ASTROEDU

Peer-reviewed Astronomy Education Activities

Meteoroids, Meteors and Meteorites

Learn about formation of meteoids.

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AGE

6 - 12

LEVEL

Primary, Middle School, Secondary

TIME

1h30

GROUP

Group

SUPERVISED

Yes

COST PER STUDENT

Low Cost

LOCATION

Small Indoor Setting (e.g. classroom)

CONTENT AREA FOCUS

Astronomy

ASTRONOMY CATEGORIES

Planetary systems

CORE SKILLS

Asking questions, Analysing and interpreting data, Engaging in argument from evidence, Communicating information

TYPE(S) OF LEARNING ACTIVITY

Interactive Lecture, Lecture Demonstration, Case Study

KEYWORDS

Meteors, meteorites, asteroids, shooting stars, comets

GOALS

- Learn the difference between meteoroids, meteors and meteorites
- Learn that shooting stars are not stars but meteors
- Learn that meteorites can affect life on Earth
- Learn about the origins of meteoroids

LEARNING OBJECTIVES

- Explain the differences between meteoroids, meteors and meteorites
- Demonstrate how meteoroids are formed using flint stones. Students will demonstrate how small pieces can break off when two asteroids collide or when a comet warms and begins to melt.
- Explain that shooting stars are not actually stars
- Understand the impact of a meteorite

EVALUATION

- Students should list the differences between meteoroids, meteors and meteorites
- Students should explain the process of how meteoroids are formed, from both asteroids and comets
- Students should understand that shooting stars are meteors
- Students should provide examples of how meteorite impacts have affected life on Earth

MATERIALS

- Rocks, preferably flint
- Safety glasses
- Cup (or similar-sized freezer-proof container for use as a mould)
- Water
- Gravel sized rocks and/or sand
- Freezer
- Printed worksheets
- Projector for watching video and images.

BACKGROUND INFORMATION

The Solar System not only consists of planets and satellites but also many other objects such as asteroids, comets and meteoroids.

Asteroids are celestial bodies orbiting the Sun, and they are made of rock or metal (mostly iron) or a combination of the two. Most asteroids orbit the Sun in a ring located between Mars and Jupiter; however, some orbit in other places. Because of the gravitational interactions with both Jupiter and the Sun, these asteroids never managed to assemble, stick together and form a planet like the Earth.

Comets orbit the Sun in a much different way. They have elliptical (oval shaped) orbits, which bring lead from the outer reaches of the Solar System close to the Sun and then back out again. Comets are made up of rocks, cemented together by ice. As they near the Sun, the ice on the surface begins to melt, giving them a huge characteristic tail of water, steam and dust.

The space between our planets is populated by billions of smaller particles, which orbit around the Sun. They are called meteoroids, and according to the International Astronomical Union, they are larger than a micron (a thousandth of a millimetre) and smaller than a meter in diameter.

A **meteor** is the flash of light that we see in the night sky when a small chunk of interplanetary debris burns up as it passes through our atmosphere, also known as a shooting star. Most meteoroids that enter the Earth's atmosphere are so small that they vaporise completely and never reach the planet's surface.

These meteors come from **meteoroids**, there are three main sources of meteoroids. Many are left over from the dust that formed the Solar System. Others are fragments of asteroids, broken off in collisions. Huge meteor showers, caused by many meteoroids entering the atmosphere in one go, are caused by comets. They occur when the Earth's atmosphere passes through a stream of small particles left behind in the comet's tail.

If any part of a meteoroid survives the fall through the atmosphere and lands on Earth, it is called a **meteorite**. Although majority of the meteorites are very small, their size can range from about a fraction of a gram (the size of a pebble) to 100 kilograms or more (the size of a huge, life-destroying boulder).

Although active processes on Earth's surface quickly destroy the impact craters formed by meteorites, about 190 terrestrial impact craters have been identified so far. These range in diameter from a few tens of meters up to about 300 km, and they range in age from the recent times to more than two billion years. The discovery of a 180-km wide crater in Mexico is suggested to be responsible for the extinction of dinosaurs over 66 million years ago.

FULL ACTIVITY DESCRIPTION

Preparation

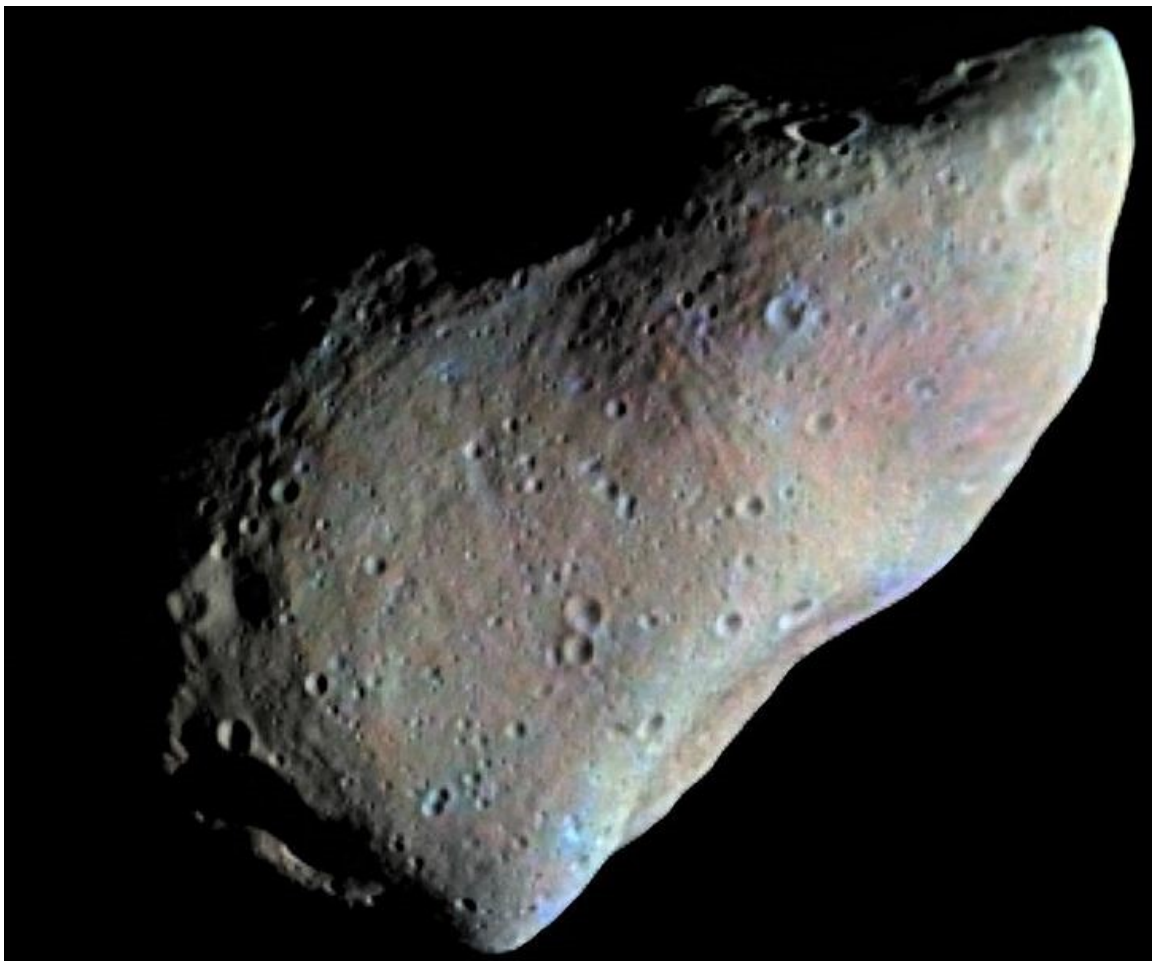
For the comet demonstration, students will need to mix small pieces of gravel and/or sand with water in a cup (or another suitable mould). This should then be frozen before the activity starts.

The students should complete their worksheets by answering each question.

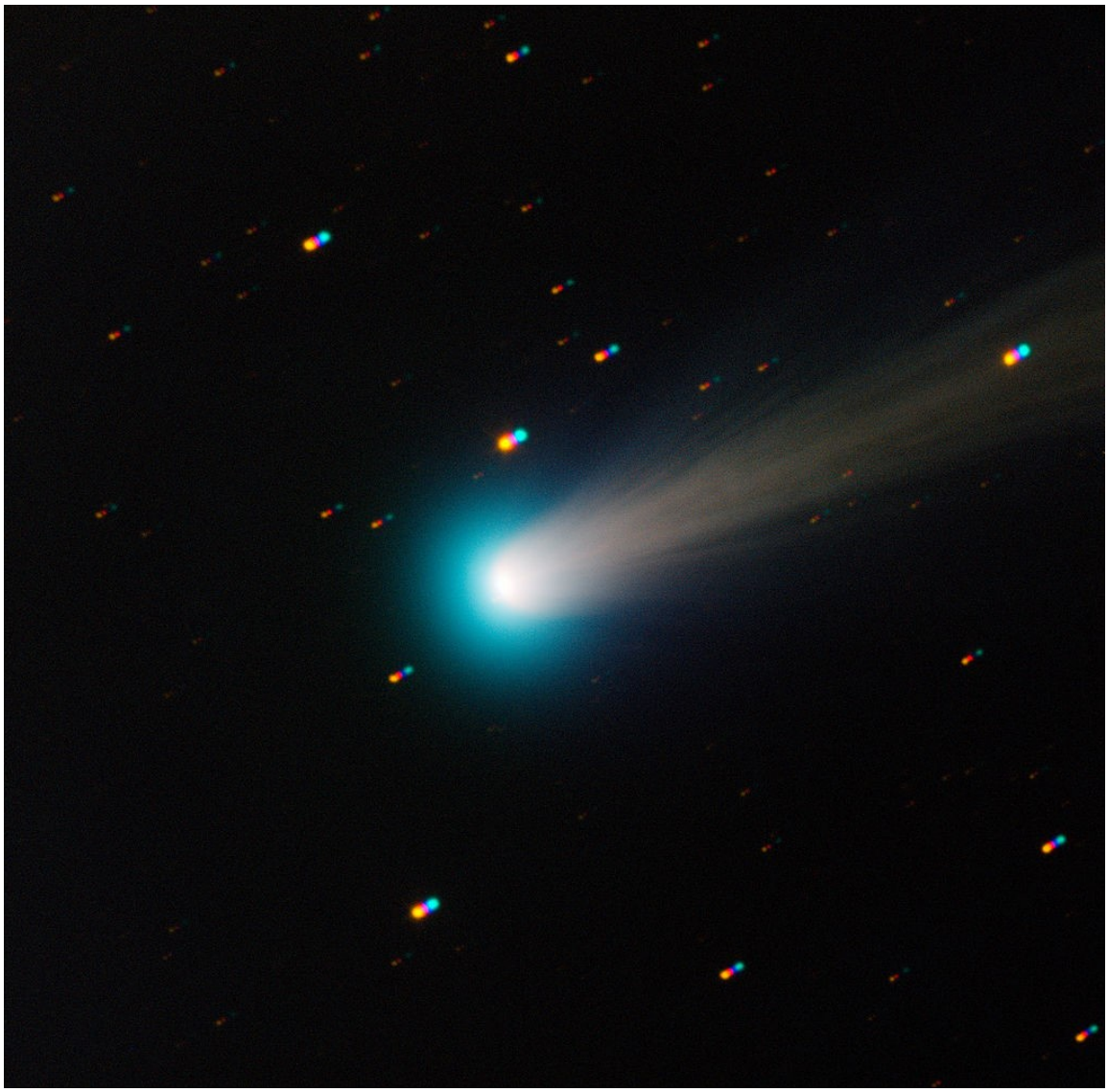
Meteoroids, Asteroids and Comets

Ask the students to name the objects that may be found in the Solar System and list them on a board. Tell the students that the main topic of the lesson is Meteors/Shooting Stars.

Pass around the rocks, explaining that they symbolise asteroids. Explain what an asteroid is using the background information and the following image (Asteroid Gaspra).



Pass the comets around the class so the students can see what it is made of. Explain what a comet is using the background information and the image (Comet ISON). You may wish to demonstrate how the tail is formed by slowly sliding it across a warm desk and looking at the tail that forms.



(Image note: The coloured blobs are stars – the different colours are because of the way the image was taken)

Explain what a meteoroid is. Explain that many meteoroids are simply small pieces left over from the formation of the Solar System, which did not get formed into planets.

Ensuring that the students are wearing safety goggles and have been warned of the dangers of sharp fragments, ask them to knock the ‘asteroid’ rocks together to see how meteoroids are formed from asteroids.

Show them how the comet has now melted and that the small rock fragments inside it have become meteoroids.

Meteors

Ask the students if they have ever heard of shooting stars, or if anyone has ever seen one. If anyone knows what they are, ask them to try and explain.

Explain that meteoroids move incredibly fast, and the Earth also orbits the Sun at a high speed. So if a meteoroid hits Earth, it will be moving very fast. Impact speeds can be up to 70 kilometres per second, which is the equivalent to 150,000 miles per hour or 250,000 kilometres per hour. This is the equivalent of flying round the equator 8 times every hour.
When an object travelling so fast hits our atmosphere, the air resistance is massive (students may be able to relate this to the force felt in a car when driving with the windows down). The immense force causes the meteorite to burn, making it a meteor.

Tell the class that very few of the meteors formed are seen. Ask them to think about why this is the case. (70% of Earth's surface area consists of oceans, with no one living on them, and during the day time, meteors cannot usually be seen).

Ask the students why they are referred to as shooting stars.
Discuss with the class what people in the past may have thought shooting stars were. (Weather event like lightning, magic/mythical origins, etc.)

Meteorites

Explain that sometimes meteorites do not completely burn up in the atmosphere, and can ‘land’ on Earth. A meteor that does this is known as a meteorite. Show the class the photograph of a meteorite.

This meteorite was found in a Saudi Arabian Desert. Notice how it stands out against the yellow rocks. Explain to the class how it is much easier to find meteorites in places where they stand out. Ask the students to discuss where it would be easy and difficult to find meteorites. (Easy – deserts, plains, sand dunes and on ice in Antarctica. Difficult – forests, lakes and seas).

Some meteorites are large enough and travel fast enough to create a crater on Earth when they impact. Ask the class what would the effect size be of a crater caused by a meteor. (Mass, impact speed, impact direction, type of ground it lands on).

‘Meteor Crater’ in Arizona, USA. It was the first in the world to be positively identified as a meteor crater.

It is possible to recall the extinction of the dinosaurs by the dust cloud from a meteor strike if the class has previously learned about this.

Case Study – Chelyabinsk Meteor

Watch the following video of the Chelyabinsk Meteor in Russia in 2013:
www.youtube.com/watch?v=ztrU90Ub4Uw
Discuss how it was bright enough to be seen during the day – try to relate the brightness to the speed and size of the meteor. It was roughly 20 meters in diameter and travelling at 60,000 km/h (40,000 mph), with a weight of 10,000 tonnes.

The video may not be suitable for younger children.
Explain to the class the dangers of meteor strikes. They have an immense amount of energy and can cause massive destruction. Watch the following video of the shockwave caused by the meteor explosion:&t=106s

Explain that the shockwave was caused by when the meteor exploded approximately 25 km above the Earth’s surface. The shockwave reached the people much after they saw the light because of the difference between the speeds of light and sound. Explain that the shockwave caused windows to shatter, and 1,500 people needed hospital treatment for injuries (mostly because of broken glass from windows).

Image: a small meteorite – a fragment of the Chelyabinsk Meteor after it exploded

CURRICULUM

ADDITIONAL INFORMATION

Consider following this activity with an experiment about impact craters, e.g.: the Lunar Landscape activity (http://astroedu.iau.org/activities/lunar-landscape/).

CONCLUSION

The students learn the differences between meteoroids, meteors and meteorites and how the impact of asteroids/meteoroids can affect life on Earth.

ATTACHMENTS

- Worksheet

CITATION

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ACKNOWLEDGEMENT

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