

**Neil Alden Armstrong** (August 5, 1930 – August 25, 2012) was an American [astronaut](#) and [aeronautical engineer](#) who in 1969 became the [first person to walk on the Moon](#). He was also a [naval aviator](#), [test pilot](#), and [university professor](#).

Armstrong was born and raised in [Wapakoneta, Ohio](#). He entered [Purdue University](#), studying [aeronautical engineering](#), with the [U.S. Navy](#) paying his tuition under the [Holloway Plan](#). He became a [midshipman](#) in 1949 and a [naval aviator](#) the following year. He saw action in the [Korean War](#), flying the [Grumman F9F Panther](#) from the [aircraft carrier USS Essex](#). After the war, he completed his bachelor's degree at Purdue and became a test pilot at the [National Advisory Committee for Aeronautics \(NACA\) High-Speed Flight Station](#) at [Edwards Air Force Base](#) in California. He was the project pilot on [Century Series](#) fighters and flew the [North American X-15](#) seven times. He was also a participant in the [U.S. Air Force's Man in Space Soonest](#) and [X-20 Dyna-Soar human spaceflight](#) programs.

Armstrong joined the [NASA Astronaut Corps](#) in the [second group](#), which was selected in 1962. He made his first [spaceflight](#) as command pilot of [Gemini 8](#) in March 1966, becoming [NASA's](#) first civilian astronaut to fly in space. During this mission with pilot [David Scott](#), he performed the

first [docking](#) of two [spacecraft](#); the mission was aborted after Armstrong used some of his re-entry control fuel to stabilize a dangerous roll caused by a stuck thruster. During training for Armstrong's second and last spaceflight as commander of [Apollo 11](#), he had to eject from the [Lunar Landing Research Vehicle](#) moments before a crash.

On July 20, 1969, Armstrong and Apollo 11 [Lunar Module](#) (LM) pilot [Buzz Aldrin](#) became the first people to [land on the Moon](#), and the next day they spent two and a half hours outside the [Lunar Module \*Eagle\*](#) spacecraft while [Michael Collins](#) remained in lunar orbit in the [Apollo Command Module \*Columbia\*](#). When Armstrong first stepped onto the lunar surface, he famously said: "That's one small step for [a] man, one giant leap for mankind."<sup>[1][2][3][4]</sup> It was broadcast live to an estimated 530 million viewers worldwide. Apollo 11 was a major U.S. victory in the [Space Race](#), by fulfilling a national goal proposed in 1961 by President [John F. Kennedy](#) "of landing a man on the Moon and returning him safely to the Earth" before the end of the decade. Along with Collins and Aldrin, Armstrong was awarded the [Presidential Medal of Freedom](#) by President [Richard Nixon](#) and received the 1969 [Collier Trophy](#). President [Jimmy Carter](#) presented him with the [Congressional Space Medal of Honor](#) in 1978, he was inducted

into the [National Aviation Hall of Fame](#) in 1979, and with his former crewmates received the [Congressional Gold Medal](#) in 2009.

After he resigned from NASA in 1971, Armstrong taught in the Department of Aerospace Engineering at the [University of Cincinnati](#) until 1979. He served on the [Apollo 13](#) accident investigation and on the [Rogers Commission](#), which investigated the [Space Shuttle Challenger disaster](#). In 2012, Armstrong died due to [complications](#) resulting from [coronary bypass surgery](#), at the age of 82.

### Early life

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Armstrong was born near [Wapakoneta, Ohio](#),<sup>[5]</sup> on August 5, 1930, the son of Viola Louise (née Engel) and Stephen Koenig Armstrong. He was of German, English, Scots-Irish, and Scottish descent.<sup>[6][7]</sup> He is a descendant of [Clan Armstrong](#).<sup>[8][9]</sup> He had a younger sister, June, and a younger brother, Dean. His father was an [auditor](#) for the [Ohio state government](#),<sup>[10]</sup> and the family moved around the state repeatedly, living in 16 towns over the next 14 years.<sup>[11]</sup> Armstrong's love for flying grew during this time, having started at the age of two when his father took him to the [Cleveland Air Races](#). When he was five or six, he experienced his first airplane flight in [Warren, Ohio](#), when he and his father took

a ride in a [Ford Trimotor](#) (also known as the "Tin Goose").<sup>[12][13]</sup>

The family's last move was in 1944 and took them back to Wapakoneta, where Armstrong attended [Blume High School](#) and took flying lessons at the Wapakoneta airfield.<sup>[5]</sup> He earned a student flight certificate on his 16th birthday, then [soloed](#) in August, all before he had a driver's license.<sup>[14]</sup> He was an active [Boy Scout](#) and earned the rank of [Eagle Scout](#).<sup>[15]</sup> As an adult, he was recognized by the Scouts with their [Distinguished Eagle Scout Award](#) and [Silver Buffalo Award](#).<sup>[16][17]</sup> While flying toward the Moon on July 18, 1969, he sent his regards to attendees at the [National Scout jamboree](#) in Idaho.<sup>[18]</sup> Among the few personal items that he carried with him to the Moon and back was a World Scout Badge.<sup>[19]</sup>

At age 17, in 1947, Armstrong began studying [aeronautical engineering](#) at [Purdue University](#) in [West Lafayette, Indiana](#); he was the second person in his family to attend college. Armstrong was also accepted to the [Massachusetts Institute of Technology](#) (MIT),<sup>[20]</sup> but he resolved to go to Purdue after watching a [football](#) game between the [Purdue Boilermakers](#) and the [Ohio State Buckeyes](#) at the [Ohio Stadium](#) in 1945 in which quarterback [Bob DeMoss](#) led the Boilermakers to a sound victory over the highly regarded

Buckeyes.<sup>[21]</sup> An uncle who attended MIT had also advised him that he could receive a good education without going all the way to [Cambridge, Massachusetts](#). His college tuition was paid for under the [Holloway Plan](#). Successful applicants committed to two years of study, followed by two years of flight training and one year of service as an aviator in the [U.S. Navy](#), then completion of the final two years of their [bachelor's degree](#).<sup>[20]</sup> Armstrong did not take courses in naval science, nor did he join the [Naval Reserve Officers Training Corps](#).<sup>[22]</sup>

## Navy service

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Ensign Neil Armstrong on May 23, 1952

Armstrong's call-up from the Navy arrived on January 26, 1949, requiring him to report to [Naval Air Station Pensacola](#) in Florida for flight training with class 5-49. After passing the medical examinations, he became a [midshipman](#) on February 24, 1949.<sup>[23]</sup> Flight training was conducted in a [North American SNJ trainer](#), in which he soloed on September 9, 1949.<sup>[24]</sup> On March 2, 1950, he made his first [aircraft carrier](#) landing on [USS Cabot](#), an achievement he considered comparable to his first solo flight.<sup>[24]</sup> He was then sent to [Naval Air Station Corpus](#)

[Christi](#) in Texas for training on the [Grumman F8F Bearcat](#), culminating in a carrier landing on [USS Wright](#). On August 16, 1950, Armstrong was informed by letter that he was a fully qualified [naval aviator](#). His mother and sister attended his graduation ceremony on August 23, 1950.<sup>[25]</sup>

Armstrong was assigned to Fleet Aircraft Service Squadron 7 (FASRON 7) at [NAS San Diego](#) (now known as NAS North Island). On November 27, 1950, he was assigned to [VF-51](#), an all-jet squadron, becoming its youngest officer, and made his first flight in a jet, a [Grumman F9F Panther](#), on January 5, 1951. He was promoted to [ensign](#) on June 5, 1951, and made his first jet carrier landing on [USS Essex](#) two days later. On June 28, 1951, *Essex* had set sail for Korea, with VF-51 aboard to act as [ground-attack aircraft](#). VF-51 flew ahead to [Naval Air Station Barbers Point](#) in Hawaii, where it conducted fighter-bomber training before rejoining the ship at the end of July.<sup>[26]</sup>

On August 29, 1951, Armstrong saw action in the [Korean War](#) as an escort for a photo [reconnaissance](#) plane over [Songjin](#).<sup>[27]</sup> Five days later, on September 3, he flew armed reconnaissance over the primary transportation and storage facilities south of the village of Majon-ni, west of [Wonsan](#). According to Armstrong, he was making a low bombing run at 350 mph



(560 km/h) when 6 feet (1.8 m) of his wing was torn off after it collided with a cable that was strung across the hills as a booby trap. He was flying 500 feet (150 m) above the ground when he hit it.

While there was heavy anti-aircraft fire in the area, none hit Armstrong's aircraft.<sup>[28]</sup> An initial report to the commanding officer of *Essex* said that

Armstrong's F9F Panther was hit by [anti-aircraft fire](#). The report indicated he was trying to regain control and collided with a pole, which sliced off 2 feet (0.61 m) of the Panther's right wing. Further perversions of the story by different authors added that he was only 20 feet (6.1 m) from the ground and that 3 feet (0.91 m) of his wing was sheared off.<sup>[29]</sup>

[F9F-2 Panthers](#) over Korea, with Armstrong piloting S-116 (left)

Armstrong flew the plane back to friendly territory, but due to the loss of the [aileron](#), [ejection](#) was his only safe option. He intended to eject over water and await rescue by Navy helicopters, but his parachute was blown back over land. A jeep driven by a roommate from flight school picked him up; it is unknown what happened to the wreckage of his aircraft, F9F-2 BuNo 125122.<sup>[30]</sup>

In all, Armstrong flew 78 missions over Korea for a total of 121 hours in the air, a third of them in January 1952, with the final mission on March 5, 1952. Of 492 U.S. Navy personnel killed in the

Korean War, 27 of them were from *Essex* on this war cruise. Armstrong received the [Air Medal](#) for 20 combat missions, two [gold stars](#) for the next 40, the [Korean Service Medal](#) and Engagement Star, the [National Defense Service Medal](#), and the [United Nations Korea Medal](#).<sup>[31]</sup>

Armstrong's regular commission was terminated on February 25, 1952, and he became an ensign in the [United States Navy Reserve](#). On completion of his combat tour with *Essex*, he was assigned to a transport squadron, VR-32, in May 1952. He was released from active duty on August 23, 1952, but remained in the reserve, and was promoted to [lieutenant \(junior grade\)](#) on May 9, 1953.<sup>[32]</sup> As a reservist, he continued to fly, with VF-724 at [Naval Air Station Glenview](#) in Illinois, and then, after moving to California, with VF-773 at [Naval Air Station Los Alamitos](#).<sup>[33]</sup> He remained in the reserve for eight years, before resigning his commission on October 21, 1960.<sup>[32]</sup>

### College years

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After his service with the Navy, Armstrong returned to Purdue. His previously earned good but not outstanding [grades](#) now improved, lifting his final Grade Point Average (GPA) to a respectable but not outstanding 4.8 out of 6.0. He pledged the [Phi Delta Theta fraternity](#), and lived in its fraternity house. He wrote and co-directed two musicals as part of the all-student revue. The first was a



version of *Snow White and the Seven Dwarfs*, co-directed with his girlfriend Joanne Alford from the [Alpha Chi Omega](#) sorority, with songs from the [1937 Walt Disney film](#), including "[Someday My Prince Will Come](#)"; the second was titled *The Land of Egelloc* ("college" spelled backward), with music from [Gilbert and Sullivan](#) but new lyrics.

Armstrong was chairman of the Purdue Aero Flying Club, and flew the club's aircraft, an [Aeronca](#) and a couple of [Pipers](#), which were kept at nearby Aretz Airport in [Lafayette, Indiana](#). Flying the Aeronca to Wapakoneta in 1954, he damaged it in a rough landing in a farmer's field, and it had to be hauled back to Lafayette on a trailer.<sup>[34]</sup> He was a [baritone](#) player in the [Purdue All-American Marching Band](#).<sup>[35]</sup> Ten years later he was made an honorary member of [Kappa Kappa Psi](#) national band honorary fraternity.<sup>[36]</sup> Armstrong graduated with a Bachelor of Science degree in [Aeronautical Engineering](#) in January 1955.<sup>[33]</sup> In 1970, he completed his Master of Science degree in [Aerospace Engineering](#) at the [University of Southern California](#) (USC).<sup>[37]</sup> He would eventually be awarded honorary doctorates by several universities.<sup>[38]</sup>

Armstrong met Janet Elizabeth Shearon, who was majoring in [home economics](#), at a party hosted by Alpha Chi Omega.<sup>[39]</sup> According to the couple, there was no real courtship, and neither could

remember the exact circumstances of their engagement. They were married on January 28, 1956, at the Congregational Church in [Wilmette, Illinois](#). When he moved to [Edwards Air Force Base](#), he lived in the bachelor quarters of the base, while Janet lived in the [Westwood](#) district of Los Angeles. After one semester, they moved into a house in [Antelope Valley](#), near Edwards AFB. Janet did not finish her degree, a fact she regretted later in life. The couple had three children.<sup>[40]</sup> In June 1961, their daughter Karen was diagnosed with [diffuse intrinsic pontine glioma](#), a [malignant tumor](#) of the middle part of her [brain stem](#).<sup>[41]</sup> X-ray treatment slowed its growth, but her health deteriorated to the point where she could no longer walk or talk. She died of [pneumonia](#), related to her weakened health, on January 28, 1962, aged two.<sup>[42]</sup>

## Test pilot

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Following his graduation from Purdue, Armstrong became an experimental research test pilot. He applied at the [National Advisory Committee for Aeronautics](#) (NACA) [High-Speed Flight Station](#) at Edwards Air Force Base.<sup>[43]</sup> NACA had no open positions, and forwarded his application to the [Lewis Flight Propulsion Laboratory](#) in [Cleveland](#), where Armstrong made his first test flight on March 1, 1955.<sup>[43]</sup> Armstrong's stint at Cleveland lasted only a couple of months

before a position at the High-Speed Flight Station became available, and he reported for work there on July 11, 1955.<sup>[44]</sup>

Armstrong, 26, as a test pilot at the [NACA High-Speed Flight Station](#) at [Edwards AFB](#), California

On his first day, Armstrong was tasked with piloting [chase planes](#) during releases of experimental aircraft from modified bombers. He also flew the modified bombers, and on one of these missions had his first flight incident at Edwards. On March 22, 1956, he was in a [Boeing B-29 Superfortress](#),<sup>[45]</sup> which was to air-drop a [Douglas D-558-2 Skyrocket](#). He sat in the right-hand co-pilot seat while pilot in command, Stan Butchart sat in the left-hand pilot seat flying the B-29.<sup>[46]</sup>

As they climbed to 30,000 feet (9 km), the [number-four engine](#) stopped and the [propeller](#) began windmilling (rotating freely) in the airstream. Hitting the switch that would stop the propeller's spinning, Butchart watched it slow, then resume spinning even faster than the others; if it spun too fast, it would break apart. Their aircraft needed to hold an airspeed of 210 mph (338 km/h) to launch its Skyrocket payload, and the B-29 could not land with the Skyrocket attached to its belly. Armstrong and Butchart brought the aircraft into a nose-down [attitude](#) to increase speed, then launched the Skyrocket. At the instant of launch, the

number-four engine propeller disintegrated. Pieces of it damaged the number-three engine and hit the number-two engine. Butchart and Armstrong were forced to shut down the damaged number-three engine, along with the number-one engine, due to the [torque](#) it created. They made a slow, circling descent from 30,000 ft (9 km) using only the number-two engine, and landed safely.<sup>[47]</sup>

Armstrong served as project pilot on [Century Series](#) fighters, including the [North American F-100 Super Sabre](#) A and C variants, the [McDonnell F-101 Voodoo](#), the [Lockheed F-104 Starfighter](#), the [Republic F-105 Thunderchief](#) and the [Convair F-106 Delta Dart](#). He also flew the [Douglas DC-3](#), [Lockheed T-33 Shooting Star](#), [North American F-86 Sabre](#), [McDonnell Douglas F-4 Phantom II](#), [Douglas F5D-1 Skylancer](#), Boeing B-29 Superfortress, [Boeing B-47 Stratojet](#) and [Boeing KC-135 Stratotanker](#), and was one of eight elite pilots involved in the [Parasev](#) paraglider research vehicle program.<sup>[48]</sup> Over his career, he flew more than 200 different models of aircraft.<sup>[37]</sup> His first flight in a [rocket-powered aircraft](#) was on August 15, 1957, in the [Bell X-1B](#), to an altitude of 11.4 miles (18.3 km). On landing, the poorly designed [nose landing gear](#) failed, as had happened on about a dozen previous flights of the Bell X-1B. He flew the [North American X-15](#) seven times,<sup>[49]</sup> including the first flight with the Q-ball system, the first flight of the number 3 X-15

airframe, and the first flight of the MH-96 adaptive flight control system.<sup>[50][51]</sup> He became an employee of the [National Aeronautics and Space Administration](#) (NASA) when it was established on October 1, 1958, absorbing NACA.<sup>[52]</sup>

Armstrong was involved in several incidents that went down in Edwards folklore or were chronicled in the memoirs of colleagues. During his sixth X-15 flight on April 20, 1962, Armstrong was testing the MH-96 control system when he flew to a height of over 207,000 feet (63 km) (the highest he flew before [Gemini 8](#)). He held up the aircraft nose during its descent to demonstrate the MH-96's g-limiting performance, and the X-15 ballooned back up to around 140,000 feet (43 km). He flew past the landing field at [Mach](#) 3 at over 100,000 feet (30 km) in altitude, and ended up 40 miles (64 km) south of Edwards. After sufficient descent, he turned back toward the landing area, and landed. It was the longest X-15 flight in both flight time and length of the ground track.<sup>[53][54]</sup>

Armstrong and [X-15-1](#) after a research flight in 1960

Fellow astronaut [Michael Collins](#) wrote that of the X-15 pilots Armstrong "had been considered one of the weaker stick-and-rudder men, but the very best when it came to understanding the machine's design and how it operated".<sup>[55]</sup> Many of the test pilots at Edwards praised Armstrong's engineering ability. [Milt Thompson](#) said he was "the most

technically capable of the early X-15 pilots". [Bill Dana](#) said Armstrong "had a mind that absorbed things like a sponge". Those who flew for the Air Force tended to have a different opinion, especially people like [Chuck Yeager](#) and [Pete Knight](#), who did not have engineering degrees. Knight said that pilot-engineers flew in a way that was "more mechanical than it is flying", and gave this as the reason why some pilot-engineers got into trouble: Their flying skills did not come naturally.<sup>[56]</sup> Armstrong made seven [flights in the X-15](#) between November 30, 1960, and July 26, 1962.<sup>[57]</sup> He reached a top speed of Mach 5.74 (3,989 mph, 6,420 km/h) in the X-15-1, and left the Flight Research Center with a total of 2,400 flying hours.<sup>[58]</sup>

On April 24, 1962, Armstrong flew for the only time with Yeager. Their job, flying a T-33, was to evaluate Smith Ranch Dry Lake in Nevada for use as an emergency landing site for the X-15. In his autobiography, Yeager wrote that he knew the lake bed was unsuitable for landings after recent rains, but Armstrong insisted on flying out anyway. As they attempted a [touch-and-go](#), the wheels became stuck and they had to wait for rescue. As Armstrong told the story, Yeager never tried to talk him out of it and they made a first successful landing on the east side of the lake. Then Yeager told him to try again, this time a bit slower. On the



second landing, they became stuck, provoking Yeager to fits of laughter.<sup>[59]</sup>

On May 21, 1962, Armstrong was involved in the "Nellis Affair". He was sent in an F-104 to inspect [Delamar Dry Lake](#) in southern Nevada, again for emergency landings. He misjudged his altitude and did not realize that the landing gear had not fully extended. As he touched down, the landing gear began to retract; Armstrong applied full power to abort the landing, but the ventral fin and landing gear door struck the ground, damaging the radio and releasing [hydraulic fluid](#). Without radio communication, Armstrong flew south to [Nellis Air Force Base](#), past the control tower, and wagged his wings, the signal for a no-radio approach. The loss of hydraulic fluid caused the [tailhook](#) to release, and upon landing, he caught the arresting wire attached to an anchor chain, and dragged the chain along the runway.<sup>[60]</sup>

It took thirty minutes to clear the runway and rig another arresting cable. Armstrong telephoned Edwards and asked for someone to collect him. Milt Thompson was sent in an F-104B, the only two-seater available, but a plane Thompson had never flown. With great difficulty, Thompson made it to Nellis, where a strong crosswind caused a hard landing and the left main tire suffered a blowout. The runway was again closed to clear it, and Bill Dana was sent to Nellis in a T-33, but he

almost landed long. The Nellis base operations office then decided that to avoid any further problems, it would be best to find the three NASA pilots ground transport back to Edwards.<sup>[60]</sup>

## Astronaut career

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Armstrong in an early [Gemini](#) space suit

In June 1958, Armstrong was selected for the U.S. Air Force's [Man in Space Soonest](#) program, but the [Advanced Research Projects Agency](#) (ARPA) canceled its funding on August 1, 1958, and on November 5, 1958, it was superseded by [Project Mercury](#), a civilian project run by NASA. As a NASA civilian test pilot, Armstrong was ineligible to become one of its astronauts at this time, as selection was restricted to military test pilots.<sup>[61][62]</sup> In November 1960, he was chosen as part of the pilot consultant group for the [X-20 Dyna-Soar](#), a military space plane under development by Boeing for the U.S. Air Force, and on March 15, 1962, he was selected by the U.S. Air Force as one of seven pilot-engineers who would fly the X-20 when it got off the design board.<sup>[63][64]</sup>

In April 1962, NASA sought applications for the second group of NASA astronauts for [Project Gemini](#), a proposed two-man spacecraft. This time, selection was open to qualified civilian test pilots.<sup>[65]</sup> Armstrong visited the [Seattle World's Fair](#) in May 1962 and attended a conference there

on space exploration that was co-sponsored by NASA. After he returned from [Seattle](#) on June 4, he applied to become an astronaut. His application arrived about a week past the June 1, 1962, deadline, but Dick Day, a flight simulator expert with whom Armstrong had worked closely at Edwards, saw the late arrival of the application and slipped it into the pile before anyone noticed.<sup>[66]</sup> At [Brooks Air Force Base](#) at the end of June, Armstrong underwent a medical exam that many of the applicants described as painful and at times seemingly pointless.<sup>[67]</sup>

NASA's Director of Flight Crew Operations, [Deke Slayton](#), called Armstrong on September 13, 1962, and asked whether he would be interested in joining the [NASA Astronaut Corps](#) as part of what the press dubbed "the [New Nine](#)"; without hesitation, Armstrong said yes. The selections were kept secret until three days later, although newspaper reports had circulated since earlier that year that he would be selected as the "first civilian astronaut".<sup>[68]</sup> Armstrong was one of two civilian pilots selected for this group;<sup>[69]</sup> the other was [Elliot See](#), another former naval aviator.<sup>[70]</sup> NASA selected the second group that, compared with the [Mercury Seven](#) astronauts, were younger,<sup>[67]</sup> and had more impressive academic credentials.<sup>[71]</sup> Collins wrote that Armstrong was by far the most experienced test pilot in the Astronaut Corps.<sup>[55]</sup>

## **Gemini program**

### **Gemini 5**

On February 8, 1965, Armstrong and Elliot See were picked as the backup crew for [Gemini 5](#), with Armstrong as commander, supporting the prime crew of [Gordon Cooper](#) and [Pete Conrad](#).<sup>[72]</sup> The mission's purpose was to practice [space rendezvous](#) and to develop procedures and equipment for a seven-day flight, all of which would be required for a mission to the Moon. With two other flights ([Gemini 3](#) and [Gemini 4](#)) in preparation, six crews were competing for simulator time, so Gemini 5 was postponed. It finally lifted off on August 21.<sup>[73]</sup> Armstrong and See watched the launch at [Cape Kennedy](#), then flew to the [Manned Spacecraft Center](#) (MSC) in Houston.<sup>[74]</sup> The mission was generally successful, despite a problem with the [fuel cells](#) that prevented a rendezvous. Cooper and Conrad practiced a "phantom rendezvous", carrying out the maneuver without a target.<sup>[75]</sup>

### **Gemini 8**

*Main article:* [Gemini 8](#)

Armstrong, 35, suiting up for [Gemini 8](#) in March 1966

The crews for Gemini 8 were assigned on September 20, 1965. Under the normal rotation system, the backup crew for one mission became the prime crew for the third mission after, but Slayton designated [David Scott](#) as the pilot of

Gemini 8.<sup>[76][77]</sup> Scott was the first member of the [third group of astronauts](#), who was selected on October 18, 1963, to receive a prime crew assignment.<sup>[78]</sup> See was designated to command [Gemini 9](#). Henceforth, each Gemini mission was commanded by a member of Armstrong's group, with a member of Scott's group as the pilot. Conrad would be Armstrong's backup this time, and [Richard F. Gordon Jr.](#) his pilot.<sup>[76][77]</sup> Armstrong became the first American civilian in space. ([Valentina Tereshkova](#) of the [Soviet Union](#) had become the first civilian—and first woman—nearly three years earlier aboard [Vostok 6](#) when it launched on June 16, 1963.<sup>[79]</sup>) Armstrong would also be the last of his group to fly in space, as See died in a [T-38 crash](#) on February 28, 1966, that also took the life of crewmate [Charles Bassett](#). They were replaced by the backup crew of [Tom Stafford](#) and [Gene Cernan](#), while [Jim Lovell](#) and Buzz Aldrin moved up from the backup crew of [Gemini 10](#) to become the backup for Gemini 9,<sup>[80]</sup> and would eventually fly [Gemini 12](#).<sup>[81]</sup>

Gemini 8 launched on March 16, 1966. It was the most complex mission yet, with a rendezvous and docking with an [uncrewed Agena target vehicle](#), and the planned second American [spacewalk \(EVA\)](#) by Scott. The mission was planned to last 75 hours and 55 orbits. After the Agena lifted off at 10:00:00 [EST](#),<sup>[82]</sup> the [Titan](#)

II rocket carrying Armstrong and Scott ignited at 11:41:02 EST, putting them into an orbit from which they chased the Agena.<sup>[83]</sup> They achieved the first-ever docking between two spacecraft.<sup>[84]</sup> Contact with the crew was intermittent due to the lack of tracking stations covering their entire orbits. While out of contact with the ground, the docked spacecraft began to roll, and Armstrong attempted to correct this with the Gemini's [Orbit Attitude and Maneuvering System](#) (OAMS). Following the earlier advice of Mission Control, they undocked, but the roll increased dramatically until they were turning about once per second, indicating a problem with Gemini's [attitude control](#). Armstrong engaged the Reentry Control System (RCS) and turned off the OAMS. Mission rules dictated that once this system was turned on, the spacecraft had to reenter at the next possible opportunity. It was later thought that damaged wiring caused one of the thrusters to stick in the on position.<sup>[85]</sup>

Recovery of [Gemini 8](#) from the western Pacific Ocean; Armstrong sitting to the right

A few people in the Astronaut Office, including [Walter Cunningham](#), felt that Armstrong and Scott "had botched their first mission".<sup>[86]</sup> There was speculation that Armstrong could have salvaged the mission if he had turned on only one of the two RCS rings, saving the other for mission objectives. These criticisms were



unfounded; no malfunction procedures had been written, and it was possible to turn on only both RCS rings, not one or the other.<sup>[87]</sup> [Gene Kranz](#) wrote, "The crew reacted as they were trained, and they reacted wrong because we trained them wrong." The mission planners and controllers had failed to realize that when two spacecraft were docked, they must be considered one spacecraft. Kranz considered this the mission's most important lesson.<sup>[88]</sup> Armstrong was depressed that the mission was cut short,<sup>[89]</sup> canceling most mission objectives and robbing Scott of his EVA. The Agena was later reused as a docking target by Gemini 10.<sup>[90]</sup> Armstrong and Scott received the [NASA Exceptional Service Medal](#),<sup>[91][92]</sup> and the Air Force awarded Scott the [Distinguished Flying Cross](#) as well.<sup>[93]</sup> Scott was promoted to [lieutenant colonel](#), and Armstrong received a \$678 raise in pay to \$21,653 a year (equivalent to \$195,299 in 2022), making him NASA's highest-paid astronaut.<sup>[89]</sup>

## **Gemini 11**

*Main article:* [Gemini 11](#)

In Armstrong's final assignment in the Gemini program, he was the back-up Command Pilot for [Gemini 11](#). Having trained for two flights, Armstrong was quite knowledgeable about the systems and took on a teaching role for the rookie backup pilot, [William Anders](#).<sup>[94]</sup> The launch was

on September 12, 1966,<sup>[95]</sup> with Conrad and Gordon on board, who successfully completed the mission objectives, while Armstrong served as a [capsule communicator](#) (CAPCOM).<sup>[96]</sup>

Following the flight, President [Lyndon B. Johnson](#) asked Armstrong and his wife to take part in a 24-day goodwill tour of South America.<sup>[97]</sup> Also on the tour, which took in 11 countries and 14 major cities, were Dick Gordon, [George Low](#), their wives, and other government officials. In Paraguay, Armstrong greeted dignitaries in their local language, [Guarani](#); in Brazil he talked about the exploits of the Brazilian-born aviation pioneer [Alberto Santos-Dumont](#).<sup>[98]</sup>

## **Apollo program**

On January 27, 1967—the day of the [Apollo 1 fire](#)—Armstrong was in Washington, D.C., with Cooper, Gordon, Lovell and [Scott Carpenter](#) for the signing of the United Nations [Outer Space Treaty](#). The astronauts chatted with the assembled dignitaries until 18:45, when Carpenter went to the airport, and the others returned to the Georgetown Inn, where they each found messages to phone the MSC. During these calls, they learned of the deaths of [Gus Grissom](#), [Ed White](#) and [Roger Chaffee](#) in the fire. Armstrong and the group spent the rest of the night drinking scotch and discussing what had happened.<sup>[99]</sup>

On April 5, 1967, the same day the Apollo 1 investigation released its final report, Armstrong and 17 other astronauts gathered for a meeting with Slayton. The first thing Slayton said was, "The guys who are going to fly the first lunar missions are the guys in this room."<sup>[100]</sup> According to Cernan, only Armstrong showed no reaction to the statement. To Armstrong it came as no surprise—the room was full of veterans of Project Gemini, the only people who could fly the lunar missions. Slayton talked about the planned missions and named Armstrong to the backup crew for [Apollo 9](#), which at that stage was planned as a [medium Earth orbit](#) test of the combined [lunar module](#) and [command and service module](#).<sup>[101]</sup>

The crew was officially assigned on November 20, 1967.<sup>[102]</sup> For crewmates, Armstrong was assigned Lovell and Aldrin, from Gemini 12. After design and manufacturing delays of the lunar module (LM), [Apollo 8](#) and 9 swapped prime and backup crews. Based on the normal crew rotation, Armstrong would command Apollo 11,<sup>[101]</sup> with one change: Collins on the Apollo 8 crew began experiencing trouble with his legs. Doctors diagnosed the problem as a bony growth between his fifth and sixth vertebrae, requiring surgery.<sup>[103]</sup> Lovell took his place on the Apollo 8 crew, and, when Collins recovered, he joined Armstrong's crew.<sup>[104]</sup>

Armstrong descends to the ground on a parachute after ejecting from [Lunar Landing Research Vehicle](#) 1.

To give the astronauts practice piloting the LM on its descent, NASA commissioned [Bell Aircraft](#) to build two [Lunar Landing Research Vehicles](#) (LLRV), later augmented with three Lunar Landing Training Vehicles (LLTV). Nicknamed the "Flying Bedsteads", they simulated the Moon's one-sixth gravity using a [turbofan](#) engine to support five-sixths of the craft's weight. On May 6, 1968, 100 feet (30 m) above the ground, Armstrong's controls started to degrade and the LLRV began [rolling](#).<sup>[105]</sup> He ejected safely before the vehicle struck the ground and burst into flames. Later analysis suggested that if he had ejected half a second later, his parachute would not have opened in time. His only injury was from biting his tongue. The LLRV was completely destroyed.<sup>[106]</sup> Even though he was nearly killed, Armstrong maintained that without the LLRV and LLTV, the lunar landings would not have been successful, as they gave commanders essential experience in piloting the lunar landing craft.<sup>[107]</sup>

In addition to the LLRV training, NASA began lunar landing simulator training after Apollo 10 was completed. Aldrin and Armstrong trained for a variety of scenarios that could develop during a real lunar landing.<sup>[108]</sup> They also received briefings from geologists at NASA.<sup>[109]</sup>

## Apollo 11

*Main article:* [Apollo 11](#)

The [Apollo 11](#) crew: Armstrong, [Michael Collins](#), and [Buzz Aldrin](#).

After Armstrong served as backup commander for Apollo 8, Slayton offered him the post of commander of Apollo 11 on December 23, 1968, as Apollo 8 orbited the Moon.<sup>[110]</sup> According to Armstrong's 2005 biography, Slayton told him that although the planned crew was Commander Armstrong, Lunar Module Pilot Buzz Aldrin, and Command Module Pilot Michael Collins, he was offering Armstrong the chance to replace Aldrin with Jim Lovell. After thinking it over for a day, Armstrong told Slayton he would stick with Aldrin, as he had no difficulty working with him and thought Lovell deserved his own command. Replacing Aldrin with Lovell would have made Lovell the lunar module pilot, unofficially the lowest ranked member, and Armstrong could not justify placing Lovell, the commander of Gemini 12, in the number 3 position of the crew.<sup>[111]</sup> The crew of Apollo 11 was assigned on January 9, 1969, as Armstrong, Collins, and Aldrin, with Lovell, Anders, and [Fred Haise](#) as the backup crew.<sup>[112]</sup>

According to [Chris Kraft](#), a March 1969 meeting among Slayton, George Low, [Bob Gilruth](#), and Kraft determined that Armstrong would be the first person on the Moon, in part because NASA

management saw him as a person who did not have a large ego. A press conference on April 14, 1969, gave the design of the LM cabin as the reason for Armstrong's being first; the hatch opened inwards and to the right, making it difficult for the LM pilot, on the right-hand side, to exit first. At the time of their meeting, the four men did not know about the hatch consideration. The first knowledge of the meeting outside the small group came when Kraft wrote his book.<sup>[113][114]</sup> Methods of circumventing this difficulty existed, but it is not known if these were considered at the time. Slayton added, "Secondly, just on a pure protocol basis, I figured the commander ought to be the first guy out ... I changed it as soon as I found they had the time line that showed that. Bob Gilruth approved my decision."<sup>[115]</sup>

## **Voyage to the Moon**

A [Saturn V](#) rocket launched Apollo 11 from [Launch Complex 39A](#) at the [Kennedy Space Center](#) on July 16, 1969, at 13:32:00 [UTC](#) (09:32:00 EDT local time).<sup>[116]</sup> Armstrong's wife Janet and two sons watched from a yacht moored on the [Banana River](#).<sup>[117]</sup> During the launch, Armstrong's heart rate peaked at 110 beats per minute.<sup>[118]</sup> He found the first stage the loudest, much noisier than the Gemini 8 Titan II launch. The Apollo command module was relatively roomy compared with the Gemini spacecraft. None of the Apollo 11 crew



suffered [space sickness](#), as some members of previous crews had. Armstrong was especially glad about this, as he had been prone to [motion sickness](#) as a child and could experience [nausea](#) after long periods of [aerobatics](#).<sup>[119]</sup>

Armstrong in the lunar module after the completion of the [EVA](#)

Apollo 11's objective was to land safely on the Moon, rather than to touch down at a precise location. Three minutes into the lunar descent, Armstrong noted that craters were passing about two seconds too early, which meant the [Lunar Module Eagle](#) would probably touch down several miles (kilometres) beyond the planned landing zone.<sup>[120]</sup> As the *Eagle*'s landing [radar](#) acquired the surface, several computer error alarms sounded. The first was a code [1202](#) alarm, and even with their extensive training, neither Armstrong nor Aldrin knew what this code meant. They promptly received word from CAPCOM [Charles Duke](#) in Houston that the alarms were not a concern; the 1202 and 1201 alarms were caused by executive overflows in the [lunar module guidance computer](#). In 2007, Aldrin said the overflows were caused by his own counter-checklist choice of leaving the docking radar on during the landing process, causing the computer to process unnecessary radar data. When it did not have enough time to execute all tasks, the computer dropped the lower-

priority ones, triggering the alarms. Aldrin said he decided to leave the radar on in case an abort was necessary when re-docking with the Apollo command module; he did not realize it would cause the processing overflows.<sup>[121]</sup>

Armstrong lands the [Lunar Module \*Eagle\*](#) on the Moon, July 20, 1969.

When Armstrong noticed they were heading toward a landing area that seemed unsafe, he took manual control of the LM and attempted to find a safer area. This took longer than expected, and longer than most simulations had taken.<sup>[122]</sup> For this reason, Mission Control was concerned that the LM was running low on fuel.<sup>[123]</sup> On landing, Aldrin and Armstrong believed they had 40 seconds of fuel left, including the 20 seconds' worth which h