

Orion spacecraft splashes down, completing Artemis I mission

Bryan Dyne

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The uncrewed Artemis I mission came to a conclusion Sunday morning after the Orion spacecraft successfully completed a parachute-assisted splashdown off the coast of Mexico's Baja California peninsula at 12:40 p.m. Eastern Time. The landing was the final major milestone of the Artemis I mission, which is being hailed by the Biden administration and the corporate media as the precursor to new crewed missions to the Moon and possibly Mars.

The mission came after several setbacks, including a two-and-a-half-month delay after technical difficulties halted the initial launch attempt on August 29. Additional engineering issues cropped up in early September, including a leak in the rocket's fuel line, pushing the launch date back to the end of the month. Further delays caused by weather threats from Tropical Storm Ian and Hurricane Nicole forced NASA to push back the launch several more weeks.

Artemis I finally launched on November 16, beginning a mission that lasted more than 25 days. The first part of the mission, from launch to about 90 minutes after liftoff, was a test of the Space Launch System (SLS), a super-heavy launch vehicle designed by NASA to lift Orion to lunar orbit. Its primary task during Artemis I was completed after its upper stage, the Interim Cryogenic Propulsion Stage, fired for 18 minutes to put Orion on a trajectory to the Moon. It then separated from Orion, deployed 10 miniature satellites (CubeSats) and then completed a final burn into an orbit around the Sun, effectively being disposed.

The rest of the Artemis I mission consisted of testing the Orion spacecraft. It entered the Moon's gravitational influence on November 20 and began a series of complex orbital maneuvers designed to enter orbit around the Moon on November 25, while minimizing fuel use. After several orbits, the spacecraft performed a burn on December 5, just after its closest approach to the Moon,

just 128 kilometers (80 miles) from the lunar surface, to set itself on an earthbound course.

Orion's final test was just before splashdown when it performed a "skip entry." Similar to how one can skip a rock off the surface of a pond, a spacecraft oriented properly can skip off Earth's upper atmosphere. The technique, when employed correctly, is designed to bleed off the spacecraft's velocity in two stages rather than one to reduce the stress on astronauts returning to Earth.

While the technique was first theorized during the Apollo era, it was never implemented because the calculations to perform the maneuver were too complex for the computers aboard the Apollo Command Module. Orion, however, is fully capable of making the calculations needed to skip off Earth's atmosphere just enough to reduce its speed but not enough to bounce back into orbit. The rest of the descent happened as expected and the capsule was ultimately recovered by the US Navy after landing safely.

The next task of the scientists and engineers on the Artemis program will be to analyze the data collected by the instruments on board the spacecraft. Orion carried a variety of acceleration, vibration and radiation sensors to gather data about the various stresses that astronauts will face while traveling aboard the spacecraft.

Several of these were mounted on three mannequins to better simulate a human's experience during spaceflight. One of the most important experiments involved two mannequins, nicknamed Helga and Zohar, and measured radiation exposure on different points of the body, with and without shielding from a radiation vest. These are among the more important measurements taken during the Orion mission and will inform future missions about dangers to humans from prolonged radiation exposure as they travel far beyond the protection provided by Earth's atmosphere and magnetic field.

There were, however, at least three unexpected issues

that cropped up during the mission that had to be resolved in flight. The first was an ongoing glitch in Orion's star tracker, one of the systems used for spacecraft navigation. There were also instances of one of the current limiters from the solar panels to the command module opening erroneously, and which had to be ordered to close. And during the final flyby of the Moon, four devices "responsible for downstream power," specifically propulsion and heating, turned off and had to be turned back on again.

The issues, which in the end did not end the mission, raise several potential problems for a crewed mission. Problems involving navigation, power, propulsion and heating bring to mind the Apollo 13 disaster and the near loss of astronauts James Lovell, John Swigert and Fred Haise. The next Artemis mission is scheduled to be launched in May 2024 and these problems will have to be resolved in the next seventeen months if the spacecraft can ever be considered as safe as possible.

And there are even more problems with the Artemis missions on the horizon, foremost among them being that while Orion is capable of orbiting the Moon, it is not designed to land on it. Instead, NASA has contracted Elon Musk's SpaceX to develop the Starship Human Landing System (HLS), a variant of the fascistic billionaire's Starship spacecraft. In theory, the HLS will launch before Orion, be fueled by propellant launched into orbit by between four and fourteen other Starship missions, transition to lunar orbit, rendezvous with Orion, receive the crew, land on the Moon, take off and transfer the crew back to Orion for their return to Earth.

Not only is such a scheme not at all efficient for landing on the Moon's surface, it is not complete. Design of the HLS only began in March 2020, when NASA awarded nearly \$3 billion to SpaceX to design the vessel rather than develop a modern analog to the Apollo-era lunar module. And while Musk has claimed that the HLS will be reusable, which will ostensibly cut costs, that will require great expenditures of money and fuel just to refuel the vessel. The entire concept is absurd.

The Starship HLS does, however, exemplify the profit-driven character of the Artemis program. Landing on the Moon is not primarily seen as an endeavor of human exploration, but a means to shovel billions of dollars into the pockets of the already super-rich. A genuinely renewed space program is only possible when the constraints of capitalism on spaceflight are eradicated.

An addendum: Why going to the Moon is not a "gateway" to Mars

One of the many claims about Artemis by NASA and echoed by the corporate media is that going to the Moon will be a stepping stone for Mars missions. In particular, much is made about the proposed Lunar Gateway, a still conceptual space station that will orbit the Moon and supposedly prepare astronauts for a trip to Mars.

In reality, going from Earth to the Moon and then from the Moon to Mars, in two stages, offers nothing other than wasted fuel. The main limiting factor across all spaceflight is the needed change in velocity, the delta-V, to enter and exit orbits and to land and take off from celestial bodies. For example, one needs to change one's velocity by 9.4 kilometers per second to leave Earth's surface and enter low orbit around our planet. In contrast, one only needs a delta-V of 1.73 kilometers per second to take off from the Moon, which is why the rocket on the Apollo lunar lander could be so much smaller than the colossal Saturn V.

To go from Earth's surface to Moon transfer, where one *could* go to the Moon, requires a total delta-V of 12.52 kilometers per second. It takes another 0.82 kilometers per second to actually enter low lunar orbit and rendezvous with the Lunar Gateway at one of its potential orbits. And one has not even yet left the full gravitational influence of Earth!

In reality, there is no reason to go to the Moon before heading to Mars. To go from Earth's surface to being captured by Mars' gravity requires a delta-V of 13.67 kilometers per second, less than what is needed to land on the Moon and only a little more than what is needed to orbit the Moon.

The orbital mechanics are clear: the claims that going to the Moon is a "gateway" to Mars are absurd. There are commercial, political and military interests that drive such conceptions, but not scientific ones.



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