# Lesson 3: Geomorphology, Impact Craters (Planetary Geology)

## Objective:

Students will understand how craters are made on planetary surfaces.

The geomorphologies of craters made by impacts on planetary surfaces change as the impact gets larger: In particular, the ratio of crater depth/diameter decreases (larger craters are less deep), in addition to formation of structures such as central peaks or multiple rings. Students should explore models and identify changes in the shape with changing crater diameter. Students should be able to identify the change in depth/diameter and describe changes to the shape (flat floors, central peaks) with increasing size.

## NGSS:

PS3.C.1: When objects collide, the contact forces transfer of energy so as to change the objects’ motions.

## Essential Questions:

1. What makes a crater on a planetary surface?
2. How do craters change in depth/diameter?

## Materials:

* 1 pie tin for each student or group of students, or a shallow baking dish
* 1 marble for each group
* Flour
* Water
* Measuring device (ruler or tactile ruler)
* Newspaper or tarp for each group—this can get messy
* Meter stick
* Small ruler
* Paper, lab notebook, or recording device
* Spoon

## Lesson Sequence:

1. Make a flour paste with 1 cup of flour to ½ cup water. It will be gooey. You may choose to use more flour for a firmer paste.
2. Evenly coat the bottom of the pan with the paste. Be sure to evenly coat the surface.
3. Ask students what they know about how craters are made on different planets. [Answers will vary.]
4. Tell students that today you will all be making craters on your planets that are represented by the pie tin. The surface of the pie tin is your planetary surface.
5. Have one group member hold a meter stick up on the surface of the “planet.”
6. Ask students what they think will happen to the surface if they drop the marble onto the surface of the planet from 20 cm. Ask them to record their predictions on a piece of a paper, their lab notebooks, or a recording device.
7. Carefully remove the marble. With the small ruler, measure the outer width of the impression of the flour paste.
8. Move the meter stick to a new location and repeat Steps 6 and 7 two more times. Average the three trials and record the data.
9. Now, make a prediction for what might happen if the marble was dropped from a height of 40 cm. Repeat Steps 6 through 8.
10. *Note.* If the surface becomes too full of craters, have students use the back of a spoon to level out the surface for the next round of experiments.
11. Repeat the prediction, dropping from a height of 80 cm and finally 100 cm.
12. Ask the students to graph the means of each crater width from each height.
13. When finished, ask the students whether their hypothesis is correct. Ask them whether they saw a pattern in the data. Finally, have them record their overall conclusion to the experiment.
14. Clean up the tins and materials.

## Extension Activities:

This lesson can be repeated using varying degrees of watery flour paste. This will demonstrate the impact of weathering on the Earth’s crust and differences in land impact depending on the trajectory of the object. You may also have students drop the water into a liquid that would demonstrate how craters cannot be made in the ocean. You could also vary the angle of the marble using various inclined planes. This would simulate the role that the Earth’s atmosphere has on an object as it moves toward Earth’s surface.

References:

“Investigating Earth and Moon Surface: Impact Craters” from the Minnesota’s Science Teachers Education Page. <https://serc.carleton.edu/sp/mnstep/activities/26312.html>

For more videos and further investigations that could expand this lesson, the “Space Racers Cosmic Craters Lesson Plan” is a great resource. <https://www.spaceracers.com/pdf/cosmic-craters-lesson-plan.pdf>