PRO POINTS

NASA's timeline for returning humans to the moon is expected to slip.

The per-launch cost of the Space Launch System could bust NASA's budget.

The lunar lander and new space suits are proving to be major challenges.

America's Return to the Moon

HOW WE GOT HERE

NASA is going back to the moon for the first time in more than half a century. The Artemis Program, so named for the Greek goddess and twin sister of Apollo, is planning to land American astronauts on the lunar surface as soon as 2025. The goal is to outpace other nations, particularly China, that have their own plans to put down stakes.

Unlike the first human moon landings in the 1960s and 1970s, Artemis is intended to develop a long-term human presence on the lunar surface. Another major difference: NASA is partnering with commercial companies with their own plans to develop a lunar economy, from mining to tourism, to help design the rockets, spacecraft, landers and other components.

WHAT'S NEXT

The first mission, Artemis I, is scheduled to take place this year. It will be the maiden uncrewed flight test of the Space Launch System, which is the heavy-lift rocket built by Boeing, Aerojet Rocketdyne and Northrop Grumman, and the Orion spacecraft built by Lockheed Martin.

The Artemis II and III missions are planned for 2024 and 2025 and involve a crewed flight around the moon and the first human landing on the lunar surface. Follow-on Artemis missions are also being planned as part of the strategy to build a sustained presence as a stepping stone to future human missions to Mars.

However, there are mounting warnings that the goal for a human landing, which has already been pushed back a year from 2024 to 2025, is overly ambitious and will likely be delayed again.

"No earlier than 2026, but could be a good bit later," NASA Inspector General Paul Martin told the House Space and Aeronautics Subcommittee in March.

The Space Launch System

The SLS mega-rocket has become synonymous with a troubled government acquisition program. It is years behind schedule and over cost, and while confidence is growing that it will be able to fulfill its mission, its predicted cost per launch of \$4.1 billion is considered unsustainable.



NASA plans to conduct a "wet dress rehearsal" of SLS at Kennedy Space Center in Florida. The agency will fuel up the rocket and test all the components of the Orion spacecraft ahead of the Artemis I flight test, which as of mid-March 2022 had not yet been scheduled.

NASA's plan for first three Artemis missions

Artemis I Uncrewed test flight

Artemis I is expected to launch in **summer 2022**. During the mission, an uncrewed capsule, known as Orion, will orbit the moon before returning to Earth.

A heavy-lift rocket, known as the Space Launch System (SLS), will carry Orion into space.

The mission will provide data for safety certification on crewed flights.



Artemis II Crewed test flight

Artemis II will be the first crewed test of Orion and the SLS. It's expected to launch in 2024.

During the 10-day mission, Orion and its four-person crew will fly around the moon at an altitude of about 4,000 miles before returning to Earth.







Artemis III Planned lunar landing

Artemis III, planned for **2025**, will put humans on the moon for the first time since 1972.









Sources: NASA, Government Accountability Office





SLS

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The Human Landing System

NASA last year awarded a contract to SpaceX to build a lander to take astronauts to the lunar surface. The agency initially said it would select two designs to encourage competition and maximize its options but determined it didn't have enough funding for two contractors.

Congress has called for an alternative design and mandated that NASA compile a report outlining how it plans to ensure it has enough landers that can safely and cost effectively carry out multiple missions in the years ahead.

NASA Administrator Bill Nelson has said the agency hopes to hold an additional competition for a lander following the Artemis III mission.

The space agency's internal watchdog has described the uncertainty in the HLS program as another major factor in likely delays in returning astronauts to the moon.

The Gateway

NASA considers the Gateway to be a "vital component" to the Artemis Program. The small space station orbiting the moon will serve as a staging point for astronauts living and working on the lunar surface and is being built with the help of commercial companies and international partners.

The schedule for the orbiting outpost is in flux. NASA's IG has predicted that the time it will take to develop the Gateway and get into lunar orbit means it likely won't be on station until at least the Artemis IV mission later in the decade.

Space Suits

In July 2021, NASA decided to award a contract to develop new space suits for the Artemis Program rather than design them in-house. NASA's plan was to award a contract in spring 2022, at which point it will learn how soon they can be ready.

The Government Accountability Office has cited the lunar lander and the space suits as two of the biggest wildcards in NASA's plans to return to the moon within the next several years.

NASA's own Aerospace Safety Advisory Panel has warned against allowing the timeline pressure to imperil safety.

Artemis Accords

NASA will have help from other countries through the Artemis Accords. The pact, which as of March 2022 included 16 signatories, lays out principles to facilitate exploration, science and commercial activities in cislunar space, or between the Earth's orbit and the far side of the moon.

It is also a means for partner nations to contribute to the development of technologies that will make the return to the moon possible and to participate in future human missions to the lunar surface.





POWER PLAYERS

Bill Nelson is the administrator of NASA and the key decision-maker on the Artemis timeline, the project's budget and negotiations with partner nations. Nelson, a former U.S. senator from Florida who also flew on the Space Shuttle, was an early advocate for NASA enlisting commercial partners rather than relying solely on the development of government-owned spacecraft.

• **Pam Melroy** is the deputy administrator of NASA and one of two women to command the Space Shuttle. She is the space agency's main liaison to other government organizations and the White House, and plays a major role in crafting NASA's budget for Congress. She will be a main adviser to Nelson in deciding how to develop a second Human Landing System and whether to further slip the Artemis timeline.

John Honeycutt is the SLS program manager at Boeing who has been overseeing the development of the rocket since 2015. He has pushed back on estimates that the Artemis missions will each cost more than \$4 billion apiece, saying "This is a generational rocket, and we all know development is costly early on."

• **Kathryn Lueders,** NASA's associate administrator for the Space Operations Mission Directorate, has overseen a number of the agency's human spaceflight programs, including the Commercial Crew Program that partnered with SpaceX and Boeing to replace the Space Shuttle with new capsules. Her portfolio includes overseeing NASA's long term plans for operation on the moon.

Jim Free, NASA's associate administrator for the Exploration Systems Development Mission Directorate, returned to NASA in 2021 after retiring in 2017. Over his long career, he helped oversee the design of the Orion spacecraft that will take astronauts to the moon's orbit. His directorate manages the development of the Artemis components and will oversee the flight readiness review for the missions.

The Artemis Team consists of 18 astronauts who were selected in 2020 to return to the moon to live and work there. They have diverse backgrounds and experience. The first women and person of color to walk on the moon will be drawn from their ranks.

