Mission Summary

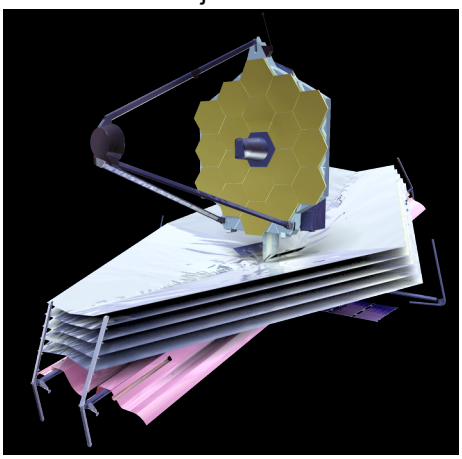
National Aeronautics and
Space Administration

Goddard Space Flight Center

James Webb Space Telescope

From the first light in the Universe to the birth of planets and the origins of life

The JWST Science Mission
How did we get here? The launch of the James Webb Space Telescope (JWST) will be a giant step in the human quest to understand our place in the Universe. With the largest telescope mirror ever placed in space—so large it must be folded during launch—JWST will examine every phase of our history: from wisps of gas condensing into the first stars and galaxies after the Big Bang, to the formation of solar systems capable of supporting life on planets like Earth, and to the evolution of our own Solar System. JWST will follow the aging Hubble Space Telescope, providing 7 times the light-collecting area to detect faint objects.



JWST's deployable 20-foot telescope

JWST will be the premier space observatory for astronomers worldwide, extending the tantalizing discoveries of the Hubble Space Telescope, as well as the Spitzer Space Telescope and giant ground-based telescopes. Identified by the National Academy of Sciences as this decade's top priority for astronomy and astrophysics, JWST is a key program in the nation's Vision for Space Exploration.

The JWST will use infrared instruments to analyze light that cannot be seen from the ground because of interference from the Earth's atmosphere. The Hubble and Spitzer telescopes cannot observe this radiation nearly as well.

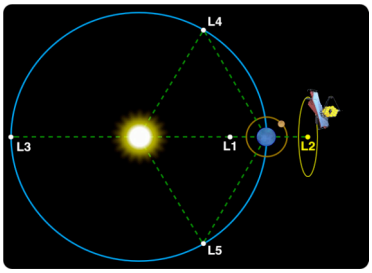
Goals
JWST will focus on four key areas to unravel the mystery of how the universe grew from a Big Bang into galaxies, stars, and planets.

- **First Galaxies**: After the Big Bang, the first galaxies probably formed as groups of very massive stars. As the stars ended their lives in explosions called supernovae, chemical elements such as carbon, oxygen and iron were formed and blown into space to seed future generations of stars and planets. JWST will search for these first galaxies.
- **Galaxy Assembly**: Large galaxies are assembled through the merging together of smaller ones. JWST will observe millions of galaxies at all stages of development with broad wavelength coverage and Hubble-like image quality. The result will be a complete picture of galaxy assembly from the epoch of First Light through the present.
- **Birthplaces of Stars**: Stars and planetary systems form within nearby dust clouds, which hide the details of this process from view. JWST, observing in infrared light that can penetrate these dusty shrouds, will reveal the environments within these stellar nurseries and the conditions for formation of planetary systems.
- **Planets and Life**: JWST will study the evolution of planetary systems and ways they

could support life. It will explore the distribution of organic molecules and water in our Solar System, identify planetary footprints around other stars, image young planets in nearby systems, and study the atmospheres of planets as they transit parent stars.

Mission Concept and Technology

To make these scientific breakthroughs, JWST will be sensitive to wavelengths from 0.6 to 27 micrometers. (Red light has a wavelength of 0.6-0.7 micrometers.) To collect enough light, the telescope must be enormous, larger than the diameter of the rocket, so it will unfold after launch. To detect infrared light, it also must be cold, about -379 F (45 K), cold enough to freeze air. This will prevent the instruments from emitting their own infrared radiation. An ESA-supplied Ariane 5 rocket will launch JWST from French Guiana and place it in orbit a million miles away, around the second Lagrange point, L2. A shield the size of a tennis court will shelter the telescope from the Sun, Earth and Moon.



JWST orbits L2, a million miles from Earth

There will be four instruments: a near infrared (IR) camera provided by the University of Arizona, a near IR spectrograph provided by the European Space Agency (ESA), a mid IR instrument provided by a European consortium and the Jet Propulsion Laboratory, and a Tunable Filter Imager from the Canadian Space Agency (CSA). CSA also provides a Fine Guidance Sensor. The instruments and detectors are colder than the telescope.

Major new technologies for JWST include (1) ultralightweight beryllium optics; (2) a folding 6.5-meter (20 foot) mirror comprised of 18 individual segments, adjusted after launch by cryogenic actuators; (3) a deployable multilayer sunshade; (4) programmable microshutters to enable object selection for the spectrograph; (5) a super-cold mechanical cryocooler; and (6) high-quality near and mid-IR detectors to detect extremely weak signals.

Mission Status

JWST is in the detailed design phase of its development. Long-lead items, such as beryllium mirror segments and science instruments, are now under construction. All necessary technology developments will be completed and tested in relevant environments by January 2007. External committees have examined the plans, schedules, and budget, and confirmed the Project's estimates. Launch is planned around 2013.

JWST's mirror blanks ready for shipment.

Heritage

JWST builds on the technical heritage of the Hubble and Spitzer space telescopes, as well as extending their scientific discoveries with extraordinary new capabilities. JWST will provide technology blueprints for future exciting missions such as the Constellation-X observatory and the Terrestrial Planet Finder.

Partners

JWST is an international collaboration among NASA, ESA, and CSA. The prime contractor is Northrop Grumman Space Technologies. The Space Telescope Science Institute will operate JWST just as it operates the Hubble.

Mission Cost

As of 2006, NASA has spent approximately $1B to develop technology and make designs. The total cost is comparable to that for the Chandra X-ray observatory and the Hubble, not counting its servicing. JWST will provide data and funds to astronomers, as the Hubble does today.

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website:*http://www.jwst.nasa.gov*

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