Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

1 University Station C9000
Austin, TX 78712
(512) 471-5847
www.esi.utexas.edu

Modeling Impact Craters

Lesson plan for grades 5-7 and 11-12
Length of lesson: 31-60 minutes
Adapted by: Laura Sanders, Environmental Science Institute, October 2011
Authored by Rebecca Powell, Covington County Red Level High School

SOURCES AND RESOURCES:

- Alabama Learning Exchange
  http://alex.state.al.us/lesson_view.php?id=11749
- Impact Craters on the Moon, Enchanted Learning,
  http://www.enchantedlearning.com/subjects/astronomy/moon/Craters.shtml
- Georgia State University, Astrophysics and Moon Concepts
  http://hyperphysics.phy-astr.gsu.edu/hbase/solar/mooncon.html#c1
- PBS Dragonfly TV
  http://pbskids.org/dragonflytv/show/mooncraters.html
- NASA
  www.nasa.gov

POTENTIAL CONCEPTS TEKS ADDRESSED THROUGH THIS LESSON:

§112.16. Science, Grade 5: 8D
§112.18. Science, Grade 6: 11A, 11C
§112.19. Science, Grade 7: 9A, 9B
§126.33. Astronomy, Grades 11-12: 9A, 9B, 14A, 14B, 14C, 14D, 14E
§126.36. Earth and Space Science, Grades 11-12: 5D, 5E, 5F, 7A, 7B, 7C

PERFORMANCE OBJECTIVES:

Students will be able to:

- Measure, record and compare impact crater sizes
- Infer how impact craters were formed
- Explain the reasons for the differences in impact crater sizes

MATERIALS (per group of four):

- Newspaper
- Aluminum pan
- Several cups of flour
- Cocoa powder
- Safety goggles

1 University Station C9000
Austin, TX 78712
(512) 471-5847
www.esi.utexas.edu

- Apron
- Marbles (rocks) of varying sizes, at least one large and one small
- Meter stick
- Computer with internet access
- Science journal for recording data and observations

ENGAGE

Divide the class into groups of 4. Students are to work in their groups with NO assistance from phones, computers, or reference books – they may only use their own minds and group collaboration to brainstorm.

Ask: How many dollar bills would need to be stacked vertically to reach from here in our classroom to the moon? In other words, how much money would we need to reach the moon?
[Answer: A stack of 1000 one-dollar bills are 4.3 inches tall. The moon is 15,133,976,377.95 inches away. Therefore, 3,519,529,391 sets of 1000 bills would be needed, meaning a total of 3,519,529,390,221 bills. So much money! How much money would that mean if they were five-dollar bills instead of one-dollar bills? What if they were hundred-dollar bills?]

Note to teachers: This is purely an exercise to help students get excited about talking about the moon and to get their minds going. They are welcome to take dollars out of their pockets and try to measure their thickness, do whatever math they want, estimate how far away they think the moon is, etc. the point is the process more than the answer. They aren't expected to know the correct answer. Other questions would work, such as "How many craters are on the moon?" The answer to this could lead into talking about fractals.

EXPLORE:

1. Divide students into small groups, each with each one of the materials listed above.
2. Students should construct tables in their science journals to record their data during this investigation. Considerations include spaces for marble size, height (dropped from), angle (dropped from) and crater width and/or crater depth.
3. Groups are to place the newspaper on the floor and put the pan in the center of the newspaper. Goggles and aprons protect eyes and clothes. Pour several cups of flour into the pan to model a section of land on the moon. Sprinkle a layer of cocoa lightly over the flour to aid in crater visibility.
4. Hold a marble at a height 20 cm above the floor. Let the marble drop straight down onto the flour.
5. Remove the marble carefully. Measure the width of the crater and record the measurement on the table. Hypothesize what difference height, marble size, and/or angle of the drop will make in the diameter of a crater.
6. Repeat this exercise for a different size marble at the same height. Record the results.
7. Repeat this exercise for each marble size at multiple heights from the floor, such as 40 cm, 60 cm, 80 cm and 100 cm.

1 University Station C9000
Austin, TX 78712
(512) 471-5847
www.esi.utexas.edu

EXPLAIN AND ELABORATE:

The class can discuss the following questions and write responses in their science journals:

- Were the student hypotheses correct? Why or why not?
- What trends did the students observe? Examples:
    - Compare the diameter of the craters to the height of the drop. How does the distance of the marble affect crater size?
    - Compare the diameter of the craters to the angle of the drop. How does the angle of the incoming marble affect crater size?
- Were the trends the same across all of the groups?
- Why do they think they got the results they got? What does this allow them to infer about the impact craters on the moon? What might have caused the craters?

Students in groups should look up information about impact craters online and see if their results match those published. Addition resources for potential use are listed above in "Sources and Resources." They can cite the information they find in an investigation write-up.

EXTENSION:

1. In instances where several craters overlapped, how could you determine which crater was formed first? If this was not noted and observed, investigations could be run again testing for this specifically. Observe and compare what each crater looks like and diagram this in science journals. Most of the craters on the moon were formed long, long ago. What could you infer from the model about how the moon's craters were formed and which may be older than others? Use the internet to find pictures of the moon's surface and try to determine which craters are the oldest and which are the newest.
2. Try using different materials to make the moonscape. Put a one-inch layer of sand in the pan, then a thin layer of flour and cocoa powder. How does this change the shape and size of the craters when you drop the marbles now?
3. Find a moon map and learn the names of some of the craters. Many craters are named after scientists. Learn about the scientists whose names appear on the moon map.
4. We see only one side of the moon. How would we get a view of the backside?