James Webb Space Telescope (JWST) and Mars

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What's in News?

The James Webb Space Telescope (JWST) has captured its first images of Mars, viewing infrared light coming from the Red Planet with high sensitivity.

James Webb Space Telescope:

- The James Webb Space Telescope is an **infrared observatory orbiting the Sun about 1 million miles from Earth** to find the first galaxies that formed in the early universe and to see stars forming planetary systems.
- It was launched by **NASA - European Space Agency–Canadian satellite observatory** designed as the **successor to the Hubble Space Telescope (HST)**
- It's the **largest, most powerful infrared space telescope** ever built.

Lagrange Point:

- It was launched aboard a rocket on December 25, 2021, and is currently at a point in space known as the Sun-Earth L2 Lagrange point, approximately 1.5 million km beyond Earth's orbit around the Sun.
- Lagrange Point 2 is one of the five points in the orbital plane of the Earth-Sun system.
- Named after Italian-French mathematician Josephy-Louis Lagrange, **the points are in any revolving two-body system like Earth and Sun, marking where the gravitational forces of the two large bodies cancel each other out**.
- Objects placed at these positions are relatively stable and require minimal external energy or fuel to keep themselves there, and so many instruments are positioned here.
- L2 is a position directly behind Earth in the line joining the Sun and the Earth. It would be shielded from the Sun by the Earth as it goes around the Sun, in sync with the Earth.

Goals of James Webb Space Telescope:

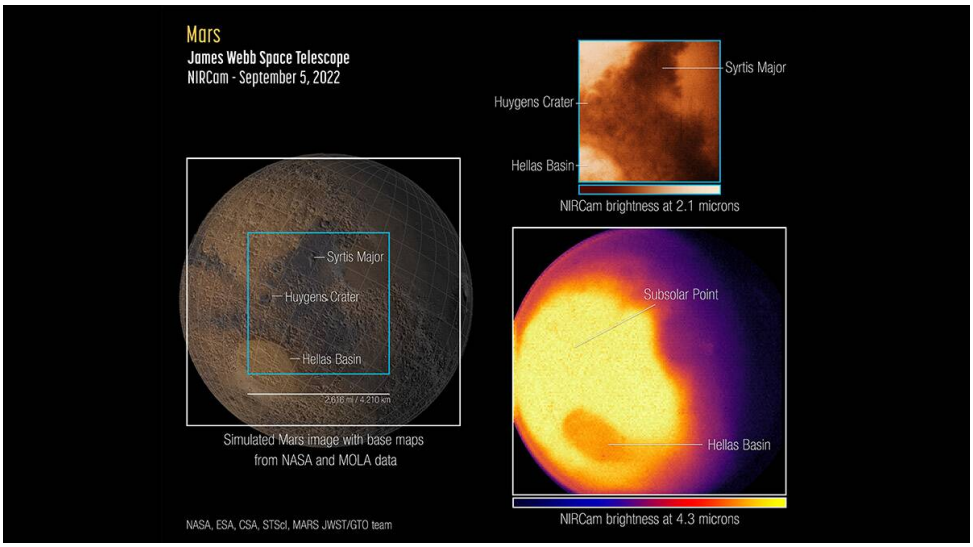
The science goals for the Webb can be grouped into four themes.

1. It is to look back around 13.5 billion years to see the **first stars and galaxies forming out** of the darkness of the early universe.
2. To **compare the faintest, earliest galaxies to today's grand spirals** and understand how galaxies assemble over billions of years.
3. To see where **stars and planetary systems are being born**.
4. To **observe the atmospheres of extrasolar planets** (beyond our solar system), and perhaps find the building blocks of life elsewhere in the universe.

The telescope will also study objects within our own Solar System.

News Highlights:

- The European Space Agency (ESA) released the James Webb Space Telescope's (JWST) first images and infrared spectrum of Mars.
- From the telescope's vantage point, it gets a view of Mars' observable disk, which is the portion of the sunlit side facing the telescope.
- This allows JWST to capture images and spectra with the specific resolution needed to study short-term phenomena.
- These phenomena include **dust storms, weather patterns, and seasonal changes**.
- Additionally, the Webb telescope could capture events that happen at different times throughout the Martian day — during the daytime, at sunset and during the night — in a single observation.
- Mars is very close to the Earth and it is one of the brightest objects in the night sky, in both visible and infrared light.
- But since Webb's instruments are so sensitive, the bright infrared light from Mars is almost blinding, causing something known **as "detector saturation."**
- Scientists need to use special detection techniques in order to overcome this, including using very short exposures and measuring only some of the light that hits the detectors.
- They then used special data analysis techniques to arrive at the image.
- Near-Infrared Camera (NIRCam) is used to capture the part of the planet's eastern hemisphere at two different wavelengths.
- Some of the parts which are found include - **the Huygens Crater**, a near 280-mile-wide (450 kilometers) impact crater, and dark volcanic rock in **the Syrtis Major Planum and Hellas Basin**



Other Space Explorations in Mars:

As of May 2021, there are three operational rovers on the surface of Mars, **the Curiosity and Perseverance rovers, both operated by the United States of America space agency NASA,** as well as the **Zhurong rover, part of the Tianwen-1 mission by the China National Space Administration (CNSA)**

The next missions expected to arrive at Mars are:

1. The joint **ExoMars program of Roscosmos and ESA has delayed the launch of the Kazachok landing platform**, which will carry the Rosalind Franklin rover, until 2022.
2. **Mars Orbiter Mission 2 by India**, planned launch in 2025

India and Mars Exploration:

- Mars Orbiter Mission (Mangalyaan) (MOM) is the **maiden interplanetary mission of ISRO.**
- Launched on **November 5, 2013**, the probe was successfully inserted into Martian orbit on September 24, 2014 in its first attempt.

- Through its Mangalyaan mission, India not only became the first Asian country to attain the feat of reaching Mars' orbit, it also became the first country to do so on its first attempt.
- The Mangalyaan Mission was also lauded for being the cheapest mission to Mars till date.
- An important conclusion of the Mangalyaan mission has been the finding that dust storms on the Martian can rise up to hundreds of kilometres.
- Mangalyaan-2, or Mars Orbiter Mission 2 (MOM 2), is ISRO's second interplanetary mission, expected to be launched in 2025.

BRIEF TIMELINE OF IMPORTANT MISSIONS TO MARS

1965: MARINER 4
NASA's Mariner 4 arrives and sends 21 p
Mars back to Earth.

1971: MARS 3
The USSR's Mars 3 lander completes a soft landing on Mars, but is lost after several seconds transmitting from the surface.

1971: MARINER 9
NASA's Mariner 9 discovers volcanoes a
Marineris in the thousands of photos it s
from Mars orbit.

1976: VIKING 1 AND VIKING 2
NASA's Viking 1 and Viking 2 both arrive and send their landers to the surface. Each spacecraft returns years of data but cannot prove the existence of microorganisms on Mars.

1997: MARS GLOBAL SURVEY
NASA's Mars Global Surveyor arrives in
around Mars and maps the Red Planet f
pole.

1997: PATHFINDER LANDER AND SOJOURNER ROVER
NASA's Pathfinder lander and Sojourner rover arrive on the surface of Mars. Sojourner becomes the first rover to trundle around on another planet.

2001: MARS ODYSSEY
NASA's Mars Odyssey begins what even
becomes more than two decades relayi
from Mars to Earth.

2003: MARS EXPRESS
ESA's Mars Express loses its lander, but the orbiter remains in service for at least 19 years.

2004: SPIRIT AND OPPORTUN ROVERS
NASA's Spirit and Opportunity, twin rove

2006: MARS RECONNAISSANCE

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