

Multiple Impact Craters

NASA Engineering Briefing

Narrative: Geologists have been studying craters on Earth for a very long time. Scientists, and the general population, have wondered how they were formed. Questions have been asked about how big were the impactors that caused the craters, will there be more impactors in the future, and how might another large impact affect life on Earth? These questions and many more have not yet been answered completely.

Scientific knowledge about lunar impact craters was greatly expanded by the NASA ***Apollo missions***¹ to the Moon in the mid twentieth century. Before Apollo, the origin of lunar impact craters was not fully understood and the origin of similar craters on Earth was highly debated. Information gathered from the Apollo explorations has given us a greater understanding of the timescales for the evolution of the ***terrestrial planets***².

Scientists want to learn more about the history and effects of ***multiple impact craters***³ on the inner planets. Since no humans have yet set foot on Mercury, Venus, or Mars, we must study the geology of these planets from photographs (***photogeology***⁴) collected by robotic space flights and/or earthbound telescopes.

NASA scientists work with NASA engineers to design and create devices and models to better understand how objects in the solar system behave. Designing and creating devices that can replicate events in nature can help scientists to better predict future events or to better understand patterns of events that have already occurred. In this case, we will be studying the formation of multiple impact craters.

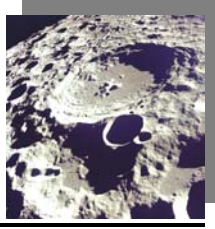
Problem: You are part of a team of NASA engineers who have been asked to design and create a prototype of a “crater replication device” that will replicate multiple impact craters.

¹ ***Apollo missions:*** six lunar landing missions that took place between 1969 and 1972.

² ***Terrestrial planets:*** Mercury, Venus, Earth, and Mars.

³ ***Multiple impact craters:*** occurrences of multiple circular, raised-rimmed depressions formed by explosions that occur when comets and asteroids collide with the Moon (or other planetary surface) at high velocity in a given area.

⁴ ***Photogeology:*** studying geology using pictures



Multiple Impact Craters Research

Research the Need or Problem:

<http://www.exploratorium.com/exploring/space/space5.html> Asteroids and Early Earth History

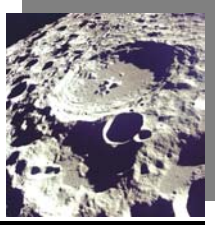
<http://www.lpi.usra.edu/expmoon/science/craterstructure.html> Lunar Impact Crater Geology and Structure

<http://www.enchantedlearning.com/subjects/astronomy/moon/Craters.shtml> Impact Craters on the Moon

http://www.lpl.arizona.edu/SIC/impact_cratering/intro/ Terrestrial Impact Craters and Their Environmental Effects

<http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/Once.and.Future.Moon/Once.and.Future.Moon.pdf>

<http://www.lpl.arizona.edu/SIC/poster1.html> Environmental Effects of Impact Cratering Poster



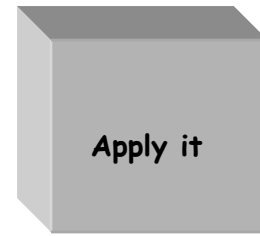
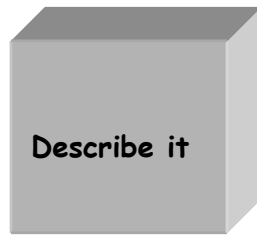
Multiple Impact Craters **Materials List**

Materials:

aluminum pie pans
flour
cocoa
clay
newspaper,
watering can
duct tape
pebbles
steel balls
straws
string
rubber bands
eye dropper
turkey baster
digital camera

CUBING

Multiple Impact Craters



RULES FOR CUBING

1. Use all six sides of the cube in any order.
2. Move fast. Don't allow yourself more than 3 to 5 minutes on each side of the cube.
3. Jot down your ideas as you progress from side to side.

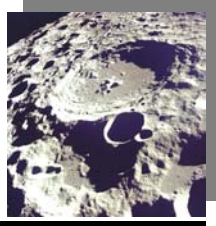
For the cubing technique, you need to use all six sides. This is not an exercise in describing, analyzing, or arguing. It is simply a technique to help you brainstorm and look at multiple impact craters from different perspectives. There are no wrong answers in a brainstorming activity.

- Describe it. Look at the photo of the multiple impact craters closely and describe what you see. Colors, shapes, sizes, and so forth.
- Compare it. What is it similar to? What is it different from?
- Associate it. What comes to mind when you think of it? Just let your mind go and see what associations you have with this photograph.
- Analyze it. Tell how you think it was made or formed.

- Apply it. Tell what you can do with it. How can it be used?
- Argue for or against it. Go ahead and take a stand. Make an argument based on how you think the craters were formed.

Now go back and reread the notes you have jotted down and prepare to share your team's perspectives with the rest of the class.

Sketch it. Based on available materials, make a sketch of the device you will create to replicate the multiple impact craters you have seen in the photographs. Your team must then work together to create a proposal, which you will present to the class, about what that device will look like.



Multiple Impact Craters
Best Possible Solution

Team members:

Consolidate and organize your brainstorming ideas and research by answering the following questions as a team:

- What do we think we know about the formation of multiple impact craters?

- What do we still need to learn about the formation of multiple impact craters?

- What do we need to know in order to create a prototype of a crater replication device?

Based on your team's discussions, research and available materials, sketch the crater replication device. Be prepared to present your proposal to the entire class.

