Motion, Forces, Energy and Electricity

Subject
Physical Science

Grade level
5-8

Duration
Two to three class periods

Objectives
Students will

- work in groups to build catapults out of everyday objects; and
- demonstrate their understanding of motion and forces by using the catapults to launch objects.

Materials

- *Motion, Forces, Energy, and Electricity* video and VCR or DVD and DVD player
- Pictures of catapults
- Computer with Internet access (optional)
- Cardboard shoe box (1 for each catapult)
- Rubber bands (4 for each catapult)
- Popsicle sticks (2 for each catapult)
- Masking tape (one 6-inch piece for each catapult)
- Plastic spoon (1 for each catapult)
- Rulers (1 per student group)
- Scissors (1 per student group)
- Marshmallows (2 per group)
- Masking tape (for launching competition)
- Object of your choice to serve as a target

Procedure

1. Begin the lesson by discussing motion and energy. Ask students: How do objects move? How do we calculate motion? What is acceleration? What is speed? What are some of the forces that act upon objects in motion? A good way to introduce this information is to view portions of the *Motion, Forces, Energy, and Electricity* video.

2. Tell students they are going to work in groups to create catapults out of everyday objects. Explain that catapults were often used as weapons of war during the Middle Ages. Show students some pictures of catapults and discuss

how they work, making sure that students understand catapult designs and uses. A good animated illustration of a catapult can be found at http://www.bow.k12.nh.us/CyberBUS/armor%20and%20weapons/animated_catapult.htm

1. Tell students that after building their catapults, they will compete to see whose catapult can fling a marshmallow the farthest and whose catapult can fling an object closest to a target.

2. Divide students into groups of five, and give each group the supplies they will need to make their catapults (see materials list) as well as any other objects you wish to provide. Tell the groups that they can design their catapults however they please, but they can use only the materials you have provided—nothing extra. Give students time to design and build their catapults, and ask them to name their team.

3. Once students have completed their catapults, clear an area in the classroom that can be used for the launching competition. Using masking tape, mark a starting line. Place the target object about 10 feet in front of the line.

4. One at a time, have the student teams place their catapults on the line and fling a marshmallow at the target—their goal is to hit the target. Mark where each team's marshmallow landed with a piece of masking tape that has been labeled with the team's name.

5. As a class, determine which team was the most successful in accurately hitting (or coming the closest to hitting) the target with its marshmallow. Talk about the design of the winning catapults. Why did this design work the best?

6. Have students again place their catapults on the starting line and fire a second marshmallow—their goal, this time, is to achieve the greatest distance. Again, mark where each marshmallow lands with a piece of labeled masking tape. Once all the catapults have been fired, have students measure the distance from the starting line to where their marshmallow landed.

7. As a class, determine which catapult was able to launch a marshmallow the greatest distance. Ask students: Why did this catapult work best? What element(s) of its design do you think helped propel the marshmallow farther than the others?

8. Have each student write a paragraph that answers the following questions.
    - What was your group attempting to achieve with its catapult design?
    - How did the catapult set the marshmallow in motion?
    - Which challenge did your catapult meet best, accuracy or distance?
    - What could you have done to make the catapult better?
    - What helped the catapult work as well as it did?
    - What did this activity teach you about motion and forces?

9. Ask for volunteers to share their answers with the class. Discuss students' answers and the forces that work on objects in motion.

Evaluation
Use the following three-point rubric to evaluate students' work during this lesson.

3 points: Students actively participated in class discussions; worked cooperatively in their teams; successfully created a team catapult; actively participated in the catapult launch; wrote a thoughtful paragraph that answered all six questions.

2 points: Students somewhat participated in class discussions; worked somewhat cooperatively in their teams; needed help to complete their catapult; did not actively participate in the catapult launch; wrote an incomplete paragraph that answered only three or four of the six questions.

1 point: Students somewhat participated in class discussions; were unable to use catapult materials without teacher guidance; created unfinished catapults; did not actively participate in the catapult launch; wrote an incomplete paragraph that answered only one or two of the questions.

Vocabulary

acceleration
Definition: The change in speed over time
Context: You can calculate the Pit Crew's acceleration during the first 10 seconds of the race with the information you have about their climb.

force
Definition: Strength or energy exerted; cause of motion or change
Context: Both teams know that getting their vehicle up the hill will require a great deal of force.

inertia
Definition: The tendency of an object to resist any change in its motion
Context: It's not moving and, because of inertia, it will take an outside force to make it move.

propel
Definition: To push or drive forward or onward by, or as if by, means of a force that imparts motion
Context: If their vehicle weighs less than the other team's, the Jet Jocks' engine won't need to exert as much force to propel their buggy up the incline.

reference point
Definition: A fixed point of comparison
Context: Each vehicle will attempt the climb by itself, so the starting line serves as a reference point, or fixed point of comparison.

Academic Standards
National Academy of Sciences
The National Science Education Standards provide guidelines for teaching science as well as a coherent vision of what it means to be scientifically literate for students in grades K–12. To view the standards, visit http://books.nap.edu.

This lesson plan addresses the following national standards:

- Earth and Space Science
- Physical Science
- Science as Inquiry
- Science and Technology

The National Council for the Social Studies (NCSS) has developed national standards to provide guidelines for teaching social studies. To become a member of the NCSS, or to view the standards online, go to http://www.socialstudies.org/.

This lesson plan addresses the following standards:

- Science, Technology, and Society

Credit

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