210 John Mitchell Center
University of Southern Maine
67 Campus Avenue
Gorham, ME 04038

207-780-5235
thomas.bickford@maine.edu

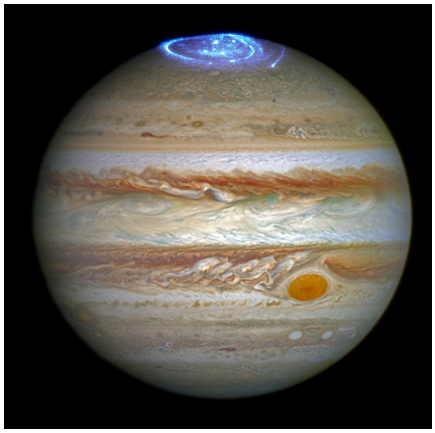
Comparing the Hubble Space Telescope and the James Webb Space Telescope

First of all, a quick word about who they were named for:

The Hubble Space Telescope was named for Dr. Edwin Hubble (1889-1953) who was a pioneer in the field of extragalactic astronomy. At a time when people were looking at stars, Hubble was looking at galaxies.

The James Webb telescope was named after James E. Webb (1906-1992). Webb was the first permanent NASA administrator (1961-1968) and was responsible for making NASAs primary objective research. Webb was an administrator without a science background and did a great deal for the development and funding of NASA during his tenure at the agency. Many have argued that he should not be given the distinction due to his decades long administration of anti LGBT policies at both the State Department and NASA.

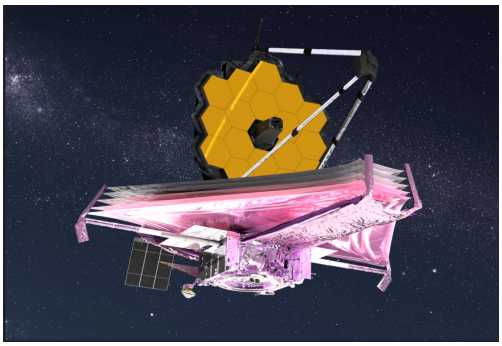
The **Hubble Space Telescope** (HST) was originally planned in 1968, with plans for a 3 meter mirror and a 1979 launch. Funding was sought and eventually secured, but delays slowed the design and construction and the launch date was pushed back to 1985, then 1986, then again, and finally Hubble was launched in April of 1990 aboard the Space Shuttle Discovery, some 22 years after it was originally proposed. It was launched on the 24th of April, deployed on the 25th, and went into service on May 20th, after start-up and calibration sequences were completed.



Hubble has taken and delivered over 1,000,000 digital images back to Earth. But it wasn't without its own troubles. Almost immediately after it started capturing images, it became obvious that there was a problem with the telescope mirror. While the mirror was one of the most perfectly designed and built mirrors, the outer edges of the mirror were out of true with the rest, this caused some of the light to reflect inaccurately and confound the more precise inner portions of the mirror. Because the replacement of the mirror would have been impossible to do in space, a series of

“corrective lenses” were designed to correct the reflected light. Think of putting on glasses to correct for imperfect vision. The corrective mission was performed by astronauts in 1994, almost 4 years after launch.

The **James Webb Space Telescope’s** (JWST) early plans date back to the early 1990s. Partly as a plan to replace the flawed Hubble, which was later corrected. The project started in earnest in 1995. In 2003 NASA awarded the prime contract for the project to TRW, an aerospace company. Initial launch was set for 2010. It was also set to be a collaboration with the European and Canadian Space Agencies.



As is often the case, the 2010 launch was delayed many times and was launched in December of 2021. But the telescope itself was completed in November of 2016. The following 5 years were for testing, repair of things that broke during testing, and getting scheduled for a launch, remembering that the last shuttle launch was in 2011, it limited the possibilities of a US launch.

NASA takes the steps of the engineering design process to create working projects. When coupled with doing things that have never been done and that have the possibility to have huge positive or negative consequences, NASA’s time tables sometimes seem slow.

.

1. Define the problem
2. Conduct research
3. Brainstorm and conceptualize
4. Create a prototype
5. Test the prototype (or final product)
6. Build your project
7. Product analysis
8. Improve (do it all over again until it falls within required parameters)

To this NASA also has to add in budgetary constraints and multi-country political considerations. It also has the most stringent safety procedures in place to handle the inherently dangerous environments found in rocket launches and space exploration.

A few side by side comparisons of the Hubble to the Webb.

	Hubble Space Telescope	Webb Space Telescope
Years in planning and construction	22 years	25 years
Launch date	4/24/1990	12/25/2021
Original length of service	15 years, with service missions	5-10 years
Current status	Operational (31 years)	In deployment on the way to L2 orbit location. First expected images likely in June or July of 2022.
Cost (adjusted for inflation)	US $16 billion	US $9.7 billion
Mirror diameter	2.4 m	6.5 m
Mirror collection area	4.5 m^2	25.4 m^2
Power	2,800 watts	2,000 watts
Orbit	Low Earth orbit (540 km/335 miles)	Sun-Earth L_2 orbit (250,000-832,000 km)
Mass	12,246 kg	6,200 kg
Image quality (comparison)	1	100 times the hubble
Number of images	+1,000,000	0
Largest image	Andromeda Galaxy image created by compiling a mosaic of 7,398 exposures from 411 different aimings, resulting in a 1.5 billion pixel image	TBD