CREATE A CRATER! (1 HOUR)

Addresses NGSS
Level of Difficulty: 2
Grade Range: 3-5

OVERVIEW

In this activity, students drop small spheres of different sizes and weights from different heights into flour. The students then describe the craters that form, measure the diameter of the craters, and draw conclusions about how different variables affect the characteristics of the craters.

Topic: (Impact) Craters

Real-World Science Topics:

- An exploration of how drop height affects a falling object
- An exploration of how weight affects a moving object
- An exploration of how (impact) craters form

Objective

Students will gain an understanding of performing an experiment and how different variables affect the characteristics of craters formed from an impact.

Materials Needed for Each Team of Students

- flour
- baking pan
- meter stick or yardstick
- small spheres of various weights (marbles, ball bearings, and wooden spheres all work well; folder students may also want to make spheres out of clay)
- plastic drop cloth or newspaper

Teacher Notes

Use your discretion on the best way to conduct this activity based on the individual level of your class. For some of the younger K-1 classes, you may wish to perform some or all of the steps of the activity, encouraging children to make predictions and observations. If the group is older or more advanced in their abilities, students can take a more hands-on role in performing the related tasks. Leveled methodologies for K-1 and 2-3 grade levels are provided, where appropriate, throughout the activity. Use your knowledge of each class to determine what the best option is for your particular group.

Teacher Preparation

1. For each group, place a baking pan on a drop cloth, and fill the pan ¾ with flour.
2. **Grades 2-3** Sort the spheres by mass so that each group ends up with a variety of masses.

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Standards Met

NATIONAL SCIENCE STANDARDS ADDRESSED

CONTENT STANDARD A: SCIENCE AS INQUIRY

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

NATIONAL MATH STANDARDS ADDRESSED

- Recognize the attributes of length, volume, weight, area, and time.
- Understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute.
- Collect data using observations, surveys, and experiments

NATIONAL TECHNOLOGY STANDARDS ADDRESSED

CREATIVITY AND INNOVATION

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:

- Use models and simulations to explore complex systems and issues.

Sources

National Science Teachers Association

http://books.nap.edu/html/nses/overview.html#content

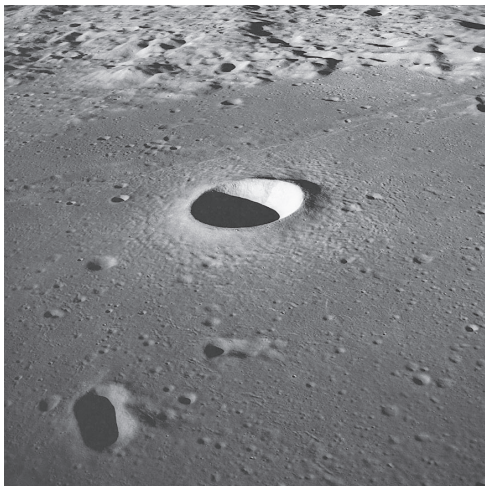
National Council of Teachers of Mathematics

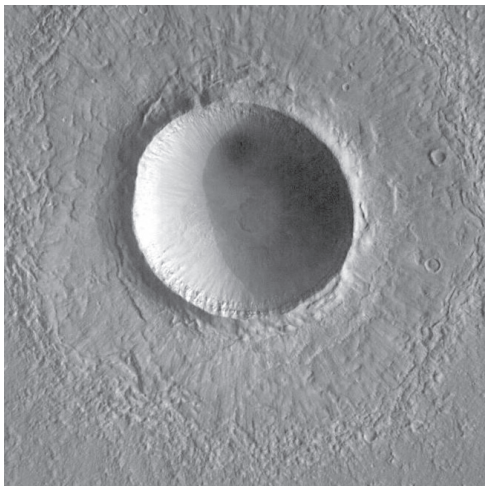
http://standards.nctm.org/document/chapter5/index.html

National Educational Technology Standards

http://cnets.iste.org/currstands/cstands-netss.html

STEPS FOR *CREATE A CRATER!*





Top Image: Moltke Crater on the Moon (Apollo 11); 6.5 km across, 1.3 km deep.
Middle Image: Tycho Crater on the Moon (Lunar Orbiter 5); 85 km across.
Bottom Image: Crater on Mars (Mars Global Surveyor)

1. **Warm-Up Activity:** Ask students if they know what a crater is. Some may know that it is a bowl-shaped or frying-pan-shaped hole in the ground. Explain that there are craters on the Moon and on Mars.

   Show students some images of craters. (A few are provided below. If you have access to the Internet, type "impact crater" into an image search engine to find more.)

   Guide students in an exploration of their ideas about how craters are formed. Lead them towards the idea that craters form when objects from space hit the Moon or Mars at high speeds. These are known as (*impact craters*). If necessary, explain that an *impact* is a crash or collision. (Note that most students will not know about volcanic craters such as Crater Lake in Oregon. However, if a student does ask a question, explain that craters do form through volcanic eruptions, but that they also form by impact.)

2. Explain that craters come in all sizes. The smallest ones, found on the Moon, are microscopic. The largest ones are hundreds of kilometers across and several kilometers deep. (If students do not have a feeling for how big that is, show students a map and compare the sizes to the size of your classroom, school, neighborhood, city, or state. For example, Tycho crater on the Moon is about 85 km across. You can show students on a map that this is approximately the distance between Baltimore and Washington, DC.) Ask students to think about why some craters are bigger than others and why they all look a little different.

3. **Grades K-1** Demonstrate this activity for students, engaging the entire class. Explain to students that they will be dropping small spheres into flour to observe the craters that form. Use the *Create a Crater!* Student Handout as a guide for discussion.

   Grades 2-3 Divide the class into groups of two to four students. Explain to students that they will be dropping small spheres into flour to observe the craters that form. Each group will work together to explore the relationship between the size and weight of the sphere, the height from which it is dropped, and the characteristics of the resulting craters.

   Make copies and distribute the *Create a Crater!* Student Handout. Students can use this handout to record the results of their trials.

STEPS FOR *CREATE A CRATER!*

4. **Grades K-1** Begin by testing height. Ask a volunteer to choose one of the spheres for you. Pass the sphere around so that students can feel the weight of the sphere. Ask them to predict what kind of crater the sphere will create when you drop it into the flour. Then, hold the meter stick in place and hold the sphere next to it at a designated height and drop the sphere into the flour. Carefully remove the sphere from the crater without disturbing the shape of the crater.

   Ask students to observe and describe the crater. Is it small? Is it large? Did it kick up a little or a lot of flour?

   Grades 2-3 Have each group begin by testing height first. Have them hypothesize how they think changes in height will affect the craters that form. You may wish to have one volunteer record the hypothesis on their worksheet.

   Have one student from each group choose a sphere. Have another student hold the meter stick in place as the first student holds the sphere next to it, at a designated height. Have students drop their spheres into the flour. Have students carefully remove their spheres, so as not to disturb the shape of the crater. Ask another volunteer from each group to measure the diameter of the crater with the ruler and record their measurements on the tables in the Student Handouts.

5. **Grades K-1** Have students make a prediction about what would happen if the same sphere were dropped from a lower height. Call on a volunteer to drop the same sphere. Ask students to compare and contrast the two craters. Did their predictions match the results? Repeat the process one or two more times from different heights.

   Grades 2-3 Have students make predictions and conduct several trials with the same sphere dropped from varying heights.

   Have students answer the questions in the Student Handout.

6. If time permits, repeat the activity focusing on spheres with different weights dropped from the same height each time.

7. **Wrap-Up Activity:** Lead the class in a guided discussion of the results of this activity. Ask them to describe what they learned about the relationship between the drop height and the size of the crater (and if appropriate between the weight and the size of the crater). A qualitative explanation (e.g., more height and greater weight leads to bigger craters) is sufficient. Explain to them that the size of the crater is determined by the size of the object and the height from which it fell.

Create a Crater! Extension Activities

There are many other possibilities for students to explore within this activity setup. Students interested in further exploring crater formation could use a ramp to guide the entry of the object into the flour. By rolling the ball down the ramp, and varying the angle of entry, students can test how the angle of entry affects the shape and size of the crater. (Note that the end of the ramp must be placed in the flour for the ball to actually hit the floor at an angle.) Students can also vary the base material to see how it affects the craters that form. Fine sand or sugar, coarse sand, soil, and mud will all result in slightly different craters.

How do craters form?

(Impact) craters form – as the name suggests – when rocky or icy objects strike other planets or their moons. The rocky inner planets (Mercury, Venus, Earth, and Mars) and their moons are covered in impact craters.

How do the size, speed, and mass of an object affect the size of the crater?

As the activity showed, the size of the object can affect the size of the crater.

How are real craters different from craters formed in this activity?

In reality, very large objects that hit planets at high speeds explode, throwing pieces of rock flying in all directions, sometimes many, many (dozens or hundreds of) kilometers outwards.

How are craters important in the real world?

Scientists use craters on other planets and moons to figure out the approximate ages of the planets (the older the surface, the more craters have accumulated).

Key Vocabulary

(impact) crater: a huge dent formed by the impact of an object

CREATE A CRATER! TEACHER HANDOUT

ANSWER THE FOLLOWING QUESTIONS:

1. Which investigation are you testing?

[the height from which the sphere is dropped (or the weight of the sphere)]

2. Which parts of the investigation are you keeping the same?

[the weight of the sphere (or the height from which the sphere is dropped); material that the sphere is dropped into; material that the sphere is made of]

3. How do you think changing parts of the investigation will affect the craters that form?

[Possible answer: I think that bigger craters will form when I drop the spheres from a greater height.]

4. What steps did you follow in your investigation?

1. Decide what height the spheres should be dropped from. Have one student hold the meter stick in place as another student holds the sphere next to it, at the designated height.
2. Drop the sphere.
3. Make observations and record them in the data table.
4. **If testing height:** Repeat the investigation using the same sphere, but dropping it from a different height. **If testing weight:** Repeat the investigation using a sphere with a different weight dropped from the same height.

CREATE A CRATER! TEACHER HANDOUT

Record the results of your investigation in the table below. Use extra paper if needed.

	Height the sphere is dropped from	Description of what happened	Sketch of the Crater	Diameter of Crater
Trial 1	[Answers will vary]	[Answers will vary]	[Answers will vary]	[Answers will vary]
Trail 2				
Trail 3				
Trial 4				

CREATE A CRATER! STUDENT HANDOUT

Name:

Date:

ANSWER THE FOLLOWING QUESTIONS:

1. Which investigation are you testing?

2. Which parts of the investigation are you keeping the same?

3. How do you think changing parts of the investigation will affect the craters that form?

4. What steps did you follow in your investigation?

CREATE A CRATER! STUDENT HANDOUT

Record the results of your investigation in the table below. Use extra paper if needed.

	Height the sphere is dropped from	Description of what happened	Sketch of the Crater	Diameter of Crater
Trial 1				
Trail 2				
Trail 3				
Trial 4				