

**This is a NASA/Design Squad Challenge called, Touchdown! The activity is on pages 13-16 in the On the Moon guide.*

Topic: Landing on the Moon

Big Concept: How can NASA design a spaceship that can land successfully on the moon while protecting the astronauts inside?

Grade: 3rd

Duration: 2- 45 minute periods

Learning Standards (*this activity listed various standards but they are not used in Pennsylvania; I included the ones that my district asks me to use in my lessons*):

Pennsylvania Science Standards

S4.A.1.3.1 Observe and record change by using time and measurement.

S4.A.2.1.2 Design and describe an investigation (a fair test) to test one variable.

S4.C.3.1.1 Describe changes in motion caused by forces (e.g., magnetic, pushes or pulls, gravity, friction).

S4.C.3.1.2 Compare the relative movement of objects or describe types of motion that are evident (e.g., bouncing ball, moving in a straight line, back and forth, merry-go-round).

S4.C.3.1.3 Describe the position of an object by locating it relative to another object or a stationary background (e.g., geographic direction, left, up).

Next Generation Science Standards:

MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.

ISTE Standards

Knowledge Constructor

Innovative Designer

Computational Thinker

Pennsylvania Science as Inquiry Standards

Ask questions about objects, organisms, and events.

Understand that all scientific investigations involve asking and answering questions and comparing the answer with what is already known.

Plan and conduct a simple investigation and understand that different questions require different kinds of investigations.

Use simple equipment (tools and other technologies) to gather data and understand that this allows scientists to collect more information than relying only on their senses to gather information.

*Use data/evidence to construct explanations and understand that scientists develop explanations based on their evidence and compare them with their current scientific knowledge.
Communicate procedures and explanations giving priority to evidence and understanding that scientists make their results public, describe their investigations so they can be reproduced, and review and ask questions about the work of other scientists.*

Problem Solving:

Moderately Structure Problem: Students will be using one final goal to drive their learning. There is more than one solution to reach the end goal but there is only one right answer (a safe craft with safe passengers).

Learning Activity- Students will be acting on the goal of landing the spacecraft and protecting the astronauts in order to produce an artifact that can be tested and restructured.

Context- Students are dealing with a real world problem and given some freedom in how to build their structure without much input and feedback from the instructor.

Knowledge:

Students will need to know THAT (declarative):

- each lander must use springs in its design.
- a shock absorber takes the energy out of an object when it hits something.
- the large marshmallows(astronauts) need to stay in the cup/cabin to be protected.

Students will need to know HOW (procedural):

- the different types of springs and cushions can help protect and land the craft more efficiently.
- the Earth's gravity pulls objects down making them accelerate at a faster speed the higher they fall.
- the force of hitting the ground can impact the astronauts' cabin.

Learning Objectives:

Students will use the engineering design process to

- Design and build a shock absorbing landing pad out of paper, straws, and marshmallows
- Attach their shock absorber system to a cardboard platform
- Test and improve their design to protect two astronauts

Other Ancillary Concepts:

Potential and kinetic energy
Acceleration and gravity
Air resistance
Measurement

Materials:

1 4x5in piece of cardboard
1 small paper cup
3 index cards
2 large marshmallows
10 mini marshmallows

3 rubber bands
8 straws
Tape

Procedure:

1. Introduce the challenge by telling students that NASA is looking for safe landing sites on the moon. Once they find one, they will need to design and construct a spacecraft that can land without harming the craft or its astronauts. Hold a discussion asking the students why NASA needs a spacecraft that lands gently and offers protection.
2. After hearing the discussion, tell students that they will be a part of NASA's engineering team and will make a lander- a spacecraft that can land safely when it is dropped on the floor. They will be using the engineering design process to test and revise their lander.
3. Before giving the students the green light, show them how to make a spring using an index card. Discuss what a shock absorber does- absorbs the energy of an impact. Using an index and folding it like an accordion will create a shock absorber to help lessen the force of impact. Other things like marshmallows, cotton balls, and bubble wrap are also shock absorbers.
4. Group students into groups of three and distribute the challenge sheet. Discuss the questions in the *Brainstorm and Design* section.
5. Allow students to work through the challenge, using only the materials provided. Observe what students are using as their shock absorber. Help them when issues arise such as if the lander tips over or bounces.
6. Remind students that they will need to test and revise multiple times in order to create their most successful lander.
7. Have students present their lander to the class. During the presentations, students should talk about what they did, what they used and why, and if they had any problems arise.
8. After presentations, hold a discussion using these key ideas:
 - a. What forces affected your lander as it fell?
 - b. After testing, what changes did you have to make?
 - c. Engineers' early ideas never really work. How does testing help improve the design?
 - d. What did you learn from watching others test their landers?
 - e. What are the advantages and disadvantages to having the moon covered in a thick layer of dust?

Extensions:

Make the drop height higher.

Increase the number of astronauts to the spacecraft.

Testing springs (cards) of different sizes/folds.