THE JAMES WEBB SPACE TELESCOPE

Science and Technology Facilities Council

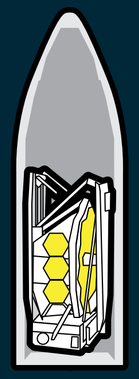
Constructing the successor to the Hubble Space Telescope has taken more than two decades and involved more than 1,000 people in 7 countries. The James Webb Space Telescope (Webb) can detect ancient light that its predecessors can't and will reveal more information about the origins of the universe than ever before.

Webb will:

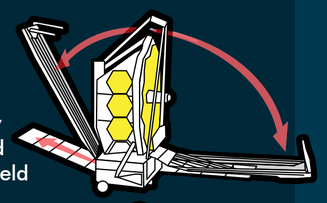
- Search for light from the first stars and galaxies to form after the Big Bang.
- Study the formation and evolution of galaxies.
- Study planetary systems and the origins of life.

Telescope origami

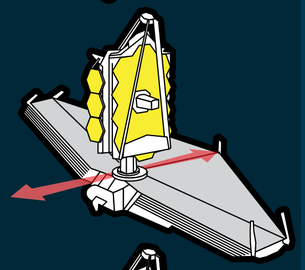
Webb is too big to be launched in its operational configuration, so it will unfold in space.



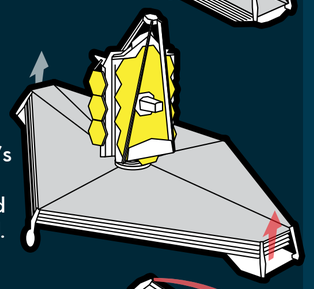
Launch configuration.



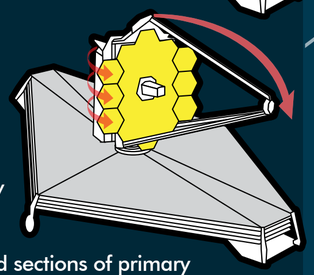
Solar array is deployed and sunshield unfolds.



Sunshield extends.



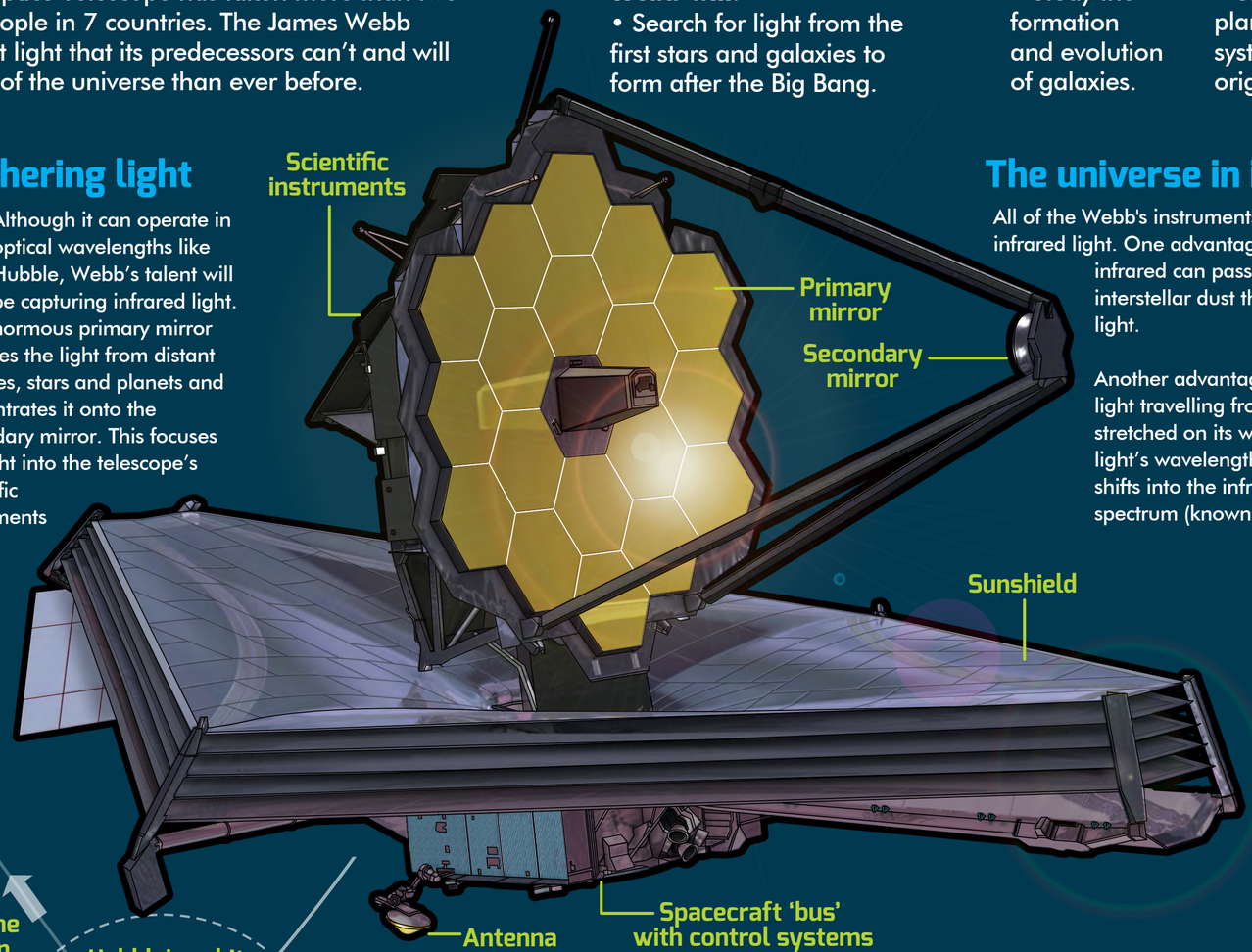
Sunshield's layers are raised and separated.

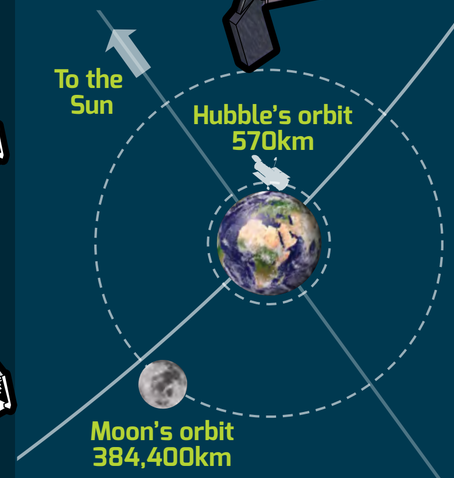


Secondary mirror is deployed and folded sections of primary mirror move into position.

Gathering light

1 Although it can operate in optical wavelengths like Hubble, Webb's talent will be capturing infrared light. The enormous primary mirror captures the light from distant galaxies, stars and planets and concentrates it onto the secondary mirror. This focuses the light into the telescope's scientific instruments





2 Unlike Hubble, which orbits the Earth, Webb will sit at an area in space called a Lagrange point. Webb will occupy Lagrange 2, which is a region about 1.5million km from Earth, where the Sun's gravity and Earth's gravity cancel each other out – allowing the craft to remain relatively stationary.

3 This means that Webb isn't subjected to the same extreme heating and cooling cycles as an Earth-orbiting craft.

Webb will not be exactly at the L2 point, but circle around it in a halo orbit.

The universe in infrared

All of the Webb's instruments will observe infrared light. One advantage of this is that infrared can pass through the interstellar dust that blocks visible light.

Another advantage is that visible light travelling from a distant star is stretched on its way to us. The light's wavelength gets longer and shifts into the infrared part of the spectrum (known as redshift).

Three of the Webb's detectors are tuned to the near infrared. One of Webb most important detectors, the Mid InfraRed Instrument (MIRI), has been designed and built by a UK-led consortium including STFC.

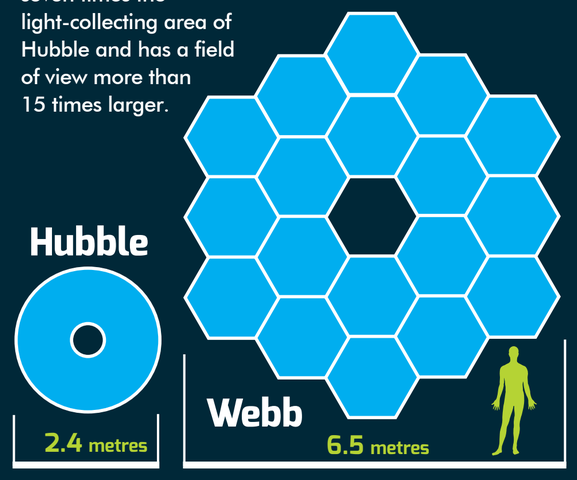
Webb will be able to reveal stars and galaxies that are too distant, dim or obscured for Hubble to see (as this Hubble image and a simulated Webb image shows)

Looking back in time

Light travels very fast, but its speed is finite and can take a long time to reach us. As a result, the more distant an object is, the further back in time we are looking. Hubble can see back to the 'toddler' stage of the universe when it was barely 1 billion years old. Webb will be able to capture light from universe's 'baby' stage when the first stars were born after the Big Bang.

The mirror

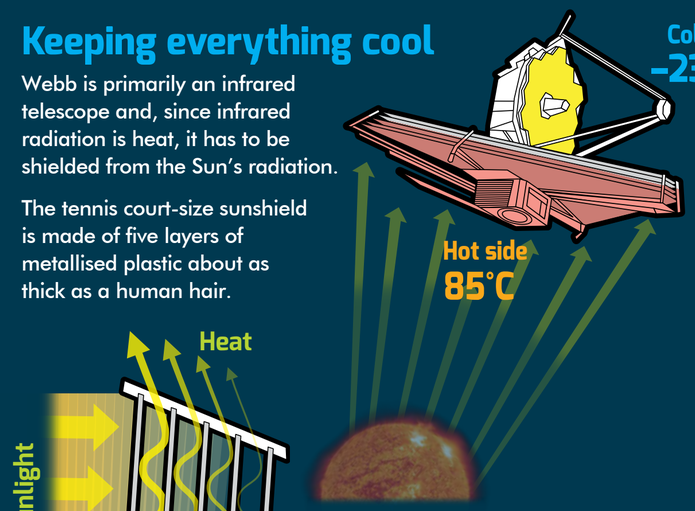
The mirror has about seven times the light-collecting area of Hubble and has a field of view more than 15 times larger.



Keeping everything cool

Webb is primarily an infrared telescope and, since infrared radiation is heat, it has to be shielded from the Sun's radiation.

The tennis court-size sunshield is made of five layers of metallised plastic about as thick as a human hair.



Each layer blocks and deflects some heat, which is then vented away from the telescope.