Meteorite

Activity

In this activity, you will make your own impact craters by dropping “meteorites” onto a planetary surface. You will explore the craters formed by different sized meteorites, which you can compare by recording your results and plotting a graph. Be sure to watch the video instructions for helpful tips on conducting the experiment!

The Science

Space is not as empty as you might think – accompanying clouds of gas and high energy radiation are rocky materials. Most of these are dust-sized (called micrometeorites when they reach the Earth’s surface), but larger objects are also flying around and may collide with planets or moons as meteorites.

These impactors sculpt planetary landscapes – on Mercury, for example, micrometeorites erode rocks on the surface, smoothing them out. Larger meteorites can be more disruptive, forming observable craters and causing gardening, where the outermost rock layers of a planet are dug up, broken apart and redistributed as a surface soil, called regolith (represented by cocoa powder in this experiment).

Impacts are important to study because they help us understand how planets may form and what the Solar System is made of. It is also vital to model the effects of an impact since their occurrence can be catastrophic to life and the environment – just like the impactor thought to have wiped out the dinosaurs 66 million years ago.

Craters are useful evidence for meteorite impacts over geologic time – their size and shape may tell us about the impact event that caused them. However, the combination of a geologically active surface (due to plate tectonics) and an atmosphere, which burns up many incoming rocks, means there are relatively few craters on Earth. Next time there is a clear night sky, look up at the Moon – can you see any craters? Do you think the Moon has an atmosphere and an active surface?

Materials

- Near-spherical objects of different sizes – at least 3 (e.g. tennis ball, kiwi, bouncy ball), solid objects larger than 2 cm will work best
- Cardboard box or equivalent container (e.g. storage box, casserole dish, baking tray) approximately 30 x 40 cm, depending on size of spherical objects
- Flour (enough to fill container with 4 cm depth – depending on container size, approximately 2 kg)
- Cocoa powder
- Sieve
- Ruler
- See *Further Investigations* for optional extra materials

Activity instructions

Note: flour may spill from container – you may want to do this outdoors or cover the experiment area (e.g. old towel or cling film).

1. Pour flour into the container and shift side to side to create a flat surface. The flour should be approximately 4-5 cm deep.
2. Sieve a thin layer of cocoa powder to cover the surface.
3. Measure the diameter of your "meteorite" (spherical object).
4. Drop the object from approximately 50 cm height into the container. *If you have access to a camera or smartphone with a slow-motion video setting, you may like to record the impact and watch how the surface responds.*
5. Measure the diameter of the crater and note down any other features of interest (e.g. crater shape, "secondary" craters formed by flour that was thrown out of the crater, lines of cocoa coming from the crater, known as "rays"; see *Parts of a Crater* resource below for things to look for). Your results can be summarised in a table like this:

Object	Object Diameter (mm)	Crater Diameter (mm) 1	2	3	Average Crater Diameter (mm)	Other Observations
Tennis ball						
Hard boiled egg						
Kiwi fruit						

6. Repeat steps 4-5 for the object twice more, dropping into a clean area of flour/cocoa. Calculate an average crater diameter from the three drops.
7. Refill the flour, ensuring the surface is flat (cocoa from the previous object can be mixed in then covered with a new layer of flour, approximately 0.5-1 cm thick), then sieve a new cocoa powder layer on top.
8. Repeat steps 4-7 for each additional object
9. Plot a graph, comparing meteorite diameter and crater size. Remember, your independent variable – the thing you change – is plotted along the x-axis; the dependent variable plots on the y-axis. What can you say about the relationship between meteorite and crater sizes?

Further investigation

- Different target rock: not all planetary surfaces are the same. Some may be powdery, whilst others are compact - Replace the flour with caster sugar, granulated sugar, sand (does wet vs. dry make a difference?) – or anything else you can think of!
- Different impactors: meteorites have different compositions, changing their densities. Compare the craters formed by two objects with a similar size, but different mass (e.g. cricket ball vs. tennis ball).
- Different speeds: meteoroids (a meteorite that's still flying around in space) travel more than 10x the speed of a bullet. However, planets with atmospheres, like Earth, can slow down and even break up incoming meteorites. How might this change the craters? Can you think of a way to simulate this (consider the drop height)?
- Different angle: meteorites won't always land from directly above a surface. Try dropping the object with more of an angle (you may need to throw a little).