



**JOURNEY TO SPACE**  
**APOLLO 11 MOON LANDING**  
**NASA: THE FIRST 25 YEARS**



**GUIDEBOOK AND LESSON PLAN**

To order this and other programs call:  
**(888) 570-5400**  
**[www.choicesvideo.net](http://www.choicesvideo.net)**

### **Timeline of Events in NASA History**

- 1915: National Advisory Committee for Aeronautics (NACA), a precursor to NASA, created by President Wilson
- 1957: Soviet Union launched Sputnik 1, the first man-made space satellite.
- 1958: The National Aeronautics and Space Administration is formed.
- 1958: Project SCORE: Communications relay satellite put in orbit; President Eisenhower broadcasts his Christmas message using this satellite as the first time a voice is beamed from space.
- 1959: Pioneer 4 makes the first successful U.S. lunar flyby.
- 1959: Project Mercury formed, included first astronauts.
- 1959: Monkeys Abel and Baker successfully complete suborbital flight aboard a Jupiter missile.
- 1960: US launches TIROS 1, the first successful meteorological satellite, for monitoring Earth's weather.
- 1961: Russian cosmonaut Yuri Gagarin becomes the first man in space and the first to orbit Earth. This leads to an acceleration of NASA's attempts to get a man on the moon.
- 1961: Alan Shepard becomes the first American to fly in space. President Kennedy commits NASA to landing on the moon by the end of the decade.
- 1962: John Glenn orbits Earth three times in his Friendship 7 Mercury spacecraft. Glenn is the first American to orbit the planet.
- 1961 66: NASA creates the Gemini project to develop techniques needed for deep-space exploration
- 1965: Astronaut Ed White is the first American to conduct a spacewalk
- 1966: Surveyor spacecraft lands on moon
- 1961 75: NASA's Apollo program developed. Apollo lands six missions on the moon.
- 1967: Three astronauts (Gus Grissom, Ed White, Roger Chaffee) die during a simulation aboard Apollo 1 when a fire breaks out in the capsule.
- 1968: Apollo 8 becomes the first manned spacecraft to leave the gravitational influence of the Earth and orbit the moon.
- 1969: Apollo 11 lands on the moon, Neil Armstrong and Buzz Aldrin become the first people to walk on the moon.
- 1971: NASA and the US Air Force begin collaboration on the space shuttle project
- 1973: Skylab, NASA's first orbiting laboratory, launched.
- 1973 Space Shuttle program develops first reusable spacecraft
- 1975: Apollo-Soyuz Test Project (ASTP) is the first joint international human spaceflight effort
- 1975: Viking 1 and Viking 2 launched, land on Mars the following year.
- 1977: Voyager 1 and 2 launched to explore outer planets and their moons
- 1983: Sally Ride becomes first American woman in space
- 1983: Guion S. Bluford becomes first African-American astronaut
- 1986: Challenger space shuttle explodes shortly after takeoff, killing its seven crew members
- 1990: Hubble Space Telescope is launched
- 1998: Work on international space station begins
- 2003: Columbia breaks apart in flames prior to landing, killing the seven crew members
- 2003: NASA launches a small satellite into orbit to measure the radiation streaming toward Earth from the sun. The satellite is named SORCE for Solar Radiation and Climate Experiment.
- 2008: Phoenix probe confirms the presence of water ice on Mars

**Vocabulary:**

**LPD:** Landing Point designator

**S-Band Antenna:** Steerable high gain primary communication for voice and data, required precise lock on Earth

**DOI:** Descent Orbit Insertion

**'DIPS' DPS:** Descent Propulsion System (main engine for descent)

**Long:** denotes a landing beyond the target point

**DSKY:** Display and Keyboard (interface with spacecraft computer)

**H-Dot:** Time derivative (interface with space computer)

**Apollo 11 and NASA: The First 25 Years**

On July 29, 1958, President Eisenhower signed a bill creating the National Aeronautics and Space Administration (NASA). NASA was designed to better understand our planet, explore the universe, and improve life on Earth. It replaced the older National Advisory Committee for Aeronautics (NACA), which had been created by President Wilson in 1915. Much of the impetus behind NASA's creation stemmed from the battle between the United States and the Soviet Union over technology. Galvanized by the Soviet Union's launch of Sputnik I, the first man-made space satellite sent into space in October 1957, Eisenhower sought to improve America's space technology and the "space race" began. Fearful of the Soviet Union's perceived advantage in space technology, and by extension national security, the US attempted to establish a strong presence in this new region. As a result, the US and USSR entered into a competition to send astronauts into space and land a man on the moon.

Shortly after the foundation of NASA in October 1958, Project Mercury was formed to train both monkeys and astronauts for voyages into space. *Apollo 11 and NASA: The First 25 Years* use original footage to recreate the American journey into space and detail the advancements and difficulties encountered by scientists and astronauts in developing the NASA program and fulfilling the dream of putting a man on the moon.

NASA quickly realized a number of important accomplishments within their first year including the broadcast of President Eisenhower's 1958 Christmas message via space satellite and America's first successful lunar flyby. After Russia sent their first man into space in 1961 America followed suit, sending Alan Shepard to space the same year. Once this was accomplished, President Kennedy committed NASA to sending an astronaut to the moon within the decade. Even with the use of advanced computers and additional technology created by NASA scientists, conditions on the moon were left to much speculation. NASA scientists and astronauts questioned how a vehicle would be able to land on the moon and expressed concerns over the possibility of whether an astronaut would sink over his head in the dust. Neil Armstrong's first steps on the moon answered these questions, but raised many more.

NASA's history is also marked by tragedy. In 1967, the crew of Apollo's first mission prepared pre-flight checks aboard the spacecraft when a fire erupted in the cockpit. Gus Grissom, Edward White, and Roger Chaffee died immediately. The Apollo program shut down in order to redesign the spacecraft and investigate the accident in order to resume manned missions. Accidents aboard the Challenger space shuttle in 1986 and the Columbia in 2003 also claimed astronauts' lives, losses that have been mourned by their fellow astronauts and by Americans.

After successfully completing the design of the new Saturn V to continue the Apollo missions, Apollo 11 launched on July 16, 1969 and carried the first crew to walk on the moon. Including narration by crewmember Buzz Aldrin, *Apollo 11* relives this journey. With the famous line

“That’s one small step for man, one giant leap for mankind,” Neil Armstrong fulfilled President Kennedy’s promise and became the first person to walk on the moon.

NASA continued developing more efficient and sophisticated methods of sending astronauts to space and gathering data on our solar system through the Apollo, Skylab, and Space Shuttle programs, as well as unmanned missions including Voyager, Viking, and the Mars pathfinder.

As demonstrated in *NASA: The First 25 Years*, NASA did more than create space technology and send astronauts and ships to explore our solar system. By encouraging innovations in new frontiers, NASA fundamentally altered the way in which we perceive our world and our surroundings. Images of the Earth, including pollution and changing landscapes, that were sent back from space raised questions of our planet’s finiteness and the availability of “limitless” resources. Scientists also began exploring the relationship between the Earth and its surroundings, including the sun and moon. In addition, NASA became a world leader in developing satellites used to predict weather, improve communications, and establish the Global Positioning System (GPS). Astronauts and spacecrafts performed experiments in biology, physics, geology, and meteorology, and incorporated experiments designed by schoolchildren. NASA’s innovations have continued to impact our daily lives and promote improvements in technology and science.

#### **Additional Resources:**

##### **Online:**

<http://www.nasa.gov/>

##### **Print:**

- Aldrin, Buzz. *Return to Earth*. New York: Random House, 1973.
- Chaikin, Andrew. *A Man on the Moon: The Voyages of the Apollo Astronauts*. New York: Penguin Books, 2007.
- Dick, Steven. *America in Space: NASA’s First Fifty Years*. New York: Abrams Books, 2007.
- Hansen, James. *First Man: The Life of Neil A. Armstrong*. New York: Simon & Schuster, 2006.
- Jacobs, Robert. *Apollo: Through the Eyes of the Astronauts*. New York: Abrams Books, 2009.
- Kranz, Gene. *Failure is Not an Option: Mission Control from Mercury to Apollo 13 and Beyond*. New York: Simon & Schuster, 2000.

## Classroom Activities (from NASA.gov)

### Diameter of the Moon

Purpose: To calculate the diameter of the Moon using proportions.

Background: The diameter of the Moon is proportional to the diameter of a cardboard disk, given that you know the distance to the Moon and the distance to the cardboard disk.

The relationship is:

$$\frac{d}{I} = \frac{D}{L}$$

so that:  $D = L(d/I)$

where **D**= diameter of Moon

**d** = diameter of cardboard disk

**L**= distance to Moon

**I** = distance to cardboard disk

In this activity, students will measure **d** and **I**. They will be given **L**.

They will calculate **D**.

The diameter of the Moon (**D**) is 3,476 km.

### Preparation

Review and prepare materials:

- 2-cm wide cardboard disk
- wooden stake (optional)
- meter stick
- calculator
- string

Choose a day and location for this activity which is best for viewing a full Moon. A cardboard disk of 2 cm diameter works well. Better accuracy may be achieved by using a larger disk, thus a greater distance. However, if obtaining or cutting cardboard is difficult, then this activity can also be done with dimes. A dime held out at arm's length will cover the Moon. The distance from Earth to the Moon for a given date can be obtained by asking a local planetarium staff, or for this activity, students may use an average value of 382,500 km.

### In Class

If students work in pairs, then one student can use the string to measure distance from their partner's eye to the disk. The same units do not have to be used on both sides of the equation, but **d** and **I** have to be the same units. The **D** will be the same unit as **L**.

### Wrap-Up

To compute the density of the Moon use the diameter to compute volume and use the mass value of  $7.35 \times 10^{22}$  kg.

Density of the Moon is 3.34 grams/cubic cm.

1. On a day when you can see the Moon: place a cardboard disk on top of a stake or on a window sill so that it exactly covers the Moon from your point of view behind the cardboard disk.
2. Have a friend measure the distance from your eye to the cardboard disk. Call this distance **I** and write the value here:

**I** =

3. The distance from Earth to the Moon varies between 360,000 km and 405,000 km. Find the distance for today's date or use an average value for your calculations of 382,500 km.
4. Write the value that you are going to use here:  
**L =**
5. What is the diameter of the cardboard disk?  
**d =**
6. The diameter of the Moon is proportional to the diameter of your cardboard disk by this equation:  

$$\frac{d}{L} = \frac{D}{L}$$
 so that,  $D = L(d/l)$   
 where: **D**= diameter of Moon  
**d** = diameter of cardboard disk  
**L**= distance to Moon  
**l** = distance to cardboard disk

### Results

1. By your calculations, the diameter of the Moon is:  
**D =**
2. Compare your result with the accepted diameter of the Moon. How close did you get?
3. How many times smaller is the diameter of the Moon than the diameter of Earth?
4. When you calculated the diameter of the Moon, did you have to use the same units on both sides of the equation?
5. How and where could you find the value for the distance to the Moon for today's date?
6. What else would you need to know to compute the density of the Moon? Try it.

## **Teacher Guide**

### The History of Rocketry

#### Background Information

The designs of today's rockets are the result of thousands of years of experimentation and research. Beginning 2000 years ago as a steam-powered toy, rockets have evolved into sophisticated vehicles capable of launching spacecraft into the solar system.

The Ares I Crew Launch Vehicle, slated to begin operations by 2015, and the Ares V Cargo Launch Vehicle, scheduled to fly by 2020 are designed to be safe, reliable, sustainable space transportation systems built on previous knowledge and space flight hardware from the Apollo-Saturn and Space Shuttle Programs. Ares I and Ares V will replace the Space Shuttle, which will be retired by 2010. The launch vehicles were named after Ares, the ancient Greek name for Mars. Using the latest technology, as well as lessons learned over years of research and experience, these rockets will take human beings to the Moon, Mars, and beyond.

In this activity, students create a multiple tiered timeline on the history of rocketry from ancient times through the Ares Projects.

#### **National Science Standards Addressed:**

##### **Grades 5 – 8**

*Science as Inquiry:* Understandings about scientific inquiry.

*Science and Technology:* Understandings about science and technology.

*Science in Personal and Social Perspectives:* Science technology and society.

*History and Nature of Science:* History of science.

##### **Grades 9 – 12**

*Science as Inquiry:* Understandings about scientific inquiry.

*Science and Technology:* Understandings about science and technology.

*History and Nature of Science:* Historical perspectives.

## **History Standards Addressed:**

### **Grades 6 – 8**

#### *Historical Understanding:*

Standard 1: Understands and knows how to analyze chronological relationships and patterns.

Benchmark 2: Knows how to construct and interpret multiple tier time lines.

### **Materials**

Student text, “From Earth to the Moon and Beyond” (below).

Printed copies or online access to “Brief History of Rockets:”

[http://exploration.grc.nasa.gov/education/rocket/TRCRocket/history\\_of\\_rockets.html](http://exploration.grc.nasa.gov/education/rocket/TRCRocket/history_of_rockets.html)

Construction paper, yardsticks, and markers (optional).

### **Procedure**

Explain to students that spacecraft are lifted into space using rockets and that current rocket design is the result of thousands of years of experimentation and research. Divide students into groups of six. Give each student a copy of a “Brief History of Rockets:”

[http://exploration.grc.nasa.gov/education/rocket/TRCRocket/history\\_of\\_rockets.html](http://exploration.grc.nasa.gov/education/rocket/TRCRocket/history_of_rockets.html)

Multiple Tiered Time Line

Important Developments in the Knowledge of Rocketry

<----->

Important Events that Apply this Knowledge

Ask each group to read the “Brief History of Rockets” and then create a time line of 10 to 15 important events. On one side of the time line, have students record important events in the scientific knowledge about rockets. On the other side, have them identify important events that show how scientists applied that knowledge (e .g ., the first launch of a liquid-fueled rocket) . Have students update their time lines by reading the student text “From Earth to the Moon and Beyond.”

Ask the groups what events they chose and why. Explore with them why they chose some events and not others.

Ask the entire class to create a single time line of the 10 to 15 most important events in the history of rocketry. Again, ask them to record important developments in the knowledge of rocketry on one side and important events in the application of that knowledge on the other side.

### **Going Further**

- Ask students to write an essay on the history of rocketry.
- Have students write a report on a specific event in the history of rocketry.
- Ask students to identify other events that occurred in the same year as an important event in the history of rocketry.
- Ask students to prepare a report on the use of rockets since the creation of NASA.

## **Teacher Resources**

### Web sites:

- Marshall Space Flight Center Offers a Timeline of Rocket History:  
<http://history.msfc.nasa.gov/rocketry/index.html>
- Rockets Teacher's Guide with Activities:  
<http://exploration.grc.nasa.gov/education/rocket/TRCRocket/Intro.html>
- Orders of Magnitude: A History of the NACA and NASA, 1915-1990:  
<http://www.hq.nasa.gov/office/pao/History/SP-4406/contents.html>
- Alternate Strategy Tip
- Expand this activity by incorporating another timeline showing what was happening in Europe, Asia, and other parts of the world at the times when significant rocketry events were occurring.

### **Student Text: From Earth to the Moon and Beyond**

Currently, NASA engineers are making decisions regarding not only transport vehicles, but also how to supply essentials like oxygen and water to support human life over long periods of time until these astronauts learn to “live off the land.” This is a goal for twenty-first century spaceflight. Before we learn about America’s next generation of rockets that will propel us to the Moon and beyond, we will review two of the most recent human transport systems that have lifted humans off the face of the planet — Apollo and the Space Shuttle.

### **Transporting Humans to Space: A Look Back in NASA History**

On May 25, 1961, President John F. Kennedy presented a challenge to a joint session of the United States Congress. “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.” This challenge mobilized the scientific and engineering communities who were determined to accomplish this goal. After successfully testing rockets and capsules that could keep humans alive in space with the Mercury and Gemini programs, the Apollo program was born.

### **Highlights of the Apollo Program**

The Apollo program included a large number of un-crewed test missions and eleven crewed missions. The eleven-crewed missions included two Earth-orbiting missions, two lunar-orbiting missions, a lunar swing-by, and six Moon-landing missions. To accomplish the goal that resident Kennedy outlined in 1961, the Apollo program was designed to land humans on the Moon and bring them safely back to Earth. Six of the missions — Apollo 11, 12, 14, 15, 16, and 17 — achieved this goal.

### **Earth to Moon in the 21st Century**

The lunar-surface experiments conducted during the Apollo era included: soil mechanics, meteoroids, seismic, heat flow, lunar ranging, magnetic fields, and solar wind experiments. The rocket that propelled the astronauts to the Moon was the gigantic Saturn V. This is the most powerful rocket ever flown. It was launched thirteen times between 1967 and 1973. In total, the Saturn V carried 27 astronauts into space. The final launch of a Saturn V placed Skylab, the first U.S. space station, into orbit around the Earth.

### **The Space Shuttle Program**

In 1981, a new system of launch vehicles made its debut with the Space Transportation System (STS) commonly called the Space Shuttle program. The purpose of the Shuttle is to deliver payloads into Earth orbit and to dock with satellites and the International Space Station (ISS). The Space Shuttle system is unique because almost all of the components are reusable (the exception is the external fuel tank). The system consists of four primary elements: an orbiter spacecraft, two solid rocket boosters (SRB), an external tank to house fuel and oxidizer, and three Space Shuttle main engines. The orbiter acts like a rocket upon ascent, a spacecraft while in orbit, and a glider as it returns to Earth.

Five orbiters have flown into space: Columbia, Challenger, Discovery, Atlantis, and Endeavour. One orbiter was lost due to an accident during ascent (Challenger in 1986) and one during descent (Columbia in 2003). While the Space Shuttle contributes to many significant accomplishments for human spaceflight, including the launch and repair of the Hubble Space Telescope and missions to build and service the space station, in 2004 NASA was charged with developing new vehicles to explore the Moon, Mars, and beyond.

### **Ares: The Next Generation**

The next generation of launch vehicles is called Ares, named after the Greek God whose Roman counterpart is Mars. The Ares launch system is part of NASA's Constellation Program and is designed for trips to the International Space Station, the Moon, and eventually to Mars and other destinations. The Ares launch vehicles include the Ares I Crew Launch Vehicle and the Ares V Cargo Launch Vehicle. These rockets capitalize on technologies previously used with the Saturn V, and the Space Shuttle, as well as other rockets.

Future astronauts will ride the Orion Crew Exploration Vehicle to orbit on Ares I, which uses a single five-segment solid rocket booster, a derivative of the Space Shuttle's solid rocket booster, for its first stage. A liquid oxygen/liquid hydrogen J-2X engine derived from the J-2 engine used on Apollo's second and third stages will power the crew exploration vehicle's upper stage.

Ares V, a heavy-lift launch vehicle, will use a 10-meter-diameter core stage powered by six RS-68 liquid oxygen/liquid hydrogen engines, and two 5 .5-segment solid propellant rocket boosters for the first stage. The upper stage, known as the Earth departure stage, will use the same J-2X engine as the Ares I. This versatile system will be used to launch the Altair lunar lander and other large cargo into Earth orbit and send it to the Moon. For the lunar mission, the Orion crew vehicle, launched by Ares I, will rendezvous with the Earth departure stage and Altair for the lunar trip. The J-2X, which put the Earth departure stage in Earth orbit, will ignite a second time to send the Altair/Orion vehicle to the Moon.

To learn more about the Ares I and Ares V rockets, go to:

[http://www.nasa.gov/mission\\_pages/constellation/ares/ares\\_education.html](http://www.nasa.gov/mission_pages/constellation/ares/ares_education.html) to see the following videos featuring Bob Armstrong and Joel Best from NASA's Marshall Space Flight Center.

#### Ares I Video:

In this video, Bob Armstrong discusses the Ares I Crew Launch Vehicle. The Ares I is a two-stage vehicle that stands over 328-feet.

#### Ares V Video:

This video introduces the Ares V Cargo Launch Vehicle. The Ares V is the sister vehicle of the crew launch vehicle, the Ares I. The Ares V will be the largest rocket ever built.

**Review Questions:**

1. What sparked America's human exploration of space?
2. How did the Apollo program contribute to space science and engineering?
3. What was unique about the Space Shuttle system?
4. What were some of the Space Shuttle program's significant accomplishments?
5. What happened to two of the orbiters during the Space Shuttle era?
6. What Ares launch vehicle components are based on similar technology used during the Apollo (Saturn) and Space Shuttle programs?
7. What is the purpose for having two different Ares launch vehicles?

**Trends of Snow Cover and Temperature in Alaska**

Purpose: To compare NASA satellite data observations with student surface measurements of snow cover and temperature

**Grade Level: 9-12**

Estimated Time for Completing Activity: one class period

Learning Outcomes:

Students will learn how to find data correlations.

Students will learn how to make scientific predictions.

Students will learn about data collection methods.

**National Standards:**

Geography: Places and Regions

Math: Data Analysis and Probability

Science Content: A Science as Inquiry

Science Content: D Earth and Space Science

Science Content: E Science and Technology

**Prerequisites:**

A working knowledge of the Scientific Method

Excel spreadsheet technology

Tools

Computer

Map of Alaska

Graph paper

Colored pencils

Overhead projector

**Vocabulary:**

Climatology

Coordinates

Snow and ice

Temperature

**Lesson Links:**

Alaska Lake Ice and Snow Observation Network (ALISON) (<http://www.gi.alaska.edu/alison/>)  
 Global Learning and Observations to Benefit the Environment (GLOBE) (<http://www.globe.gov/>)  
 The International Satellite Cloud Climatology Program (ISCCP) (<http://isccp.giss.nasa.gov/>)

**Background:**

The Alaska Lake Ice and Snow Observatory Network (ALISON) is a network of 22 ground stations around the state of Alaska. Each site records and reports observations of surface parameters (such as snow or ice depth and temperature), and the data becomes available on the ALISON Web site. The site at Shageluk Lake was established in January 2003 and is operated by high school students.

NASA satellite missions also monitor surface conditions from space. This method is called remote sensing. One project, the International Satellite Cloud Climatology Program (ISCCP), has been studying global atmospheric and surface climatology for over two decades. In this lesson, ISCCP data and ALISON data will be compared to examine trends in snow cover and temperature in Alaska.

**Procedure:**

First, students will gather historical snow cover and temperature data from the MY NASA DATA Web site for the Shageluk Lake site (62.41N,159.34W):

- 1) Access the MY NASA DATA Live Access Server.
- 2) Select Cryosphere, then Monthly Snow Ice Amount (ISCCP). Click Next.
- 3) Under Select View, pick Time Series.
- 4) Enter the coordinates for Shageluk in the boxes to the right of the map. Click the Go button if there is one. Click Next.
- 5) A pop-up window should appear showing a line graph of snow cover for the site. Notice the seasonal variation (trend) in snow cover. Save or print the graph before closing the window. A text file of the data is also available by selecting output as Table of Values (text).
- 6) Return to the Live Access Server start page by clicking on Select Datasets.
- 7) This time, select Land Surface, Surface Conditions, then Monthly Surface Clear-sky Temperature (ISCCP). Click Next.
- 8) If necessary, repeat steps 3 and 4 to select the time series for Shageluk. Click Next.
- 9) Again, a pop-up window should appear showing the temperature trend for the site. The units will be shown in degrees Kelvin. If you wish to convert it to Fahrenheit or Celsius, go back and use the Evaluate Expression box below the global map. Save or print the graph before closing the window. Again, a text file of the data is available by selecting the output as Table of Values.

Next, students will gather the ground measurements from the ALISON Web site for Shageluk Lake:

- 10) Access the ALISON Web site using the link above.
- 11) Click on Data Download, ALISON - Shageluk data. A spreadsheet should appear showing the recorded data. Focus on the snow or ice depth measurement (presence) and the snow or ice surface temperature.
- 12) Graphs of the Shageluk data are also available. Return to the ALISON home page, click on ALISON sites, Shageluk, Current or Past data.

**Questions:**

- 1) What trends or correlations do you see in the ISCCP snow cover and temperature data? Can you relate the data to seasonal variations? Is the data what you expected? What conclusions can you make regarding the climatology of the Shageluk Lake area?
- 2) Do you see the same trends in the ALISON snow and temperature data? Does the data follow your climatological prediction? Can you plot the differences on a graph?
- 3) Discuss the general differences between ground measurements and satellite observation methods. Could they explain some of the difference you may see?

**Extensions:**

- 1) Set up a ground observation site at your school or home. For assistance or guidance, we recommend contacting the GLOBE organization (see link above). Begin to record surface temperature and snow cover at your site on a regular basis to be able to compare your data with satellite observations from MY NASA DATA.
- 2) If you already have a weather station at your school site, explore the Live Access Server to find climatological satellite data for your location for any parameters of interest. Compare the data with your local observations using a similar procedure.