Past, Present and Future Spacecraft

Lesson Development **GRADES 9-12**

Apollo capsule (Image: NASA)

Apollo 17 Night Launch (Image: NASA)

Earth (Image: NASA)

INSTRUCTIONAL OBJECTIVES

Students will

- create and test a model rocket;
- discover how past technologies are adapted to future missions;
- verify observations and deepen their understanding of rockets and spacecraft through Internet resources; and
- create a PowerPoint™ presentation to reflect their understanding of past, present and future spacecraft.

BACKGROUND

"Whatever one man is capable of conceiving, other men will be able to achieve." Jules Verne

On July 20, 1969 NASA put a man on the Moon and achieved what Jules Verne envisioned a century earlier. Information and technological advancements have guided scientists and engineers on a journey from the Earth to the Moon.

Now, almost 40 years later, the Ares I Crew Launch Vehicle will propel future astronauts back to the Moon. Building on the successes of past launch systems, Ares I uses a combination of the Saturn rocket and space shuttle propulsion elements.

Ares I is an in-line, two-stage rocket topped by the Orion Crew Exploration Vehicle (CEV). Upon launch, the first stage booster powers the CEV toward low Earth orbit. The solid fuel booster separates after all of the fuel is expelled. The upper stage J-2X engine ignites, propelling the vehicle into low earth orbit. The Orion's launch abort system, combined with the rocket's configuration will improve crew safety by facilitating a rapid evacuation during a launch emergency.

Although the primary mission of Ares I is to carry crews of four to six astronauts to low Earth orbit, it may use its 25-ton payload capacity to deliver resources and supplies to the International Space Station. Ares I may also allow astronauts to "park" payloads in space for retrieval by other spacecraft bound for the Moon or beyond.

Ares I is scheduled to transport crews to the International Space Station no later than 2014, and back to the Moon by the 2020 timeframe.

NATIONAL EDUCATION STANDARDS

National Science Education Standards

- **Science as Inquiry**
  - Abilities necessary to do scientific inquiry
  - Understandings about scientific inquiry
- **Science and Technology**
  - Abilities of technological design
  - Understandings about science and technology
- **Science in Personal and Social Perspective**
  - Natural and human induced hazards
  - Science and technology in local, national and global challenges
- **History and Nature of Science**
  - Nature of scientific knowledge
  - Historical perspectives

National Educational Technology Standards

- Creativity and Innovation
- Communication and Collaboration
- Research and Information Fluency
- Critical Thinking, Problem-Solving, & Decision-Making
- Digital Citizenship
- Technology Operations and Concepts

National Council of Teachers of Mathematics

- Geometry
- Measurement
- Data Analysis & Probability
- Problem Solving
- Communication
- Connections

Ares I (Image: Boeing)

Saturn V (Image: NASA)

"Black Eye Galaxy" M64 (Image: NASA)

ENGAGE

Use the Discovery Now audio clips, Apollo 8 and Apollo 11, to discuss with your students their understanding of how NASA's past missions influence future missions. The clips can be found at:
http://www.discoverynow.us/2008/nasa50.html

Use these questions to help guide your discussion:

- What significant events took place during the Apollo 8 and Apollo 11 missions?
- What prompted the "change of plan" for the Apollo 8 mission?
- How did these missions affect the future of space exploration?
- How has technology influenced space flight?

EXPLORE

Space exploration has evolved through the decades utilizing new and existing technology, allowing for past visions to become realities. During this EXPLORE Activity; your students will create a two-stage rocket system. Once the lower stage has exhausted its propellants, it drops away, lightening the load and making the upper stages more efficient. The two stages are frequently mounted one over the other, with the lower stage larger and heavier than the upper stage.

A. Two-stage Rocket Model

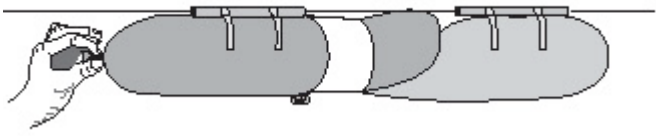
This activity is a modification of a lesson, Balloon Staging, which can be found at: ***http://www.nasa.gov/auduence/foreducators/topnav/materials/listbytype/Balloon_Stagin.html***

1. Prepare for the Lesson:
   - Organize students into teams of three.
2. Gather these materials for each team of students:
   - Two long balloons
   - Nylon monofilament fishing line (any weight)
   - Two plastic straws
   - One foam cup
   - Masking tape
   - Scissors
   - Two clothespins
3. Set up a launch track for each group of students. Thread fishing line through the two straws and stretch the fishing line between two chairs that span the widest side of the room. The line should be tight and about or below waist height. Caution students to be careful moving around the rocket launch paths.
4. Demonstrate how to cut the foam cup in half so that the lip of the cup forms a continuous ring.
5. Ask your students to stretch the balloons by pre-inflating them. Show them how to inflate the first balloon about three-fourths full of air and hold the neck of the balloon tight. Demonstrate how they'll pull the neck of the balloon through the foam ring, twist the balloon neck and clamp it shut with one of the clothespins.
6. Demonstrate how students will inflate the second balloon with the front end of the first balloon extended a short distance through the foam ring. As the second balloon inflates, it will press against the twisted neck of the first balloon and put pressure on the first balloon to keep it clamped shut.
7. Show your students how to use the second clothespin to clamp the neck of the second balloon so that air doesn't escape.
8. Demonstrate how to tape each balloon to one of the straws on the fishing line. When taped to the straws, the balloons should be parallel to the fishing line.

Apollo capsule (Image: NASA)

Earth (Image: NASA)

"Black Eye Galaxy" M64 (Image: NASA)



Two-stage
Balloon Rocket

9. Ask your students to predict what will happen when you remove the clothespin from the first balloon and untwist the neck of the balloon.
10. Remove the clothespin from the second balloon, but hold the nozzle of the balloon closed until students predict what they think will happen when you release the second balloon.
11. Lead a rocket countdown with your students and then release the second balloon.
12. If all goes as planned, the escaping air from the second balloon will propel both balloons along the fishing line. When the second balloon runs out of air, the nozzle of the first balloon will be unblocked so that air may now escape from the first balloon.
13. Ask your students to make predictions about how far one balloon might travel on its own. Lead a discussion with your students about ways to maximize the distance the balloons travel.
14. Discuss how this is a model of a two-stage rocket. Suggest that some students try to create a side-by-side multi-stage system.

EXPLAIN

A. Use the following questions to guide your students in a discussion about their EXPLORE experiences:

- How might you improve this two-stage rocket system?
- How do we use previous missions to design new exploration vehicles?
- How has technology shaped man's ability to explore and travel through space?
- What do you know about NASA's plans to return to the Moon?

ELABORATE

A. Share these resources with your students to deepen their understanding of how past technologies are adapted for future missions:

1. Rockets
   - World Book@NASA gives basic information about rockets ***http://www.nasa.gov/worldbook/rocket_worldbook.html***
   - View a 30-minute NASA CONNECT video, Rocket to the Stars, to learn more about two innovative propulsion programs: ***http://connect.larc.nasa.gov/programs/2004-2005/rocket_stars/***
   - A brief history of rockets ***http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Brief_History_of_Rockets.html***
   - This Launch Vehicle Family Album contains photos and descriptions of historic rockets, today's rockets and concept designs that might be used in the future ***http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Launch_Vehicle_Family_Album.html***
2. Ares I Crew Launch Vehicle
   - Overview of Ares I ***http://www.nasa.gov/mission_pages/constellation/ares/aresI.html***
   - Main site for NASA's Constellation Program ***http://www.nasa.gov/mission_pages/constellation/main/index.html***

Apollo capsule (Image: NASA)

Earth (Image: NASA)

"Black Eye Galaxy" M64 (Image: NASA)

- Ares Crew Launch Vehicle
  http://www.globalsecurity.org/space/systems/clv.htm
- Discover more about the Ares Launch Vehicles
  http://www.nasa.gov/mission_pages/constellation/ares/index.html

3. Orion Crew Exploration Vehicle
   - Lockheed Martin Website
     http://www.lockheedmartin.com/products/Orion/index.html
   - SPACE.com – Lockheed Martin to Build NASA's Orion Spaceship:
     http://www.space.com/news/060831_nasa_cev_contract.html
   - NewScientistSpace – NASA to Boldly Go … with Lockheed Martin
     http://space.newscientist.com/article/dn9895
   - Astronomy – Lockheed Martin to Build Orion
     http://astronomy.com/asy/default.aspx?c=a&id=4502
4. Saturn Rockets
   - Saturn 1B Rocket
     http://www.astronautix.com/lvs/saturnib.htm
   - Grand Opening for Restored Saturn V Rocket
     http://www.nasa.gov/centers/johnson/home/jsc_grand_opening.html
   - The Saturn V Moon Rocket
     http://history.msfc.nasa.gov/milestones/chpt7.pdf

B. Challenge your students to create a PowerPoint™ presentation to reflect their understanding of past, present and future spacecraft. Remind them to include how past technologies have influenced present and future missions.

It may also be helpful for your students to review Nortel LearniT video tutorials for help in creating their PowerPoint™ presentations. They can be found at: ***http://nortellearnit.org/technology/PowerPoint_Presentations/***

Encourage your students to put a descriptive title screen, credits and references at the end of the project. Please remind students to use only images that they have permission to include. Review copyright and copywrongs by watching the Nortel LearniT video tutorial at: ***http://nortellearnit.org/technology/Digital_Ethics/***

EVALUATE

Through discussion and the results of the EXPLORE experience, determine if your students have an accurate and deeper understanding of the structure and function of a launch vehicles.

To evaluate PowerPoint™ presentations, use a rubric found at the Nortel LearniT site:
http://nortelearnit.org/resources/Handouts/

Apollo capsule (Image: NASA)

Earth (Image: NASA)

"Black Eye Galaxy" M64 (Image: NASA)

EXTEND

These activities may be used to extend or continue your students' exploration.

A. Encourage your students to listen to these additional Discovery Now audio clips from previous Discovery Now seasons:
   - Project Mercury ***http://www.discoverynow.us/2008/nasa50.html***
   - Last Apollo Mission ***http://www.discoverynow.us/2007/moon.html***
   - ARES Multi-Stage Rockets ***http://www.discoverynow.us/2007/exploration.html***
   - Orion ***http://www.discoverynow.us/2007/shuttle.html***
   - Spacecraft Recycling ***http://www.discoverynow.us/2007/exploration.html***

Once they've listened to the clips, challenge them to create "Breaking News" videos to correspond with the Discovery Now radio spots. Ask them to share their videos with their classmates.

B. Students may also wish to view these videos: "Ares: NASA's New Rockets" and "To the Moon and Beyond" found at: ***http://www.nasa.gov/mission_pages/constellation/ares/***

   Challenge them to create their own videos highlighting past, present or future spacecraft.

   The students may find it helpful to review this Nortel LearniT video tutorial when creating their videos. The tutorial can be found at: ***http://nortellearnit.org/technology/Video_Productions/***

   Encourage your students to put a descriptive title screen, credits and references at the end of the video. Please remind students to use only images that they have permission to include. Review copyright and copywrongs by watching the Nortel LearniT video tutorial at: ***http://nortellernit.org/technology/Digital_Ethics/***