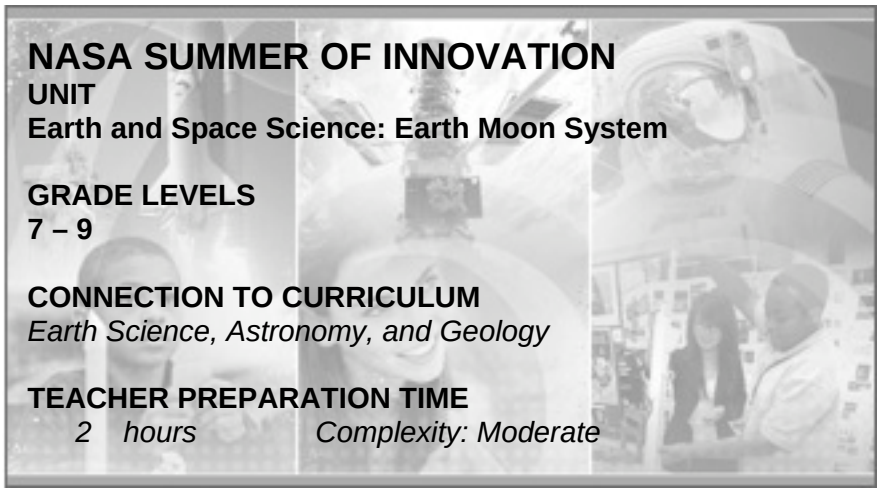
The Sky is Falling



NASA SUMMER OF INNOVATION
UNIT
Earth and Space Science: Earth Moon System

GRADE LEVELS
7 – 9

CONNECTION TO CURRICULUM
Earth Science, Astronomy, and Geology

TEACHER PREPARATION TIME
2 hours *Complexity: Moderate*

LESSON THEME
This lesson combines a series of activities to provide students with an understanding of how meteorites can unlock answers to the early history of the solar system and how meteorites and their big brother, asteroids, have played a role in shaping planetary surfaces.

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.

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)
The 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
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. Insure 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 times, 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 creating craters. Impacts by asteroids and large meteorites during the early formation of the solar system are believed to have been capable of rupturing a planet's crust, resulting in an oozing of lava upon a planet's surface.

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 into what the early conditions of the solar system were like. Meteorites are pristine examples of rock and debris left over from the solar system formation.

MATERIALS
- Images of impact crate rs from Cosmic Secrets
- Balloons
- Small rock flakes to be inserted into the balloons filled with water
- Materials for Activity A "**Follow the Falling Meteorite**": blindfold, noisemaker, and yarn
- Computers with Internet access

VOCABULARY:
Lava—molten rock from the interior of the planet
Meteorite—remnant of rock left over from the formation of the solar system
Meteoroid—sand to boulder-sized particles of debris in orbit in the solar system
Meteor—results when a meteoroid comes into contact with a planet's atmosphere, commonly referred to as a "shooting star"
Asteroid—large meteoroid in orbit within the solar system—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 Web site to draw conclusions on what would happen in the event if an asteroid struck Earth.
http://craters.gsfc.nasa.gov/index.htm

Space Rocks! A Meteorite Game: Students listen to an on-line Native American tale followed by boardgame activitiy; reinforces understanding of the origins of meteors, meteoroids, and meteorites, as well as their characteristics and importance, while tackling some common misconceptions.
http://www.lpi.usra.edu/education/skytellers/meteors/activities/space_rocks.shtml

Follow the Falling Meteorite: Apply geometric properties and triangulation to determine the location where a meteorite fell.
http://ares.jsc.nasa.gov/ares/education/program/ExpMetMys/LESSON2.pdf

Lava Layering: Simulate repeated volcanic eruptions and how they build a terrain.
http://www.nasa.gov/pdf/180574main_ETM.Lava.Layering.pdf

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.
Lithograph Set

Google Earth

Google Earth provides a detailed view of the planet. Students are encouraged to investigate known impact craters such as the Barringer Crater (Meteor Crater) in Arizona to the Wolf Crater in Australia and compare their characteristics using Google Earth.
http://www.google.com/earth/index.html

Earth's 10 Most-Impressive Impact Craters (Suggestion: Use in conjunction with Google Earth)
http://www.universetoday.com/19616/earths-10-most-impressive-impact-craters/

Impact Craters on Earth
http://www.thelivingmoon.com/43ancients/02files/Earth_Images_08.html

DISCUSSION QUESTIONS

Impact craters are commonly found on all planets except 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.* Comparing a planet like Mercury or a moon like ours, it is easily seen that these two worlds have been bombarded as a result of impacts from asteroids and meteorites. Why does Earth show little evidence of impacts compared to Mercury or the Moon? *The 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 the Earth transforming its surface through geologic activity such as earthquakes, volcanoes, and plate tectonics.*

What affect would a large asteroid have if it struck Earth? *Extinctions 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 are to 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 on meteorites.

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

www.nasa.gov