FIELD TRIP TO THE MOON (live script)

Pre-show: Lunar Imagery and Q&A

As the audience enters the pre-show area, they see high-definition footage of the Moon revolving on the monitors. This visualization (created within the software environment Uniview) of the rotating moon, is presented in a loop, with fades to black between loop segments the Field Trip to the Moon program logo.

Q&A are interspersed with the Uniview moon visualization.

The FTM preshow loop alternates with a short visualization of the formation of the Moon from the American Museum of Natural History's Science Bulletins program called Our Moon [This visualization can be viewed at: www.sciencebulletins.amnh.org]

Prologue: Launch

Just prior to entering the Dome, the audience watches a two-minute prologue that introduces a very brief history of the Apollo mission) and communicates that NASA is planning on returning.

[Audience enters the Dome and the program begins as follows. These are the script talking points. Because the program is presented live, in an interactive fashion, the script provided is intended as a guide. Additional background information is presented for each section which can be integrated into the live presentation according to venue needs.]

PRESENTER

Good morning and congratulations! You have been selected to be an astronaut on our “virtual” spacecraft. You are about to embark on a voyage to the Earth’s Moon. Only a few astronauts have ever actually taken this trip, and it usually lasts three days. But through state of the art virtual technology we will complete our journey in just a matter of minutes. My name is ___________________ and I will be your commander today. We’ll be heading over to the Kennedy Space Center in just a moment. So to ensure a safe flight, please make sure that your spacesuits are fully functional, all electronic devices are powered off and your virtual seatbelts are fastened. It looks like mission control is ready for us to begin boarding. Are you ready to experience what it would be like to go to the moon? *[crowd responds]* All right, let’s head out to the launch pad.

Part One: Pre-Launch

SOUND CUE: Pre-launch chatter

FLIGHT CUE: VAB and pad flight paths, pre-recorded

(The visualization begins at Kennedy Space Center in the early morning, flying around the site and viewing the Ares rocket emerging from the Vehicle Assembly Building. A view of the pad shows us the site with the Ares prepared to launch.

Background information: In NASA’s planned mission to return to the Moon,t The Ares V contains the Lunar Lander and cargo and will launch first, followed by the launch of the Ares I which will contain the ORION Crew Capsule. An important safety feature of the ARES I is a launch abort system on top of the capsule which can move the crew away from the rocket in case of a launch emergency. The Crew Capsule will join with the Lunar Lander while orbiting the Earth. Both vehicles use a J-2X engine similar to that used by the Saturn V rocket to put the Orion into Earth orbit and to send the mated Lunar Lander/Orion combination on its journey out of Earth orbit and on to the Moon.)

PRESENTER

As we arrive at Kennedy Space Center's Vehicle Assembly Building, let's take a look at one of the Ares rockets designed to be used in NASA's upcoming mission to return to the moon. Because the Moon is nearly a quarter million miles away, we need a rocket large and powerful enough to not only escape Earth's gravity, but to take us all the way to the Moon. Two Ares rockets will carry everything we need for our mission, us, our spacecraft, our supplies and our lunar lander.

This Ares rocket can carry nearly 100 *thousand* pounds to the Moon—that's as heavy as four school buses! The entire assembly stands more than 350 feet tall.

The long tubes you see on either side of the Ares rocket are reusable solid rocket boosters. The same boosters that are used on the Space Shuttle, but Ares' central core more closely resembles the Saturn V rockets that carried the Apollo astronauts to the Moon in the 1960s and 70s.

We are nearing the final ten seconds to lift off, so let's hear that countdown 10, 9, 8, 7…..*[Crowd responds]*

Part Two: Launch

SOUND CUE: Countdown sequence from NASA shuttle launch

(Low rumble as we begin to fire engines and lift off the surface, heading due east. We see more of the panorama around us, the flat Florida marshes merging with the distant horizon. As our altitude increases, we see the Florida Peninsula, and Earth's spherical shape becomes more evident as our trajectory changes from a vertical ascent to a more horizontal orbit.)

Part Three: Earth Orbit in Daylight

(Now in a relatively low-inclination orbit around Earth, we follow a trajectory that takes us over southern Africa and Madagascar, the Indian Ocean, Western Australia, and across the Pacific Ocean to the Baja Peninsula.)

PRESENTER

As we leave Earth, we can clearly see the bright haze from the protective layer of air that surrounds our planet. Anyone know what that's called? *[crowd responds]* Yes, the Atmosphere. This amazingly thin layer contains the oxygen we breathe, the carbon dioxide that fuels plants, and generates all of our weather — including rain, snow, hurricanes, and tornadoes. —

Our flight path will take us one full orbit around Earth before we're able to change our trajectory for the moon. We're heading east, and below is the Atlantic Ocean, which contains Earth's most precious resource. Can anyone name it? *[crowd responds]* exactly…….water. Nearly three-quarters of Earth's surface is covered with water, but most of this is saltwater. Does anyone know what percentage of our water we can actually drink? *[crowd responds]* Just 1 percent. Even thought the Earth is covered with water, only 1% of it is fresh water that we can drink. And since we know that all living things need water to survive, that makes water one very important resource on our planet.

We're approaching the western coast of Africa and the vast expanse of the Sahara desert. The Sahara is as large as the United States. See any water? *[crowd responds]* Not here. But watch as the dry Sahara gives way to the rich, green jungle of the Congo. And as we pass the western border of Tanzania, if you look to the south you can get a glimpse of some of that rare fresh water in the giant lakes that outline its border.

We are flying over Madagascar now, and approaching the day-night boundary. What is the day-night boundary….. well, how long does it take the Earth to rotate on its axis? *[crowd responds]* Exactly…… one day, or 24 hours. This rotation carries the planet from daylight into darkness and back again. And we can see this day-night boundary line from space.

Part Four: Earth Orbit at Night

(We move into the night-time side of Earth over the Indian Ocean.)

PRESENTER

Underneath us is the immense darkness of the Indian Ocean… virtually uninterrupted by islands or civilization. But as we approach Australia, you can that see its western coastline is dotted with lights. Anyone know what those lights are coming from? *[crowd responds]* Yes, cities and where there are cities, there are people. Lots of people. Even from space the signs of life on Earth are visible.

We are now traveling over Earth's largest ocean. Can anyone name it? *[crowd responds]* The Pacific. You may notice the clouds below appear to be illuminated. And what is lighting up the clouds? *[crowd responds]* The sun, of course. Light from the sun has been reflected off the moon, which in turn illuminates the clouds.

We can see the day night boundary approaching

Part Five: Earth Orbit, Return to Daylight

PRESENTER

And a gorgeous sunrise greets us as we move from darkness into light. A sunrise from orbit, the kind of sunrise most people will never see.

We're now crossing the Gulf of Mexico, on our way to the place where we started our journey, Cape Kennedy.

There's Florida's panhandle right in front of us. It's time to leave Earth orbit and follow our trajectory toward the Moon.

A trajectory is the path or course created to get from one place to another. Now, plotting that course through space is a bit tricky since everything in space is moving. Not only do we have to figure out how to get to the Moon, but we have to determine where the Moon will be when we arrive—not only in its orbit but also in its rotation. We will need to fire our thrusters again, just as we did taking off from Earth. We can see our destination rising ahead of us now and we will fire our thrusters as we alter course.

Part Six: Breaking Earth Orbit

SOUND CUE: Trans-lunar Injection

(We break earth orbit with another low rumble—although not quite the seat-shaker of the KSC launch. We will leave Earth behind and then linger inside to view satellite trajectories from near Earth. Background Information: When the Orion crew capsule docks with the lunar lander, the lunar lander will still be attached to its Earth Departure Stage from the Ares V rocket. After all systems are checked out, the Earth Departure Stage engine (J-2X) will fire, putting the crew and lander into trans-lunar injection, or in other words, on course for lunar orbit. Once in lunar orbit, the lunar lander provides the descent propulsion to get the crew to the Moon's surface and its ascent propulsion returns the crew to orbit, where it will dock with the Orion capsule left in lunar orbit.)

PRESENTER

We are now on our way to the Moon!

Let's use our spacecraft's virtual technology to take a look at a few things that we wouldn't normally see out the window of an actual ship on its way to the Moon. For example, notice the positions of human-made satellites around Earth. Those in high orbits are often used for communication. Anyone have GPS in your car? *[crowd responds]* Well, these are the satellites that enable us to locate and communicate with people all over the world. The satellites in lower orbits closer to the Earth are often used for things like monitoring the weather. In the last fifty years, we've put a lot of stuff into orbit around Earth. And these devices have become an important part of our daily lives.

Now, let's take a virtual look at our own spacecraft from the outside.

Part Seven: Viewing Earth's Space Environment

FLIGHT CUE: Switch to flight path exterior to spacecraft

(After leaving Earth orbit, we pull away from the lunar module to see it from the exterior.We then take a look at Earth's space environment.)

PRESENTER

This is what our spacecraft actually looks like. We are going to hang out here and continue to explore the environment in space around Earth while our craft continues its journey to the moon.

Now, most people think of space as being totally empty. But the space between the Sun and the planets, and even between Earth and the Moon, actually contains many tiny particles that we can't see. Most of these particles come from the Sun. They fly through space so quickly that if a burst of them were to hit a satellite, a spacecraft or especially an astronaut, they could cause a lot of damage. These particles make up solar storms that we call “Space Weather.”

Fortunately, on Earth, we are protected from space weather by our magnetic field, if you could see it, it would look something like this.

FLIGHT CUE: Magnetosphere fades up

(A dynamic magnetosphere fades up, in addition to the satellite trajectories. We will then pull away slightly to see the Moon’s orbit in relationship to the Earth’s magnetic field)

PRESENTER

The rounded form surrounding our planet represents Earth’s magnetic field. It changes from day to day and hour to hour, but it looks generally like this. Notice that one side of the magnetic field seems almost squished-in close to Earth. That’s because particles from the Sun are constantly pushing against it. The opposite side stretches away, so it looks kind of like a tail.

Almost all of our satellites remain inside Earth’s protective magnetic field, A few that lie in between the Earth and the Sun sneak outside the zone of protection once in a while, and their exposure to space weather can cause some serious damage. But most of the satellites are pretty much unaffected.

The Moon lies far outside Earth’s magnetic field, as you can see from its orbital line, represented here. That means that on the Moon, astronauts are exposed to potentially dangerous radiation from the Sun’s solar storms.

Part Eight: Rejoining the Lunar Module

(We approach the lunar module from "below," the LSAM's footpads pointing toward us, with Earth in the distance. After about 20 seconds, our perspective gradually shifts until we see it from the side, including the powder-blue command module, elegant in the harsh sunlight of space.)

FLIGHT CUE: Lunar Module Fly-By

PRESENTER

Here comes our spacecraft. That's Earth in the distance. Closest to us is our Lunar Lander--the craft that will actually land on the Moon. Those things sticking out of it are the footpads, which will actually touch the lunar surface.

We can also see the lander's thrusters; the rockets that will help slow the craft's descent by pushing against the Moon's gravity. This will ensure a gentle landing. The thrusters will also lift us off the Moon when our mission on the lunar surface has ended.

As the spacecraft passes in front of us, we can see a blue cylinder with a cone-shaped unit below. This houses the crew module although it will be empty while the entire crew goes down to the lunar surface. The large thruster and engine on the crew module will be used to rocket back home. And the cone-shaped part of the spacecraft will actually make the return trip home, parachuting through the Earth's atmosphere and landing in the ocean at the end of the mission.

We're getting close to our destination now, so we'll turn off our virtual view and rejoin our spacecraft to experience the rest of the trip like real astronauts.

Part Nine: Orbiting the Moon

(We rejoin the mission flight path close to the Moon, approaching it from its north pole. We will go into a low polar orbit around the Moon, following a trajectory that will essentially take us along the terminator. This should give us a good view of the topography of the Moon as well as put us on an appropriate path to take us over the south pole and toward our final destination—the Apollo 17 landing site.)

FLIGHT CUE: Back to first-person flight path

PRESENTER

As we approach the Moon we begin to see details that were only faintly visible back on Earth. The moon's surface is almost uniformly grey. See any water? [crowd responds] Any green plant life? [crowd responds] Any city lights? [crowd responds] Really different from home.

The darker, flatter areas you can see on the moon's surface are called maria. When astronomers first looked at the Moon and saw these large dark patches; they thought they were created by water. They called them "maria," from the Latin word for ocean. But when astronauts actually visited the moon and brought back samples of this terrain we learned that the maria was not created by water; but instead by volcanic rock that oozed out of the Moon's surface billions of years ago.

If you look to the horizon you will notice that this line looks sharper than it did on Earth, because the Moon has no atmosphere. Because of that lack of atmosphere, conditions on the Moon can be quite severe. On the sunlit side, temperatures can reach 250 degrees Fahrenheit, and the night-time side can plummet to *minus* 250 degrees Fahrenheit.

FLIGHT CLUE: Increasing presence of craters

PRESENTER

We are now in orbit on the "far side of the moon" the side that faces away from the Earth. Because the moon rotates at the same rate that it orbits the Earth, we always have the same side of the moon facing us. The side that faces away we call the "far side" On the far side of the Moon, we can see a lot more craters. Craters are formed by what kinds of objects? *[crowd responds]* Asteroids and comets, hitting the lunar surface. Most of the larger craters were made a long time ago, but many of the smaller craters are more recent. How can we tell? Look for craters inside of other craters. The big crater was created first; the little crater was made later on.

We are approaching the edge of the largest know crater in the Solar System. And it is right here on **OUR** moon. Known as the "Aitken Basin" this super crater is over 7 miles deep and 1500 miles wide - that's about half the width of the entire continental US.

At the South Pole we get a good look at the day-night boundary on the Moon. The Moon has a day and night cycle just like Earth but the Moon's day and night cycle lasts almost thirty days—that's a long time compared to the twenty-four hours in Earth's day and night cycle.

Part Ten: South Pole to Tranquility

PRESENTER

Let's begin our preparations for landing. Today we're headed for the Apollo 17 landing site. This is where humans last walked on the Moon December 11, 1972.

On our final approach we pass over the mare known as the "Sea of Tranquility." This mare was made famous by the crew of Apollo 11, the first people to walk on the Moon back in 1969.

We are headed to the far side of the mare.

Part Eleven: Lunar Landing

(We are on final approach to the Apollo 17 landing site. Background information: This site is at the lunar equator, partly because of the limited capabilities of the Apollo equipment. The return trips NASA is planning for the 2020 timeframe will most likely put us at the poles, rather than the equator..)

FLIGHT CUE: Maintain first-person perspective as we descend

PRESENTER

As we approach you'll notice the map of terrain in this area is very detailed compared to the rest of the moon. This is because Astronauts have brought back detailed data that tell us exactly what it looks like. The ridge of mountains ahead of us includes peaks that would dwarf most mountains on Earth. This is because the Moon's lower gravity allows for much steeper peaks than we have back home. The South Massif looms ahead of us and the North Massif beyond. We'll be landing in the valley between them, at the Taurus-Littrow landing site.

Imagine what the Apollo 17 astronauts must have felt, seeing this place for the first time.

SOUND CUE: comment from Apollo 17 Astronauts

[Pause until we have landed.]

PRESENTER

Welcome to the Moon! You have made it, give yourselves a round of applause!

Part Twelve: Lunar Landing

(We fly around the LSAM, now resting on the lunar surface.)

FLIGHT CUE: Third-person view of LSAM

PRESENTER

We can see what our Lunar module looks like now, resting on the Moon.As you descend this ladder to explore the lunar surface; look around. No people, no water, no life anywhere nearby, just you and your spacecraft.

The terrain dates back to the early history of the solar system.

This valley formed nearly four billion years ago, when a giant asteroid or comet struck the Moon. The impact formed two ranges of enormous mountains called the North and South Massifs. The valley we're in collapsed soon after. Some time later, lava flows from ancient volcanoes seeped into the valley. All of that activity makes this a fascinating place to explore.

We have simulated a trip to the Moon, but perhaps someday, you'll have a chance to experience the real thing. NASA is currently making plans to return to the Moon; to further explore the geological connection between the Moon and the Earth; to identify potential resources to support future space exploration; to give astronauts the chance to learn how to live in space while still relatively close to home, and to prepare us for future destinations, such as Mars.

Who knows? Maybe one of you could be a part of that journey.

Wherever your explorations lead you today, we hope you have enjoyed your Field Trip to the Moon!

For More Information, Visit:
http://amnh.org/education/ftm
http://nasa.gov