A FILM BY TODD DOUGLAS MILLER

APOLLO 11

DISCUSSION GUIDE

THE FILM

Apollo 11 takes us inside NASA's most celebrated mission—the one that first put men on the Moon, and forever made Neil Armstrong and Buzz Aldrin into household names. Crafted from a newly discovered trove of footage and uncatalogued audio recordings, the film immerses viewers in the perspectives of the astronauts, the team in Mission Control, and the millions of spectators on the ground. It launches us to those momentous days and hours in 1969 when humankind took a giant leap into the future.

THEMES

The film showcases themes that can stimulate discussion and support viewer engagement:

- Technology: its impact and how it changes
- Scientific progress
- Curiosity and exploration of the natural world
- The power of collective action
- Bravery, vision, and bold thinking

> *If anything is going to be remembered about the 20th Century, it's going to be the fact that we took our first steps on another celestial body — because this is the future of humanity, the promise of going further. Apollo 11 was only the first step."*
>
> –ROBERT PEARLMAN,
> historian of the space program

> *The mission of Apollo 11 is one of the greatest achievements in human history – hundreds of thousands of people spread across tens of thousands of companies all focused on putting the first humans on another world."*
>
> –TODD DOUGLAS MILLER,
> director of *Apollo 11*

CONVERSATION IDEAS BEFORE VIEWING THE FILM

The following questions may be useful for stimulating thinking and exploring prior to viewing the film:

- What do you know about the space program and Moon missions?
- What are some challenges and hazards of space travel?
- Can you think of any large-scale scientific and technological challenges we face as a society? How can we address them?
- What parts of our world do you want to know more about? Do you know of any places people have yet to explore?

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CONVERSATION STARTERS AFTER VIEWING THE FILM

The Apollo program lasted from 1963 to 1972, encompassed 17 missions, required hundreds of thousands of workers, and landed six groups of astronauts on the Moon. Explore what you learned about Apollo 11, the first manned mission to land on the Moon, with the following conversation suggestions:

- In the film, many groups of people were shown working together. What are some of the important roles involved in the mission that you learned about?
- What are some critical technologies you noticed in the film? What are some inventions that helped to get people to the Moon?
- What kinds of plans and calculations were required to make the journey? What hazards do astronauts face?
- Astronauts brought experiments to the Moon. What kinds of tests can you do in space that you can't do on Earth? What might you learn?
- Hundreds of millions of people watched the moon landing on television in 1969. Why do you think so many were interested? Have people's feelings changed over 50 years? If so, how?

DIG DEEPER

Here are some concepts from the film that can spark discussion and activity ideas:

SCIENTIFIC AND TECHNOLOGICAL PROGRESS

- What are some of the natural forces that planners had to contend with to get people to the Moon? How did technology help them?
- How do you think a mission to the Moon might be different today? What new kinds of technology do you think we might use?
- What kinds of science and technology might be required to live on the Moon or travel to Mars?
- What are some things you want to learn about the solar system? Can you think of experiments or explorations that would yield knowledge?
- How have you seen technology change in your lifetime? How do you think it might change in the future?

CURIOSITY AND EXPLORATION

- What kinds of steps do you think were necessary to prepare for the Moon journey? What kinds of space exploration did people do first?
- Do you think people would want to go to the Moon if the Apollo missions never happened? Why or why not?
- Should our country continue to send astronauts into space? Why or why not?
- Are there places in the solar system that you think we should explore? Why? What about places outside of the solar system?
- What are some of the great explorations in human history? Where might future explorations take us?

BOLD THINKING AND TEAMWORK

- The Apollo missions required hundreds of thousands of people working together. What do you think inspired them? Why did they do it?
- How did leaders inspire people to reach the Moon? Who inspires you today?
- How do you think the astronauts dealt with scary and stressful parts of their journey?
- What are the greatest challenges we face as a society today? What might be required to confront them?

ACTIVITIES

Suggested activities to extend the viewing experience:

- Keep a Moon journal. When is the Moon up and down in the sky? How does it move across the sky? How and why does the Moon appear to change when viewed from Earth? What forces and motions shape the Earth-Moon system? Track the Moon every day over at least one month.
- Make a Moon map of discovery. What are some of the major landscape features on the Moon? Where have people landed Moon missions? Obtain a map or globe of the Moon, and plot important locations. Find an interactive map here **https://astrogeology.usgs.gov/facilities/mrctr/moon-online-map**. Where else have space missions ventured?

- Where are the planets today? Think about journeys to other planets and how the constant motion of the solar system would affect planning and travelling. How do planets and moons move? How long does it take? How does the solar system change over days/weeks/years? Find an interactive model of the solar system here: **https://theskylive.com/3dsolarsystem**.
- Report on a day in the life of a modern astronaut. Learn about who is currently in space at the International Space Station and what they are doing at **https://www.nasa.gov/mission_pages/station/main/index.html**. What experiments have been conducted recently? Where are the astronauts from? How does long-term life in space affect astronauts?

RESOURCES

Apollo 11 and the Apollo Program: https://www.nasa.gov/mission_pages/apollo/missions/index.html

Moon Science: https://www.nasa.gov/moon

Solar System Encyclopedia https://solarsystem.nasa.gov/

Experiments Conducted on the Moon: https://www.hq.nasa.gov/alsj/HamishALSEP.html

Current NASA Missions: https://www.jpl.nasa.gov/missions/?type=current

Current and Future Space Exploration: http://www.planetary.org/

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OVERTHROWING GRAVITY

ACTIVITY LEADER'S GUIDE

OBJECTIVE

The journey to the Moon is in many ways a battle against the forces that keep humans safely tied to Earth's surface. Primary among those forces is **gravity**.

In the film *Apollo 11*, you saw astronauts reach a mission milestone when they entered the Moon's **sphere of influence,** a point at which the Moon's gravity became the dominant force on their craft's motion. You can think of their trajectory as fighting against Earth's gravity until it was time to manage the Moon's gravity in a controlled fall, and vice versa for the return. (At no point is a spacecraft outside of the effect of gravity.)

Apollo 11, like all missions that have put people and objects in space, used **rockets** to fly. Rockets are vehicles or engines that burn fuel to generate thrust that launches them into space. When the force of the **thrust** is greater than the force of gravity, the rocket rises.

Rockets generate force by burning their fuel to create exhaust. Their flight is an example of **Newton's Third Law of Motion**: every action has an equal and opposite reaction. In this case, the rocket pushes exhaust out and the exhaust pushes back. Rockets do not need air to combust their fuel, so they can produce thrust in the void of space.

The enormous size of Apollo 11 on the launch pad reflects how much fuel is needed to overcome Earth's gravity, as well as the Moon's. At launch, the engine generated around 7.6 million pounds of thrust to overpower the gravity on the roughly 6.5 million pound rocket. As the journey progressed, Apollo 11 jettisoned different stages as it used up fuel and reached speeds that allowed it to navigate the forces of gravity between Earth and the Moon. The capsule that returned the three astronauts weighed only 13,000 lbs, or about 0.2 percent of the pre-launch weight of the rocket!

Participants in this activity will build a rocket to explore what kinds of forces cause it to fly. After the activity, they will understand how rockets generate force to send people to the moon and back. They will be able to make hypotheses about how forces like gravity, air resistance, and thrust affect flying objects.

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OVERTHROWING GRAVITY

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PRINCIPLES

The major principles discussed in this activity relate to:

- **Gravity –** a force created by anything with mass that pulls other objects with mass towards it; more mass creates more gravity, and gravity decreases with distance
- **Sphere of influence –** the region around an object in space in which the gravity of that object is the primary force acting upon something in its orbit
- **Rocket –** a vehicle or engine that travels by burning fuel to create lifting force
- **Thrust –** a force that moves a flying object, usually against gravity and air resistance
- **Newton's Third Law of Motion –** originally; "To every action there is always opposed an equal reaction," more commonly "for every action there is an equal and opposite reaction"

ACTIVITY

In the following activity, participants will build a rocket powered by air pressure. (There is a version for young rocketeers and one for older builders.) After construction, they will launch their rockets. Time permitting, they can make measurements on the flight and hypothesize about the forces at play.

MATERIALS

Squeeze Rocket (good for younger rocketeers)

- Individual-size plastic bottle
- Scissors
- Drinking straw
- Glue
- Paper
- Pencil or pen
- Tape

Pump Rocket (good for older rocketeers) MUST BE LAUNCHED OUTSIDE

- 2-liter plastic bottle
- Rubber cork
- Thin nail
- Inflation needle (the type that fits on a bicycle pump)
- Bicycle pump
- Cardboard
- Water

TIME: 1-2 HOURS.

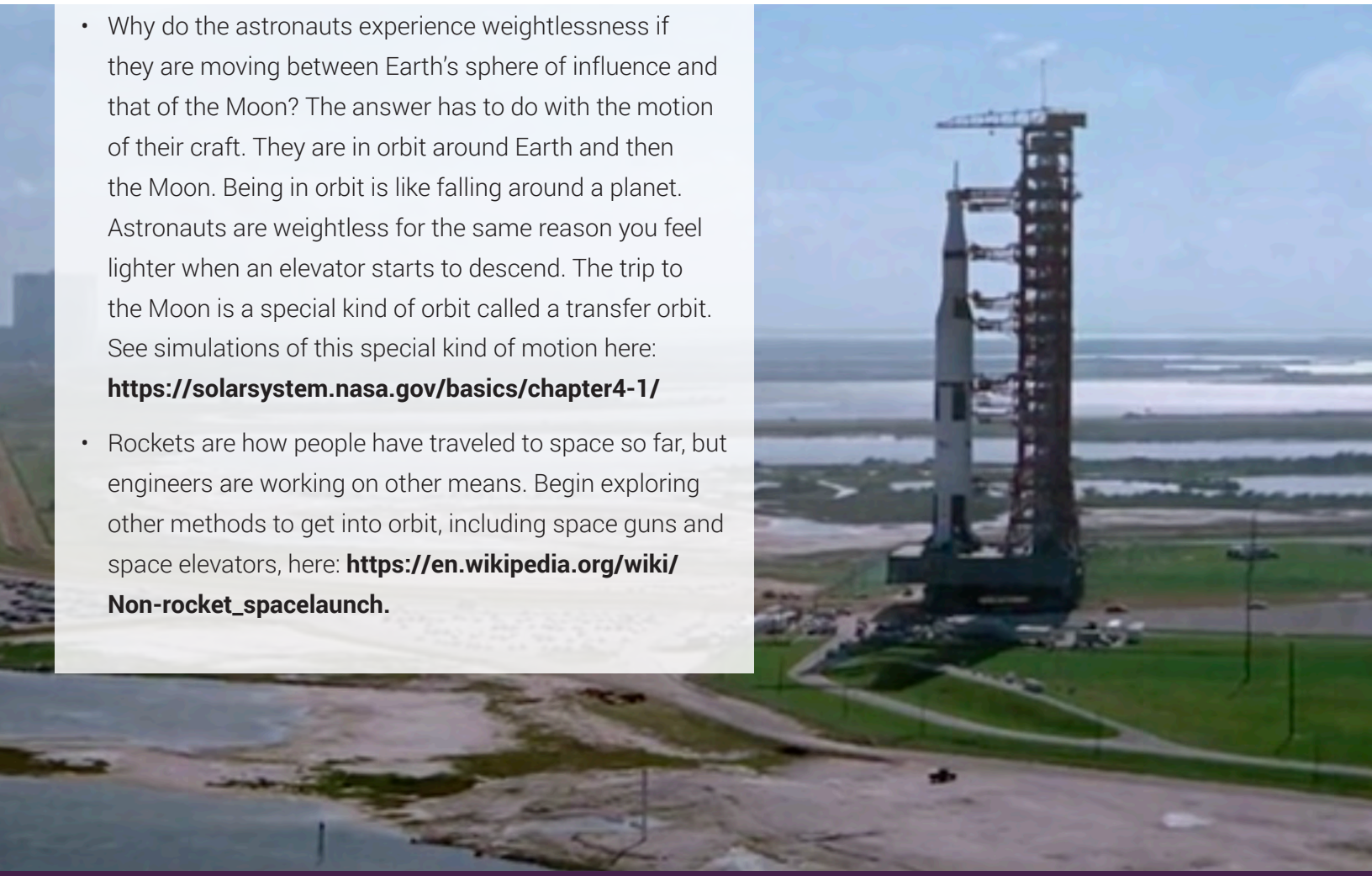
OVERTHROWING GRAVITY
ACTIVITY LEADER'S GUIDE

EXTEND THE LESSON: RESOURCES FOR FURTHER DISCOVERY

- Explore the laws of motion. If participants have a hard time understanding or believing that exhaust pushes back on a rocket, try this simple experiment: have them sit in a chair that spins while holding a basketball straight in front of them. Then they should forcefully throw the ball to the side. What happens? They will spin in the opposite direction. Witness more examples of the laws of motion in this video from the International Space Station: **https://youtu.be/KvPF0cQUW7s**
- Why do the astronauts experience weightlessness if they are moving between Earth's sphere of influence and that of the Moon? The answer has to do with the motion of their craft. They are in orbit around Earth and then the Moon. Being in orbit is like falling around a planet. Astronauts are weightless for the same reason you feel lighter when an elevator starts to descend. The trip to the Moon is a special kind of orbit called a transfer orbit. See simulations of this special kind of motion here: **https://solarsystem.nasa.gov/basics/chapter4-1/**
- Rockets are how people have traveled to space so far, but engineers are working on other means. Begin exploring other methods to get into orbit, including space guns and space elevators, here: **https://en.wikipedia.org/wiki/Non-rocket_spacelaunch.**

SCIENCE STANDARDS

- Motion and Stability: Forces and Interactions
- Earth's Place in the Universe



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APOLLO 11

OVERTHROWING GRAVITY

ACTIVITY

NAME:

_____

DATE:

_____

The enormous size of the Apollo 11 rocket was required to hold all of the fuel that powered its mighty engines. Those rocket engines produced the force that overcame the gravity on the towering machine and the three tiny men who rode at the top. The engines ejected exhaust, which pushed back and lifted the rocket.

OBJECTIVE

In this activity, you will build your own rocket. You will apply force to cause the rocket to fly. You will observe the effect of competing forces, and how they affect your rocket.

WHAT YOU NEED

Squeeze Rocket (good for younger rocketeers)

- Individual-size plastic bottle
- Scissors
- Drinking straw
- Glue
- Paper
- Pencil or pen
- Tape

Pump Rocket (good for older rocketeers) MUST BE LAUNCHED OUTSIDE

- 2-liter plastic bottle
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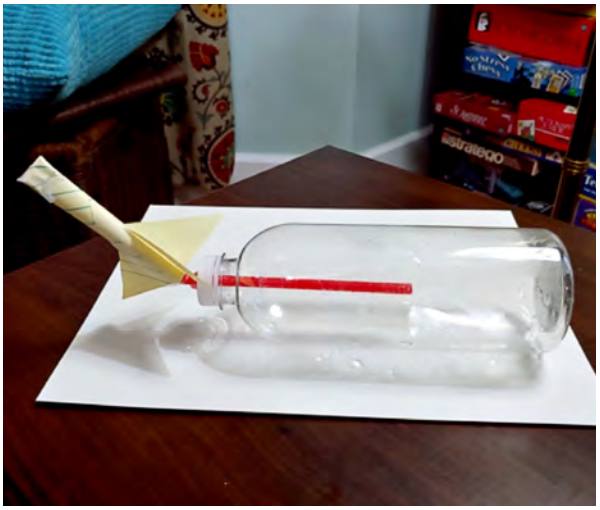

WHAT TO DO

Squeeze Rocket

1. Carefully poke a hole in the center of the bottle cap with the scissors. Widen the hole so a straw fits snugly through it.
2. Place the straw through the hole so about 2-3 inches stick out. You may wish to trim the straw.
3. Run glue or tape around the outside of the straw where it meets the cap to hold it in place.
4. Once the glue is dry, place the cap on the bottle. This is your rocket launcher.
5. Build your rocket. Roll paper around a pencil and tape it. Remove the pencil, leaving a paper tube.
6. Make sure the tube fits over the straw. Cut the tube so it is 3-4 inches long, long enough to reach past the top of the straw sticking out of the bottle. This will be your rocket.
7. Pinch one end of the tube closed and tape it to make the top of your rocket. You may use more paper to make a cone for the top and tail fins for the bottom. Tape them on. Be sure to leave the bottom of the rocket tube open.
8. Place your rocket over the straw and you are ready for launch! Quickly squeeze the bottle. If you use a flexible straw, you can put the bottle on the ground and stomp on it to launch.

OVERTHROWING GRAVITY

ACTIVITY LEADER'S GUIDE

WHAT TO DO

Pump Rocket – to be launched outdoors

1. Use a thin nail to pierce the center of a rubber cork. Remove the nail.
2. Push an inflation needle through the center of the cork.
3. Affix the needle to a bicycle pump. This is your launcher.
4. Build your rocket with an empty 2-liter plastic bottle. Discard the cap. Turn the bottle upside down and cut cardboard to make legs. Tape them firmly to the bottle. The rocket should stand so the open lip is a couple of inches above the ground.
5. Fill the bottle with a little bit of water. You can experiment with the amount. Less than one-quarter full works well.
6. Insert the rubber cork into the bottle. Place it firmly.
7. Turn the rocket over so it stands on its legs. You're ready for launch! This rocket can fly far, so launch it outdoors in an open area for safety.
8. Pump air into the rocket until the pressure pops the cork out to launch. Stand clear and be ready to get splashed

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EXPLANATION

Whether you constructed the squeeze rocket or the pump rocket, you saw how force causes a rocket to fly through the air. In the cases of Apollo 11 and other rockets that launch into space, that force is called thrust. It comes from rocket engines that burn fuel to produce exhaust. The exhaust pushes the rockets up.

For the squeeze rocket, the thrust was provided by air. Unlike a real rocket that carries fuel to provide constant thrust, the air created thrust only while the rocket was still on or very close to the straw. When you squeezed or stomped on the bottle, the air that was in the bottle rushed out. This pushed the paper rocket up and off.

For the pump rocket, pressure built up inside the bottle as you pumped. When the pressure was great enough to dislodge the cork, the bottle launched. The water and air inside acted like exhaust in a real rocket. As the pressure pushed it out of the bottle, it continued to push the bottle up until the water and pressurized air completely escaped, at which point your rocket was out of fuel.

Did either the paper rocket or bottle rocket make it in to orbit? Of course not. Why not? Neither had enough force for a long enough duration to escape Earth's gravity or the friction of moving through the air. Real rockets generate incredible amounts of force, enough to get them above the atmosphere and moving fast enough to reach orbit and not fall back to Earth.

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A MODERN MOONSHOT

ACTIVITY LEADER'S GUIDE

OBJECTIVE

Getting people to the Moon and back was a tremendous achievement. In the film *Apollo 11*, we saw scores of planners, engineers, assistants, drivers, pilots, sailors, and many more, who all contributed. NASA estimates that 400,000 people worked on the Apollo program. The effort required nearly uncountable hours of work and more than $25 billion (more than $100 billion in today's dollars).

Mobilizing all of the needed resources took bold vision and inspired people. These were provided, in part, by motivating speeches from American leaders.

President John F. Kennedy buoyed the then-new Apollo program with a speech in 1962. His words were aimed at the whole nation. "Vast stretches of the unknown and the unanswered and the unfinished still far outstrip our collective comprehension," he said. His language drew on Americans' pride of accomplishment, wonder at technology, sense of history, good natures, and respect for knowledge. JFK tied the present task to America's past when he said, "William Bradford, speaking in 1630 of the founding of the Plymouth Bay Colony, said that all great and honorable actions are accompanied with great difficulties, and both must be enterprised and overcome with answerable courage." His speech motivated Americans for the required investment to come, and hinted at competition from geopolitical rivals like the Soviet Union.

President Richard M. Nixon was in charge when Apollo 11 landed in 1969. His phone call to astronauts can be thought of another kind of speech. "As you talk to us from the Sea of Tranquility, it inspires us to redouble our efforts to bring peace and tranquility to Earth," he said. And astronaut Neil Armstrong was certainly considering a global audience (estimated at 530 million!) when he replied: "It's a great honor and privilege for us to be here, representing not only the United States, but men of peace of all nations, and with interest and curiosity, and men with a vision for the future." These words were selected to influence more than just the men on the phone call.

Participants in this activity will consider motivating words about the Moon mission and write their own persuasive speech. They will plan a topic and thesis, target an audience, choose language, decide upon organization, and develop other means of effective communication.

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A MODERN MOONSHOT

ACTIVITY LEADER'S GUIDE

PRINCIPLES

The major principles discussed in this activity relate to the ways leaders motivated Americans to support the Apollo missions. Useful and related concepts include:

- Brainstorming
- Identifying problems and crafting a thesis
- Persuasive speech and rhetoric
- Selecting an audience

ACTIVITY

In the following activity, participants will write a speech to pitch a modern moonshot. They will brainstorm ideas for an issue to talk about, why the issue is important, who their target audience will be, practical concerns like time and funding, and so on. Then they will use their brainstorming to write their speech.

MATERIALS

- Modern Moonshot" brainstorming worksheet
- "Modern Moonshot" speech worksheet
- Pencils or pens
- (Optional) a copy of President Kennedy's "We Choose to Go to the Moon" speech, available here: https://er.jsc.nasa.gov/seh/ricetalk.htm
- (Optional) online or other resource material to research topics for speeches

TIME: 1-2 HOURS.

A MODERN MOONSHOT
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EXTEND THE LESSON: RESOURCES FOR FURTHER DISCOVERY

The following research and writing prompts and resources may be useful for deeper learning.

- Watch the speech. Kennedy's speech at Rice University, commonly called "Why we go to the Moon," can be viewed online at the site of his Presidential Library: **https://www.jfklibrary.org/asset-viewer/archives/USG/USG-15-29-2/USG-15-29-2**. Analyze his words. Who was he trying to reach? Do you think he was successful?
- Read and hear more speeches. Great Americans are frequently remembered in the context of their great speeches. Explore important speeches from Martin Luther King, Jr., Ronald Reagan, Eleanor Roosevelt and more at: **https://www.americanrhetoric.com/top100speechesall.html.** Choose a speech and analyze what makes it effective. How might you update it for 21st century listeners?
- Explore the Space Race. A consistent subtext of speeches about going to the Moon was the challenge posed by similar efforts from the Soviet Union. Read about the Soviet Moon program here: **http://www.russianspaceweb.com/spacecraft_manned_lunar.html.** What would have happened if the American mission failed? What if the Soviets made it first? How might history have changed?

EDUCATIONAL STANDARDS

- Write arguments focused on discipline-specific content.
- Identify aspects of a text that reveal an author's point of view or purpose.

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APOLLO 11

A MODERN MOONSHOT

ACTIVITY

NAME:

_____

DATE:

_____

MOONSHOT

NOUN

- An act or instance of launching a spacecraft to the Moon.
- An extremely ambitious and innovative project.

Sending astronauts to the Moon was so impressive, so unprecedented, that the word "moonshot" has come to mean any project that stretches beyond what is currently thought possible. The American public was persuaded to support the Apollo program through speeches by presidents and other leaders. The speeches made people believe that the difficult and costly project was worth the effort.

OBJECTIVE

In this activity, you will write a speech about a new moonshot for the 21st century. Think about important problems, challenges, and tasks currently before your society. Choose one project, then plan a speech and write to influence the world!

WHAT YOU NEED

- Modern Moonshot brainstorming sheet
- Modern Moonshot speech sheet
- Pen or pencil

WHAT TO DO

1. Follow the instructions on the Modern Moonshot sheets to plan and write your speech.
2. Brainstorm with the brainstorming sheet. Note any ideas that come to you while you work.
3. Read over your brainstorming sheet and circle or highlight the ideas that you think will make good additions to your speech.
4. Use the ideas and notes on your brainstorming sheet to write your speech on the speech sheet.
5. Carefully read your speech. Correct any errors.
6. Read the speech in front of other participants. Were they convinced?

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A MODERN MOONSHOT

ACTIVITY : BRAINSTORMING SHEET

Brainstorm ideas for your moonshot. In each box below, make notes for ideas to include in your speech. These ideas will help you write and organize your speech.

PROBLEMS OR CHALLENGES What issues do we confront as a society that will require an effort like the one that took astronauts to the moon? Some ideas you might want to think about include the environment, medicine, energy, or new space exploration. Be creative!

CHOOSE A THESIS Pick one challenge and make an argument that explains what it is and what you think our society should do about it. A premise for an argument is called a thesis. Use your thesis to help you fill in the other boxes.

WHAT IS NEEDED Think of what is required to solve the problem. Consider money, supplies, people, time, knowledge, etc.

WHO IS YOUR AUDIENCE? Who do you need to convince? Who will help?

CHOOSE WORDS THAT WORK The art of persuasive writing and speaking is called rhetoric. For the Moon missions, leaders spoke of "vast stretches of the unknown," "great and honorable actions," "a vision for the future," and "peace and tranquility." Think of words and phrases that will reach, move, and persuade your audience. List them.

A MODERN MOONSHOT

ACTIVITY : SPEECH SHEET

Use your thesis, ideas about what is required, audiences, and your persuasive language to write a short speech in the space provided. Be sure to craft a strong beginning and ending.