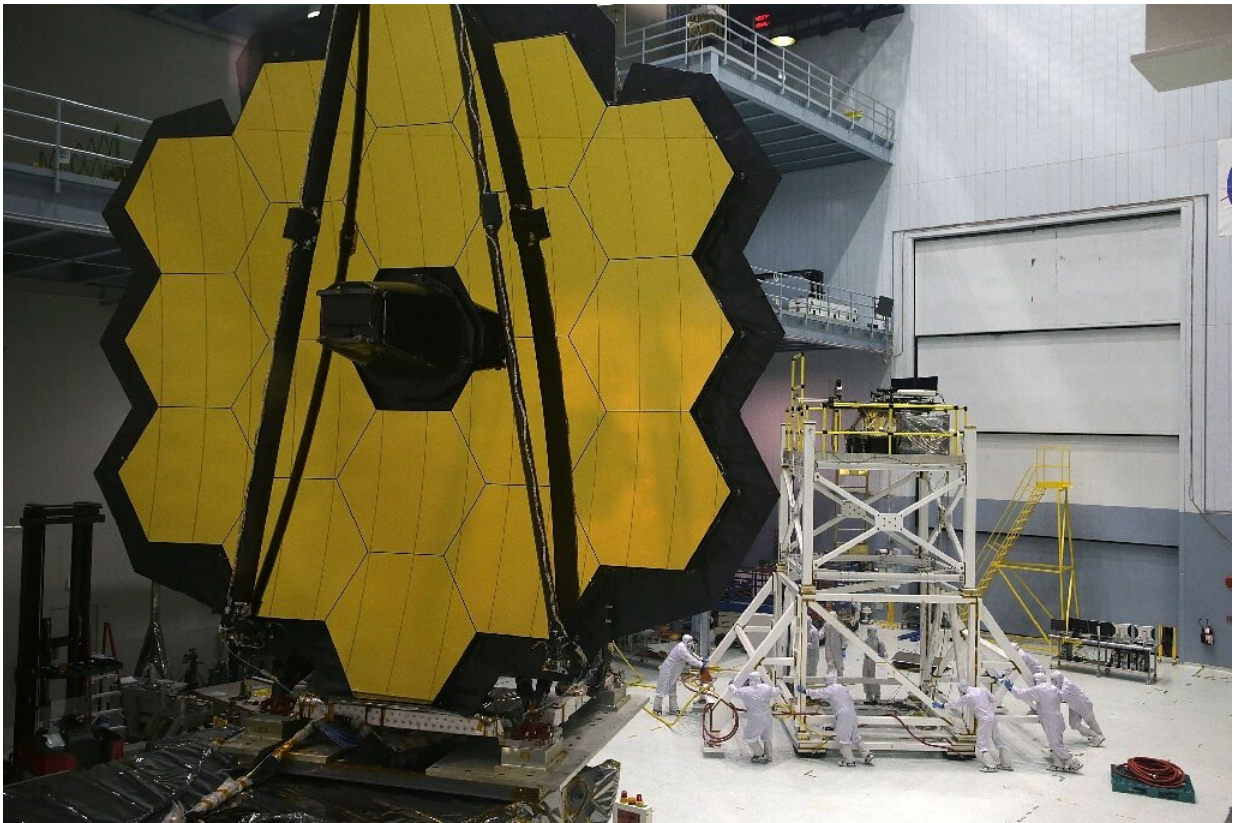


Five things to know about the James Webb Space Telescope

December 22 2021, by Lucie Aubourg



Webb's centerpiece is its giant primary mirror, a concave structure 21.5 feet (6.5 meters) wide and made up of 18 smaller hexagonal mirrors.

The James Webb Space Telescope, the most powerful space observatory ever built, is now tentatively set for launch on Christmas Day, after

decades of waiting.

An engineering marvel, it will help answer fundamental questions about the Universe, peering back in time 13 billion years. Here are five things to know.

Giant gold mirror

The telescope's centerpiece is its enormous primary mirror, a concave structure 21.5 feet (6.5 meters) wide and made up of 18 smaller hexagonal mirrors. They're made from beryllium coated with gold, optimized for reflecting [infrared light](#) from the far reaches of the universe.

The observatory also has four [scientific instruments](#), which together fulfill two main purposes: imaging [cosmic objects](#), and spectroscopy—breaking down light into separate wavelengths to study the physical and chemical properties of cosmic matter.

The mirror and instruments are protected by a five-layer sunshield, which is shaped like a kite and built to unfurl to the size of a tennis court.

Its membranes are composed of kapton, a material known for its high heat resistance and stability under a wide temperature range—both vital, since the Sun-facing side of the shield will get as hot as 230 degrees Fahrenheit (110 degrees Celsius), while the other side will reach lows of -394F.

The telescope also has a "spacecraft bus" containing its subsystems for electrical power, propulsion, communications, orientation, heating and data handling; all told, Webb weighs around as much as a school bus.

James Webb telescope

The new space telescope*, the successor to Hubble, will detect primarily infrared light outside the visible range to show otherwise hidden regions of space, when in position 1.5 million kms from Earth in early 2022.

MISSION GOALS (10 YEARS)

- Measure planetary systems and investigate for potential life
- Observe the formation of stars and evolution of galaxies
- Search for the first galaxies formed in the early universe

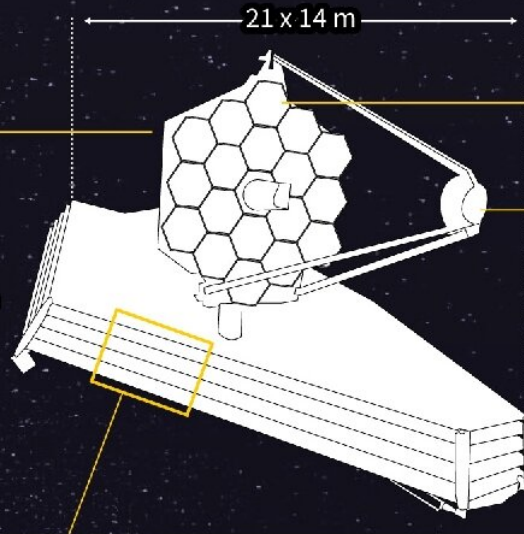
LAUNCH

On an Ariane 5 rocket
Dec. 22 from European Spaceport
near Kourou, French Guiana

Instruments:

**cameras
and spectrographs**

must be kept very cold
to detect extremely faint
heat signals in the universe



Primary mirror

diameter: 6.5 m
18 segments

Secondary mirror:

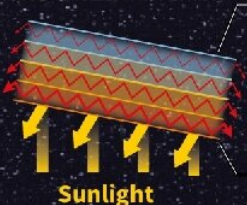
0.74 m

weight:

6.2 tonnes

SUN SHIELD

5 layers:
0.05-0.025 mm thick



Inner layer
temp -235 °C
(-390 °F)

Outer layer
125 °C (260 °F)

ORBIT

Arriving 1.5 million kms from
Earth one month after launch



Source: NASA

*Joint project by NASA, ESA and Canadian Space Agency

AFP 

Graphic of the James Webb space telescope, the successor to Hubble, and where it will be stationed after launch on December 22.

Million-mile journey

The telescope will be placed in orbit about a million miles from Earth, roughly four times the distance of our planet from the Moon.

Unlike Hubble, the current premier space telescope that revolves around the planet, Webb will orbit the Sun.

It will remain directly behind Earth, from the point of view of the Sun, allowing it to remain on our planet's night side. Webb's sunshield will always be between the mirror and our star.

It will take about a month to reach this region in space, known as the second Lagrange point, or L2. While astronauts have been sent to repair Hubble, no humans have ever traveled as far as Webb's planned orbit.

High-tech origami

Because the telescope is too large to fit into a rocket's nose cone in its operational configuration, it has to be transported folded, origami style. Unfurling is a complex and challenging task, the most daunting deployment NASA has ever attempted.

About 30 minutes after take-off, the communications antenna and [solar panels](#) supplying it with energy will be deployed.



Because the telescope is too large to fit into a rocket's nose cone in its operation form, it has to be transported folded, origami style.

Then comes the unfurling of the sunshield, hitherto folded like an accordion, beginning on the sixth day, well after having passed the Moon. Its thin membranes will be guided by a complex mechanism involving 400 pulleys and 1,312 feet of cable.

During the second week will finally come the mirror's turn to open. Once in its final configuration, the instruments will need to cool and be calibrated, and the mirrors very precisely adjusted.

After six months the telescope will be ready to go.

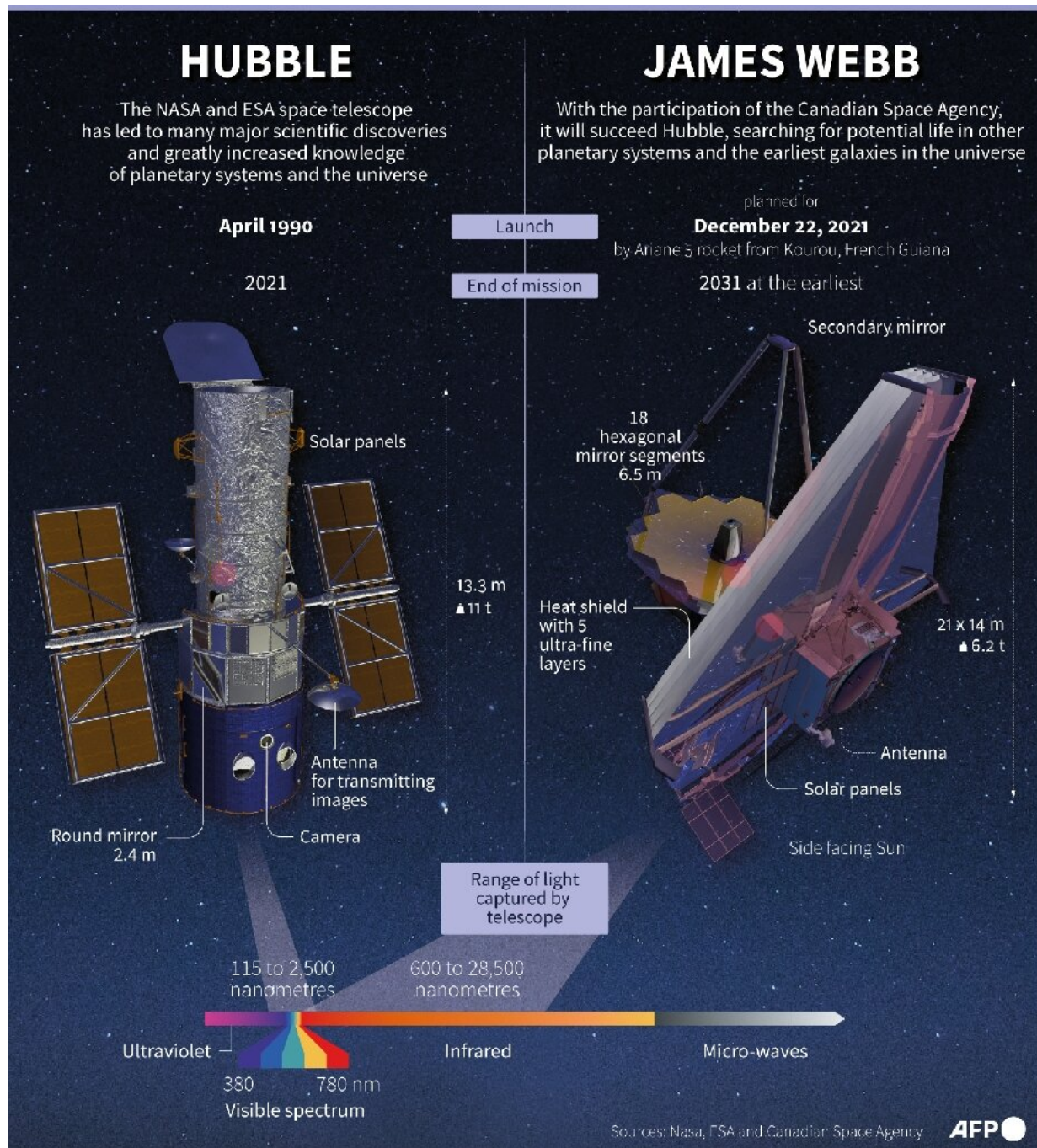
Life, the universe, and everything

Webb has two primary scientific missions, which together will account for more than 50 percent of its observation time. First, explore the early phases of cosmic history, looking back in time to only a few hundred million years after the Big Bang.

Astronomers want to see how the very first stars and galaxies formed, and how they evolve over time.

Its second major goal is the discovery of exoplanets, meaning planets outside the solar system. It will also investigate the potential for life on those worlds by studying their atmospheres.

The great promise of Webb lies in its infrared capacity.



Comparison of the space telescopes Hubble, in orbit since 1990, and its successor the James Webb telescope, to be launched on December 22.

Unlike the ultraviolet and visible light Hubble mostly operates in, the longer wavelengths of infrared penetrate dust more easily, allowing the early universe shrouded in clouds to come more clearly into view.

Infrared also lets scientists go further back in time because of a phenomenon called redshifting. Light from objects farther away is stretched as the universe expands, towards the infrared end of the spectrum.

Also planned are closer observations, in our solar system, of Mars and of Europa, Jupiter's icy moon.

Decades in the making

Astronomers began debating the telescope that should succeed Hubble in the 1990s, with Webb's construction beginning in 2004.

Launch has been pushed back several times, initially penciled for 2007, then 2018...mainly because of the complexities associated with development.

The observatory is the result of an immense international collaboration, and integrates Canadian and European instruments.

More than 10,000 people worked on the project, with the budget eventually snowballing to around \$10 billion.

The mission is set to last for at least five years, but hopefully 10 or more.

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