

The Greatest Leap, part 3: The triumph and near-tragedy of the first Moon landing

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Video shot by Joshua Ballinger, edited and produced by Jing Niu and David Minick. [Click here for transcript.](#)

A vast, gray expanse loomed just a few hundred meters below as Neil Armstrong peered out his tiny window. From inside the spidery lunar lander, a fragile cocoon with walls only about as thick as construction paper, the Apollo 11 commander finally had a clear view of where the on-board computer had directed him to land.

He did not like what he saw there. A big crater. Boulders strewn all around. *A death trap.*

To make matters worse, *Eagle* had limited fuel reserves. If Armstrong couldn't find a safe landing site soon, he would have to ditch the bottom half of the lander and burn like hell for lunar orbit in a dangerous and risky abort procedure. Otherwise, he and Buzz Aldrin would not only become the first humans to land on the Moon, they'd become the first humans to die there, too.

Apollo: The Greatest Leap

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Fortunately, NASA had chosen this crew well. Armstrong, in particular, had a cool head, thanks to his extensive test pilot background. He knew that he needed to focus on the problems he could solve rather than the problems he couldn't, and monitoring the fuel state was the ground's responsibility anyway. Armstrong knew CAPCOM Charlie Duke would tell him when the gas got too low. So he carefully steered the lunar module away from the boulders. And though plumes of lunar dust made it difficult to judge his speed relative to the Moon's surface, he made a soft touchdown.

No one watched this drama unfolding 240,000 miles away more avidly than a gaggle of flight controllers in Mission Control. "What I remember most is the tension," said Duke, the astronaut designated to talk to the spacecraft from Houston, in an interview with Ars. "We were literally holding our breath."

CAPCOM Charlie Duke (foreground) with backup commander Jim Lovell (center) during Apollo 11's tense landing.

So when Neil Armstrong called to Houston from "Tranquility Base" on the Moon to say the *Eagle* had landed, Duke's reply flubbed the word "Tranquility" as "Twan...Tranquility," and blurted out the first thing that came into his mind. "We copy you on the ground. You got a bunch of guys about to turn blue. We're breathing again."

Nearly half a century later, Duke still smiles at the recollection. "It was absolutely spur of the moment," he said. "I was so excited I couldn't even say Tranquility at first. I was just speaking the truth. I get to repeat that line a lot. I remember the words, but I also remember the emotions. I look at the pictures of Mission Control now, and what's striking is the intensity of all the faces."

Today, the Moon landings still take our breath away. On July 20, 1969, NASA pulled off arguably the greatest technical achievement of the 20th century. Certainly, it has no equal yet this century. Humanity reached so far, so fast in the 1960s that even today we have yet to match their achievements in space. Truthfully, we haven't even come close.

Apollo 9

Seven months before the Apollo 11 landing, NASA had already made history in late 1968 with its euphoric Apollo 8 mission around the Moon. Yet much work remained to be done in the spring and summer of 1969 before Armstrong and Aldrin could take flight. The Apollo program was designed somewhat like a ladder, with each mission building on the one before it. So before we could land on the Moon, we had to build a lander to do it in—and then we had to take it to the Moon for a test drive.

During Apollo 8 three astronauts had swooped down to within about 100km of the desolate world's surface. The six-day flight had proven the Apollo Block II Command Module could carry humans safely into deep space. And after this mission NASA could be more confident in its Brobdingnagian Saturn V rocket, which on its third flight into orbit had solved some of the shaking issues that had marred its second launch.

But to reach the Moon, NASA would need more than a space capsule and a giant booster. The Moon has no oceans for a lander to splash down in, nor an atmosphere to arrest the descent of a spacecraft's parachute. Rather, to reach the lunar surface NASA would need a wholly new kind of vehicle never built before in human spaceflight—or since.

Initially, NASA's engineers had no idea, really, how they could safely put a crew on the Moon and then return the astronauts to Earth. Eventually they were won over by an idea championed by John Houbolt known as "lunar orbit rendezvous."

This involved launching a stack from Earth that included the command module, its service module, and the “lunar module.” Upon reaching an orbit around the Moon, the lunar module would detach from the stack and make a powered descent to the surface. Then, only a small part of the lunar lander, its ascent stage, would blast back off the surface and rendezvous in lunar orbit with the command module for a return to Earth. That rendezvous was seen until very late in the planning as a huge risk—NASA wasn’t sure until after Gemini that rendezvousing would be possible, and it required a lot of math and a lot of convincing to get NASA management to agree to pin the entire lunar mission profile on a far-away rendezvous in orbit around the Moon.

The Apollo “stack” on top of the Saturn V rocket, showing the command module, service module, and lunar lander.

Selecting this mission profile meant that an entire lunar landing and return flight could be accomplished by a single Saturn V launch, but it also meant the rocket's payload-carrying capacity was stretched to its limit. The lunar module must be a very low-mass craft in order for the Saturn to be able to throw it all the way to the Moon, and so the spindly, spidery spaceship gained its iconic appearance as a result of the mission configuration. The shiny orange Kapton foil, the four landing legs, the distinctly face-like window and hatch arrangement—all came from a merciless campaign to keep the mass as low as possible.

Fortunately, because it would be safely tucked inside a payload fairing at launch, the lunar module did not need a heat shield nor the kinds of aerodynamic controls an airplane or spacecraft must have to navigate through an atmosphere. Its shape didn't matter. If antennas or legs or other components stuck out at odd angles, it made no difference for a vehicle that would never encounter any air resistance. And because of the Moon's weak gravity, the 7-meter-tall lunar module's materials could be delicate.

If Apollo 8 was the agency's most daring mission, there is a general sense among NASA veterans that the Apollo 9 mission to test the fragile and complex lunar module would be its most difficult, at least prior to the lunar landing. Finally, by early March, 1969, the lunar module was ready to fly. And at this late date it had to work, because a mere nine months remained of the decade. Were there major problems with the lunar vehicle, it is difficult to imagine NASA assessing them, applying those fixes, and testing again before time ran out.

The flight's command fell to Jim McDivitt, with Rusty Schweikart and David Scott alongside. NASA managers chose McDivitt for this flight, which he characterized as "a test pilot's dream," because he was in many ways a far better all-around pilot and commander than anyone else in the corps. Apollo 9 was never going to get much glory sandwiched in

between the Apollo 8 flight around the Moon and landing missions and merely flying in low-Earth orbit, but it was a linchpin flight in NASA's plans to reach the Moon.

After a nominal launch and subsequent orbital maneuvers and all systems were checked out, McDivitt and Schweikart clambered down a narrow tunnel from the Apollo command module into the lunar module. Then, they detached from the command module and proceeded to test the lunar module engines as if they were about to descend to the Moon.

- Dave Scott peeks his head out of the command module during the flight of Apollo 9.
- A view of the Apollo 9 Lunar Module "Spider" in a lunar landing configuration, as photographed from the Command and Service Modules on the fifth day of the Apollo 9 Earth-orbital mission.
- Here, the landing gear on the "Spider" has been deployed.
- The Apollo 9 Command/Service Modules photographed through the window from the Lunar Module, "Spider."
- The docking mechanism is visible in the nose of the Command Module, "Gumdrop." Object jutting out from the Service Module aft bulkhead is the high-gain S-Band antenna.
- No, that's not Mars beneath the lunar module.
- The Apollo 9 crew walks on a red carpet after arriving aboard the prime recovery ship, USS *Guadalcanal*. Left to right are astronauts Russell L. Schweickart, David R. Scott, and James A. McDivitt.
- Aerial view of the Apollo 9 space vehicle on the way from the Vehicle Assembly Building to Pad A, Launch Complex 39, Kennedy Space Center. The Saturn V stack and its mobile launch tower are atop a huge crawler-transporter.
- Nighttime view of the 363-feet-high Apollo 9 space vehicle at Pad A, Launch Complex 39, Kennedy Space

Center, during preparations for the scheduled 10-day Earth-orbital space mission.

- Astronaut Russell L. Schweickart, lunar module pilot, operates a 70mm Hasselblad camera during his extravehicular activity on the fourth day of the Apollo 9 Earth-orbital mission. The Command/Service Module and the Lunar Module 3 “Spider” are docked.
- As seen from inside the lunar module, astronaut Russell L. Schweickart, lunar module pilot, stands in “golden slippers” on the Lunar Module porch during his extravehicular activity.

Then came the big moment, a simulation of the lunar module taking off from the Moon. The separation mechanism used the same explosive-based abort stage function as an actual abort, with guillotines severing wires and explosive cords, and bolts blowing the two ships apart. They had to test this in Earth orbit because it was fraught with hazards. With McDivitt and Schweickart piloting the lunar module inside the ascent stage, they initiated separation and broke away from the larger descent stage. Nothing blew up that wasn’t supposed to blow up. Soon, maneuvering back up to the command module and docking, the crew of three was together again.

Throughout the Gemini program, NASA had tested rendezvous and docking, and now they’d built two brand-new spacecraft—the Apollo capsule and lunar module—and flown them in space less than three years later. And the complicated system had performed beautifully. After Apollo 9, NASA had a deep space capsule, a huge rocket, and a lightweight lander—all of the hardware it needed to land on the Moon.

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