

SUGGESTED REFERENCES

- *The Lunar Navigator Interactive Maps of the Moon.* A complete series of interactive lunar maps. <http://www.lunarrepublic.com/atlas/index.shtml>
- A complete resource about the Moon from NASA including activities for students. <http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Exploring.the.Moon.html>
- Site has information about solar events and how they will impact Earth. <http://www.spaceweather.com/>
- Fred Espenak's website has useful background information about eclipses of the Sun and Moon. <http://www.mreclipse.com/MrEclipse.html>

NATIONAL SCIENCE EDUCATION STANDARDS

Grades K-4

Earth and Space Science
Objects in the sky
Changes in Earth and sky

Grades 5-8:

Earth and Space Science
Structure of the Earth System
Earth in the Solar System

Physical Science
Transfer of Energy

*Source: *National Science Education Standards, 1996, National Academy Press*

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SYNOPSIS

The formation of the moon was a cataclysmic event in the history of the Earth. This program shows that it was probably a giant impact on Earth that caused the material that formed the moon to break away. Students will see how the moon affects many phenomena on Earth including the climate and ocean tides.

The Earth's moon sometimes blocks the sun's rays, causing a solar eclipse. Students will also get a chance to experience the Aurora Borealis when particles from the solar wind are electrified by their interaction with the Earth's magnetic field and our atmosphere.

CURRICULUM UNITS

- PHYSICAL SCIENCE
- PHYSICS
- INTEGRATED SCIENCE

RUNNING TIME

20:00

BACKGROUND

Scientists predict that the moon was formed about 50 million years after the formation of the Earth. The impact theory suggests that a protoplanet as large as Mars struck the molten Earth. The impact sent debris into space that was captured by Earth's gravitational field. Both Earth and its new moon then cooled and formed into the layers we see today.

At the time of its formation, the moon was much closer to the Earth than it is today. As a result, the moon's orbit was "captured." The moon turns once on its axis during each orbit around the Earth, always presenting the same face to Earth.

The moon produces no light; it shines because it is reflecting light from the sun. It orbits the Earth every 27.3 days. The lunar phases result because different parts of the moon are lit at different times and during the new moon phase the half that is lit is not the half we see.

The moon does not have an atmosphere and the temperatures can range from 120 to -160 degrees Celsius. Because of its small size, the Moon's gravity is only one-sixth that of the Earth.

The Moon is pulling away from the Earth about 4 centimeters per year. The cause is tidal drag - the gravitational pull exerted by the moon on our oceans, the same pull that creates our tides. This drag is slowing the spin of the Earth. As the Moon and Earth move farther apart, our day lengthens.

Eventually, the Moon will be too far away from the Earth to stabilize its tilt. The wobble of the Earth will increase, tilting from zero to 85 degrees. As a result, our biosphere will be destroyed.

At this time, the Moon is just the right distance from the Earth and the Sun to create an amazing phenomenon, the solar eclipse. The moon is 400 times smaller than the sun and it is 400 times closer to us than to the sun. Approximately 70 times a century, the moon completely obscures the solar disc.

A total eclipse has several phases. The partial phase lasts up to 90 minutes as the Moon creeps across the solar face. Totality can last up to 7.5 minutes; the only part of the sun that is visible is the corona, the sun's outer solar atmosphere. On Earth light levels drop dramatically. As the totality ends, sunlight begins to show through the Moon's mountains.

Solar eclipses occur about once per year while lunar eclipses occur up to three times a year. Lunar eclipses occur when the Earth is aligned directly between the Moon and the Sun. When the Moon moves into the Earth's shadow, our atmosphere bends the sunlight and projects a reddish tint on the Moon.

There is another light show we can see near the poles of the Earth. It is caused by the solar wind interacting with the Earth's magnetic field. The wind is made up of electrically charged particles and gases. It flows around the Earth as some particles spiral down magnetic field lines towards the poles. There they collide with particles in the atmosphere and release light that is visible as an aurora.

Sometimes the Sun erupts with a massive explosion called a coronal mass ejection. The ejection speeds up the solar wind and sends a shockwave hurtling towards Earth. The shockwave pushes against the magnetosphere and creates geomagnetic storms and spectacular auroras. It also affects satellite transmissions and can knock out power lines.

ADVANCED ORGANIZERS

Prior to viewing this program, students should have some understanding of the following Benchmarks for Science Literacy, Oxford University Press which are excerpted and, in some cases, abbreviated below. Refer to the Benchmarks for more information.

Benchmark 4: The Physical Setting
Section A - The Universe

Know by Grade 8

- Planets of very different size, composition, and surface features move around the sun in nearly circular orbits. Some planets have a great variety of moons and even flat rings of rock and ice particles orbiting around them. Some of these planets and moons show evidence of geologic activity. The earth is orbited by one moon, many artificial satellites, and debris.
- The moon's orbit around the earth once in about 28 days changes what part of the moon is lighted by the sun and how much of that part can be seen from the earth-the phases of the moon.

Section F - Motion

Know by Grade 8

- An unbalanced force acting on an object changes its speed or direction of motion, or both. If the force acts toward a single center, the object's path may curve into an orbit around the center.

*Benchmarks can be found at www.project2061.org/tools/benchol/bolintro.htm

CRITICAL THINKING EXERCISES

- EXPLAIN how a solar eclipse occurs.
- DESCRIBE how solar wind interacts with Earth's atmosphere and magnetosphere to produce an aurora.
- EXPLAIN how the Moon affects tides on Earth.
- EXPLAIN why we can never see the dark side of the Moon here on Earth.
- DESIGN an experiment to calculate the diameter of the Moon.
- EXPLAIN why the Moon has so many impact craters.

VOCABULARY

- Aurora** A radiant emission from the upper atmosphere that occurs sporadically over the middle and high latitudes of both hemispheres in the form of luminous bands, streamers, or the like, caused by the bombardment of the atmosphere with charged solar particles that are being guided along the earth's magnetic lines of force.
- Core** The central portion of the earth, having a radius of about 2100 mi. (3379 km) and believed to be composed mainly of iron and nickel in a molten state.
- Corona** A white or colored circle or set of concentric circles of light seen around a luminous body, especially around the sun or moon.
- Crater** A bowl-shaped depression in a surface made by an explosion or the impact of a body, such as a meteoroid.
- Lunar Eclipse** The obscuration of the light of the moon by the intervention of the earth between it and the sun.
- Magnetosphere** An asymmetrical region surrounding the earth, extending from about one hundred to several thousand kilometers above the surface, in which charged particles are trapped and their behavior is dominated by the earth's magnetic field.
- Mare** Any of the several large, dark plains on the moon and Mars.
- Penumbra** A partial shadow, as in an eclipse, between regions of complete shadow and complete illumination.
- Solar Wind** A stream of high-speed, ionized particles ejected primarily from the sun's corona.
- Umbra** The completely dark portion of the shadow cast by the earth, moon, or other body during an eclipse.

CAREER POSSIBILITIES

- GEOLOGIST
- PHYSICIST
- MECHANICAL ENGINEER
- ASTRONAUT