



The Sky Is Falling

LESSON THEME

This lesson combines a series of activities to help students understand how meteorites can unlock answers to the early history of the solar system.

OBJECTIVES

Students will

- Determine the origin of meteorites, what they are composed of, where they have impacted Earth, and their association to early Earth's history.
- Investigate a simulated meteorite debris field.

NASA SUMMER OF INNOVATION

UNIT

Earth and Space Science: Comparative Planetology

GRADE LEVELS

7-9

CONNECTION TO CURRICULUM

Earth Science, Astronomy, Biology, Geology

TEACHER PREPARATION TIME

1 hour Complexity: Moderate

NATIONAL STANDARDS

National Science Education Standards, NSTA

Earth and Space Science

- Earth In the solar system.
- Origin and evolution of the Earth system.
- Origin and evolution of the universe.

National Geography Standards, NCGE

Uses of Geography

- How to apply geography to interpret the past.
- How to apply geography to interpret the present and plan for the future.

ISTE NETS and Performance Indicators for Students, ISTE

Technology Operations and Concepts

- Understand and use technology systems.
- Select and use applications effectively and productively.
- Transfer current knowledge to learning of new technologies.

MANAGEMENT

The investigations in these lessons are best adapted for engaging students in learning groups of four. Ensure that sufficient materials for each activity are available for each group. The activity "Searching for Meteorites" should be done outdoors.

CONTENT RESEARCH

Meteorites are remnants of rock left over from the formation of the solar system that have been captured by a planet's gravity and pulled to its surface. Often, a large meteorite will make an indentation on a planet's surface. Larger meteorites, also known as **asteroids**, can fall to a planet making impacts resulting in a **crater**. When a meteorite is in outer space and before it strikes the surface of a planet, it is known as a **meteoroid**. As

the meteoroid comes into contact with a planet's atmosphere, pressure builds up around the meteoroid, and it will begin to heat up and emit light energy. This process changes the meteoroid to a **meteor** (shooting star). By studying meteorites, scientists can glimpse at what the early conditions of the solar system were like. Meteorites are pristine examples of rock and debris left over from the solar system's formation.

VOCABULARY

Meteorite -- a remnant of rock left over from the formation of the solar system

Meteoroid -- a grain of sand- to boulder-sized particle of debris in orbit in the solar system

Meteor -- object that results when a meteoroid comes into contact with a planet's atmosphere, commonly referred to as a "shooting star"

Asteroid -- a large meteoroid in orbit within the solar system. Asteroids have impacted all planets, and they are believed to have caused mass extinctions on Earth.

LESSON ACTIVITIES

Searching for Meteorites -- Small balloons are inserted with an assortment of small fragments of rock chips of different colors and then filled with water. Students drop the water-filled balloons and observe and record the debris field pattern of the impact by observing the scattered rock chips where the balloons broke.

http://solarsystem.nasa.gov/docs/Searching_For_Meteor_508FC.pdf

Finding Impact Craters -- Images are provided to students of land formation to determine possible evidence of where Impact craters were formed. Students also are provided resources within the website to draw conclusions on what would happen in the event if an asteroid struck Earth.

<http://craters.gsfc.nasa.gov/index.htm>

Follow the Falling Meteorite -- Apply geometric properties and triangulation to determine the location where a meteorite fell.
<http://ares.jsc.nasa.gov/education/Activities/ExpMetMys/Lesson2.pdf>

MATERIALS

- Images of impact craters
- Balloons
- Small rock flakes to be inserted into the balloons filled with water
- Materials for Activity A
Follow the Falling Meteorite: Blindfold, Noisemaker, Yarn
- Computers with Internet access

ADDITIONAL RESOURCES

Solar System Lithograph Set

This lithograph set features images of the planets, the sun, asteroids, comets, meteors and meteorites, the Kuiper Belt and Oort cloud, and moons of the solar system. General information, significant dates, interesting facts and brief descriptions of the images are included

http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Our_Solar_System_Lithograph_Set.html

Google Earth

Google Earth provides a detailed view of the planet. Students are encouraged to investigate known impact craters such as Barringer Crater (Meteor Crater) in Arizona or Wolf Crater in Australia and compare their characteristics using Google Earth.

<http://www.google.com/earth/index.html>

DISCUSSION QUESTIONS

Impact craters are commonly found on the four planets nearest the sun but not the gaseous planets Jupiter, Saturn, Uranus and Neptune. Why are these planets devoid of impact scars?

--These planets are gaseous in nature and any incoming projectile striking these planets would quickly disappear beneath the planet's dense atmosphere. When examining a planet like Mercury or a moon like ours, we easily can see from the impacts that these two worlds have been bombarded by asteroids and meteorites.

Why does Earth show little evidence of impacts compared to Mercury or the moon?

--Earth has an atmosphere with a dynamic weather system. Over time, erosion plays a part in erasing evidence of impacts.

What other factors on Earth result in craters not being found?

--Earth's geology contributes to Earth's transforming its surface through geologic activity such as earthquakes, volcanoes and plate tectonics.

What effect would a large asteroid have if it struck Earth?

--Extinction of life forms could result if a large asteroid hit Earth.

ASSESSMENT ACTIVITIES

Students are to compare craters on Mercury, Venus and Mars using images from NASA planetary missions and then draw conclusions as to why these planets have more asteroid impact evidence than Earth. Students should explain why impact craters do not occur on planets such as Jupiter, Saturn, Uranus or Neptune.

ENRICHMENT

Invite a guest astronomer from a local college or university or speakers from a local astronomy group to speak to students about meteorites.

There are many video clips on asteroids posted on YouTube. Have students compile some of the best asteroid videos to share with other students.