James Webb Space Telescope may help answer Humanity's Questions

Why in news?

The telescope, which moved into its final position this week, has already begun its work of looking for answers to some of humanity's most pressing questions, including about the possibility of life elsewhere in the universe.

What is James Webb Space Telescope?

- The James Webb Space Telescope is an infrared telescope formerly known as the "**Next Generation Space Telescope**".
- It was launched on December 25, 2021 on a mission to study the earliest stars and peer back farther into the universe's past than ever before.
- Webb is an international collaboration between **NASA, ESA** (the European Space Agency), and the Canadian Space Agency (**CSA**).
- The Webb telescope is said to be the **scientific successor to the Hubble Space Telescope**.
- It is NASA's largest and most powerful space science telescope ever constructed.
- Webb is now orbiting **Lagrange point 2 (L2**) located between Earth and Sun nearly 1 million miles (1.6 million km).
- The telescope will
    - Hunt for the unobserved formation of the first galaxies, and
    - Look inside dust clouds where stars and planetary systems are forming today.
- The telescope's four instruments - cameras and spectrometers have detectors that are able to record extremely faint signals.
- The collected data will help find answers to questions in 4 areas of modern astronomy
    1. First light,
    2. Assembly of galaxies,
    3. Birth of stars and protoplanetary systems and Planetary systems
    4. The origin of life

Significance of Lagrange points:

- *Help objects to stay put as the gravitational pull of two large masses precisely equals the centripetal force required for a small object to move with them*
- *Reduce the fuel consumption of spacecrafts*

What is Hubble Space Telescope?

- Hubble Space Telescope was launched in 1990.
- Hubble is a **Cassegrain reflector telescope** that uses a combination of a primary concave

mirror and a secondary convex mirror.
- In addition to observing **visible and near-infrared light**, Hubble detects **ultraviolet light**, which is absorbed by the atmosphere and visible only from space.
- The Telescope has embarked on an extensive three-year program, known as Hubble's Ultraviolet Legacy Library of Young Stars as Essential Standards (**ULLYSES**), to observe a set of high- and low-mass young stars.
- **Contributions**
    1. Hubble has revealed the age of the universe to be about 13.8 billion years
    2. Hubble played a key role in the discovery of dark energy, a mysterious force that causes the expansion of the universe to accelerate.
    3. Hubble has shown scientists galaxies in all stages of evolution, including galaxies that were around when the universe was still young, helping them understand how galaxies form.
    4. It found protoplanetary disks, clumps of gas and dust around young stars that likely function as birthing grounds for new planets.
    5. It discovered that gamma-ray bursts — strange, incredibly powerful explosions of energy that occur in far-distant galaxies when massive stars collapse.

What is the difference between Hubble and James Webb Telescope?

- **Location**- Hubble was launched into low-Earth orbit whereas Webb is orbiting in L2 region.
- **Size**- Webb will have an approximately 6.5 meter diameter primary mirror, which would give it a significantly larger collecting area than the mirror available in the Hubble which is 2.4 meters in diameter.
- **Images Captured-** The images taken by Webb will be better than that of Hubble and would be fundamentally different because of its different wavelengths.
- **Wavelength-** Webb has the ability to detect infrared light while Hubble can observe light at optical and ultraviolet wavelengths.
- **Specification-** Webb needs to be colder than Hubble in order to capture faint infrared wavelengths of light and needs to be shielded from the Sun, Earth and Moon's infrared radiation.
- **The South Atlantic Anomaly**- Hubble passes through the South Atlantic Anomaly (a small dent in the Earth's magnetic field that can impact satellites) about 15% of the time whereas Webb will not cross paths with the anomaly.
- **Delving deeper-** Webb is expected to go beyond Hubble's range and behold light from universe's first stars and galaxies, revealing how the stars looked 13.7 billion years ago.

The Herschel Space Observatory was an infrared telescope built by the European Space Agency that too orbited the L2 point.

References

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