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Chandrayaan-3 landing: All you need to know about the mission, what happens after it lands on the Moon

What is a soft landing, why is India sending Chandrayaan-3 to the Moon and what happens after it successfully lands? We explain.

By: **Explained Desk**
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The powered descent of Chandrayaan-3's Lander is expected to begin on August 23, 2023, around 6 pm. (Photo via X.com/ISRO)

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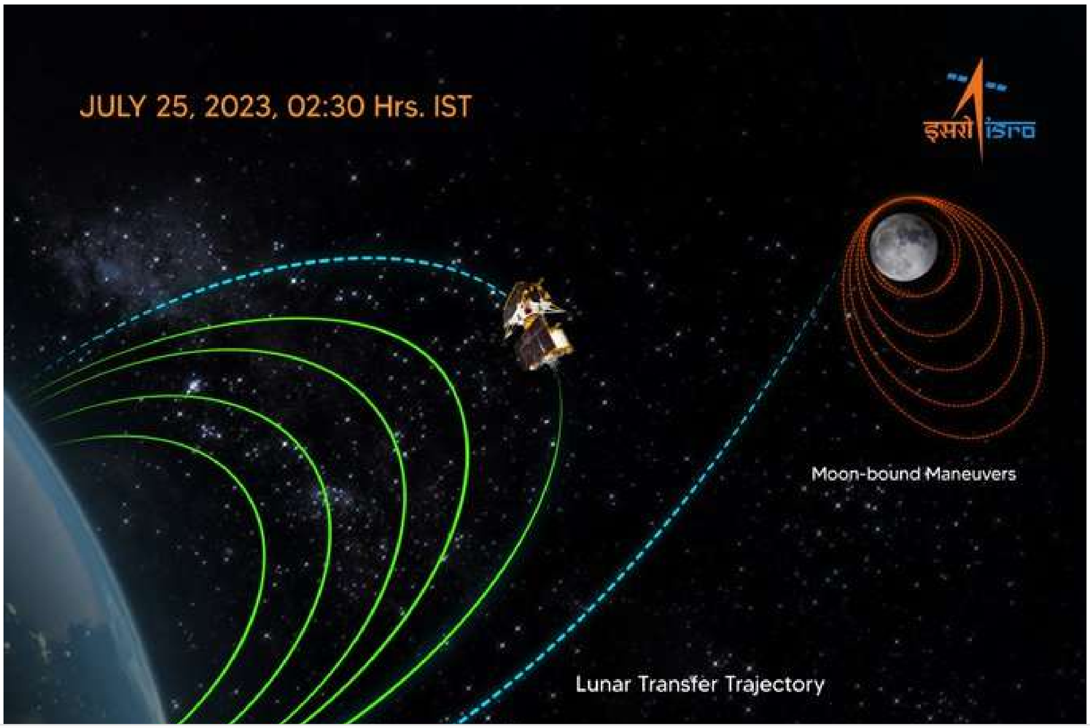
India's Moon mission Chandrayaan-3 scripted history by successfully landing on the lunar surface earlier today at 6:04 pm.

With the Lander accomplishing a 'soft landing' on the Moon's south pole, India becomes the only country to have ever done so. Now, a rover, which is a small vehicle that is meant to move around on the Moon's surface, will come out of the Lander.

When Chandrayaan-3 took off for the Moon on July 14, we explained the basics of the mission – how a mission launches into Space, what the Chandrayaan-1 and Chandrayaan-2 missions were, etc. You can **click here to read it**.

CHANDRAYAAN-3: A TIMELINE OF THE MOON MISSION

Chandrayaan-3 is set to become India's first spacecraft to make a soft landing on the moon. It is a follow-on mission to Chandrayaan-2 to demonstrate end-to-end capability in safe landing and roving on the lunar surface.



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TimelineJS

Here, we further take a look at why a 'soft landing' is crucial to the mission, what makes landing on the south pole a difficult feat, and what happens after India does so.

What is a soft landing, and why is Chandrayaan-3 landing on the south pole?

According to ISRO, the mission's three objectives are to demonstrate a safe and soft landing on the lunar surface, to demonstrate a Rover roving on the Moon and to conduct in-situ scientific experiments.

Soft landing simply means landing at a gentle, controlled speed to not sustain damage to a spacecraft. Amitabha Ghosh, a scientist for NASA's Rover mission to Mars, **explained it in *The Indian Express* thus**: "Imagine a spacecraft hurtling through space, at 10 times the speed of an airplane, having to nearly come to a standstill in order to land gently on the Earth — all in a matter of a few minutes and, more importantly, without any human intervention. This, in a nutshell, is a soft landing."

Explained | Chandrayaan-3 mission: Why ISRO wants to explore the Moon's south pole

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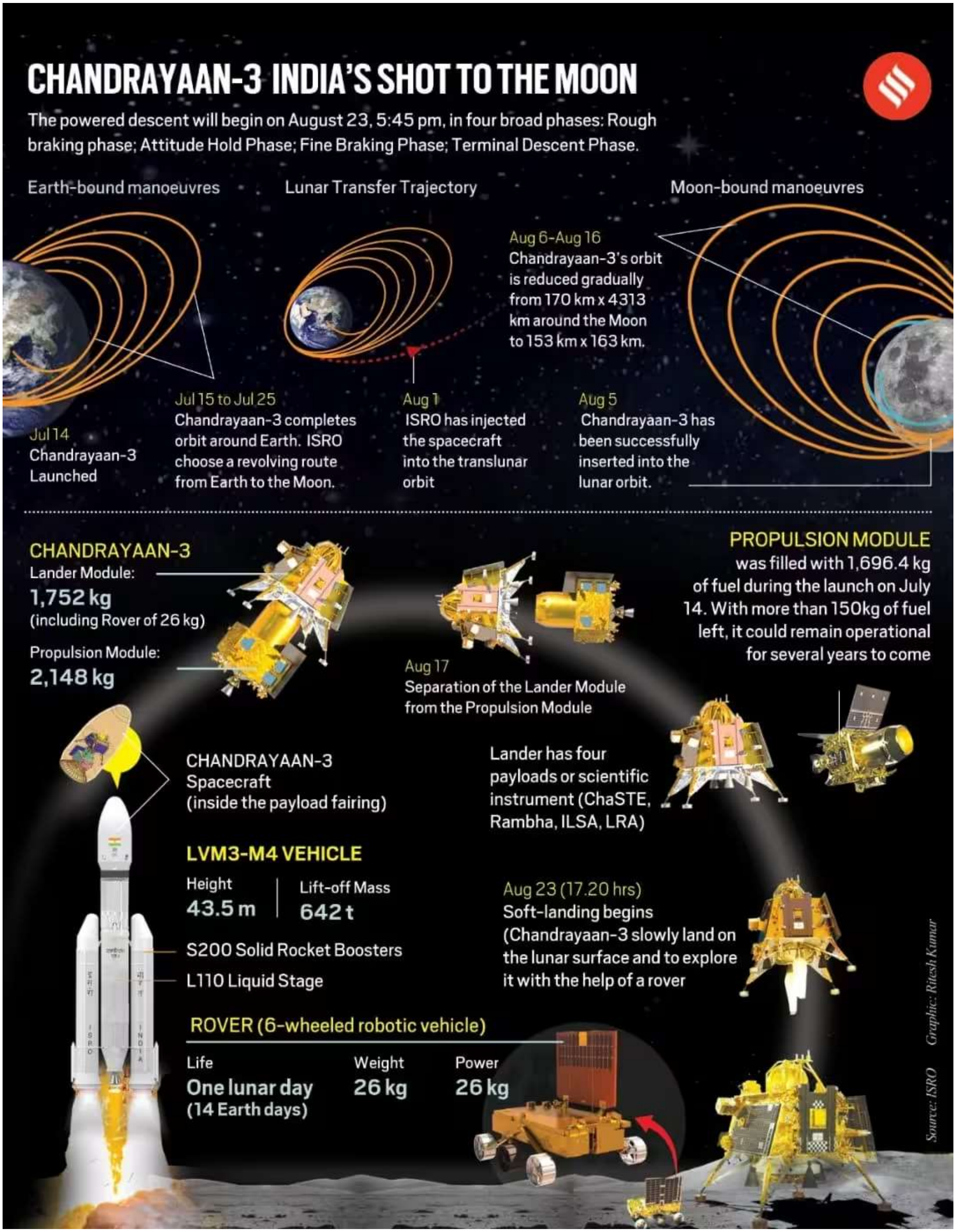
Doing so showcases a spacecraft's technical capabilities. The landing site is near the south pole of the moon at 70 degrees latitude.

All of the previous spacecraft to have landed on the Moon have landed in the region near the Moon's equator, firstly because it is easier and safer here. The terrain and temperature are more conducive for a long and sustained operation of instruments. Sunlight is also present, offering a regular supply of energy to solar-powered instruments.

The polar regions of the Moon, however, are different. Many parts lie in a completely dark region without sunlight, and temperatures can go below 230 degrees Celsius. This creates difficulty in the operation of instruments. In addition, there are large craters all over the place.



Here's how the Chandrayaan-3 reached the lunar orbit and how it plans to descend to the Moon's surface.

As a result, the polar regions of the Moon have remained unexplored. The extremely cold temperatures could mean that anything trapped in the region would remain frozen in time, without undergoing much change. The rocks and soil in Moon's north and south poles could therefore provide clues to the early Solar System.

Notably, Chandrayaan-2 also planned to land in this region in 2019, but it was not able to accomplish a soft landing and lost contact after it hit the surface.

Why was Chandrayaan-2 unable to land correctly, and what has changed since then?

Subsequent analyses reported that there were both software and hardware problems in 2019's Chandrayaan-2. Isro chairperson S Somanath recently said the changes to the current mission were "failure-based." He said, "Instead of a success-based design in Chandrayaan-2, we are doing a failure-based design in Chandrayaan-3 —we are looking at what can go wrong and how to deal with it."
Some of the changes that have been made are:

*Chandrayaan-2 lost control over its descent around 7.2 km from the surface of the Moon. Its communications system relayed data of the loss of control up to around 400 m above the surface. The Lander had slowed down to about 580 km/hr when it crashed.

A Lander does not have wheels; it has stilts, or legs, which are supposed to touch down on the lunar surface, the legs of Chandrayaan-3 have been strengthened to ensure that it would be able to land, and stabilise, even at a speed of 3 m/sec, or 10.8 km/hour.

*The prospective landing site has had its range increased. Instead of trying to reach a specific 500mx500m patch for landing as targeted by Chandrayaan-2, the current mission has been given instructions to land safely anywhere in a 4kmx2.4km area.

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*The Chandrayaan-3 Lander is carrying more fuel than Chandrayaan-2. This has been done to ensure that the Lander is able to make a last-minute change in its landing site, if it needs to.

*The Chandrayaan-3 Lander has solar panels on four sides, instead of only two in Chandrayaan-2. This is to ensure that the Lander continues to draw solar power, even if it lands in a wrong direction, or tumbles over. At least one or two of its sides would always be facing the Sun, and remain active.

What needs to happen for Chandrayaan-3 to land successfully?

The critical technical manoeuvre that the Chandrayaan-3 Lander will have to perform on August 23 when it enters the final 15 minutes of its attempt to make a soft landing on the Moon will be to transfer its high-speed horizontal position to a vertical one — in order to facilitate a gentle descent on to the surface.

After Chandrayaan-2 failed in its soft landing mission, K Sivan, then chairman of ISRO, had described this as "15 minutes of terror". It includes four phases:

1. The Rough Braking phase would include reducing the lander's horizontal velocity from a range of 1.68 km/sec (more than 6,000 km/h) at a height of 30 km from the lunar surface, to almost zero for a soft landing at the designated site. This has to be done with precision, within certain durations. **Read this explainer for a more detailed explanation**.

2. At a height of 7.42 km from the surface, the lander will go into an "attitude hold phase" lasting around 10 seconds, during which it will tilt from a horizontal to a

vertical position while covering a distance of 3.48 km.

3. The “fine braking phase” will last around 175 seconds, during which the lander will move fully into a vertical position. It will traverse the final 28.52 km to the landing site, the altitude will come down to 800-1,000 m, and it will reach a nominal speed of 0 m/sec. It was between the “attitude hold phase” and the “fine braking phase” that Chandrayaan-2 lost control and crashed.

4. “Terminal descent” is the final stage, when the spacecraft is supposed to descend totally vertically onto the surface.

And finally, what happens after Chandrayaan-3 successfully lands on the Moon?

Spacecraft are often carrying certain instruments and experiments with them (called payloads) that observe and record what is happening in Space. This information is then relayed to Earth for scientists to analyse and study.

The six payloads on the Vikram lander and rover Pragyan remain the same as the previous mission. There will be four scientific payloads on the lander to study lunar quakes, thermal properties of the lunar surface, changes in the plasma near the surface, and a passive experiment to help accurately measure the distance between Earth and the Moon. The fourth payload comes from NASA.

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There are two payloads on the Rover, designed to study the chemical and mineral composition of the lunar surface and to determine the composition of elements such as magnesium, aluminium and iron in the lunar soil and rocks.

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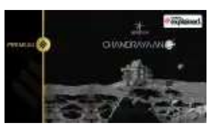

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