TEACHER'S GUIDE

Lunar Craters

Background

Look at the Moon through a pair of binoculars, and you will see craters. Lots of them. In fact, it is hard to find any place on the Moon where there aren't any craters.

Craters are formed when meteoroids, small chunks of rock and metal that roam the Solar System, fall to the surface of a planet. The resulting impact forms a usually circular depression in the ground, which is called a crater. The base of a crater is called the floor, whereas the sides are called the wall. At the top of the crater wall is the crater's rim. When a meteoroid strikes a planet, debris is typically ejected from the site of the impact. This debris is called *ejecta*. Because the debris is ejected in streaks, rays are often observed surrounding a crater.

Because of the intense amount of energy involved, large impacts often cause the rock at the impact area to behave like a fluid. This causes many larger craters to exhibit a small, raised area in the center of the crater called a "central peak." It is not unlike the peak that is momentarily formed when a drippy faucet leaks onto a pool of water. In the case of craters, this peak solidifies, essentially frozen in time.

Craters on the Moon range in size from over 200 kilometers in diameter (larger than the state of Connecticut) to smaller than the head of a pin. Because there is no weather on the Moon, the only way to erode an existing crater is to cover it with more impacts or more debris from impacts. Young craters have sharp rims and are relatively deep. Older, more worn craters are usually more shallow and have less distinct rims. Scientists can estimate the relative ages of portions of the Moon by counting the number of impact craters present. The more craters, the longer the surface has been exposed to bombardment by meteoroids.

What you did in this activity is different than real cratering events in some ways. When a crater is formed on a planetary surface, the energy of the impactor can break apart—even vaporize—the impactor. In addition, crater size is determined by the energy of the impact, not the size of the impactor.

Topic

Craters

Objective

Students will:

- Evaluate and interpret the physical characteristics of a crater.

Overview

In this lesson students will simulate crater impacts by dropping pebbles or marbles into a pan of flour and cocoa. Students will identify the characteristics of lunar craters and compare them to the picture of a lunar crater.

Key Question

What are the characteristics of a crater?

Key Concepts

- Craters are depressions or pits formed by impacts.
- Craters have identifiable features.

Materials & Preparation

- Pie pans
- Pebbles or marbles
- Bags of flour
- Metric ruler
- Newspapers
- Powdered cocoa
- Meter stick

1. Divide students into pairs.
2. Ask students, "What are craters, and how are they formed?" Discuss with students the formation of craters and their features (rays, rim, ejecta, central peak).
3. Cover the floor with newspaper.
4. Fill pie pans with a thick layer of flour. Smooth out the flour so that it is as flat as possible.
5. Cover the top of the flour with a light dusting of cocoa (a sifter works well).
6. Have students place the pie pan on the floor or the ground.

7. Students will place one end of the meter stick on the floor and measure 30 cm above the pan.
8. Have students drop a pebble into the pan from the 30 cm height.
9. Students will then draw a picture of the crater that they have created on the student worksheet (do not have the students remove the pebble).
10. Have students repeat steps 7 through 9, creating the second impact in the pan so that it is not too close to the first impact.
11. Have students remove the pebbles, smooth the flour, sift on a new layer of cocoa, and repeat steps 7-10.
12. After students have drawn all four impacts give them the lunar crater image and have them label all the parts of their craters that they can identify in their drawings.

Management

One 50-minute class period.

Students must wear safety goggles when dropping the pebbles.

If corn starch is used instead of flour it will store longer and can be used again.

Reflection & Discussion

1. Discuss the features of craters with students.
2. Use the lunar crater image to show students how to tell the difference between older and newer craters.
3. Explain to students why ancient impact craters are still visible on the lunar surface today.

Transfer/Extension

1. Research crater impacts on Earth.

STUDENT WORKSHEET

Lunar Craters

Student Procedures

1. Place the pie pan with the flour and cocoa on the floor or the ground.
2. Place one end of the meter stick on the floor and measure 30 cm above the pan.
3. Drop the pebble into the pan from the 30 cm height.
4. Carefully remove the pebble from the crater and draw a picture of the crater that you have created on the student worksheet.
5. Repeat steps 2 and 3 and create a second impact in the pan near the first impact. Carefully remove the pebbles from the crater and draw a picture of both craters on the student work sheet.
6. Refill the pan, sift on a new layer of cocoa and repeat steps 2-5.
7. After you have drawn all four impacts, use the Crater Fact Sheet and label all the parts of your craters.

Questions & Conclusions

1. How did the appearance of the surface of the flour change after it had been impacted?
2. What does the cocoa reveal about how impacts change the surface?
3. Describe the features of each of your craters.
4. Compared to the Crater Fact Sheet, was your model an accurate representation of lunar craters? Explain why or why not.

FACT SHEET

Impact Crater Fact Sheet

What is an Impact Crater?

Impact craters are marks found on every solid body in the Solar System, like planets and moons. Even asteroids are pitted with craters. When an object slams into a planet, it hits the surface very hard and explodes. Rocks and dust fly everywhere. The object that hits the planet is called an impactor. The impactor breaks apart because of the force of the impact, and the impact explosion leaves a round hole or crater in the surface of the planet.

Crater Parts

Walls–The sides of the bowl. Walls can be very deep. They may look like steps, or walls can be shallow. If a crater has shallow walls, then the hole was filled or eroded somehow.

Floor–The bottom part of the impact site (the hole). It may be the shape of a bowl, or it may be flat. This part is lower than the surrounding surface.

Rim–The highest point along the edge of the hole.

Ejecta–The debris that shoots, or ejects, out of the impact site when the crater forms. There is a lot of ejecta close to the crater, so it is thick. The ejecta gets thinner the farther away it is from the crater. The explosion creates debris as it crushes, heats and melts the rock.

Rays–The bright streaks that start at the rim of the crater and extend outward.

Central Peak–A small mountain that forms at the center of the crater in reaction to the force of the impact. Only really large craters, typically more than 40 km across, can have a central peak. These craters are the size of large cities.

What Changes the Shape of a Crater?

Initially, craters have a crisp rim and blankets of ejecta around the sides. On the Earth, actions of wind, water, lava flows and plate tectonics can alter the appearance of a crater. Wind can blow away debris around the crater. Rivers and floods can erode the crater's walls and rim. On the Moon, lava flows can fill in the crater and make the rim smoother. Another impactor may come along and give the crater its own crater. Other impactors can partially or completely destroy an older crater.

Craters and Surface Age

The older a surface is, the more time impactors have to hit it. Really old surfaces have so many craters that it would be difficult to tell if another impactor hit it. Little of the surface is smooth. Most cratering took place right after the planets and moons formed. Places like the Earth's Moon and the planet Mercury have heavily cratered, old surfaces.

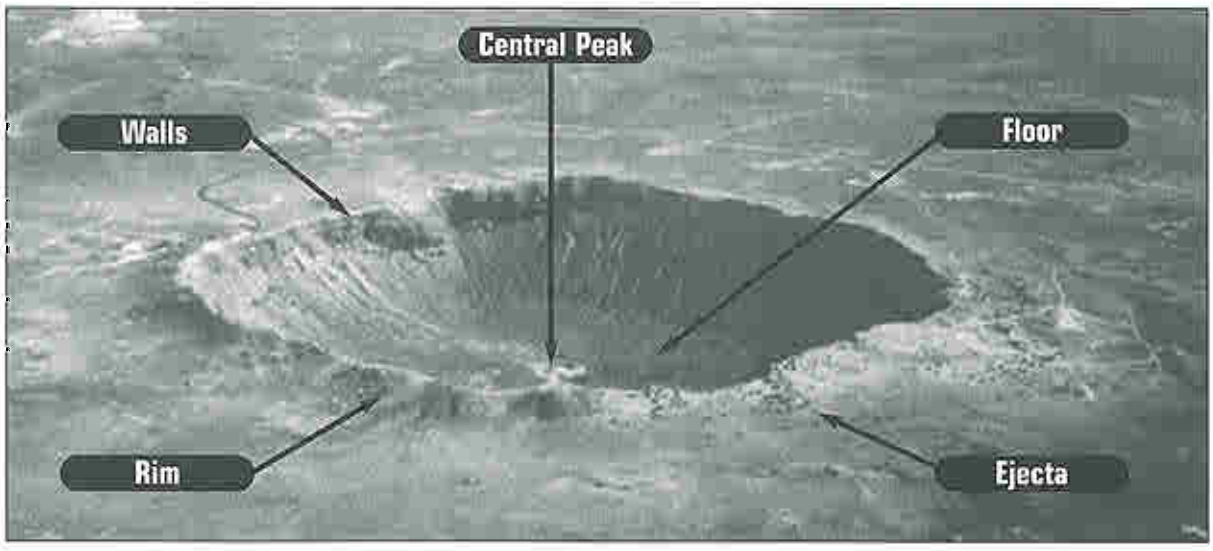
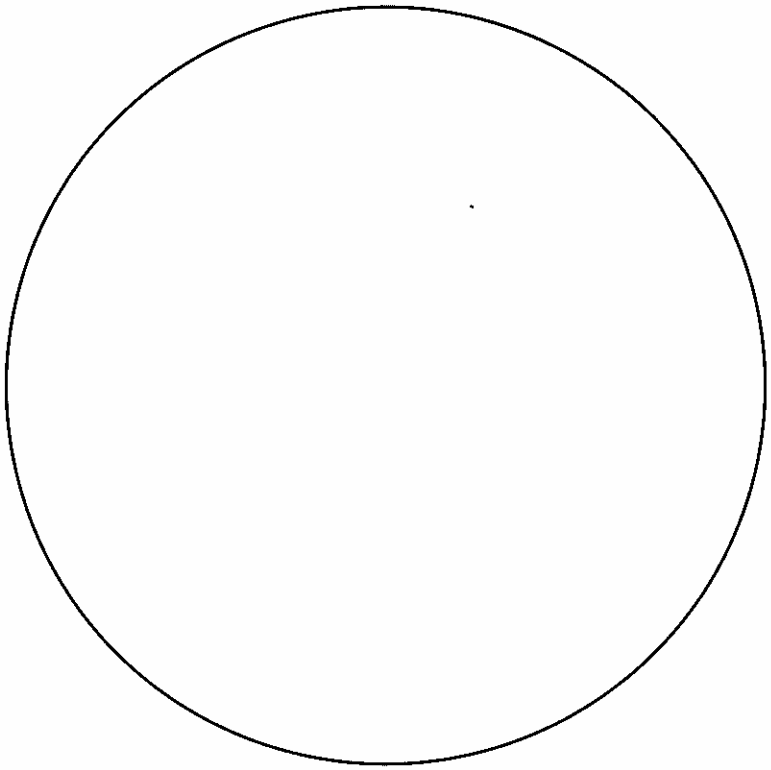
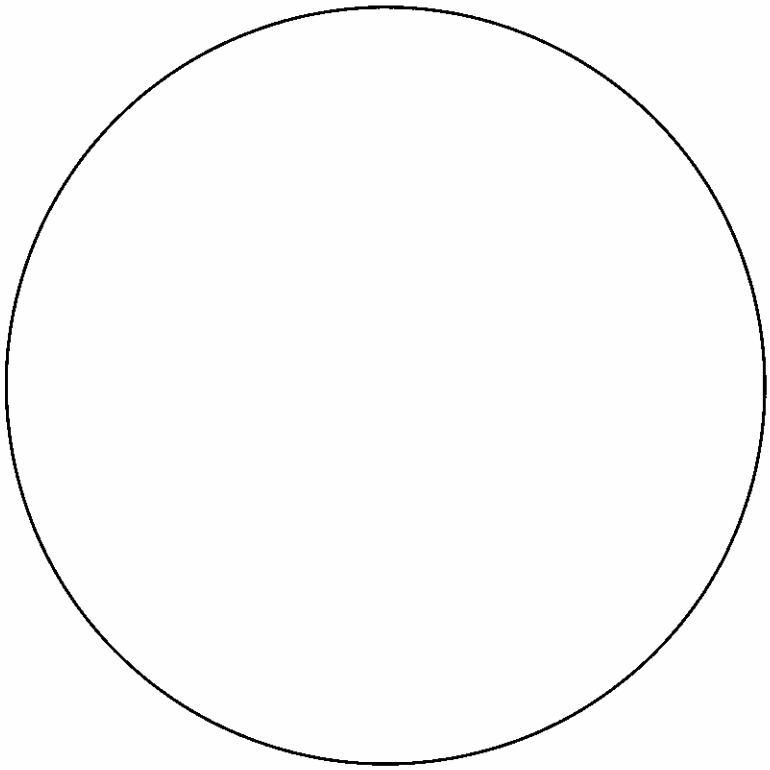


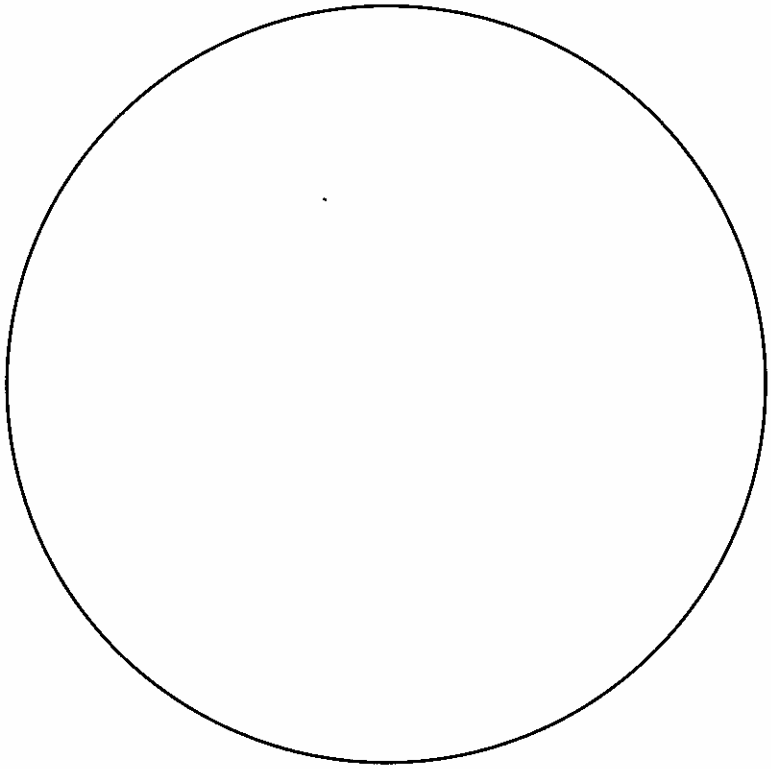
Image courtesy of NASA



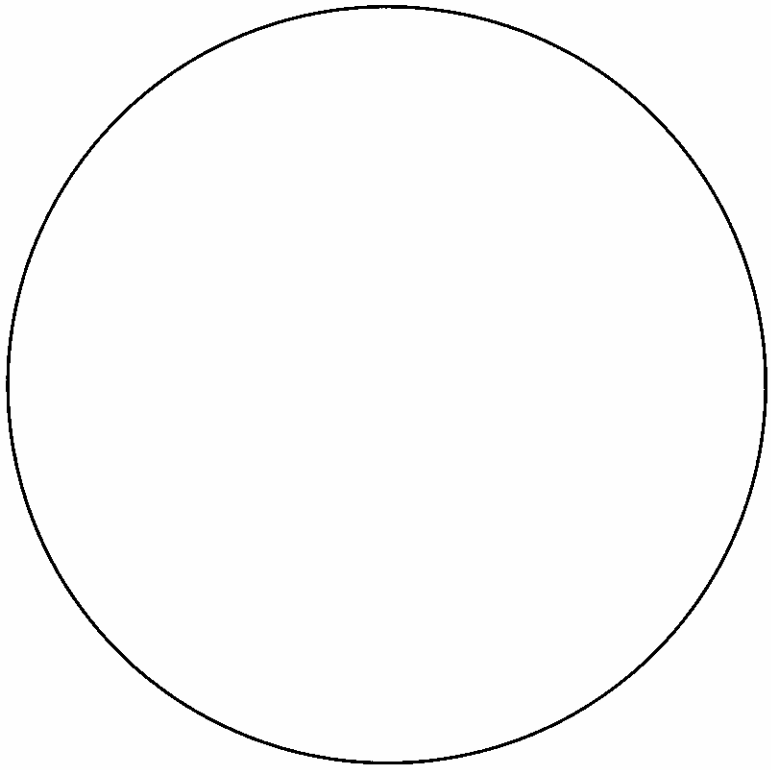
Crater #1



Craters #1 & #2



Crater #3



Craters #3 & #4