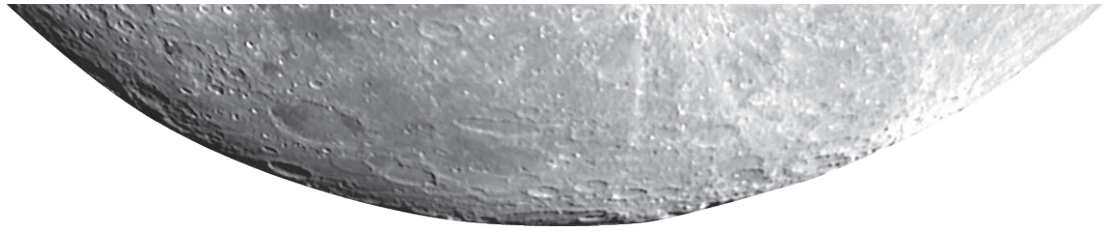
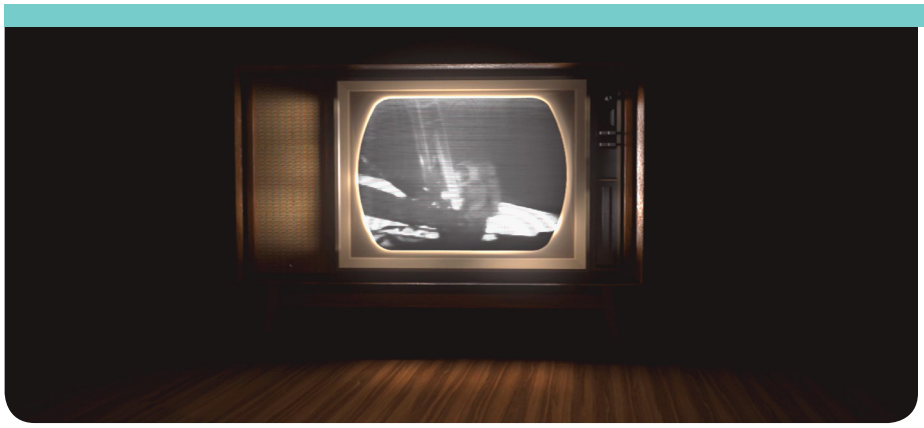


CAPCOM GO!

THE APOLLO STORY

NSC creative

NATIONAL SPACE CENTRE

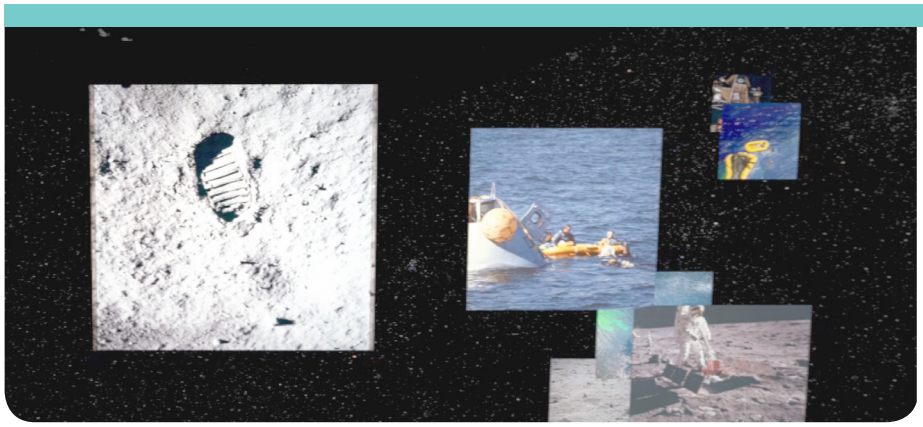


Bruce McCandless
CAPCOM
Apollo 11

Audio Recording

"Okay. Neil, we can see you coming down the ladder now."

It was the 20th of July 1969. All over the world, people were gathered around television sets and radios. They knew they were witnessing a historic moment of human achievement – broadcast live from the surface of the Moon.



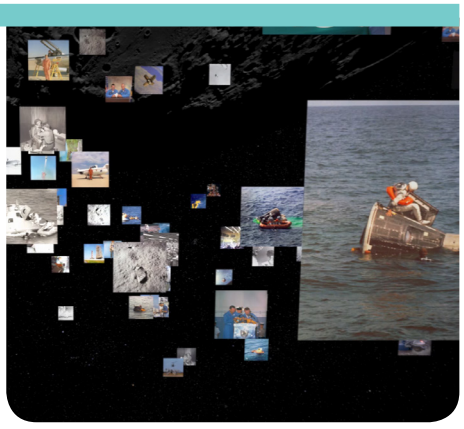
Neil Armstrong
Commander
Apollo 11

Audio Recording

"That's one small step for man, one giant leap for mankind"

The world celebrated as the astronauts took their first steps on the Moon. But few people would have been aware just how huge an effort it had taken to get them there.

These Apollo 11 astronauts were just two of nearly 400,000 people who had worked over ten years towards this goal. But how did they do it? What did it take to put humans on the Moon?



Our story starts in the 1950's when rival superpowers the Soviet Union and the United States of America begin competing to build the best spacecraft.

The Soviets achieved the first triumph when they put the world's first artificial satellite, Sputnik 1, into orbit. One month later, they launched a second satellite, this time with a living passenger: a dog named Laika.

Working hard to catch up, the Americans launched their first satellite, Explorer I, the following year. Within three years, they had advanced their technologies enough to successfully launch and return Ham the Chimp.

But then the Soviets achieved another major triumph: they successfully launched Cosmonaut Yuri Gagarin, who became the first human to orbit the Earth.

Less than a month later, Astronaut Alan Shepard became the first American in space. His successful flight gave America confidence in its space program.

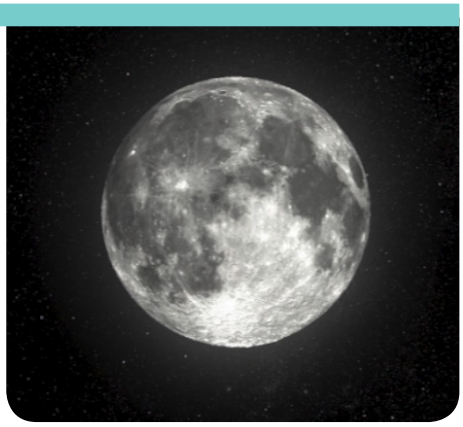
Before we find out how NASA planned to get to the moon, we need to cover the basics. First: distance. The Moon is about 400,000 kilometres (248,549 miles) from Earth: so far, that all the other planets in the Solar System could fit between us.

John F. Kennedy
U.S. President

Audio Recording

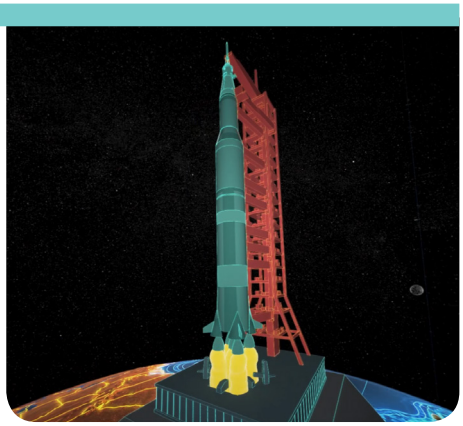
"I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space."

It is in constant motion, completing an orbit of Earth in just over 27 days. On the Moon there is no air to breathe, and the sun-lit surface gets very hot: up to 127 degrees Celsius. But it gets cold in the shadows, dropping to minus 173 degrees.



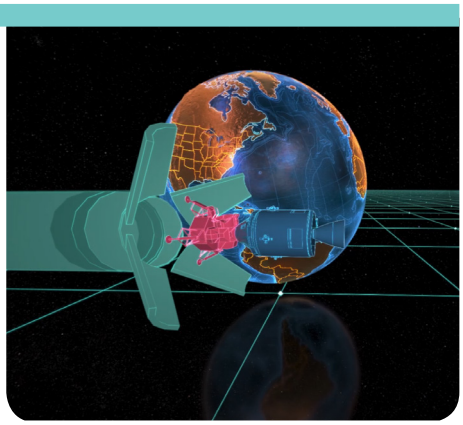
So, how did NASA plan to get people to cross this great distance and survive such extreme conditions? The plan was to break the journey into stages.

The first of those was getting off the ground. For this they designed the mighty Saturn V. Three stacked rockets made it the most powerful launch system ever.



Rather than land the whole spacecraft on the Moon, NASA built a small landing craft, which was latched on for the ride. This would be the astronauts' home on the surface and return them to the main craft.

Next, they had to consider the length of the journey. NASA calculated that it would take about four days to reach the Moon. The craft had to be able to carry all the food, water, air and fuel the three astronauts needed to reach the Moon. And for their four-day journey back.



Two astronauts would descend in the lunar module, leaving one in orbit. But to walk on the Moon, they would need spacesuits. These would need to protect the astronauts and be flexible enough to move easily.

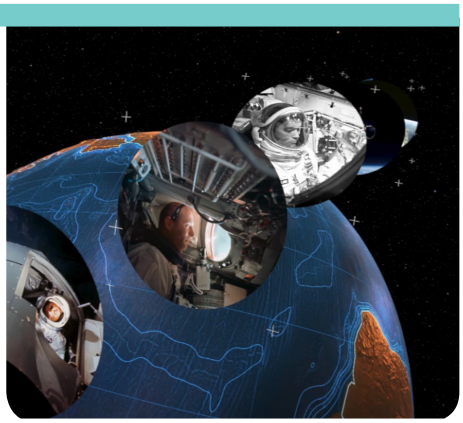
Finally, they'd need to get home. The tiny craft

that would land in the sea, was just a small part of the tip of the giant Saturn V. This great project was called Apollo.

Once they had a plan, NASA began to select astronauts by recruiting the best test pilots. The first group and their families moved to Houston to begin training in 1963.

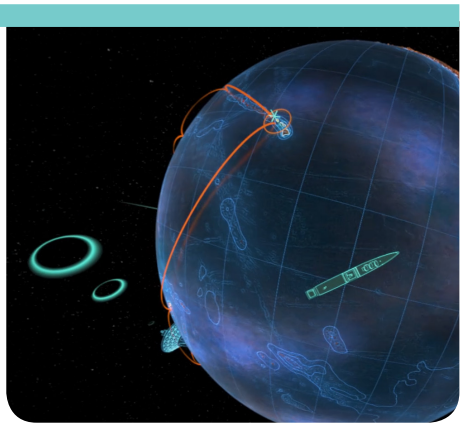
NASA recruited the best scientists, engineers and mathematicians to design the components of the mission. They also called in support from specialist companies and universities around the country.

This meant that the Astronauts had to travel all over the United States: one day they would be in Virginia, training to land on the Moon. The next, they would be in the Los Angeles harbor, training with the Navy for their return to Earth.



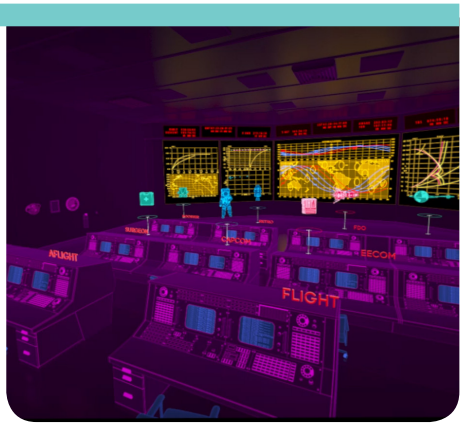
Days later they would be in Houston, practicing to set-up experiments in their space suits. Then they would be sent to the Kennedy Space Centre in Florida. From here they would be launched into space to test the new systems and space craft.

In orbit they also learnt how to perform space walks. As their spacecraft orbited the Earth, radio telescopes around the world enabled constant communication with the astronauts.



This international communication network made it possible to run the moon missions from a single building in Houston, Texas: Mission Control.

Due to the complexity of the spacecraft, the astronauts were supported 24 hours a day by teams of scientists, engineers and doctors. By watching the data displayed at these desks they were able to help the astronauts control the space craft.

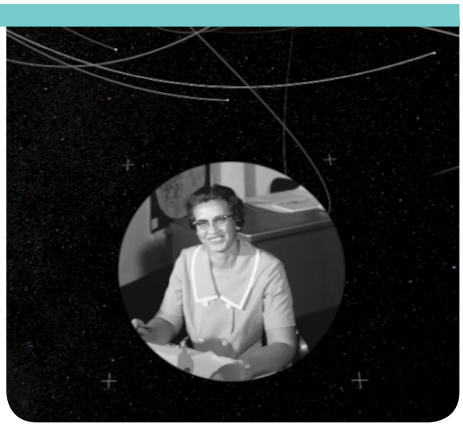


Everything was monitored here, from the position and speed of the craft to the astronaut's health. All the teams constantly updated Flight Control; the person in charge of the room and keeping the mission going according to plan.

But only one person was allowed to talk to the crew. That was CAPCOM; the capsule communicator. The astronauts preferred to talk to one of their own, so CAPCOM was usually a trained astronaut too.

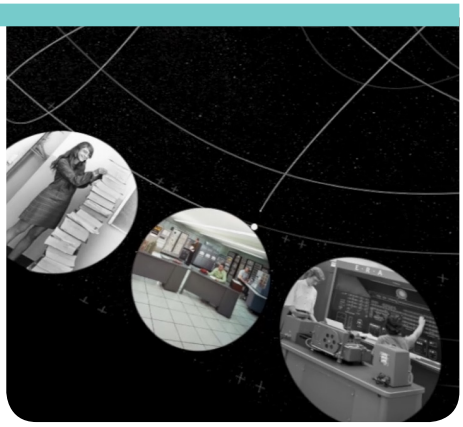
While the astronauts were busy training and testing the craft that would carry them to the Moon, someone needed to figure out the spacecraft trajectories required to get them there. In space, travel is complicated as everything is in motion, the Moon itself is moving at over 3,500 kilometres (2,175 miles) an hour.

So, to calculate the speeds, mass and forces the spacecraft needed, NASA needed exceptional people, like Katherine Johnson. She led a group of mathematicians to get a spacecraft to the moon using no more than pencils, equations and their brilliant minds.

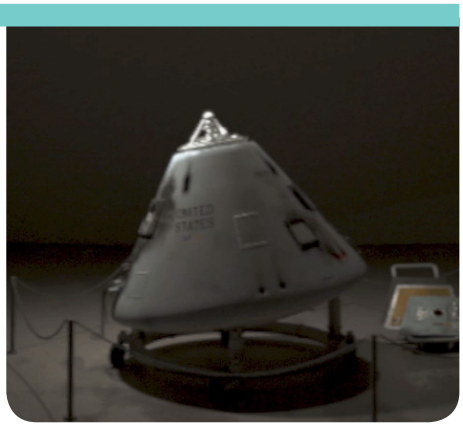


In the early days, the mathematicians

themselves were called “computers”. But as the new electronic computers became more reliable, many of these women became programmers, creating new software for spaceflight. It was Margaret Hamilton’s team that wrote the computer software that would allow the Apollo astronauts to get to and land on the moon.



Kennedy’s declaration to be the first to land on the moon and achieve it by the end of the decade put enormous pressure on everyone involved in the Apollo program. As a result, an early Apollo spacecraft was hurriedly assembled and delivered un-tested.



On the 27th of January 1967, Astronauts Gus Grissom, Roger Chaffee and Ed White were conducting a flight rehearsal. Throughout the exercise there were problems as communication links between Mission Control and the capsule’s systems kept failing.

Gus Grissom
Commander
Apollo 1

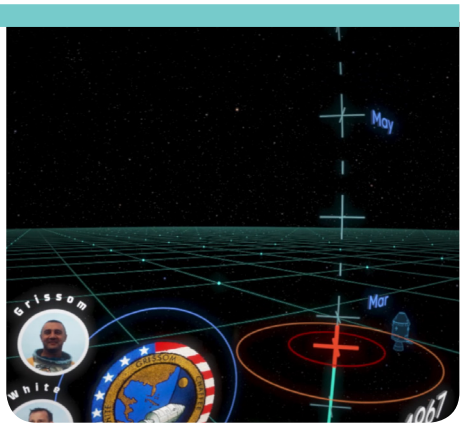
Audio Recording

“How are we going to get to the Moon if we can’t talk between two or three buildings?”

As part of the rehearsal the capsule was pressurized by filling it with 100 percent Oxygen. Then, perhaps due to a spark from a faulty wire, the oxygen-rich atmosphere ignited. The inward-opening hatch made rescue impossible. Tragically, all three astronauts died

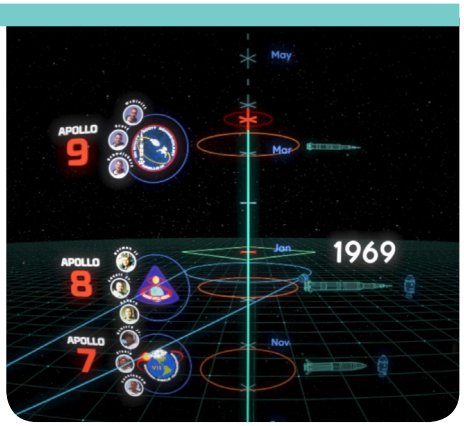
in the fire. Their loss had a huge impact on the program. As a result, every procedure, system and wire was reviewed so that an accident like this could never happen again.

But the Apollo program kept going, now more careful and dedicated to crew safety. They continued to improve the rockets and space craft but without astronauts on board.



Apollo 4 marked a major success with all the Saturn V rocket stages working together for the first time, this was improved upon with Apollo 5 and 6.

Apollo 7 had the first crewed flight, testing the craft in low-earth orbit for almost 11 days in space. Apollo 8 was a breakthrough in space flight. It was the first time humans left the Earth, orbited the moon and returned.



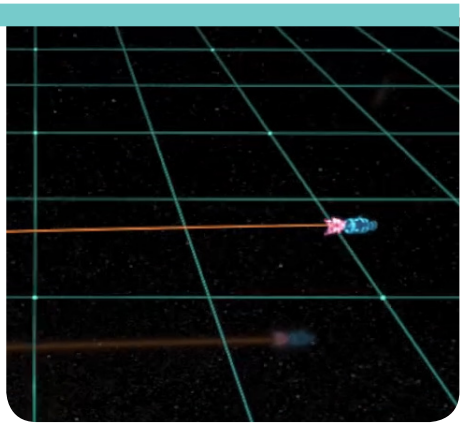
On Apollo 9 All three modules worked together for the first time. Apollo 10 was a dress rehearsal and return to the moon. Every stage had been accomplished. It was time to attempt the last goal: To walk on the moon.

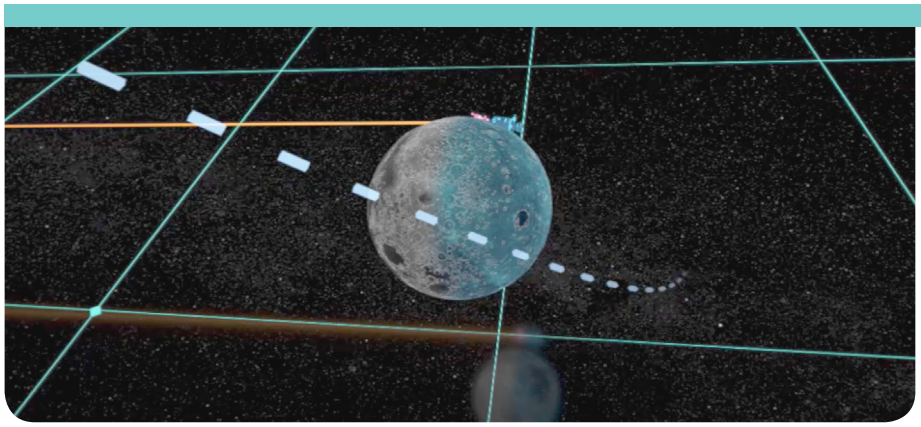
It was the 16th of July 1969 at Kennedy Space Center, Florida. On the launch pad was the biggest rocket ever built, standing 111 meters tall and weighing almost 3,000 tons. This is the Saturn V. Inside the top, in a tiny metal capsule are the astronauts of Apollo 11.

Their names are Neil Armstrong, Buzz Aldrin and Michael Collins. They will make the first attempt to land on the Moon.

After three days in space the Apollo 11 astronauts began preparing to slow down and put the craft in orbit around the moon. Unfortunately, this maneuver had to be carried out on the far side of the Moon, away from radio contact.

A mistake at this time might send them crashing into the Moon, or, worse, speeding off into deep space with no hope of return.





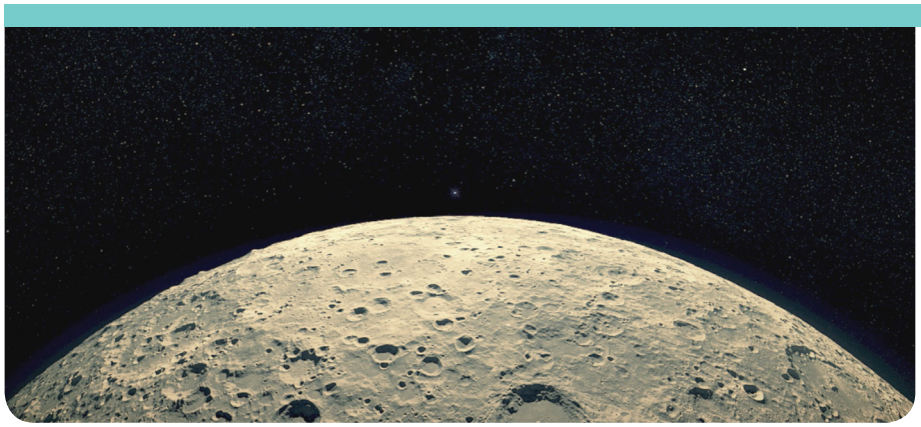
The astronauts were on their own. There was nothing Mission Control could do but wait.

Bruce McCandless
CAPCOM
Apollo 11

Audio Recording

"Apollo 11, this is Houston. All your systems are looking good going around the corner, and we'll see you on the other side. Over."

"Apollo 11, Apollo 11, this is Houston. Do you read? Over."



The calculations were perfect to the second. Apollo 11 was now safely in orbit around the Moon. It was now time. Neil Armstrong and Buzz Aldrin entered the Lunar lander, ready to attempt the first ever moon landing.

Neil Armstrong
Commander
Apollo 11

Audio Recording

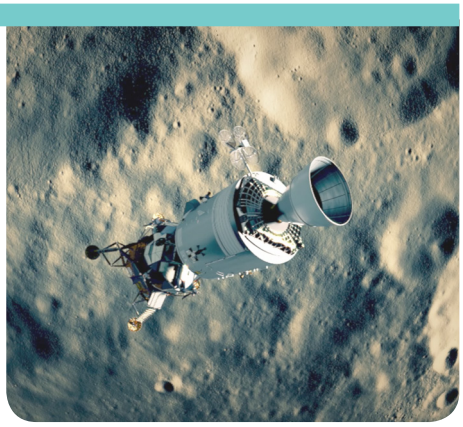
"Reading you loud and clear, Houston. How us?"

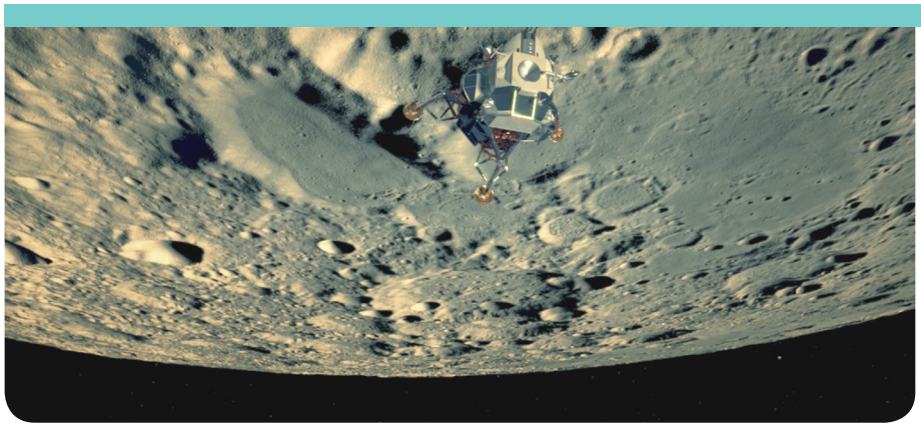
"It looks very much like the pictures, but like the difference between watching a real football game and watching it on TV. There's no substitute for actually being here. "

As they detach, Michael Collins is left alone in the main spacecraft. He knows there is a high likelihood that he will be making the return journey to Earth alone.

There are three possible outcomes to their attempt: They will land, they will abort, or they will crash.

Back in Mission Control, Flight Director Gene Kranz and his team monitor the progress of the landing craft.





An alarm sounds, something is wrong with the computer. Mission Control must quickly decide whether to abort the mission. They choose to continue.

In the lander, Armstrong realizes that they are going to miss the planned landing site and are heading for a boulder field.

He takes over control from the landing computer, all those hours of training come into play.

Neil Armstrong tries to find a flat landing site, but the lander is running out of fuel. When the clock gets to zero, they'll have to abort.

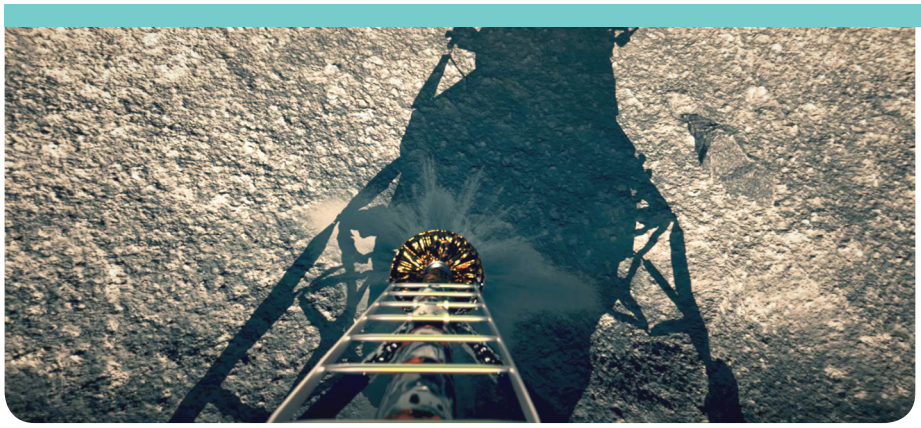
Gene Kranz
Flight Director
Apollo 11

Audio Recording

"OK, all flight controllers go-no-go for powered descent:

Retro? Go
FIDO? Go
Guidance? Go
Control? Go
TELCOM? Go
GNC? Go
EECOM? Go
Surgeon? Go

CAPCOM we're go for powered descent"



They had done it. Every single person in the Apollo program had contributed to this moment. Together they had put humans on the Moon, and they had got there first.

Back on Earth half a billion people watched Neil Armstrong descend the ladder and become the first human to walk on the Moon.

Neil Armstrong
Commander
Apollo 11

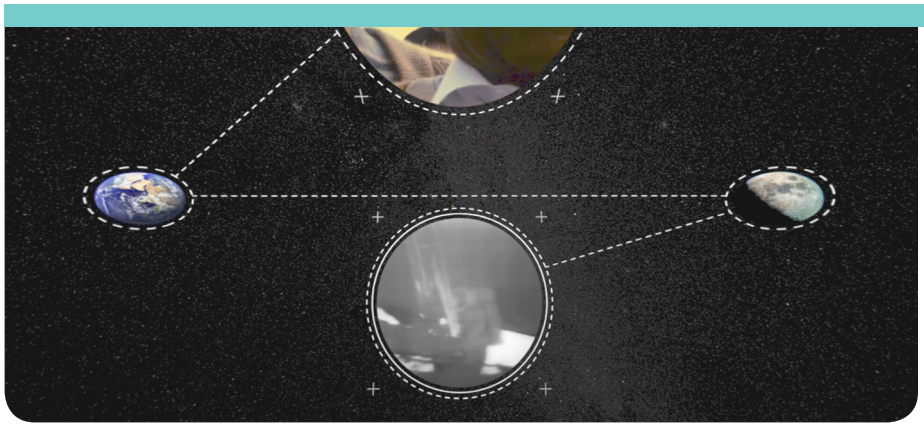
Audio Recording

"Houston, Tranquility Base here. The Eagle has landed"

Charlie Duke
CAPCOM
Apollo 11

Audio Recording

"Roger, Tranquility. We copy you on the ground. You got a bunch of guys about to turn blue. We're breathing again. Thanks a lot."



Neil Armstrong
Commander
Apollo 11

Audio Recording

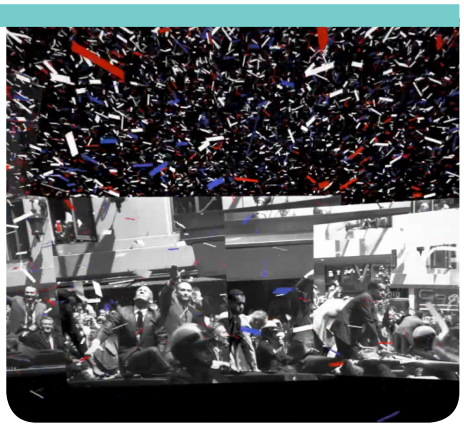
"That's one small step for man, one giant leap for mankind"

Minutes later, Buzz Aldrin joined him on the Moon. The two moon walkers had little time to enjoy the scenery. For the next two and a half hours they took photographs, set out experiments, and collected different types of rock and soil to bring home.

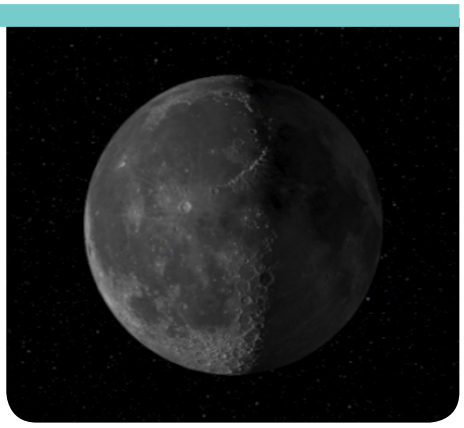
Apollo 11 revolutionized our relationship with space. We had now proved that we could go beyond Earth. We had taken our first steps

to exploring the Cosmos. When the three astronauts returned, they were celebrated by a changed world. They returned to Earth as heroes.

Politically, the reason for going to the Moon had been accomplished, the Space Race had been won. The national ideal that dedication could achieve anything, even take you to the Moon, had triumphed. For many this is where the story ends, but the Apollo 11 landing was only the first step in the human exploration of space.



With renewed confidence in their spacecraft, NASA set out to explore other areas of the Moon.But first they needed to improve their accuracy; Apollo 11 had missed its landing site by six kilometres (four miles).



Only four months later, Apollo 12 successfully landed just 200 metres (656 feet) from its target, near an earlier space craft called Surveyor 3. They collected samples and set up science stations. These continued to transmit data long after the crew returned to Earth.

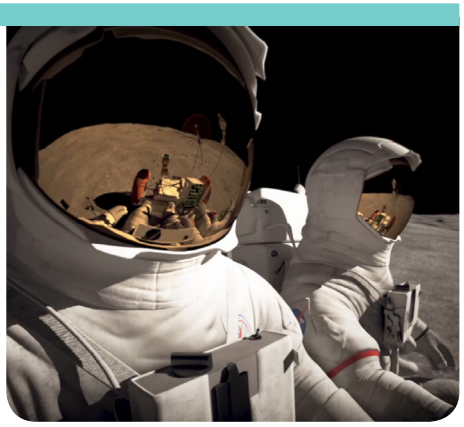
Apollo 13 was unable to attempt a Moon landing. Early in the journey, an oxygen tank exploded, forcing the crew to abort the mission. Travelling too fast to turn around and fly straight back to Earth; they had to use the Moon's gravity to slingshot them back home.

The teams in Mission Control worked around the clock trying to save the crippled spacecraft. Over the radio, Capcom talked the crew through every plan the teams had devised to keep them

alive. Incredibly, all three Astronauts survived, but only just.

Budget constraints forced NASA to reduce the number of Moon missions it had planned. So, to increase the astronaut's range of exploration and science, the engineers packed an electric moon rover.

On Apollo 15, Moon exploration moved up a gear. The first astronauts had engineering qualifications and were able to set up scientific experiments, but NASA now realized they needed a trained geologist to identify the most valuable rocks to study and return.



On Apollo 17 Harrison Schmitt became the first scientist to walk on the Moon. The samples they returned are still giving us insights into the Moon today.

Harrison Schmitt
Lunar Module Pilot
Apollo 17

Audio Recording

"There is orange soil. It's all over! Orange!"

But on December the 14th, 1972 Gene Cernan left the last footprint on the moon. No one has set foot on the Moon since.

Looking back, it seems incredible that all this was possible so long ago. But why have we never returned?

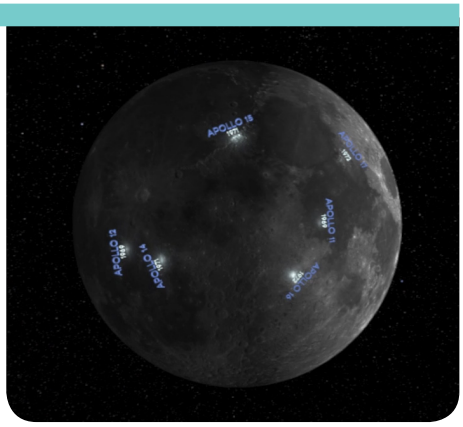
Apollo proved that humans could get to the Moon, but only for short visits, making exploration extremely expensive. The challenge then, is that if we want to explore space, we must first learn how to live in space.

Since Apollo, astronauts have remained within low Earth orbit. Small space stations like Mir and Skylab pioneered technologies for living in space. More countries began to develop their own space programs. Fifteen nations came together to build the International Space Station.

Onboard this science laboratory, astronauts and scientists have been learning how to live in space for long periods. Their work is helping us to prepare for the next goal, not just to visit the Moon for a few days like Apollo but to live there, and explore.

We are still learning but are tantalizingly close to real solutions. Soon, we'll need a new generation of people, working together, to plan our next great adventure into space.

Are you ready for the next giant leap?



Neil Armstrong
Commander
Apollo 11

Audio Recording

"We would like to give a special thanks to all those Americans who built the spacecraft, who did the construction, design, the tests, and put their hearts and all their abilities into those crafts. To those people, tonight, we give a special thank you, and to all the other people that are listening and watching tonight, God bless you. Good night from Apollo 11"

Astronaut portraits credit: NASA