

Back to the Moon

Program Summary

To win the Google Lunar XPrize, a team must land a robotic spacecraft on the Moon, navigate 500 meters across its surface, and send video, images, and data back to Earth. This dramatic program examines what we've learned about our nearest neighbor in space and introduces some of the international teams competing for the largest prize in history. To get back to the Moon without government funding! Who will be the first to get back to the Moon...perhaps this time, for good.

Tennessee Science Standards

See www.adventuresci.com to find specific Grade Level Expectations (GLE).

EMBEDDED INQUIRY

Conceptual Strand: *Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.*

EMBEDDED TECHNOLOGY AND ENGINEERING

Conceptual Strand: *Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.*

STANDARD 11 – Motion

Conceptual Strand 11: *Objects move in ways that can be observed, described, predicted, and measured.*

STANDARD 12 – Forces in Nature

Conceptual Strand 12: *Everything in the universe exerts a gravitational force on everything else; there is an interplay between magnetic fields and electrical currents.*

HIGH SCHOOL: Physical Science Standard 4, Forces In Motion, and Standard 5, Mechanics. Physical World Concepts Standard 1: Mechanics, Physics

Objectives

1. Describe at least two general characteristics of the Moon's surface.
2. Name at least two teams, launch vehicles, or methods of moving across the surface described in the program.
3. Name at least two reasons why humans want to return to the Moon.

Pre-Visit Activities

1. Have students observe the changing phases of the Moon starting two days after New Moon. Review the cause and names of lunar phases.
2. Students can examine the different features on the lunar surface: mountains, and craters, and investigate the origins of the names.
3. Make a list of the challenges for going to the Moon, landing, and returning to Earth, for both robotic and human explorers.

Post-Visit Activities

1. How many human and robotic spacecraft have successfully orbited or landed on the Moon? How many have failed? How many have returned to Earth? The United States and Soviet Union are not the only countries to accomplish this.
2. Investigate reasons why humans want to return to the Moon.
3. What other historic "prizes" have spurred exploration, discovery, invention, and technology? How much money was offered, and when were they awarded?

Vocabulary

Ansari XPrize
Apollo
astronaut
Team Angelicum
Team Astrobotic
Chandrayaan
Chang'e
Barcelona Moon Team
exploration
Google XPrize
Team Hakuto
Kaguya
gram
kilometer
Team Italia
Team Lunar Lions
hydrogen
oxygen
LCross
orbit
innovate
Yutu
Lunokhod
Team Stella
Team Omega Envoy
propulsion
Ranger
Team Part Time Scientists
Space race
Soviet Union
Surveyor

4. What is the current status of the Google Lunar Xprize? How many teams started the competition? How many teams are still in the running? When is the deadline? What intermediate prizes have been awarded to which teams for what milestones?
5. Have students research astronauts from the Apollo program. Who was the last person to walk on the Moon? What were their backgrounds, interests, and experiences?
6. Investigate the effort and people involved on the ground who designed, built, and managed the complex program to get humans to and from the Moon in less than ten years.
7. Compare the total cost of the Apollo program in current dollars to the budgets of the Google X Prize teams? What are NASA's plans for getting back to the Moon? What is the planned timeline? How much money is budgeted, and what percentage of the federal budget is spent on space exploration overall?

Exhibit Connections

1st floor Test Bed

- Learn about the engineering challenges of spaceflight and Newton's Laws of Motion

1st floor Solar System

- Using the Solar System Touchscreens, look for information on the many spacecraft now exploring the solar system.

Resources

Websites

Google Lunar XPrize homepage
<http://lunar.xprize.org/>

Team Hakuto and Astrobotic flying together:
<http://lunar.xprize.org/press-release/two-google-lunar-xprize-teams-announce-rideshare-partnership-mission-moon-2016>

Choose a team to follow!
<http://lunar.xprize.org/teams>

The 2015 MOONBOTS Challenge: on-line competition for youth
<http://www.moonbots.org/>

US Lunar Exploration:
Lunar Reconnaissance Orbiter Camera
<http://www.lroc.asu.edu/>

LCROSS impact mission
http://www.nasa.gov/mission_pages/LCROSS/main/index.html

GRAIL mission
<http://moon.mit.edu/>

Indian Lunar Program
<http://www.isro.gov.in/chandrayaan-2>

Chinese Lunar Program
<http://www.cnsa.gov.cn/n360696/n361228/n361378/371772.html>

Japanese Lunar Program
<http://www.jspec.jaxa.jp/e/enterprise/moon.html>

History of space exploration:
<http://www.aerospace.org/education/inspiring-the-next-generation/space-primer/a-brief-history-of-space-exploration/>

Books

[Where No Man Has Gone Before: A History of Apollo Lunar Exploration Mission](#)
By William David Compton (1989)

[Lunar Exploration: Human Pioneers and Robotic Surveyors](#)
by Paolo Ulivi and David Harland

[The Kaguya Lunar Atlas: The Moon in High Resolution](#)
By Motomaro Shirao and Charles A. Wood

[Robotic Exploration of the Solar System: Part 4: The Modern Era 2004 -2013](#)
by Paolo Ulivi and David Harland

[Lunar Outpost: The Challenges of Establishing a Human Settlement on the Moon](#)
by Erik Seedhouse

[DIY Instruments for Amateur Space: Inventing Utility for Your Spacecraft Once It Achieves Orbit](#)
by Sandy Antunes

[The Story of Flight: Early Flying Machines, Balloons, Blimps, Gliders, Warplanes & Jets](#)
by Dan Hagedorn and Sheila Keenan

[Dreams of Other Worlds: The Amazing Story of Unmanned Space Exploration](#)
by Chris Impey and Holley Henry

[The Lunar Exploration Scrapbook : A Pictorial History of Lunar Vehicles](#)
by Robert Godwin