

## Lesson Preparation – Crater Case (<1 hour active time)

### Materials (for 24 students) :

Aluminum Broiling Pan ( 1 per group )

Flour ( ~2 lbs per group )

Golf Ball or other Small Spherical Object ( 1 per group )

Yard Stick ( 1 per group )

Ruler ( 1 per group )

Rubber Poppers ( 1 per student )

Crater Case Worksheet ( 1 per student )

### Before Lesson:

1. Fill aluminum pans with a depth of flour equal to twice the size of your golf ball.

## Lesson Plan – Crater Case (50 min)

### Opening (5 Min)

Begin by reviewing what the students know about energy. What is energy? How do we know if something has energy? *Energy is the ability to do work, and it can be measured in many ways. The energy in our food is measured as a calorie, but the energy in electricity is measured in kilowatt hours. Because energy is used to do work, we can often see energy as a change of some sort, like something getting hot, or a lightbulb lighting up.*

Briefly discuss the idea of evidence, what is it and why do we need it? *Evidence is the set of facts that supports an idea. Evidence helps us to know when an idea is correct and when it might be wrong.*

Have one of the students read the paragraph at the top of the worksheet.

### Instruction (5 min)

Show the students the aluminum pan full of flour. Briefly, go over the guidelines for behavior when using this experimental set-up (you may choose to do this experiment outside).

Demonstrate how to use the meter stick to line up the golf ball at a specific height for a drop. Use the golf ball to make an impression in the flour, and demonstrate how to measure across the crater. Remind the students that they need the largest measurement they can find. Ask the students where they should write the number they collect down. *They should record the number in the table on the worksheet, across from the appropriate height.*

Using your fingers, demonstrate how to comb the flour around in the aluminum pan to make the surface flat again. The ruler can also be used on its side to create a flat spot in the crater.

### Exploration (30 min)

Split the students into groups of four, have them decide who will hold the meter stick, who will drop the ball, who will measure the crater, and who is going to record the measurements on their worksheet. Provide each group with a pan of flour, a meter stick, a ruler, and a golf ball.

Allow the students about 20 minutes to complete their activities. As they are working, you can discuss with the groups what they might be learning about energy. What do you notice about your craters as the marble is dropped from different heights? What do you think might be happening to the marble when you drop it from higher? Where is the energy for the marble to move coming from? Where is the energy for the flour to move coming from? *The higher the marble is dropped from, the greater the size of the crater. This is because the higher the marble is dropped from, the more potential energy it starts with. The potential energy is converted to kinetic energy, and the marble gains speed. The faster the marble is going when it hits the flour – the more energy it has and the bigger the crater.*

### Making Connections (10 min)

When the students are done collecting their data, have them gather together as go over some questions with the entire group. Have the students fill out the conclusion section of their worksheet independently.

What did you observe about energy in this experiment? What is your evidence for your conclusion? *In order to lead students to the conclusion (Greater Height/Speed = More Energy), you can go through some of the questions used during the exploration section.*

Demonstrate how the rubber popper is used. *Fold the rubber popper by pushing the dome of the popper into the hollow section. Dropping it from a very short height should result the popper flipping right-side out and propelling itself into the air.*

Ask the students where they think the energy for the popper comes from. Explain that energy is often transferred from place to place, like from the golf ball to the flour. In this case, the energy for the popper is actually stored in the folded shape, just like the energy for the gold ball is stored by holding it high off the ground. Hand out a rubber popper to each student.

Allow students to ask any questions they may have about energy.