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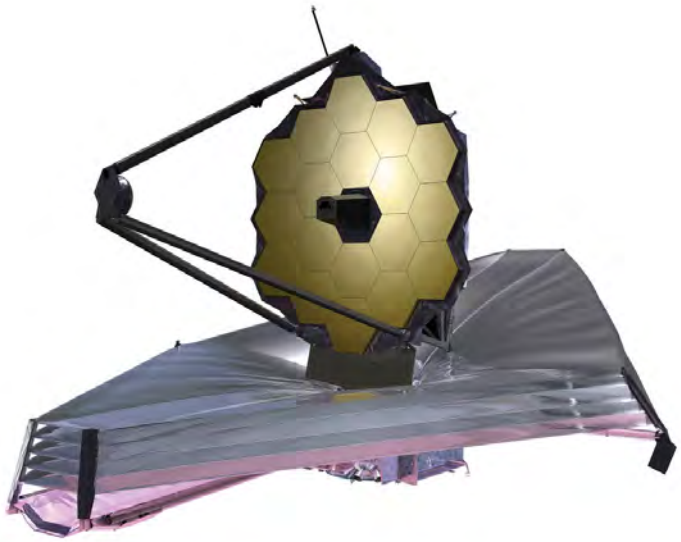
By Mariel John Borowitz

Four Top Reasons for Funding JWST

The James Webb Space Telescope (JWST) should be fully funded at the level requested in the President's Fiscal Year 2012 NASA Budget Proposal to allow for timely completion and launch of the spacecraft. The Space Foundation finds four compelling, primary reasons:

1. JWST will help ***answer fundamental questions about our universe,*** including the origins of the universe and the origins of life, which cannot be studied in the same way by any other observatory under development anywhere in the world. ***Thousands of astronomers will use this data*** over the coming decades. JWST, like its predecessor, the Hubble Space Telescope (HST), has the potential to ***captivate the public and inspire interest in science, technology, engineering, and math (STEM) education*** with unprecedented images and information about our universe.
2. JWST will use ***cutting-edge technologies*** that have been developed and tested specifically for this project. The development and implementation of cutting-edge technology, pushing the boundaries of science, is a fundamental role of NASA and is at the center of the space agency's contribution to national technical means, intellectual capital, and industrial capacity.
3. JWST is being developed in ***international partnership*** with the European Space Agency and the Canadian Space Agency. Unilaterally canceling this program, especially so close to completion, will significantly undermine our relationships with key allies on both sides of the Atlantic.
4. While it is unfortunate that initial cost assessments have proven unrealistic, ***JWST has maintained excellent technical progress*** and has already reached the manufacturing and testing stage of development. The project should be fully funded and completed in a timely manner to allow the United States, its international partners, and all humanity to realize the benefits articulated above.

Certainly, the Space Foundation recognizes that there are important lessons to be learned from the evolution of the JWST program. Unrealistic cost estimating has led to unexecutable programs and cost overruns on many NASA programs in recent years. The solution to this endemic weakness at the space agency is not to cancel large projects near completion, but to insist that NASA improve its cost estimating and acquisition processes on programs early in their development, and that the nation then invest only in programs that have a high probability of being completed on time and within budget.



Credit: NASA

SCIENCE

The James Webb Space Telescope will help answer fundamental questions about our universe. The data collected will be used by thousands of astronomers, and images and information from the telescope will captivate the public and increase interest in STEM education.

When we observe objects that are very far away in the universe, we are essentially looking back in time because it takes eons for light from such distant places to reach us. Right now, the Hubble Space Telescope is our best tool for viewing the young universe.[1] While HST can see some early galaxies, the James Webb Space Telescope will be able to look even further back in time. In fact, JWST will be able to see some of the very first galaxies created after the big bang. The illustration below shows how far back various observatories are able to see.[2]

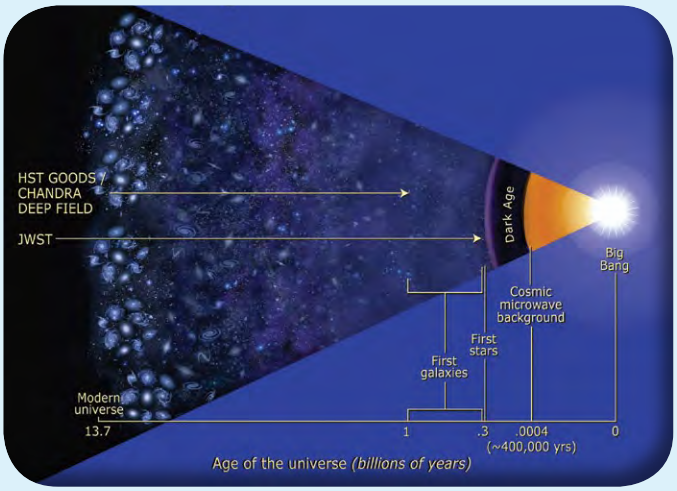
Because JWST will be able to see so far back in time, scientists will be able to use data from JWST to help us understand what the first stars were like and how they led to the creation of galaxies.[3] We observe galaxies of different shapes and sizes, but scientists do not know how they are formed and why they take on particular attributes. By looking back to when the first galaxies were formed, JWST will help us answer these questions.[4]

Many people have seen beautiful HST images of dense dust clouds in space where star formation is taking place. Hubble's primary capabilities are in the ultraviolet and visible parts of the spectrum. This means that when we try to look at the birth and early evolution of new stars and planets, all we see are dense and dusty clouds. Because JWST is designed to observe the infrared part of the spectrum, we will be able to see into the hearts of those dusty clouds with more detail than ever before. This will enable scientists to observe the formation of stars and solar systems. JWST will also allow us to study organic molecules in space that may have had a role in the development of life.[5]

Understanding planet formation and evolution will also help scientists to trace the origins of the Earth and life in the universe. They will be able to use JWST to understand how other solar systems form and compare those findings to characteristics of our own solar system. JWST will also be powerful enough to identify and characterize the comets and other icy bodies at the very edges of our solar system. Understanding these bodies may provide clues to how life arose on Earth.[6]

These are only some of the questions that scientists know JWST can help answer. Another exciting prospect with science is that we often get our biggest returns from observations we never expected at all.[7]

Seeing Back into the Cosmos



JWST will be capable of peering deeper into the past than any existing observatories. This will enable scientists to study the formation of the very first generation of stars and galaxies, whose characteristics are a mystery at present.
Credit: NASA and Ann Field [STScI]

JWST will allow scientists to observe stars forming within dusty clouds, such as the one shown in this Hubble Space Telescope image.
Credit: NASA

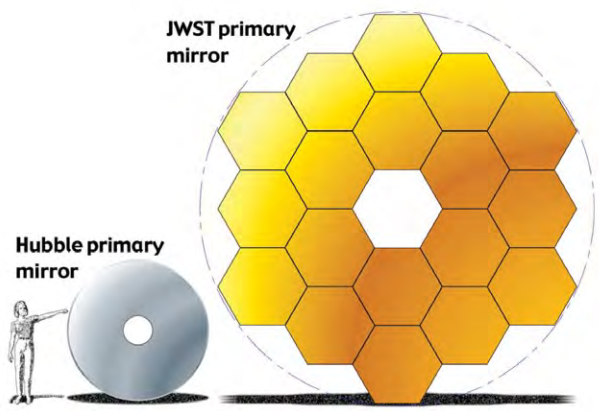
TECHNOLOGY

The James Webb Space Telescope will be a technological marvel, incorporating cutting-edge technologies developed specifically for this project.

The James Webb Space Telescope is already impressive to behold. Its sunshield is the size of a tennis court and its mirror is 21.3 feet in diameter. Because it is so large, technology was developed to allow it to be launched while folded up and then unfurl once in space.[8]

Many innovative new technologies were developed to enable JWST to achieve its mission. The amount of detail that a telescope can see is mostly determined by the size of its mirror, so building one big enough to see the birth of the first galaxies was a challenge. Simply building a larger version of the mirror designed for Hubble was not an option because it would have been too heavy and too wide to launch into orbit. Instead, engineers designed a mirror that folds up for launch and then unfolds in space. This mirror is made of 18 hexagonal mirror segments that fit together perfectly, aligned to 1/10,000 of the thickness of a human hair.[9] Another factor that will enable JWST to see more than any previous space telescope is the state-of-the-art infrared detectors that were developed specifically for this project. These are essential for allowing JWST to detect the faint signals from very distant objects.[10]

To prevent nearby light sources (for example, from stars in our own galaxy) from obscuring faint objects that are farther away, engineers created shutters—similar to the ones on a camera—that are the width of three to six human hairs. Thousands of these shutters are arranged in a grid, enabling the precision needed to block out interference from unwanted light.[11]



Credit: NASA

Mirrors Unfolded

The JWST mirror is 21.3 feet in diameter. It is more than twice the diameter of the mirror used for the Hubble Space Telescope.

Credit: NASA

The James Webb Space Telescope is being built at room temperature and with gravity acting on it. When it is launched into space, there will be no gravity and temperatures will be lower than -400 degrees Fahrenheit, yet the giant mirror must be held extremely steady to allow it to see back in time. To meet this challenge, engineers used advanced materials and new test methods to develop an innovative structure that will remain stable despite the changing environment.[12]

These, and other innovative technologies developed for JWST, will not only allow the spacecraft to carry out research not possible with any other existing astronomical instrument, but are very likely to have applications for future research, spacecraft design, and as-yet-unforeseen consumer products and industries on Earth.

INTERNATIONAL PARTNERS

JWST is being developed in international partnership with the European Space Agency (ESA) and the Canadian Space Agency. Unilaterally canceling this program, especially so close to completion, will significantly undermine our relationships with key allies on both sides of the Atlantic.

The European Space Agency and the Canadian Space Agency have been collaborating with NASA on the design and construction of JWST since 1996 and officially became partners in 2003. Europe is providing one of the four major scientific instruments for the telescope and a portion of a second instrument. It is also providing the launch on an Ariane 5 launch vehicle and will provide manpower to support JWST operations. In return, ESA is counting on access to the observatory for its astronomers, including at least 15 percent of the total observing time, similar to the current arrangement with Hubble.[13] Canada is also designing and building one of the four scientific instrument packages. Canadian astronomers are expecting at least 5 percent of the telescope's observation time for astronomical research.[14] Both partners have already invested time and money in developing their portion of the instruments. As we attempt to increase our knowledge about the universe, we require increasingly complex systems. To build and operate these systems, international partnerships are becoming more and more important. Unilaterally canceling JWST would send a disheartening message to existing and potential partners and allies, and damage to U.S. credibility would likely make future joint endeavors much more problematic.

COSTS AND BENEFITS

Technical performance in developing the James Webb Space Telescope has been excellent, and more than 75 percent of the telescope's hardware has already been delivered. The funding required to complete the project in a timely manner should be provided, allowing the United States, its international partners, and the world to realize all the benefits articulated above.[15]

Unrealistic cost estimating, such as that which positioned JWST for cost and schedule overruns, is unfortunate and frustrating for everyone involved. While recrimination has its place, the nation must make decisions based upon current reality. According to the report of the Independent Comprehensive Review Panel, released in late 2010, the current estimate for completing and launching JWST by 2015 is approximately $1.5 billion. So the decision at hand is whether to cut JWST funding and gain none of the capabilities offered by the observatory, or to fund JWST to its logical conclusion—completion of the project. [16]

In making this cost-benefit decision, each of the myriad of benefits offered by JWST is compelling. In aggregate, the case for JWST is overwhelming. In addition, truncating funding for a project for which 75 percent of the hardware has been delivered—and whose technical progress is described by an independent panel as "commendable and often excellent"—represents a "penny wise and pound foolish" approach to stewardship of taxpayer dollars.[17]

The James Webb Space Telescope should be fully funded. In addition to fiscal and political considerations, it is our shared responsibility and privilege to enable new generations to experience the excitement of seeing things no one has ever seen before and to feel the thrill of unlocking the secrets of the universe.

If you have questions about this paper, please contact **Research@SpaceFoundation.org**.

Micah Walter-Range
Director – Research and Analysis
+1.202.618.3062

Mariel John Borowitz
Research Analyst
+1.202.618.3064

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