Congratulations to India-Proud to be an Indian

Chandrayaan-2 is India's second lunar exploration mission after Chandrayaan-1. Developed by the Indian Space Research Organisation, the mission has launched from Sriharikota Space Center on 22 July 2019 to the Moon by a Geosynchronous Satellite Launch Vehicle Mark III.

One of India's most ambitious space-based mission, Chandrayaan-2, took flight today. The brainchild of Indian Space Research Organisation (ISRO), the mission will attempt to explore the south polar region of the Moon. It is a region hitherto unexplored by any country.

Delayed yet undeterred

The lunar mission, which was originally planned for July 15, 2019, was delayed when a 'technical snag' was discovered just before the final countdown. Chandrayaan-2 will reach its orbit with the help of GSLV MK-III, which is capable of carrying 4-tonne class of satellites to the Geosynchronous Transfer

The technology being used

The payload will include terrain mapping cameras to prepare a 3-D map of the intended area; while a collimated large array soft x-ray spectrometer will map the majority of
major rock-forming elements. An orbiter high resolution camera will capture high-resolution images of the landing site and an imaging infrared spectrometer will identify minerals along with signatures of hydroxyl (OH) and water (H₂O) molecules in Polar Regions.

While there, we will also explore discoveries made by Chandrayaan-1, such as the presence of water molecules on the Moon and new rock types with unique chemical composition. Through this mission, we aim to expand India's footprint in space, surpass international aspirations and inspire a future generation of scientists, engineers and explorers", ISRO said in a statement.

**Made in India**

**India's Central Tool Room and Training Centre** (CTTC) has manufactured 22 types of valves for fuel injection and other parts for the cryogenic engine of the GSLV Mark III rocket. This Bhubaneswar-based institution had started manufacturing the parts for this particular lunar mission in March 2017.

**What is Chandrayaan 2?**

Chandrayaan is an amalgamation of Chandra – Moon and Yana – vehicle. Chandrayaan-1 was India’s first unmanned mission which was launched in October 2008. Chandrayaan 2 is the second unmanned mission and will launch after almost a
decade since the first mission. The ambitions with the second Moon mission are understandably greater.

**What are the objectives of Chandrayaan 2?**

Chandrayaan 2 is expected to make a soft landing on the unmapped surface of the Moon on the South Pole. This will be the first time any mission touched down so far from the equator, according to a report in Science. One of the primary objectives is to demonstrate the ability to soft-land on the lunar surface.

Among the scientific objectives, there are experiments that will be conducted to study the lunar topography, mineralogy, elemental abundance, the lunar exosphere and signs for hydroxyl – a molecule involving hydrogen and oxygen which has, among other things, significance when it comes to the search for extraterrestrial life – and water ice on the lunar surface.

**What do you mean by a soft-landing?**

A soft landing is actually a technical term to indicate a landing technique that prevents any kind of damage to sensitive instruments onboard. Hard landings are those where damage to the craft or instruments occurs, when an aircraft crash lands, for example. With the onboard central-mounted propulsion system, the lander will make a vertical descent to the predetermined landing site near the South Polar Region of the moon.
What is the duration of Chandrayaan 2?

The scientific experiments will be conducted on the lunar surface for 14 Earth days (1 lunar day) by the Lander and Rover. The Orbiter will be operational for a year.

Why go to the Moon when we have already been there with Chandrayaan-1?

Well, why not? Chandrayaan 2 mission has different objectives which were not part of Chandrayaan-1, so it makes the mission quite relevant. According to ISRO, in addition to being only the fourth nation (after the US, Russia and China) to be attempting a soft landing on the lunar surface, Chandrayaan 2 will achieve lots of firsts.
Chandrayaan 2 will be the first space mission to conduct a soft landing on the Moon's south polar region.

Chandrayaan 2 will be the first Indian expedition to attempt a soft landing on the lunar surface with home-grown technology.

Chandrayaan 2 will be the first Indian mission to explore the lunar terrain with home-grown technology.

The Moon also happens to be a sort of preparation for demonstrating technologies that can be used for further deep space missions. To quote from the ISRO website, "The Moon provides us with the best linkage to Earth's early history and an undisturbed record of the nascent Solar System environment. While a few mature models do exist, the Moon's origin still needs further explanations. Extensive mapping of the lunar surface will aid us in studying variations in its composition — an essential piece of information in tracing the Moon's origin and evolution. Evidence of water molecules — discovered by Chandrayaan 1 — and the extent of its distribution on the lunar surface and sub-surface also require further studies."

So it's clear that a lot still needs to be discovered on the Moon.

**How much will Chandrayaan 2 cost?**

The total cost of building and testing the Chandrayaan-2 orbiter, lander and rover is Rs 603 crores, according to ISRO chief Dr Sivan. This does not include the cost of building the GSLV-Mk-III rocket. According to Sivan, the mission will be supported by over 500 academic institutions and 120 industries who have contributed around 60 percent of the...
Rs 603 crore budget and 80 percent of the Rs 375 crore cost of the GSLV Mk-III. That pegs the total cost of the Chandrayaan 2 mission at around Rs 978 crore or around $140 mn.

In terms of cost, how does Chandrayaan 2 compare with other Moon missions?

ISRO is renowned for completing space missions at affordable costs. Mangalyaan, India's mission to Mars, cost less than the amount it took Hollywood to make the movie The Martian. Putting things into perspective, it cost more money for Hollywood to make a movie about sending someone to Mars, than ISRO took for an actual space mission that reached the Red Planet. So here's a table comparing Moon missions.

<table>
<thead>
<tr>
<th>Mission Name</th>
<th>Country</th>
<th>Year</th>
<th>Cost (in USD)</th>
</tr>
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<tbody>
<tr>
<td>Chandrayaan 2</td>
<td>India</td>
<td>July 2019</td>
<td>140 mn</td>
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<tr>
<td>Beresheet</td>
<td>Israel</td>
<td>February 2019</td>
<td>100 mn</td>
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<tr>
<td>Chang'e 4</td>
<td>China</td>
<td>December 2018</td>
<td>180 mn</td>
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<td>USA</td>
<td>April 2018</td>
<td>287 mn</td>
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<tr>
<td>LADEE</td>
<td>USA</td>
<td>September 2013</td>
<td>280 mn</td>
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</tbody>
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What is so significant about the South Pole of the Moon?

It's not explored much. A large section of the lunar South Pole stays under the shadow of the North Pole. There is speculation of water being present there in the permanently
shadowed areas around it. Moreover, the South Pole is also said to have cold traps which can contain fossilized information of the early Solar System.

**What comprises Chandrayaan 2?**

Chandrayaan 2 comprises three modules: The Orbiter, Vikram Lander and Pragyan Rover. According to ISRO, the Orbiter and Lander modules will be having a mechanical interface and will be stacked together as an integrated module inside the GSLV MK-III launch vehicle.

“The Rover is housed inside the Lander. After launching into Earth-bound orbit by GSLV MK-III, the integrated module will reach Moon orbit using the Orbiter propulsion module. Subsequently, Lander will separate from the Orbiter and soft land at a predetermined site close to the lunar South Pole. Further, the Rover will roll out for carrying out scientific experiments on the lunar surface. Instruments are also mounted on the Lander and Orbiter for carrying out scientific experiments,” according to ISRO.

Chandrayaan 2 will be carrying 14 payloads: 8 on the Orbiter, 3 on Lander and 2 on Rover.

**Chandrayaan Orbiter: Highlights**
- Weight: 2,379 kg
- Power generation: Solar arrays capable of generating 1,000 W.
- Communication: It will communicate with the Indian Deep Space Network and the Lander.
- Payload: 8 instruments
- Scientific experiments expected: The Imaging Infra-Red Spectrometer (IIRS) will try to identify minerals and indicators of hydroxyl and water molecules. Other payloads include a visible terrain mapping camera, a neutral mass spectrometer, a synthetic aperture radar, a radio occultation experiment, solar X-Ray monitor and a soft X-Ray spectrometer.
Vikram Lander: Highlights

- Weight: 1,471 kg
- Power generation: Solar arrays can generate 650 W.
- Period of operation: 14 days or 1 Lunar Day.
- Communications: It can communicate directly with the Indian Deep Space Network as well as the Orbiter and the Rover.
- Payloads: 3
- Scientific experiments expected: The first payload is a Langmuir probe, an instrument that can measure the electron temperature, electron density and electric potential of plasma. It is expected to study and measure the lunar surface
A thermal probe onboard will be running the Chandra’s Surface Thermo-physical experiment to measure the vertical temperature gradient and thermal conductivity of the lunar surface. The third payload is a simple seismometer named 'Instrument for Lunar Seismic Activity' or ILSA for short and will be studying lunar quakes.

**Pragyan Rover**

- Weight: 27 kg
- Power generation: Runs on 50 W of solar power.
- Period of operation: 14 days or 1 Lunar Day.
- Communications: Communicates directly with the Lander.
- Travel speed: 1 cm per second for 500 metres.
- Payloads: 2
- Scientific experiments expected: Pragyan will have two instruments onboard. The instruments will test mineral and chemical compositions on the surface of the Moon as well as the soil and rocks. Data on and around the South side of the pole will be collected and sent.

Thank You!!