

Earth Science Misconceptions

Overview

(excerpted from *Atlas of Science Literacy*, Volume 2, AAAS Project 2061. See pages 20-21 for full explanation and strand map of Weather and Climate.)

Students of all ages (including college students and adults) have difficulty understanding the causes of the seasons. Students may not be able to understand the relative size, motion, and distance of the sun and the earth. (Sadler, 1987; Vosniadou, 1991) The explanation of the seasons in terms of the tilt of the earth requires students to engage in fairly complex spatial reasoning. Many students before and after instructions in earth science think that winter is colder than summer because the earth is farther from the sun in winter (Atwood & Atwood, 1996; Dove, 1998; Phillips, 1991; Sadler, 1998).

Students' ideas about how light travels and about the earth-sun relationship, including the shape of the earth's orbit, the period of the earth revolution around the sun, and the period of the earth's rotation around its axis, may interfere with students' understanding of the seasons (Galili & Lavrik, 1998; Salierno, Edelson & Sherin, 2005).

Recognizing that air has weight may be challenging even for high-school students (Sere. 1985; Driver et al., 1994a; Krnel, Watson, Glazar, 1998).

Students of all ages may confuse the ozone layer with the greenhouse effect, and may have a tendency to imagine that all environmentally friendly actions help to solve all environmental problems (for example, that the use of unleaded petrol reduces the risk of global warming) (Andersson & Wallin, 2000; Koulaidis & Christidou, 1998; Meadows & Wiesenmayer, 1999; Rye, Rubba, & Wiesenmayer, 1998).

Students have difficulty linking relevant elements of knowledge when explaining the greenhouse effect and may confuse the natural greenhouse effect with the enhancement of that effect (Andersson & Wallin, 2000)

Sample Earth Science Misconceptions

(Items from "*Earth Science Misconceptions*", William C. Philips, February 1991

(<http://k12s.phast.umass.edu/~nasa/misconceptions.html>) and

<http://beyondpenguins.nsd1.org/issue/column.php?date=June2008&departmentid=professional&columnid=professional!misc>
[onceptions](#)

K-3

The Earth is larger than the sun.

The Sun disappears at night.

K-9

Rain comes from holes in the clouds.

Rain occurs when clouds are shaken.

Clouds come from somewhere above the sky.

Rain falls when clouds become too heavy.

Empty clouds are refilled by the sea.

Clouds are formed by vapor from kettles.

Clouds are made of cotton, wool, or smoke.

Air and oxygen are the same thing.

4-9

Seasons are caused by the Earth's distance from the Earth.
Day and night are caused by the Sun going around the Earth.
Dinosaurs and cavemen lived at the same time.
Coral reefs exist throughout the Gulf and North Atlantic waters.

4-Adult

Winter weather can be predicted by studying the thickness of the fur on some animals.
The carbon cycle consists of photosynthesis and respiration.
The Sun goes around the Earth.
The ozone hole is a hole in the sky.
The ozone hole is the cause of global warming.

College/Adult

All rivers flow "down" from north to south.
Ground water typically occurs as basic, lakes, and fast-flowing streams.
The oxygen we breathe does not come from plants.

Web Resources for Earth Science Misconceptions

1. Fraser, A., 2000. [Bad Meteorology \(more info\)](#) (accessed 15 November 2004). Find discussion relating to cloud formation, raindrop shop, greenhouse effect, and coriolis effect.
2. Henriques, L. , 2000. [Children's misconceptions about weather: A review of the literature \(more info\)](#) (accessed 15 November 2004). A tabular presentation of misconceptions relating to the water cycle, phase changes, clouds, precipitation, atmosphere, seasons, heating of the earth, and greenhouse effect. An extensive bibliography accompanies the article.
3. [CSMEE, 1997](#) . Misconceptions as Barriers to Understanding Science (accessed 15 November 2004). Chapter four of "[Science Teaching Reconsidered](#)", assesses the role of misconceptions in the learning process, descriptions and examples of some common misconceptions in science, methods to identify misconceptions, and methods to break down misconceptions.
4. Phillips, W, 1991. [Earth Science Misconceptions \(more info\)](#) (accessed 15 November 2004). Find a variety of misconceptions categorized by age level as well as subject.
5. Plait, B., 2004. [Phil Plait's Bad Astronomy: Misconceptions \(more info\)](#) (accessed 15 November 2004). Bill Plait discusses a variety of celestial misconceptions ranging from the moon landing hoax to the cause of the seasons.

Classroom resources for Teachers

Website with information and links to lesson plans about Changing Seasons
http://www.education.noaa.gov/Climate/Changing_Seasons.html

The Real Reasons for Seasons, Sun-Earth Connections, Grades 6—8
Written by Alan Gould, Carolyn Willard and Stephen Pompea
<http://lawrencehallofscience.org/gems/GEMSSeasons.html>

Uncovering Student Ideas in Science by Page Keeley (@2005-2008 by NSTA Press)
Volume 3 contains two probes related to the study of weather. (What are Clouds Made Of? Rainfall)