

1. Were the Apollo missions motivated by politics or science—or both? Why?
2. What were some of the early technological challenges of the space program and how did NASA staff respond?
3. The astronauts in the film refer to “the right stuff.” What was this “stuff” and how did the astronauts embody it?
4. How did the social elements of the 1960s—including the Vietnam War—affect the outlook of the astronauts?
5. What did rocket liftoff feel like both physically and emotionally for the astronauts?
6. What emotions do astronauts Buzz Aldrin and Michael Collins share when recounting their Apollo 11 mission?
7. How did the moon missions unite people in an incredibly divisive time?
8. Later, NASA lost funding as taxpayers’ money went toward the Vietnam War. Can there be a proper balance between scientific research and military spending?
9. Have you ever dedicated yourself to a venture that many deemed unrealistic? What propelled you forward, and did you meet your goal? If not, what did you gain from the experience?
10. How do the Apollo missions—the engineers, support staff, astronauts, and their families—inspire you? What can you take from their experiences and carry with you?


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Accompanying primary source:

***Excerpt of* Flying to the Moon *by astronaut Michael Collins***

Early on the morning of July 20, 1969, I was circling the Moon with Neil Armstrong and Buzz Aldrin in our spacecraft Columbia. We had just awakened from a short sleep and were sucking lukewarm coffee out of plastic tubes and munching on bacon that had been squeezed into little cubes, like lumps of sugar. While we were eating our breakfast, we were talking on the radio with our friends in Mission Control in Houston, Texas. Today was the day Neil and Buzz were going to land on the Moon, and Houston was giving them some last-minute advice. Mostly it was technical stuff about their schedule, but all of a sudden they said, “Watch for a lovely girl with a big rabbit. An ancient legend says a beautiful Chinese girl called Chang-O has been living there for four thousand years. It seems she was banished to the Moon because she stole the pill of immortality from her husband. You might also look for her companion, a large Chinese rabbit, who is easy to spot since he is always standing on his hind feet in the shade of a cinnamon tree.” Of course, our friends in Houston were kidding, because the Moon doesn’t have any cinnamon trees or even any air for people or rabbits to breathe. They probably just wanted to make us laugh a little bit so we wouldn’t be too nervous about landing on the Moon for the first time ever.

We were a little nervous that morning. We were concerned about how well our spacecraft and computers would work. We also worried about the rocket blast from Eagle, our lunar module, which might kick up a lot of dust and prevent Neil Armstrong from being able to see well enough to land. Or suppose Neil couldn’t find a spot smooth and level enough to put Eagle down? As it turned out, we need not have worried about the Moon, because the Eagle landed beautifully in the Sea of Tranquility, and Neil and Buzz were able to walk around and collect some rocks.

The Moon’s surface didn’t surprise us, because people had studied the Moon very carefully long before Project Apollo came along. In fact, as long as there have been human beings, I suspect that they have wondered about the Moon. How far away was it? How big? What was it made of? How could one visit it? It looked like a shining silver plate hanging in the sky, and on a clear night it seemed almost close enough that a cow could jump over it. But really it is far away—nearly a quarter of a million miles from Earth. Before anyone visited the Moon, scientists made very accurate measurements of its distance. How can you tell how far away something is when you haven’t even been there? There are at least two ways. One is to get two people on different sides of the Earth to look at the Moon at the same time and measure where it appears with respect to the stars in the background; that is, which stars appear next to it. By comparing what the two observers see, it is possible to measure an angle—called parallax. Once the parallax angle and the distance between the observers are known, it is possible to draw a triangle and calculate the distance to the Moon:

Another way is to bounce a radar signal off the Moon and measure the time it takes the signal to travel from the Earth to the Moon and back again. Since radio waves always travel at the same speed (the speed of light), it is easy to calculate the distance if you know the time. Scientists over the years used both the parallax and the radar methods and got the same answer: 238,000 miles from the Earth to the Moon. That’s a long, long way, and yet it took Neil and Buzz and me only three days to get there, so you know we must have been traveling pretty fast.

The reason we were able to go so fast is that we started out riding on a rocket—a huge rocket taller than a football field standing on end. As the rocket’s engines blasted away, we left the Earth slowly and then got going faster and faster until finally we had enough speed to overpower the pull of the Earth’s gravity. By this time, the rocket had used all its fuel, so we separated from it and floated to the Moon in the weightlessness of space.

Of course, huge rockets weren’t invented until fairly recently, and humankind has always wanted to go to the Moon, so you might guess that there were a number of crazy schemes thought up before the rocket came along. My favorite would-be astronaut is Cyrano de Bergerac, a Frenchman who was born four hundred years ago. His idea was to get up early in the morning and gather up dew from his garden. He would put the dew into tiny bottles and strap the bottles to his body. Then, when the morning sun’s heat caused the dew to evaporate, he would float up with it—to the Moon.

Another famous Frenchman was Jules Verne, who was born almost two hundred years ago. His idea was to shoot a moonship out of a huge cannon, which he called the Columbiad. Verne wrote a fascinating make-believe story about a trip to the Moon, and many of his ideas came close to the way the Apollo flights actually took place. For example, as a location for his Columbiad, he picked, of all places on Earth, Tampa, Florida—just a few miles west of Cape Canaveral, the launching pad for our Columbia.

As I circled the Moon in July of 1969, I was thinking about Armstrong and Aldrin, not de Bergerac and Verne. Okay, so we were 238,000 miles from Earth—that much I knew—but what would Neil and Buzz find on the surface? No one had ever been there before, and I was worried, even though we did have a lot of information to help us. Ever since Galileo first peered at the Moon through his telescope more than four hundred years ago, we had been gathering facts about its pockmarked surface. We had photographs of it, and maps too. We had crashed into it with our Ranger unmanned spacecraft and even soft-landed a Surveyor spacecraft loaded with instruments. We knew it had no atmosphere and we knew its surface could be either colder than Siberia in January or hotter than the Sahara Desert in August. Whether any one spot on its surface was hot or cold depended on its angle to the Sun. The Moon does not spin, but keeps one side pointed toward the Earth as it makes a gigantic orbit around the Earth.

It takes the Moon one month to go around the Earth once. In the meantime, the Earth is making an even bigger (much bigger) orbit around the Sun. What all this means is that in a month’s time a spot on the Moon’s surface will be exposed to every possible condition of lighting—from inky black to sunlight directly overhead (“noon”). Months before our flight, scientists had picked a landing spot that looked nice and smooth. Then they figured out what time of the month we should arrive at that spot. We wanted Neil and Buzz to be able to see well, with the Sun behind them as they descended, and we wanted them not to get too hot, so we decided that landing just after dawn would be best. As you look at the full Moon, if you use your imagination, you can see the face of the Man in the Moon. Neil and Buzz would be landing just below his left eye. On the day they landed, his left eye was barely visible and his right eye was in darkness. In other words, the people on Earth would see slightly less than a half moon.

Remember that the Moon produces no light of its own, but merely bounces back sunlight that hits its surface, so you can tell the direction of the Sun by looking at the Moon.

The Moon always has one half lighted and one half dark. The reason it looks different to us is that, as it goes around the Earth in its circular orbit, its angle to the Sun keeps changing, and sometimes we see only the light side (“full moon”) or only the dark side (“new moon”) or half and half (“half moon”) or mostly dark (“crescent moon”). When I was young, I only thought a little bit about why the Moon seemed to change shape as the month wore on, and I never thought about what the Earth would look like when seen from the Moon. The planet Earth produces no light of its own but merely reflects sunlight, just as the Moon does. Sure enough, coming back from the Moon, I could look out my spacecraft window and see a crescent Earth.

The Moon is not nearly as large as the Earth, and therefore its gravity is not as strong. Any object, such as a human body, is attracted more strongly to a large planet than to a small one. On Earth I weigh 165 pounds, but on the Moon I would weigh only 27 pounds. Imagine a grown man weighing 27 pounds! That is why Neil and Buzz were able to jump around like kangaroos on the Moon, even though they were loaded down with heavy equipment. Now, on the surface of Jupiter, which is the largest planet in our solar system, I would weigh 436 pounds. A person would have a difficult time standing up on Jupiter, much less jumping.

Before we got to the Moon we had a pretty good idea of what we would find—rocks, and more rocks. We knew this from photographs taken on Earth through telescopes, and also those taken by spacecraft from up close. Neil and Buzz should have brought a small piece of green cheese with them from Earth, just so they could say they had brought some green cheese back from the Moon. In addition to being all rocks, another bad thing about the Moon is that there is no air to breathe. We didn’t think there was any water either, although we weren’t too sure about that. With no air or water, the Moon would be a very difficult place for humans to live, or even visit. Neil and Buzz carried their own breathing supply of oxygen in packs on their backs. If someone wanted to live on the Moon more or less permanently, that person would probably have to put up a plastic bubble, fill it with air, and stay inside it. The Moon would be a great place to observe the stars because there is no atmosphere to get in the way and block the view. On Earth, we think we can see the stars clearly, but we really can’t. Over 90 percent of the energy coming from the stars is blocked out by our atmosphere and never reaches the ground. On the Moon, with no atmosphere, astronomers would not have this problem, and they would be able to learn a lot more about our universe.

Of course, it’s going to be a long, long time before astronomers or anyone else begins to live on the Moon inside a bubble. It would be very complicated and expensive to get all the necessary equipment up there. It took us eight years from the time President John F. Kennedy said we should go to the Moon until Neil stepped on it. It took me six years of training as a NASA astronaut to learn everything I needed to know to make the trip. That is a long time to study, especially when you know you have only one chance to pass the final exam. But along the way I learned a lot of fascinating things, like how to find food in the jungle or what to do about chiggers, and I would like to tell you about some of them.