Creating Craters

Objective:

Students will learn about the formation of craters and their structure.

National Science Standards:

Standard A: Abilities necessary to do scientific inquiry
Standard F: Natural hazards

Materials:

- Plastic dish pan or shallow box
- Flour
- Red or brown tempera paint, powdered cocoa, or chocolate cake mix (You will need a smaller amount of a different color for the last crater exercise.)
- Sieve or flour sifter
- Slotted serving spoon
- Small rocks, marbles, or different sized balls to use as meteorite impactors
- Ruler
- Weight balances or scales
- Slides, posters, pictures, or planetary globes that show cratered surfaces
- Meter stick
- Student sheet
- Two colors of crayons or colored pencils

Engage:

Brainstorm with the class (or in small groups) about how craters are formed. Show students the crater posters. Ask them to predict if there is a relationship between the mass of the object, the size of the object and how it will affect the formation of the impact crater. Predictions can also be made about how increasing the velocity (speed) of the impactor will affect the diameter of an impact crater.

Exploration:

Suggested student group size is three to four. Fill the pans up with up to three inches of flour before the students begin.

Part 1: Formation of Impact Craters

A. How mass affects impact craters.
   1. Students will determine the mass of three objects and use their results to determine whether this variable does indeed affect the size and shape of the resulting impact crater. It would be useful to find impactors that have different sized masses for example a small rock, a small marble, or a small metal ball-bearing.

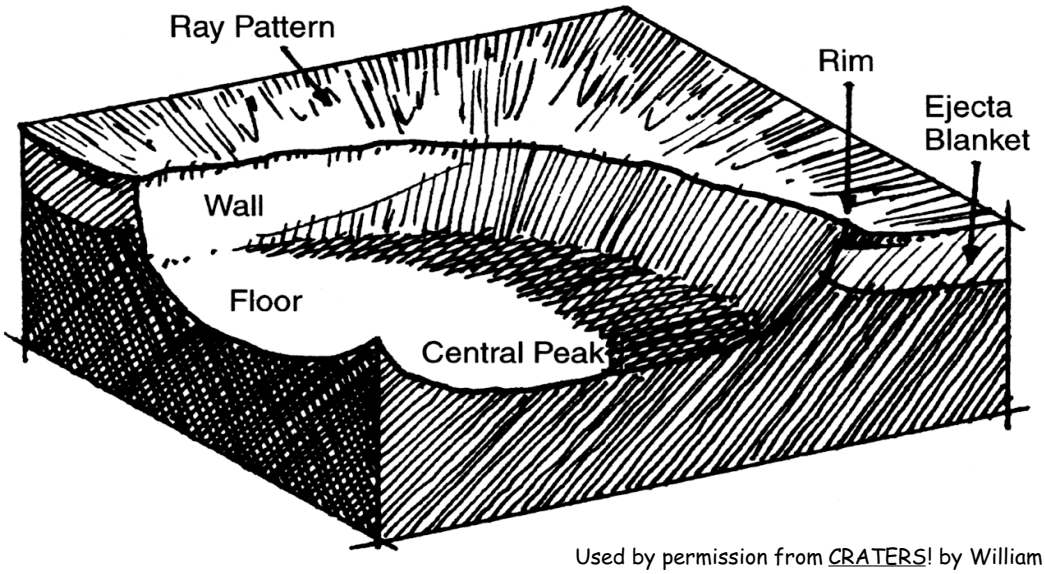
B. How velocity (speed) affects impact craters.
   1. Students will drop a impactor from different heights in order to see how velocity will affect the size and shape of the impact crater. It is

important that they use the same impactor for each drop. A small rock or marble would be a good impactor.

C. How size of projectiles affects impact craters.
   1. Students will use three different-sized impactors to determine how size affects the shape and size of an impact crater. It would be easiest to use three different sized rocks.

Part 2: Crater Structure

A. Parts of an impact crater.
   1. Students will use the drawings from parts A, B, and C to identify the features of the impact crater. They will identify the rim, ejecta, central peak, ray pattern, crater wall, and crater floor and label each.



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B. Layers in the impact crater.
   1. Students will use a layer of tempera paint to represent the layers of the rocks and determine the dispersal pattern of these layers after an impact.

Extensions:

1. Describe a simple experiment to create an impact crater that looks like the crater at http://mars3.jpl.nasa.gov/mgs/msss/camera/images/8_13_98_ejecta_rel/index.html

2. Compare the shape of the impact crater you drew with the Martian volcano Olympus Mons. Write a description of an impact crater for someone who has never seen one. You can find it at: http://mars3.jpl.nasa.gov/mgs/msss/camera/images/8_13_98_ejecta_rel/index.html

Credits: Passport to Knowledge - Live From Mars - Activity 3.2
Adapted by ASU Mars K - 12 Education, Tempe, AZ.

Name_____

Creating Craters

Part 1: Formation of Impact Craters

A. The affect of mass on impact craters.

Procedure:

1. Smooth the flour in the tray with the ruler and sprinkle a thin layer of tempera paint on top of the flour. It is important that the light dusting of the tempera paint completely covers the flour in the area where the impact will take place.
2. Find the mass of the objects and fill in the table below.
3. Drop your first impactor into the flour and measure the width of the crater (the diameter) and record it on the chart.
4. Draw your crater in the space provided. (Note: The movement of the tempera paint is important because it represents ejecta from the impact.)
5. Smooth the flour flat again and repeat steps 2 - 4 for each object.

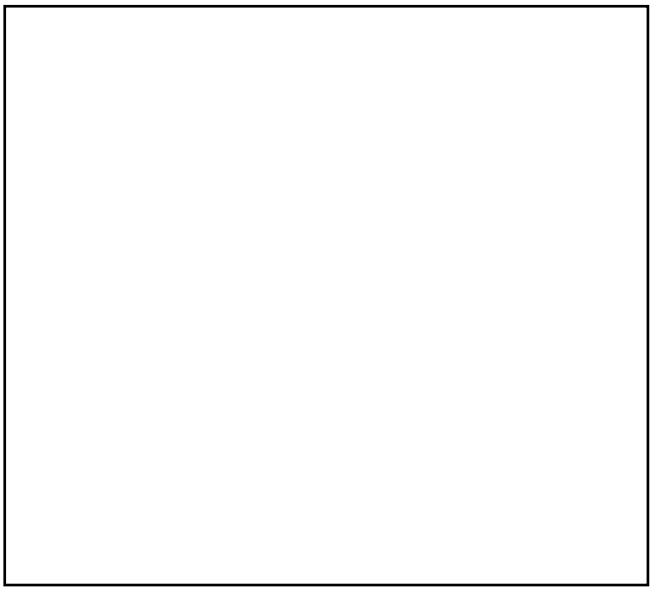
Object	Object Type	Object Mass	Crater Diameter
Impactor #1		_____ g	_____ cm
Impactor #2		_____ g	_____ cm
Impactor #3		_____ g	_____ cm

Observations:

Crater #1 - Least Mass

Crater #2 - Middle Mass

Crater #3 - Heavy Mass*.



Conclusions:

1. Compare your craters. Which is the largest? Why?

2. Can you form a hypothesis (make a scientific guess) about the relationship between the mass of the impactor and the size and shape of the crater?

B: The affect of velocity on impact craters.

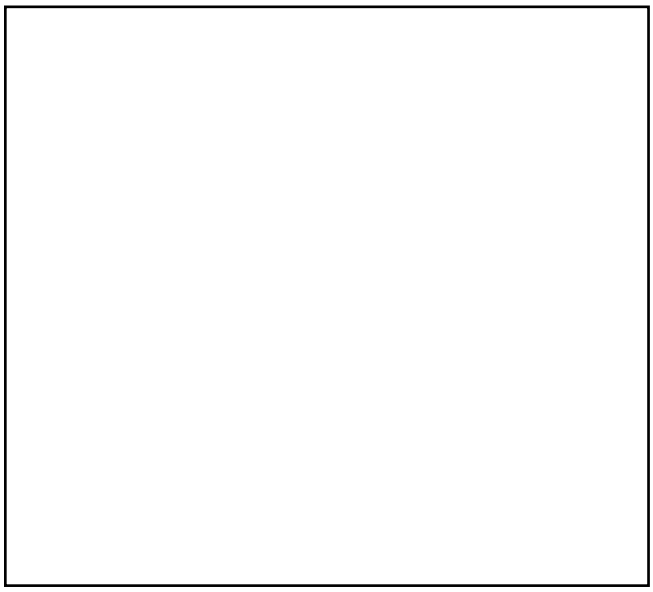
Procedure:

1. Smooth the flour with the ruler, spinkle a thin layer of tempera on top, same as before.
2. Drop one impactor from a height of 10 cm. Record the crater diameter on the chart and draw your results below.
3. Smooth the flour with the ruler, sprinkle a thin layer of tempera on top.
4. Drop the impactor from a height of 50 centimeters. Record the crater diameter on the chart and draw your results below.
5. Smooth the flour and add the tempera.
6. Drop the impactor from a height of 1 meter. Record and draw your results.
7. With teacher permission, gently toss the impactor into the flour and record your results. (Do not forget to smooth the flour and add tempera paint first.)

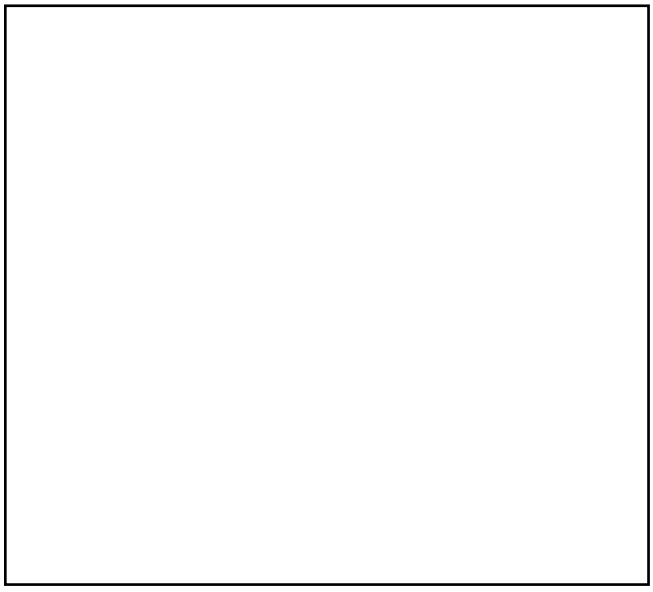
Drop #	Velocity	Height	Crater Diameter
1 (10 cm)	140 cm/s	10 cm	_____ cm
2 (50 cm)	443 cm/s	50 cm	_____ cm
3 (1 m)	626 cm/s	100 cm	_____ cm
4 (gentle toss)	1000 cm/s	about 100 cm	_____ cm

Observations:

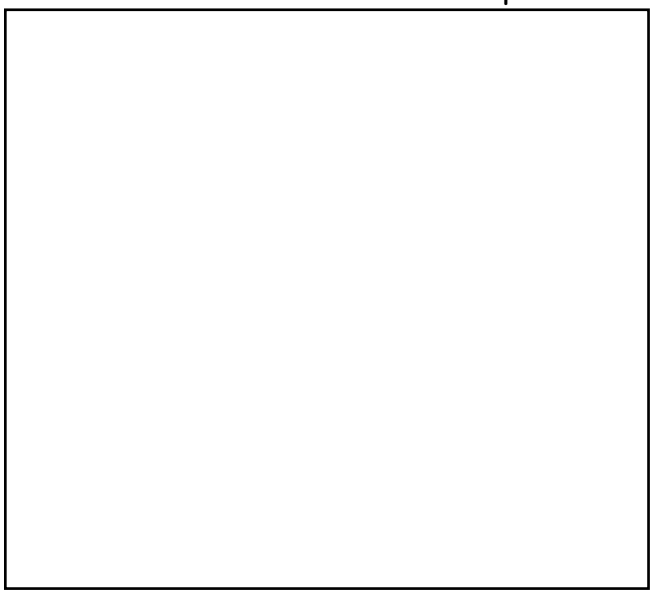
Crater #1 - 10 cm drop



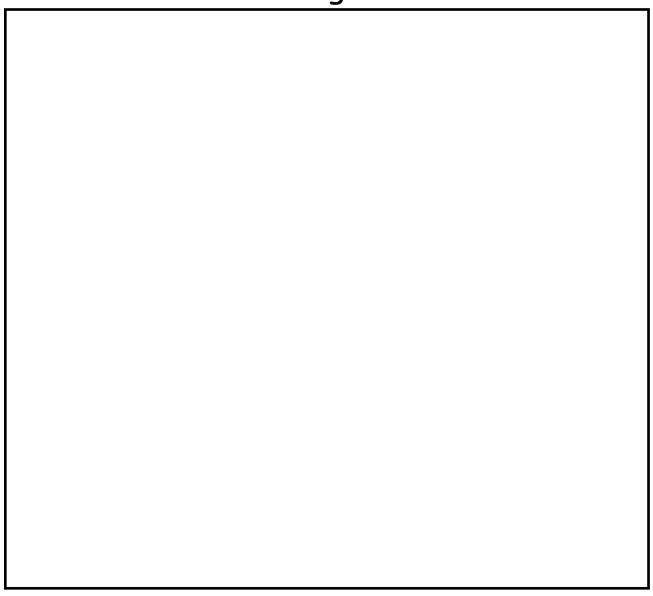
Crater #2 - 50 cm drop



Crater #3 - 1 meter drop



Crater #4 - gentle toss



Conclusions:

1. Compare your craters. Which is the largest? Why?

2. What variable differed when you made the craters?

C: The Affects of the Size of the Object on Impact Craters.

Procedure:

1. Use the three different sized impactors and drop them from a height of 1 meter.
2. Record the diameter on the data chart below and draw your results. (Note: Do not forget to smooth your flour and add a thin layer of tempera between each drop.)

Object	Impactor Diameter	Crater Diameter
Impactor #1	_____ cm	_____ cm
Impactor #2	_____ cm	_____ cm
Impactor #3	_____ cm	_____ cm

Observations:

Crater #1 - Small diameter

Crater #2 - Medium diameter

Crater #3 - Large diameter

Conclusions:

1. Compare your craters. Which is the largest? Why?

2. What variable differed when you made the craters?

D: Variable Conclusions.

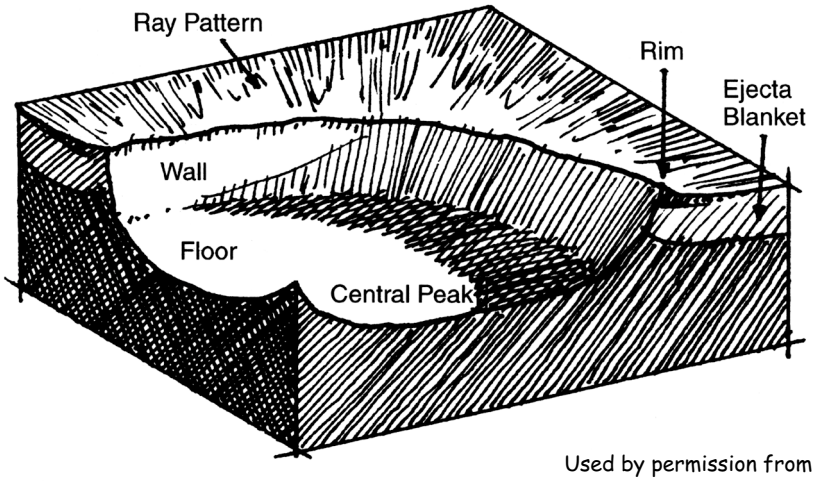
1. Based on your previous experiments, which variables affect the size and shape of an impact crater the most? the least?

2. What combination of these variables will produce the largest impact crater?

Part 2: Crater Structure

A: Parts of an Impact Crater.

Procedure:
1. Look back at your crater drawings from Part 1.



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2. Do you see any of the listed crater features in your drawings? Label them. Be sure to use each label at least once.

B: The Layers of an Impact Crater.

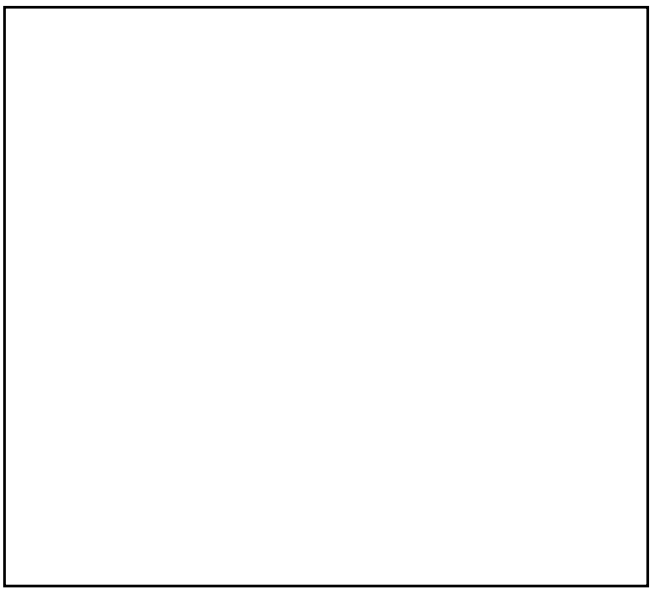
Procedure:

1. Smooth out a layer of flour and coat it with a layer of tempera paint. It should be a little thicker than the thin layers you have used before. It is important that the tempera completely covers the flour.
2. Sprinkle another color of tempera paint over the first layer. Be sure that the first layer is completely covered in the area where the impact will take place.
3. Take the large impactor and drop or gently toss it from a height of approximately 1 meter.
4. Draw the crater below. Pay special attention to the differences in the color of the ejecta because they represent the layers of rock that have been impacted.
5. Measure the crater's diameter. How does it compare with the diameter from the large impactor drop in Part 1: Section C?

Observations:

Draw your crater and label its parts.

Large impactor - 2 colors



Conclusions:

1. Where is the crater ejecta the thickest?

2. If the flour layers from top to bottom are youngest (top) to oldest (bottom) before the impact, where in the new crater do you find the oldest rocks? Why?

3. Color and label the younger rock layers and older rock layers in your crater picture.