Workshop 7: Sun and Seasons

DESCRIPTION

The tilt of the Earth's axis causes the cycle of the seasons. In this workshop we'll discuss how different parts of the Earth receive different amounts of light energy that result in the Earth's seasons. In particular, we will look at the tilt of the Earth's axis and how the hours of daylight change throughout the year. We will also touch on the long-term history of climactic changes on Earth.

LEARNING OBJECTIVES

Participants will be able to:

- Describe the apparent motion of the Sun across the sky during a day in winter, spring, summer, and fall using patterns of shadows as supporting evidence.
- Explain the reason for varying lengths of daylight in terms of Earth's orbit around the Sun and the angle of Earth's axis relative to the plane of the orbit.
- Explain the cycle of the seasons in terms of Earth's orbit around the Sun, the angle of Earth's axis relative to the plane of the orbit, and length of daylight.

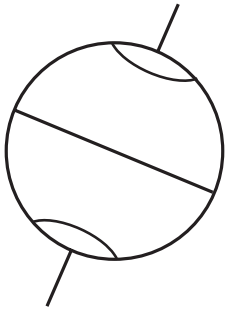
Workshop 7 timeline

GETTING READY

30 minutes

The Arctic and Antarctic Circles

In this workshop we will explore the orbit of the Earth around the Sun. As you already know, it takes 365 and 1/4 days, or one year, for the Earth to complete one revolution around the Sun. During this time the northern and southern hemispheres experience distinct and opposite seasons.



The diagram above (not drawn to scale) shows the Earth on which the Arctic Circle, Equator, and Antarctic Circle are marked.

The Arctic Circle experiences 24 hours of daylight during the June solstice, while at the same time the Antarctic Circle experiences 24 hours of darkness.

- Sketch the orbital path of the Earth around the Sun.
- On your orbital path draw the Earth in a position that represents the June solstice.
- Use your drawing to explain why the Arctic has 24 hours of light while the Antarctic has 24 hours of darkness.
- Now draw the Earth in a position in which the Arctic has 24 hours of darkness and the Antarctic has 24 hours of light.
- Discuss your explanations with your colleagues and write down any problems that you encountered as you completed your drawings.

The Arctic and Antarctic circles of the Earth, although experiencing changes in temperature between the winter and summer, are always cold. Yet when we see pictures of these regions there are often clear, sunny skies.

- If the polar circles receive sunlight in their respective “summers” why are they always cold?

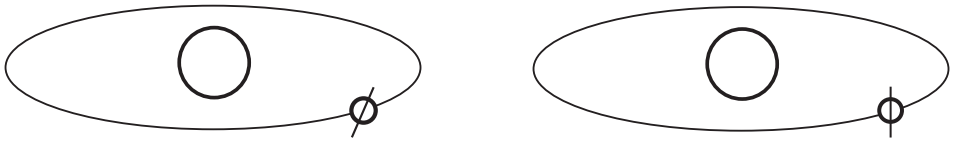
Workshop 7 timeline

GOING FURTHER

30 minutes

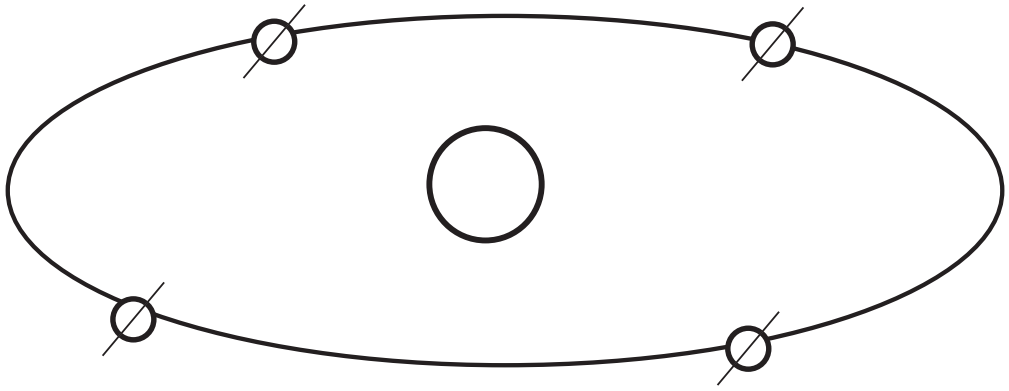
The Tilt of the Earth's Axis

The axis of the Earth's rotation is at a 23.5 degree angle to the plane of its orbit around the Sun. If the Earth's axis was not tilted then there would be no seasons in either the northern or the southern hemisphere. See diagram A and B (not drawn to scale).



Now think about what would happen if we increased the tilt of the Earth's axis relative to its orbit around the Sun.

What would the northern and southern hemispheres be like if the tilt of the Earth's axis were substantially larger, say 40 degrees instead of 23.5 degrees? Use the diagram below (not drawn to scale) to explain what the temperatures would be like in the northern and southern hemispheres (including the poles) in positions A, B, C, and D. What if the tilt of the Earth's axis was at 90 degrees?



For next time

HOMEWORK ASSIGNMENT

Rethinking Your Words

Revisit your journal entries concerning the physical properties of light. Change or extend your ideas as a result of what you have now learned.

Two words that are often used to describe the Sun's light hitting the Earth are direct and indirect. If you asked children to draw a diagram of indirect light hitting the Earth what do you think their pictures would look like? Sketch your ideas.

In the Northern Hemisphere we often speak of the Sun being overhead at midday, although it is never actually overhead north of the Tropic of Cancer. How does our everyday language impact students' ideas? Think of other examples of everyday language which might mislead students as they connect science ideas to their real-world experiences.

Below is a list of some of the concepts that have been discussed in this program. For each concept list verbs, nouns and adjectives which you associate with the concept. Look over your list and, based on what you have learned in these workshops, decide which terms you would choose to use with your students to help them better understand the concept.

Reflection

Refraction

Absorption

Radiation

Energy

Photons

Electromagnetic spectrum

Energy transfer

Energy flow

Standards

National Science Education Standards

K-4 Standards: http://bob.nap.edu/html/nses/html/6c.html#es

The sun provides the light and heat necessary to maintain the temperature of the earth.
Content Standards: K-4: Earth and Space Science: Objects in the Sky

The surface of the earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.

Weather changes from day to day and over the seasons.
Content Standards: K-4: Earth and Space Science: Changes in the Earth and Sky

5-8 Standards: http://bob.nap.edu/html/nses/html/6d.html#es

The solid earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core.

Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground.

Water is a solvent. As it passes through the water cycle it dissolves minerals and gases and carries them to the oceans.

Clouds, formed by the condensation of water vapor, affect weather and climate.
Content Standards: 5-8: Earth and Space Science: Structure of the Earth System

Fossils provide important evidence of how life and environmental conditions have changed.
Content Standards: 5-8: Earth and Space Science: Earth's History

The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotation on its axis and the length of the day.
Content Standards: 5-8: Earth and Space Science: Earth in the Solar System

Standards

American Association for the Advancement of Science (AAAS) Project 2061 Benchmarks

http://project2061.aaas.org/tools/benchol/bolframe.html

By the end of the 2nd grade, students should know that:

> Some events in nature have a repeating pattern. The weather changes some from day to day, but things such as temperature and rain (or snow) tend to be high, low, or medium in the same months every year.
> *The Physical Setting: 4B The Earth: K-2*

By the end of the 2nd grade, students should know that:

> Water can be a liquid or a solid and can go back and forth from one form to the other. If water is turned into ice and then the ice is allowed to melt, the amount of water is the same as it was before freezing.
> *The Physical Setting: 4B The Earth: K-2*

By the end of the 5th grade, students should know that:

> The earth is one of several planets that orbit the sun, and the moon orbits around the earth. Stars are like the sun, some being smaller and some larger, but so far away that they look like points of light.
> *The Physical Setting: 4B The Earth: 3-5*

By the end of the 8th grade, students should know that:

> Energy cannot be created or destroyed, but only changed from one form into another. Most of what goes on in the universe—from exploding stars and biological growth to the operation of machines and the motion of people—involves some form of energy being transformed into another.
> *The Physical Setting: 4E Energy Transformations: 6-8*

Related Sources

Dennis, Jerry, (1992). It's Raining Frogs and Fishes: Four Seasons of Natural Phenomena and Oddities of the Sky. New York, NY : HarperCollins

Hiscock, Bruce, (1993). The Big Storm. New York : Maxwell Macmillan International

Kingsbury, Stewart A., Kingsbury, Mildred E., Mieder, Wolfgang, (1996). Weather Wisdom : Proverbs, Superstitions, and Signs. New York : Peter Lang

Llewellyn, Claire, (1997). Wild, Wet and Windy : The Weather--From Tornadoes to Lightning. Cambridge, Mass. : Candlewick Press

Lutgens, Frederick K., Tarbuck, Edward J., (1995). The Atmosphere: An Introduction to Meteorology. Englewood Cliffs, N.J. : Prentice Hall

Lynott, Bob, (1994). How Weather Works, and Why. Portland, OR : Gadfly Press

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Murphree, Tom, (1998). Watching Weather. New York : Henry Holt & Company

Perry, Phyllis Jean, (1996). Rainy, Windy, Snowy, Sunny Days: Linking Fiction to Nonfiction. Englewood, Colo. : Teacher Ideas Press

Wagner, Ronald L., (1994). The Weather Sourcebook : Your One-stop Resource for Everything You Need to Feed Your Weather Habit. Old Saybrook, Conn. : Globe Pequot Press

Watson, Benjamin A., (1993). Acts of God: The Old Farmer's Almanac. New York : Random House

Useful web sites:

http://aerohost.com/weather-satellite.htm

http://www.photolib.noaa.gov/lb_images/historic/nws/monster.htm

http://www.esdim.noaa.gov/weather_page.html

http://www.nws.noaa.gov

http://www.learner.org/exhibits/weather