NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
ACTIVITY : 50 MINS

Landing a Space Probe or Rover

Students design and create a capsule to safely land an egg on a hard surface.

GRADES

6 - 8

SUBJECTS

Astronomy, Experiential Learning, Mathematics

CONTENTS

1 Video, 1 PDF, 1 Link, 1 Image

OVERVIEW

Students design and create a capsule to safely land an egg on a hard surface.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/landing-a-space-probe-or-rover/

Program

WILDEST WEATHER IN THE SOLAR SYSTEM

DIRECTIONS

1. Watch the NASA video "Intro to Engineering."
Show students the NASA video. As you hear each step described in the video, write it on the board:

- Question—identify the question you are trying to answer

- Ideas—brainstorm ideas to solve the problem; pick the one that makes the most sense
- Draw plan—sketch out a plan
- Build—build the model
- Test —test multiple times, improving on the original idea between each test

Explain to students that they will follow these same steps that scientists and engineers use as they design and create a vehicle that can safely land a probe or rover on a planet. To simulate this, students will build something that can land an egg on a hard surface. Ask: *Why is being able to safely land a probe or rover on another planet important for space exploration?* (Landers allow scientists to study the surface and atmosphere of other planets without going to the planets themselves.)

2. Have groups determine criteria for success.
Distribute a copy of the worksheet Space Probe Landing Tests to each group. Ask each group to discuss and agree on criteria for a successful test of the space probe or landers, such as longest air time, highest drop with successful landing, or closest to the target. Have groups write their chosen criteria on the worksheet. Make sure at least one group chooses each of the criteria.

3. Identify the question or problem students will address.
Remind students that the atmosphere varies on other planets. Ask: *What is the main challenge we'll face in this experiment, due to our atmosphere?* Elicit from students that gravity will pull the egg toward the hard surface, possibly breaking it. Then ask: *What is an example of a tool we use on Earth to provide friction against the pull of gravity and slow the speed of a falling person or object?* Students should think of parachutes, which provide resistance or opposing force. If they need prompting, ask them to think about skydivers or the space shuttle when it lands. Explain to students that space probes may also use parachutes to land safely on a planet. Go to the NOVA: Design a Parachute website. Have students advise you on how to adjust the diameter, band width, and material thickness until the parachute successfully passes a test of its volume, drag, strength, and stability.

4. Have students design and build lander models.
Project the illustration Space Probe Lander for students to refer to. Divide students into small groups. In one space in the classroom, set out all possible materials students can choose from to build their landers. Give each group time to choose the following:

- parachute material, such as cut up garbage bags, paper
- lander (egg) container, such as egg carton segments, paper cups

- lander (egg) protection, such as bubble wrap, crumpled newspaper, styrofoam
- devices to attach the parachute to the lander, such as string, rubber bands, paper clips

Encourage students to consider not just the material of each part, but size as well. Allow groups time to discuss, design, and draw their lander models. Then have them build the separate parts. Once students have built the parachute and protected lander container, have students secure the strings of the parachute to the lander container. If any groups decide to use a rubber band, ask them to make sure it fits securely around the egg, but not so tightly that it cuts into the egg.

5. Select and set up the drop site.
As a class, select a drop site that will allow students to drop their landers from a defined height. A stairwell is ideal, if available. If not, you can use a stepladder or select another area that will allow for different drop heights. Make sure you take student safety into consideration when choosing the drop site. Create a landing area by clearing the space and covering it with a tarp or large sheet of plastic. Define a target area for groups using that criteria.

6. Have small groups complete five tests each.
Give students time and opportunity to test and gather data. Provide each group with the appropriate measurement device to collect data, based on their chosen criteria for success. For example, if they decide on highest drop or closest to the target, students will need a meter stick. For longest air time, students will need a stop watch. Make sure all groups have at least five eggs to use for redesign and testing. Have students record data on their worksheets for measurements, observations, and design changes for each of five tests.

7. Have groups compare and analyze data.
Have groups compare and contrast their data. Ask:

- *Do you notice any patterns in your group's data? Explain.*
- *Do you notice any patterns across groups' data? Explain.*
- *If you had an opportunity to try another design modification, what would you change? What would you keep the same? Why?*
- *What additional conditions must you consider to have successful landings on other planets?* (any differences in atmosphere and gravity)
- *What can you do on Earth when testing landers to ensure the best possible results on other planets?* (simulate the conditions of other planets)

Tell students that scientists use vacuum chambers and reduced gravity flights to test possible results.

Modification

If possible, have some groups poke two holes and hollow out their eggs. Students may have more success with a lighter egg.

Tip

If you plan to use a stepladder, always assign another student to hold it steady, and supervise students as they use the stepladder to make sure they do not climb too high or do anything that might cause a fall.

Informal Assessment

Ask each student to write a paragraph summarizing their group's engineering process and results. Then have students identify possible improvements to the design, and draw and label their lander with its proposed improvements.

Extending the Learning

Have each small group repeat the testing process using different criteria for success than during original testing. Ask them to reflect on any differences in results.

OBJECTIVES

Subjects & Disciplines

Earth Science

- Astronomy

- Experiential Learning
- Mathematics

Learning Objectives

Students will:

- use the engineering/design process to build a lander to successfully land on Earth's surface

- determine possible modifications to land successfully on another planet

Teaching Approach

- Learning-for-use

Teaching Methods

- Discussions
- Hands-on learning
- Inquiry
- Lab procedures

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Learning and Innovation Skills
    - Critical Thinking and Problem Solving
  - Life and Career Skills
    - Productivity and Accountability
- Critical Thinking Skills
  - Analyzing
  - Creating
  - Evaluating

National Standards, Principles, and Practices

NCTM PRINCIPLES AND STANDARDS FOR SCHOOL MATHEMATICS

• **Measurement (6-8) Standard 1:**
Understand measurable attributes of objects and the units, systems, and processes of measurement

NATIONAL SCIENCE EDUCATION STANDARDS

- **(5-8) Standard A-1:**

Abilities necessary to do scientific inquiry

- **(5-8) Standard E-1:**

Abilities of technological design

- **(5-8) Standard G-1:**

Science as a human endeavor

ISTE STANDARDS FOR STUDENTS (ISTE STANDARDS*S)

- **Standard 4:**

Critical Thinking, Problem Solving, and Decision Making

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- Bubble wrap
- Drawing paper
- Drop cloth
- Egg cartons, cut up into sections
- Meter sticks
- Newspapers
- Paper clips
- Paper cups
- Pencils
- Plastic garbage bags
- Raw eggs (5 per small group)
- Rubber bands
- Safety goggles
- Scissors
- Stepladder
- String
- Styrofoam
- Tarp or large sheet of plastic

- Timer or stopwatch

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per classroom, Projector, Speakers
- Plug-Ins: Flash

PHYSICAL SPACE

- Classroom

SETUP

You will either need access to a stairwell or another way to provide students with a test site that allows them to drop their landers from varied heights, such as open space for a stepladder in your classroom. Note that testing may be messy if eggs break. Be prepared to clean up after the activity.

GROUPING

- Small-group instruction

BACKGROUND & VOCABULARY

Background Information

When scientists and engineers want to send a probe to land on another planet, they first decide where to land and the method they will use to get the probe there. Then they need to figure out how to land the probe or rover safely. It is very expensive to send something into space, and NASA, other agencies, and corporations follow careful design and testing processes to ensure safe landings prior to launching into space. They also consider how the atmosphere varies on other planets and how that impacts what they need in order to have successful landings.

Prior Knowledge

["atmospheric conditions on other planets"]

Recommended Prior Activities

- Extreme Weather in Our Solar System

Vocabulary

Term	Part of Speech	Definition
atmosphere	*noun*	layers of gases surrounding a planet or other celestial body.
force	*noun*	power or energy that activates movement.
friction	*noun*	force produced by rubbing one thing against another.
gravity	*noun*	physical force by which objects attract, or pull toward, each other.
lander	*noun*	space probe designed to land on a moon, planet, asteroid, or other celestial body.
momentum	*noun*	speed, direction, or velocity at which something moves.
rover	*noun*	vehicle that remotely explores a region, such as the surface of a moon, planet, or other celestial body.
space probe	*noun*	set of scientific instruments and tools launched from Earth to study the atmosphere and composition of space and other planets, moons, or celestial bodies.
velocity	*noun*	measurement of the rate and direction of change in the position of an object.

For Further Exploration

Websites

- Nat Geo Movies: Wildest Weather in the Solar System
- National Geographic Science: Space
- National Geographic Video: Polar Probe to Land on Mars

FUNDER