Cater Creation
Student Version

Adapted from "Exploring Space & Cyberspace: Live From Mars" Resource Book and NASA's "Mars Activities: Teacher Resources and Classroom Activities – Mud Splat Craters" located at mars.jpl.nasa.gov/classroom/pdfs/MSIP-MarsActivities.pdf

Why should your team do this activity?

What does a crater look like? What happens to a planet's surface during an impact? What are the features created during an impact? How do mass, velocity, size of the projectile, angle of approach, and type of surface material at impact affect how the crater looks? This activity will help you find out the answers to these questions and more.

Background Information

Almost all objects in the Solar System that have solid surfaces (including planets, satellites, and asteroids) have craters. While a few are of volcanic origin, most are the result of impacts from space. Much of the cratering we see dates back to a "period of bombardment;" in the early days of the Solar System, the gravitational pull of larger bodies attracted smaller objects causing the small objects to crash into these bodies. This process has been important in the evolution of the planets. Cratering caused early melting of the planets' crusts and excavated fresh sub-surface material. Impacts from space continue, but at a slower rate. A recent example is the collision of Comet Shoemaker-Levy 9 with Jupiter in July 1994.

Impacts are caused when meteoroids strike a planet or other object in space. A meteoroid is a particle of rock traveling through space. Size can range from microscopic to several meters across. The average size of the meteors we see at night (shooting stars) are probably no larger than a grain of sand. Speeds of meteoroids can exceed 50,000 miles per hour.

When we do see a streak of light in the night sky, which we call a meteor, it is caused by a meteoroid entering the Earth's atmosphere and vaporizing in a flash of light. The heat of friction between the meteoroid and the Earth's atmosphere produces the light. When a meteoroid actually strikes the Earth, it is known as a meteorite. On impact, large meteorites leave craters and may bury themselves deep in the ground.

The Earth, our Moon, and the planet Mars all bear the scars of impacts from space, but the Moon and Mars have many more craters than Earth. This is partly because water covers almost three-fourths of our planet, and partly because geologic processes like crustal movements and wind and weather have eroded most of the Earth's craters over time. There is no atmosphere or plate tectonics on the Moon, where many craters are visible. Many lunar craters still have steep walls and are very rugged in appearance--evidence of the lack of weathering.

Mars occupies a middle ground between the Earth and the Moon in terms of craters. Widespread cratering is visible, but more craters are seen in Mars' southern hemisphere than in the north. Since the bombardment was presumably uniform across the planet, the relative lack of craters in the north correlates well with the evidence of geological activity we can see in the region (faulting, uplifting, volcanism and flooding). Also, Martian craters show the effects of weathering. They are shallower, have lower rims, and look much less rugged than most lunar craters.

The Necessities:

- ★ Flour and Cocoa
- ★ Fairly clean dirt
- ★ 3 balls the same size (approx. 1" across) but of differing weights / masses
- ★ 3 marbles/balls of different sizes
- ★ Large tub or pan *(plastic dishpans or double layer foil roasting pans work best)*
- ★ Plastic sheeting *(to keep the floor clean if you're inside)*
- ★ Aprons or old front button shirts *(to protect clothes)*
- ★ Water pitcher filled with water *(to create mud)*
- ★ Large spoons to mix the mud and sturdy plastic spoons
- ★ Ruler and meter stick
- ★ Baby wipes or paper towels to clean mud off skin
- ★ Broom and dustpan
- ★ Crater Creation Answer Sheet
- ★ Pens, Pencils and Idaho TECH Lab Notebook

Illustration 1: This diagram shows the stages of an impact of a crater. Used by permission CRATERS! by William K. Hartman with Joe Cain.

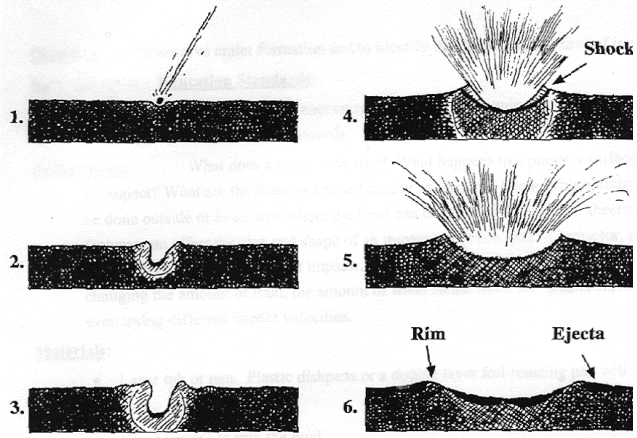
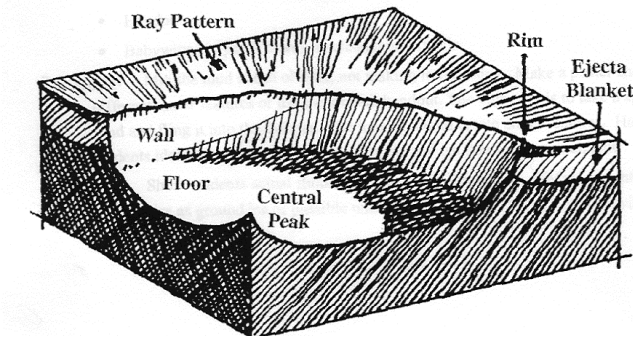


Illustration 2: This diagram shows the features created by an impact crater. Used by permission of CRATERS! by William K. Hartman with Joe Cain.



Directions:

1. Fill the large tub or pan with flour approximately 3" deep, sprinkling a little cocoa on the surface to help make the changes more visible.

2. Form a hypothesis about each cratering test prior to conducting the tests described in Step #3 and Step #5 (there are a total of 5 tests).

3. With your teacher or parent's help, conduct the four cratering tests described below. Choose one team member to record measurements and observations. Choose another team member to drop the balls / marbles / mud into the tub. One to two team members can describe the resulting crater to the recorder. Finally, one to two team members can measure the crater diameters. You may want to switch roles between each experiment. After each crater test, smooth out the flour and sprinkle additional cocoa on the surface before you conduct another test.

Experiment #1: How mass affects impact craters

- ★ Using the 3 balls that have the same size but differing masses, drop the first ball into the flour from a height of 2 meters. Record the diameter of the crater created.
- ★ Repeat the process with the remaining 2 balls. Be sure that each ball is dropped from the same height above the box.

Experiment #2: How velocity affects impact craters

- ★ Using the largest marble, drop it into the flour from a height of 10cm. Record the diameter of the crater created.
- ★ Repeat the process with the same marble dropped from 1 meter above the box and 2 meters above the box.
- ★ From a height of 2 meters above the box, *throw* the marble into the box and record the diameter of the crater created.

Experiment #3: How size of projectiles affects impact craters

- ★ Using the 3 different sized marbles, drop the smallest marble into the flour from a height of 2 meters. Record the diameter of the crater created.
- ★ Repeat the process with the remaining 2 marbles. Be sure that each marble is dropped from the same height above the box.

Experiment #4: How angle of approach affects impact craters

- ★ Using the largest marble, throw it into the flour with a moderate amount of force. Record the shape and diameter of the crater created.
- ★ Using the same marble and the same amount of throwing force, repeat the process while varying the angle of the marble's approach. Be sure that the height from which the marble is thrown remains constant.

4. Now you will try making craters in a different medium - mud! Be sure you do this part of the activity outside or in an area where the floor can be covered with plastic sheeting. Also, wear aprons or old shirts over your clothes to keep them clean!

5. Empty your tub or pan of flour. Mix the dirt with some water in the tub or pan to create mud. Be careful not to add too much water – you don't want the mud to be soupy! Then conduct the fifth experiment below.

Experiment #5: How the type of surface material affects impact craters

- ★ Scoop a spoonful of mud out of the pan.
- ★ Carefully fling the mud back into the box.
- ★ Record the diameter of the crater created. Repeat this several times.
- ★ How do these craters compare to the craters you created in the flour?

6. When you are done with all five tests, compare your results with your five original hypotheses. Form a statement for each test that explains your results, and record this information in your Lab Notebook. Ask your teacher for help with this if you get stuck.

Crater Creation Answer Sheet

Experiment # 1: How Mass Affects Impact Craters

How do you determine an object's mass?

State your hypothesis (What do you think will happen?):

Record the following:

Mass of Ball 1:_____ Diameter of Crater 1:_____
Mass of Ball 2:_____ Diameter of Crater 2:_____
Mass of Ball 3:_____ Diameter of Crater 3:_____

Experiment # 2: How Velocity Affects Impact Craters

What does velocity mean?

State your hypothesis:

Record the following:

Diameter of crater 1 when ball is dropped from 10 cm: _____
Diameter of crater 2 when ball is dropped from 1 meter: _____
Diameter of crater 3 when ball is dropped from 2 meters:_____
Diameter of crater 4 when ball is thrown from 2 meters: _____

Experiment # 3: How Size of Projectiles Affects Impact Craters

State your hypothesis:

Diameter of crater created by smallest ball: _____
Diameter of crater created by medium sized ball: _____
Diameter of crater created by largest ball: _____

Experiment # 4: How Angle Affects Impact Craters

State your hypothesis:

Diameter of crater when ball is thrown from above: _____
Diameter of crater when ball is thrown from ____angle: _____

Diameter of crater when ball is thrown from ____angle: _____

Experiment # 5: How the type of surface material affects impact craters:

State your hypothesis:

Diameter of crater(s) when mud is flung with spoon: _____

General Observations about craters in mud versus craters in dry sand/dirt: