The James Webb Space Telescope

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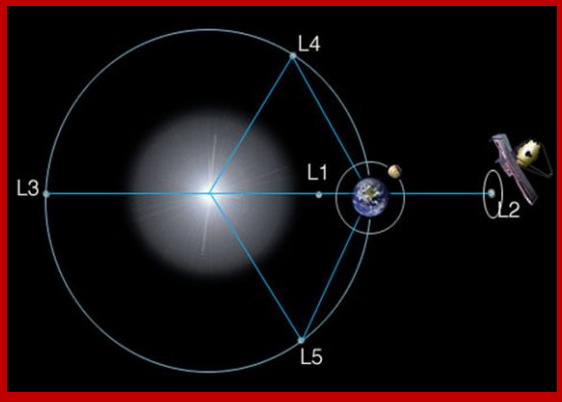
An artist's impression of JWST once all components are fully deployed – image from Northrop Grumman.

How?

JWST has been a long time coming, as you would probably expect from such an enormously complicated, expensive, and ambitious scientific project. The design process began in 1996 under the name "Next Generation Space Telescope," and after a series of delays resulting from budget debates, political challenges, a torn sunshield during a practice deployment, COVID-19, weather issues and many other events, a launch date was secured for late 2021.

Eventually, by Christmas Day of 2021, after over two decades, JWST finally launched in an internationally coordinated joint operation with the European Space Agency, who launched the telescope on an Ariane 5 rocket from their site in French Guiana. It was a textbook takeoff – NASA referred to it as "flawless." $10B USD and the hopes of astronomers worldwide took off without a hitch, in a launch codenamed VA256. It was the most valuable payload carried on and arguably most important Ariane-series rocket flight yet.

VA256 and the JWST ready to take off, 23/12/21 – image from nasa.gov.



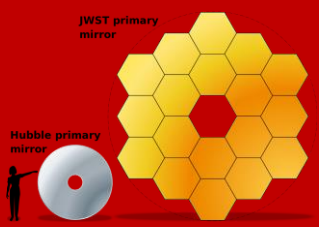
A diagram showing the location of the Lagrange points – image from nasa.gov.

What?

The James Webb Space Telescope (abbreviated JWST) is an unmanned NASA-operated spacecraft and telescope. It is intended to replace the aging Hubble Space Telescope and improve NASA's astrophysics observation capabilities - a task which its' 5.6 times larger light-collecting mirror area will certainly help with. Operations are expected to begin as soon as summer 2022, with JWST having launched on the 25th of December 2021. It is expected to serve for at least ten years, as it has enough fuel to maintain its position for that long.

A key part of its' mission is studying the oldest and most distant objects in the observable universe – up to 46 billion light years away! (We can observe objects over 13.8 billion light years away as the universe is expanding, so while the light we see coming from the farthest reaches of observable space may be ~13 billion years old, the objects it comes from have at this point moved to be 46 billion light years away.)

JWST represents the modern pinnacle of orbital astronomy and cosmology, and the technology that has gone into it reflects that. It is designed to receive electromagnetic radiation from low-wavelength visible light (red light) to mid-infrared, which is favorable for studies of the most distant detectable objects. It will be able to see features too faint, far, or distorted for any existing telescopes to observe. The conditions required to achieve this are exacting – the telescope must maintain a temperature below -223 degrees C* to function properly.



Size comparison between the Hubble Space Telescope mirror and JWST mirror – image from nasa.gov.

Where?

JWST orbits in the Earth-Sun L2 point, one of a few points (known as Lagrange points) where the gravitational pull of the Earth and the Sun precisely equals the centripetal force required for a small object to move with them. Being situated in L2 allows JWST to stay in roughly the same place relative to the Earth and the Sun – which is helpful for communications and getting a clear view out at deep space, as JWST will be positioned with the Earth, Sun, and Moon as well as their brightness and reflectiveness away from the lens. Such a positioning would be harder to achieve at any other location.