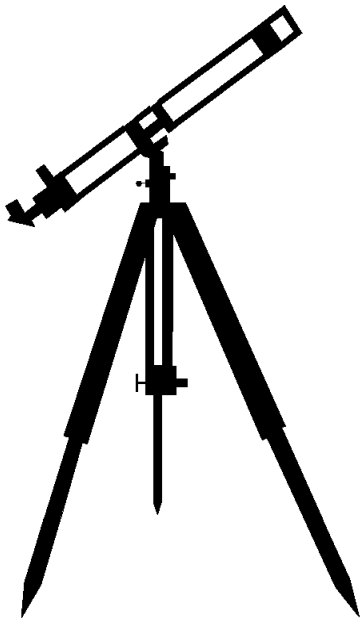
Universe Cycle

The Search for Our Beginnings

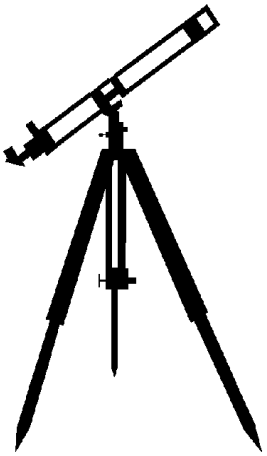
FOURTH GRADE

EARTH



1 WEEK
LESSON PLANS AND
ACTIVITIES

UNIVERSE CYCLE
OVERVIEW OF FOURTH GRADE



UNIVERSE

WEEK 1.
PRE: *Comparing astrology and astronomy.*
LAB: *Contrasting the different types of galaxies.*
POST: *Exploring how galaxies evolve.*

SOLAR SYSTEM

WEEK 2.
PRE: *Plotting the relative distances of planets from the Sun.*
LAB: *Observing craters on the surface of planets and moons.*
POST: *Discovering new facts about the Solar System.*

EARTH

WEEK 3.
PRE: *Understanding wind erosion.*
LAB: *Exploring the Earth/Moon system.*
POST: *Comparing the landscapes of the Earth and Moon.*

GEOGRAPHY

WEEK 4.
PRE: *Exploring the importance of soil on Earth.*
LAB: *Plotting data of soil locations.*
POST: *Deriving information from maps.*

UNIVERSE CYCLE - EARTH (4)

PRE LAB

Students discover how wind transports sediment on the Earth's surface

OBJECTIVE:

1. Exploring wind erosion and the formation of sand dunes
2. Comparing surface processes on the Earth and Moon.

VOCABULARY:

erosion
saltation
soil
wind
cross bed

MATERIALS:

worksheet

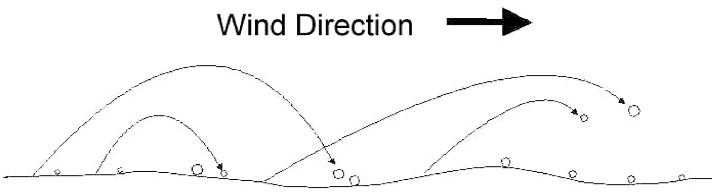
Wind-blown sand

BACKGROUND:

Water is a very powerful erosional force on the surface of the Earth. Flowing water, as a liquid or solid (ice), is very effective at eroding and transporting loose material from high places to low places. Mountains are worn down, and valleys, lakes, and part of oceans are filled in.

Wind is also important in shaping the Earth's surface. Wind is caused by the movement of gas molecules in the Earth's atmosphere, in response to changing atmospheric pressures. Wind is not as effective or "violent" an agent of erosion as are ice and water, but over time it can transport much material and finely sculpture a landscape. Wind is capable of transporting loose, unconsolidated fragments of sand and dust. Larger particles are too heavy for normal winds to move, except in storm conditions.

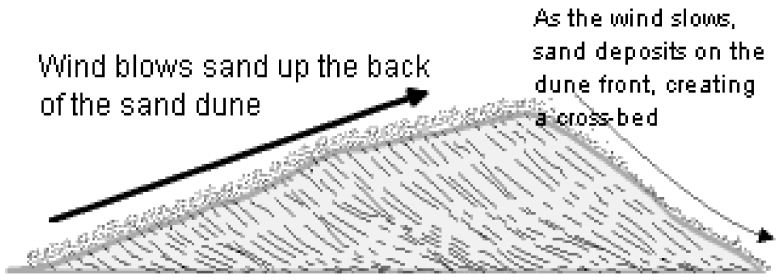
Normal winds are barely strong enough to move sand, so this material moves by an intermittent series of jumps or skips along the Earth's surface. This transport process is called saltation. Dust particles are light enough that they can be picked up and fully transported by the wind. This allows dust to blow long distances, even across wide ocean basins.



Saltation in action - grains hop from left to right as the wind blows

Sand dunes are mounds of sand that have been piled up and transported by the wind. They commonly form in dry

Earth surface environments. Viewed from one end, sand dunes have a flat back side and a steep front side. The wind blows up the back side of the dune. If the wind blows fast enough, it will pick up and transport sand grains up the back of the dune. When the wind goes over the top of the dune, it slows down. This causes it to drop the sand grains it was carrying. The sand lands on the steep front of the dune. This forms an inclined layer of sand, called a cross-bed. The cross-bed gets flatter at the bottom because some of the sand rolls down to the bottom of the dune and piles up. As more and more sand blows through an area, many cross-bedded layers of sand accumulate. This process causes a sand dune to migrate down wind. Sand is continually eroded from its upwind side, and deposited on its downwind side.



The formation of a sand dune and cross-beds

Water and wind are both effective surface processes on the Earth. The Earth is just the "right" distance from the Sun that liquid water is abundant on its surface. The reasons for this are complex. Essentially, the amount of solar radiation that the Earth receives, combined with the concentrations of greenhouse gases in the atmosphere, keep the temperature in the proper zone for water to be liquid. If the Sun were cooler or if there were less greenhouse gases, ice would be more abundant. If there were more of either of these, much liquid water would evaporate. Wind erosion and transport is common on the Earth because it has an atmosphere.

In contrast, neither water nor wind are effective on the Moon. It lacks an atmosphere, so there is little wind to blow on the lunar surface. The Moon also has little if any water on its surface. Any water that may be present is frozen. At present, the main factors that shape the lunar landscape are impacts and the formation of craters, and occasional landslides caused by gravity.

PROCEDURE:

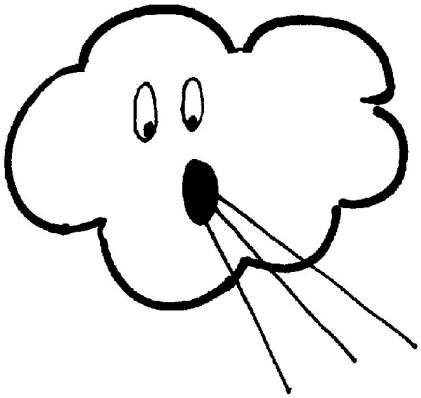
1. Introduce students to wind erosion and transportation. Make sure the students understand that an atmosphere is necessary for wind to blow. Explain saltation, and the formation of sand dunes. You may wish to have them complete the first three questions on the worksheet as you lecture.

2. Have the students speculate about the presence or absence of wind erosion on the Moon. Discuss their answers as a group, and have them complete the worksheet.

3. **ANSWERS:** 1. and 2. see the drawings above. 3. No, because without movement of the wind, sand would not be piled up into dunes. Water and ice might move the sand from place to place, but would not make sand dunes. 4. No, because the Moon does not have an atmosphere.

UNIVERSE CYCLE - EARTH (4) PRE LAB

1. In the space below, draw the movement of a sand particle by saltation.



2. Draw a sand dune in the space below. Show the direction the wind blows, and cross-beds.

3. If the wind is not blowing, could sand dunes form? Explain your answer.

_____
_____
_____

4. Can sand dunes form on the Moon? Explain your answer.

_____
_____
_____

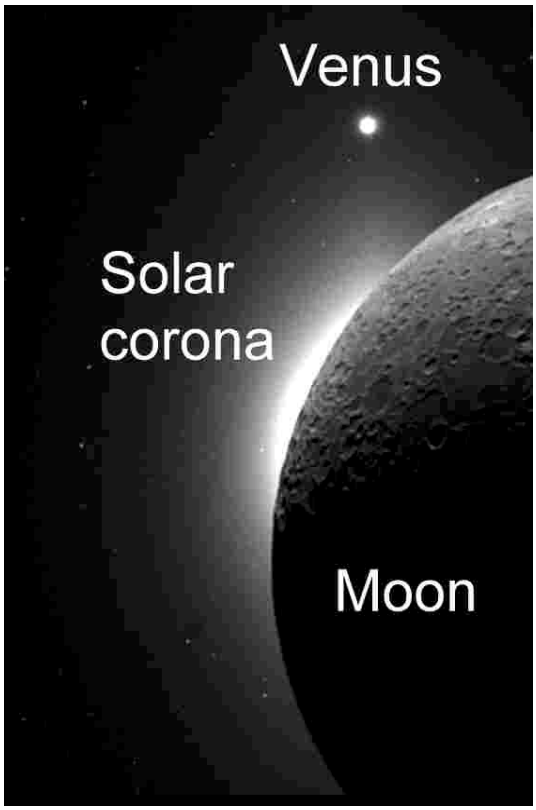
UNIVERSE CYCLE - EARTH (4)

LAB

Students explore motions in the Earth/Moon system

OBJECTIVES:

1. Exploring the Earth/Moon system.
2. Differentiating rotation from revolution.



VOCABULARY:

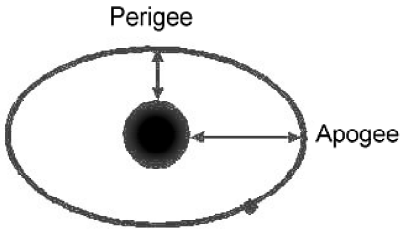
apogee
attraction
axis/axes
circular
elliptical
gravity
orbit
perigee
revolution
rotation

MATERIALS:

Universe Cycle - Earth (4)
Planetarium Model
worksheet

BACKGROUND:

The Moon and the Earth are held together by gravity. Because the Earth is much more massive than the Moon, the Moon orbits around the Earth. The Moon revolves eastward (counterclockwise). Each orbit takes 27.3 days. The Moon also rotates, or revolves on an internal axis once every 27.3 days. The rotation and revolution is the same generally due to gravitational attraction of the Moon to the Earth. It makes one rotation per revolution. The Earth/Moon system also revolves around the Sun, taking 365.25 days (or a year) to complete one orbit.



The Moon's orbit around the Earth is slightly elliptical or oval-shaped. At its closest point, called perigee, the Moon is 363,000 kilometers from the Earth. At its maximum distance, called apogee, the Moon is 405,000 kilometers away. Apogee and

perigee are highly elliptical.

There are at least three reasons why the orbits of the Moon and Earth are elliptical. First, due to their rotation, both bodies are slightly wider at the equator than between the poles. They are not perfect spheres, which makes their orbits a little erratic. Second, it is also possible that Moon's internal structure is slightly uneven, which would also contribute to an elliptical orbit. Finally, the elliptical orbit of the Moon may reflect its origin. Current evidence suggests that the Moon formed after the collision of the Earth with a protoplanet early in the Solar System's history. The debris from this collision coalesced to form the Moon. Computer models suggest that the early orbit of the Moon may have been highly elliptical, and became rounder with time.

The gravitational forces between the Earth and the Moon cause some interesting effects. The most obvious is the tides. The Moon's gravitational attraction is stronger on the side of the Earth nearest to the Moon and weaker on the opposite side. Since the Earth, and particularly the oceans, is not perfectly rigid it is stretched out along the line toward the Moon. From our perspective on the Earth's surface we see two small bulges, one in the direction of the Moon and one directly opposite. The effect is much stronger in the ocean water than in the solid crust so the water bulges are higher.

Actually, the Moon appears to wobble a bit (due to its slightly non-circular orbit) so that a few degrees of the far side can be seen from time to time, but the majority of the far side was completely unknown until the Soviet spacecraft Luna 3 photographed it in 1959. Note: there is no "dark side" of the Moon; all parts of the Moon get sunlight half the time (except for a few deep craters near the poles). Some uses of the term "dark side" in the past may have referred to the far side as "dark" in the sense of "unknown" (i.e. "darkest Africa") but even that meaning is no longer valid today!

PROCEDURE:

1. This lab comprises 4 stations, each of which has questions for the students to answer. Each station helps to understand a different concept in the relationship of the Earth/Moon system. Set up the stations as described in the Lab below. You may want to make multiple sets for each stations, to allow the students to work more quickly.

2. Explain the rotations and revolutions of the Earth/Moon system to the students. The Moon revolves around the Earth due to the gravitational attration between the two.

3. Have the students work in groups, and answer the questions on the worksheet.

ANSWERS:

STATION A. stretchy substance, revolving styrofoam ball.

1. An elliptical orbit can be created at a high speed.
2. A circular orbit forms at lower speeds.

3. The Moon's orbit is elliptical, but not eccentric (more elongated). The Moon orbits the Earth because the latter is much more massive. The reason for the shape of the orbit is unclear, but relates to how the Earth/Moon system evolved has through time.

4. Gravity holds the Earth and Moon together.

STATION B. plain styrofoam ball, styrofoam ball with pin

5. The students should realize that a spherical object will roll in a straight line, but once a sphere becomes oblate (its center of mass is offset from its center), its travel path will change. This is like the Earth/Moon relationship; both bodies are not perfectly spherical, so their rotations and revolutions are slightly distorted or they wobble.

STATION C. 2 styrofoam balls with handles

The students should visualize that the Moon revolves around the Earth, and both the Earth and the Moon rotate.

6. The small styrofoam ball is the Moon.

7. The Earth is the large ball.

8. Students may have difficulty showing revolution, until they try putting one ball upside down.

STATION D. Planetarium

Students should be able to see that this planetarium does not show distances correctly. However, it does show the correct Moon/Earth relationships. They may also note that only Venus, Earth, and the Moon are included; the other planets are missing. They may also make silly comments, such as the Sun is not a light bulb!

UNIVERSE CYCLE - EARTH (4) LAB

PROBLEM: How do the Earth and Moon move in space?
PREDICTION _____
PROCEDURE: Go to the 4 stations and complete the following experiments.
STATION A:
MATERIALS - stretchy substance, revolving styrofoam ball.
1. Experiment with the revolving styrofoam ball. When can you get an elliptical orbit to form? _____
2. When can you get a circular orbit to form? _____
3 What type of orbit does the Moon have around the Earth? Why?
_____
4. What force keeps the Moon and Earth together? _____

STATION B:
MATERIALS - plain styrofoam ball, styrofoam ball with pin
5. Try to roll the plain styrofoam ball. Now try to roll the ball with the pin in it. Draw the path of each below. Why does this happen?

styrofoam ball styrofoam ball with pin

STATION C:
MATERIALS - 2 styrofoam balls with handles
6. Which one of these models represents the Moon? _____
7. Which model represents the Earth? _____
8. Revolve the Moon ball around the Earth ball while rotating both of them. Have your teacher watch your movements. Have them initial that you have done the revolution and rotation correctly. _____

STATION D.
MATERIALS - Planetarium

9. After what your instructor has taught you about planets and the Earth and the Moon, can you find anything wrong with this model?
_____
_____
CONCLUSION: Describe how the Earth and Moon move in space with regards to the Sun.
_____
_____

UNIVERSE CYCLE - EARTH (4)

POST LAB

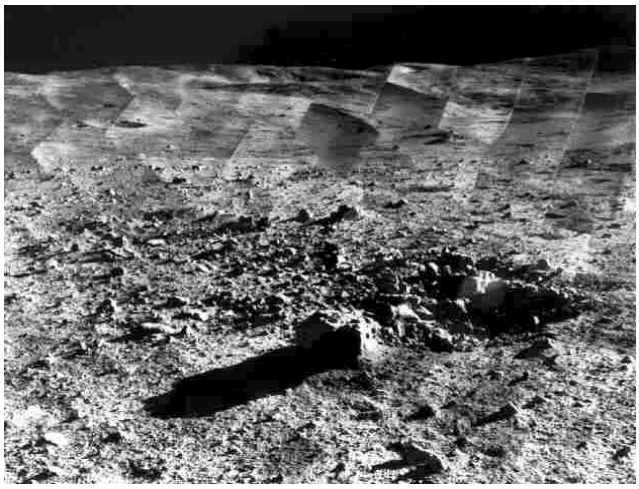
Students compare the landscapes of the Earth and the Moon.

OBJECTIVES:

1. Comparing the landscapes of the Earth and Moon.
2. Exploring types of erosion that occur on Earth.

VOCABULARY:

erosion
ice
Moon
revolution
rotation
water
wind


Lunar surface

MATERIALS:

worksheet
What the Moon is Like by F. Branley
All about the Moon by D. Alder, or any other book on the Moon.
Internet

BACKGROUND:

The surfaces of the Earth and the Moon are very different. The surface of the Earth is dynamic because it changes constantly. This is caused by movement of crust, erosion by water and wind, and living organisms. Plate tectonics changes the positions of the continents, reshapes ocean basins, and creates mountain ranges and volcanoes.

The Earth's atmosphere and abundant liquid water and ice on its surface causes erosion and reworking of the Earth's surface. The wind blows, moving material from place to place. Running water and ice carve away at rocks and loose material. Through time, these processes act to flatten the Earth's surface, wearing away mountains and filling in low areas.

The Earth's surface is modified by the presence of life. The activity of life enhances the effects of physical surface processes. In addition, life has modified the compositions of the atmosphere and oceans. The combination of these forces means that the Earth's surface is very young.

The surface of the Moon changes slowly, because none of these factors are active. The Moon is essentially "dead" geologically with little tectonic activity. The Moon lacks

an atmosphere, and the small amount of water that is present is "buried" in the polar areas. Finally, there is no life on the Moon.

The major factor which does change the Moon's surface is the impact of meteoroids, forming craters. Even this process is very slow today; most of the Moon's craters, and all of the large ones, are hundreds of millions to billions of years old. The surface of the Moon is very old, compared to the Earth.

PROCEDURE:

1. Ask the students to think about why the Moon and the Earth are different. You may want to have students fill in a chart like the one below.

	atmosphere	water	type of erosion	landscape
EARTH	yes	yes	water, wind, ice, heat	varied
MOON	no	no	impact	craters, dust, rocks

2. Have the students take turns reading *What the Moon is Like* and *All about the Moon* out loud, or read them to the class yourself. The books ask the students to consider what the Moon looks like from the Earth. There have been many myths and stories about this, but it was not until astronauts walked on the Moon, that people could actually describe what was there. This story also follows what the students have learned about craters in previous grades, but also informs them that there are rocks and dust on the Moon's surface. You can use the pictures in the book to give students a good sense of what the Moon looks like. In addition, the websites listed below have excellent pictures of the lunar surface.

a) http://cass.jsc.nasa.gov/expmoon/lunar_missions.html - Exploring the Moon, a NASA site with excellent photographs from orbit and the surface of the Moon. Covers all NASA missions, including Apollo. Good descriptions accompany photographs.

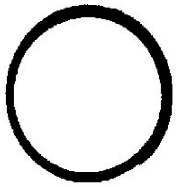
b) http://www.inconstantmoon.com/ - Inconstant Moon - shows the phases of the Moon, plus daily information and images of the lunar surface.

c) http://www.fourmilab.ch/earthview/vplanet.html - The Earth and Moon Viewer. This site shows what the Earth and Moon look like at any given time, from various positions in Earth orbit. Good images.

3. Have the students draw the different landscapes that they would see if they were on the Moon and the Earth. Make sure that they realize that the Earth's surface can have trees, life, water, and clouds. Where the Moon's surface can only have craters and rocks. Have the students refer to the books to make sure that they are drawing the Moon's surface accurately.

UNIVERSE CYCLE - EARTH (4) POST LAB

1. DRAW WHAT THE EARTH LOOKS LIKE FROM THE MOON. DRAW A SCENE ON THE EARTH.



2. DRAW WHAT THE MOON LOOKS LIKE FROM THE EARTH. DRAW A SCENE ON THE MOON.