

# Craters and Meteorites

## Objective

Investigate how the size of a meteorite is related to the size of the crater it makes upon impact.

## Introduction

Craters are round, bowl-shaped depressions surrounded by a ring, like the one shown in Figure 1. They are made when a **meteorite** collides with a **planet** or a **moon**. The craters are what make our moon look like Swiss cheese. Each round hole is the place where a meteorite *impacted*, or hit, the surface of the moon, so craters are often called **impact craters**. Often, the meteorite that creates a crater explodes on impact, so the crater is an empty reminder of the collision.



**Figure 1.** This is a picture of the Barringer Crater in the desert of Arizona. (David Roddy, USGS)

There are **meteors** traveling around throughout space, and all of the moons and planets have been impacted by meteorites since the formation of our solar system. (When a meteor hits a planet or moon, it is called a meteorite.) On Earth, we only see a few impact craters because of a couple of different reasons. First, most meteors never reach the Earth's surface because they burn up in the atmosphere. This is what we are seeing when we watch a *shooting star* during a *meteor shower*. Second, impact craters from meteorites can be changed by geological forces (like earthquakes and continental movements), or eroded away by atmospheric forces (like wind or rain). There is no atmosphere on the moon, which means that falling meteors do not burn up and there is no weather to erode away the craters. In fact, the footprints of the astronauts who landed on the moon over 30 years ago are still there, perfectly preserved!

Where can you find the few impact craters on the Earth? There are only about 170 scientifically confirmed impact craters on the Earth. Not all of them are obvious because most are eroded, covered by sediment, or under water. Each crater has to be identified using several different kinds of clues. First, geological clues are found by looking for pieces of the exploded iron-rich

meteorite, or for glass that formed during the impact. Satellite imaging can be used to visualize crater formations that are beneath the Earth's surface or a body of water. Finally, chemical evidence is used to date the crater and find traces of elements that are more common in space than on our planet.

By piecing together this evidence, scientists can study craters on Earth and link them to different periods of Earth's history. This involves many different types of scientists, including astronomers, geologists, chemists, paleontologists, and meteorologists (who actually study weather, and not meteorites). This has led to an interesting hypothesis being proposed about the formation of a sea, the extinction of the dinosaurs, and even the origins of life!

The craters on both the Moon and Earth come in many sizes. Some are very deep, while others are shallow. Have you ever wondered why?

Speed is not the only meteorite variable that could change the look of an impact crater. In this science project you will investigate whether or not the size of a crater depends upon the size of the meteorite. To test this, you will use different sized, nearly spherical objects as your "meteorites", like the objects shown in Figure 2. What types of clues will you look for in your investigation? How will studying an impact crater give you information about the collision, even if the meteorite is no longer there? Are there other clues of a meteorite impact that are important?



**Figure 2.** In this astronomy science project, you will use different sized, nearly spherical objects, like the ones shown here, to act as your "meteorites." How will the size of the meteorite affect what kind of crater it makes?

## Materials and Equipment

- Different-sized objects that are nearly spherical (at least 3 total), such a rubber ball, a baseball, and a piece of roundish fruit.
  - *Tip:* Solid objects may work better than hollow ones.
  - *Note:* Smaller objects, such as marbles and beads, will not work well for this science project unless you use metal or magnetic balls and a magnet to carefully remove them.
- Ruler, metric
- Cardboard box; it should be larger than a shoebox and fairly deep. Something like a small moving box would be perfect.
- Flour (10-lb bag)
- Cocoa powder
- Flour sifter or sieve
- Optional: Graph paper
- Lab notebook

## Experimental Procedure

1. In your lab notebook, make a data table like Table 1.
  - a. Be sure to include the types of objects that you will be testing.
2. Using a ruler, measure the diameter of each of your nearly spherical objects (in centimeters [cm]). The **diameter** is the distance across the middle of the sphere, from one side to the other. Write your measurements in the data table in your lab notebook. Each object will serve as a "meteorite" in this science project.

| Object      | Diameter of Object (cm) | Diameter of Craters (cm) |  |  | Average Crater Diameter (cm) |
|-------------|-------------------------|--------------------------|--|--|------------------------------|
| Rubber ball |                         |                          |  |  |                              |
| Baseball    |                         |                          |  |  |                              |
| Round fruit |                         |                          |  |  |                              |
| Etc.        |                         |                          |  |  |                              |

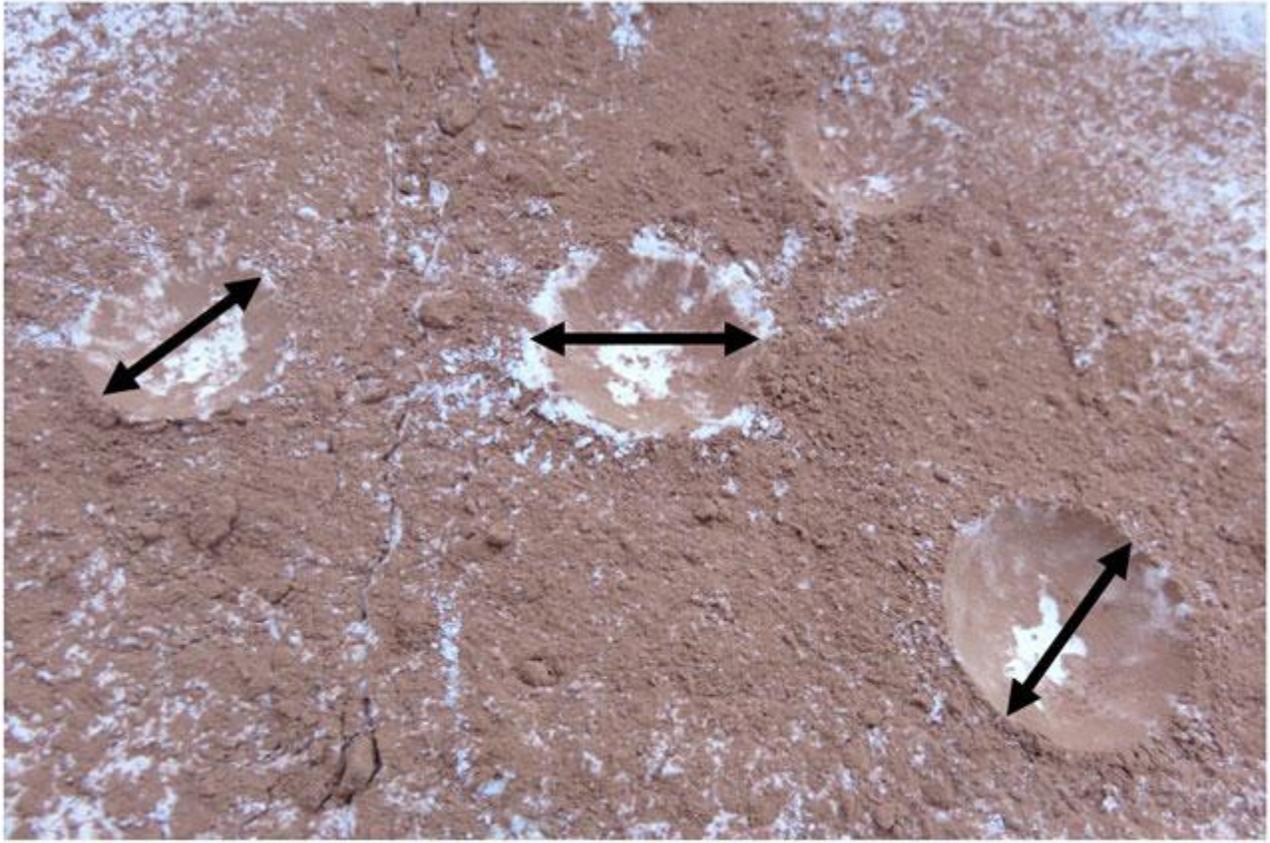
**Table 1.** In your lab notebook, make a data table like this one to record your measurements and data in.

3. Prepare your meteorite landing area.
  - a. Slowly pour a 10-lb bag of flour into the cardboard box. Shift the box from side to side to evenly distribute the flour. The flour should be a depth of at least 5 cm in your box. If there is not enough flour, you can either transfer the flour to a smaller box, or add another bag of flour.
  - b. Use a sifter or sieve to add a thin layer of cocoa powder.
  - c. When you are done preparing it, your box should look similar to the one in Figure 3.



**Figure 3.** Your prepared box should look similar to this one.

4. Now drop one of your "meteorites" into the box by holding the object out at arm's length over the box and letting go. Use the ruler to make sure you drop the meteorite from a height of 50 cm above the flour.
5. After the "meteorite" impacts the flour, carefully remove the object without disturbing the "crater" left behind.
6. Repeat steps 4 to 5 two more times using the same object, each time in a different spot in the box. Remember to drop the meteorite the same way and from the same height each time for accurate results. You should now have three craters made by the first object.
7. Measure the diameter of the first crater by measuring the distance across the center of the depression in the flour, as shown in Figure 4. Be very careful not to disturb the flour and cocoa with your ruler, by breathing too hard, or by shaking the box. Write the diameter of the first crater in the data table in your lab notebook.



**Figure 4.** Measure the diameter of the impact crater by measuring the distance across the center of the depression, as indicated here with the black lines.

8. Repeat step 7 for the other two craters, writing each measurement in the data table.
9. Calculate the average crater diameter by adding up the three measurements and then dividing your answer by three. Write the answer in your data table.
10. Prepare your box for the next "meteorite".
  - a. Mix the cocoa into the flour.
  - b. Shake the box from side to side to even out the flour until it is smooth and level.
  - c. Add a new thin layer of cocoa.
11. Repeat steps 4-10 for all of your objects, each time recording the diameter of the three craters and the averages in the data table in your lab notebook.
  - a. Be sure to always drop the meteorites the same way and from the same height so that your results are accurate.
12. Now make a graph of your data.
  - a. You can make a graph by hand using graph paper or use a website like [Create a Graph](#) to make a graph on the computer and print it.
  - b. On the left axis (y-axis), plot the average diameter of the crater (in cm), and on the bottom axis (x-axis), plot the diameter of the meteorite (in cm).
13. What size craters did the smallest objects make? What size craters did the biggest objects make? Do you notice any pattern between the size of the crater and the size of the meteorite? What do you think your results tell you about how the diameter of a meteorite is related to the diameter of the crater it makes upon impact?