks of **the USA**, **Russia**, and **China**.



Data Collection by the ChaSTE Experiment:

- **ChaSTE (Chandra's Surface Thermophysical Experiment)**:
    - The **ChaSTE experiment**, onboard the **Vikram lander**, conducted **in-situ temperature measurements** at **69.373° south, 32.319° east** coordinates, which are near the Moon's south pole.
    - The **temperature measurements** collected by ChaSTE were found to be **higher than predicted** by NASA's **Lunar Reconnaissance Orbiter (LRO) Diviner instrument**.
    - The study indicates that **higher latitude regions** on the Moon experience **extreme temperature variations**, which could impact the **stability of water ice** and influence the planning of future lunar missions.
- **ChaSTE Probe's Design and Functionality**:
    - The ChaSTE experiment was equipped with **10 platinum Resistance Temperature Devices (RTDs)**, which were placed at various depths to capture **temperature gradients** across the lunar surface.
    - These RTDs helped measure **temperature fluctuations** and assess the **thermal conductivity** of the lunar soil.
    - The **ChaSTE probe** was mounted on the **Vikram lander**, and after landing, the probe was inserted into the **lunar soil** to collect real-time data.
    - This is the **first in-situ thermal measurement** near the **south pole** of the Moon, which is critical for understanding how **temperature gradients** affect lunar resources, especially the presence of **water ice**.

Conclusion:

- Chandrayaan-3 has provided valuable insights into the **temperature variations** on the Moon's surface, which will help in **future lunar missions** by influencing the strategies for water ice extraction, lunar habitation, and fuel generation.
- The mission has also set new benchmarks in **India's space exploration capabilities**, especially with the successful soft landing and **data collection** from the **ChaSTE experiment**. These findings could play a crucial role in planning **sustainable human missions** to the Moon and beyond.

Source: **https://www.thehindu.com/sci-tech/science/chandrayaan-3-scientists-say-moon-has-more-water-ice-than-believed/article69311958.ece**