

## Ready-to-Go Lessons from BioEd Online

Life on Earth is dependent on water and variations in its availability. The Earth's hydrological (water) cycle controls the distribution of water, which is always in movement; and always changing states from liquid to vapor to ice and back again. The water cycle is integrated with the complex physical, chemical, and biological processes that sustain ecosystems and influence climate. Ongoing research focuses on human activities that influence the natural distribution system and quality of water within the Earth's systems and to what extent the resulting changes are predictable.

### Title

The Water Cycle and Global Warming

### Objective/Proficiencies

Students will trace the flow of water in the environment.

Students will investigate simulated effects of global temperature change on oceanic surface levels.

Students will evaluate consequences of changes within water cycle using data from current models.

Students will observe and explain several different properties of water.

### National Education Science Standards

The Interdependence of Organisms:

The atoms and molecules on the earth cycle among the living and nonliving components of the biosphere.

Human activities modify ecosystems.

Physical properties of compounds reflect the nature of the interactions among their molecules.

### Audience/Time

Grades 8 - 12

2 -55 minute class periods

### Materials/Preparation

1. Download the following slides found within the slide set entitled, *Ecosystems*, <http://www.bioedonline.org/slides/slide01.cfm?tk=7> :
  - Slide 13 – Biogeochemical Cycles
  - Slide 14 – Water CycleUse the slides in PowerPoint format or make transparencies.
2. Download the PDF version of the activity sheet entitled *Why Should I Care?* Photocopy 1 for each student or have students make their own worksheets (hint: Make a transparency to use as a guide).
3. Download the PDF version of *Three States of Water Demonstration*. Assemble the materials listed for the demonstration.

4. Download the PDF version of the *Water Level Activity*. Assemble the materials listed for the activity.
5. Access the most recent yearly State of the Climate Report from the National Climatic Data Center, <http://www.ncdc.noaa.gov/oa/climate/research/monitoring.html> . Prepare a transparency or PowerPoint slide of *Global Surface Mean Temp Anomalies*.
6. Locate each of the following four *Nature News* articles in the Biology News section of BioEd Online.
  - “Sea-level rise is quickening pace,” January 19, 2006, *Nature Update (BioEd Online)* <http://www.bioedonline.org/news/news.cfm?art=2287>
  - “Ocean currents flip out,” January 4, 2006, *Nature Update (BioEd Online)* <http://www.bioedonline.org/news/news.cfm?art=2257>
  - “Ocean freshens up,” June 16, 2005, *Nature Update (BioEd Online)* <http://www.bioedonline.org/news/news.cfm?art=1836>
  - “Amazon hit by worst drought for 40 years,” October 11, 2005, *Nature Update (BioEd Online)* <http://www.bioedonline.org/news/news.cfm?art=2094>
7. Download and photocopy the *3-2-1 Activity Sheet* (1 for each student).

## Lesson

### Engage:

1. Follow instructions for the *Three State of Water Demonstration*. Do Part 1 as a class demonstration.
2. Pass out the activity sheet entitled, *Why Should I Care?* or demonstrate to students how to set up their own paper.
3. Show the class the water cycle slide. Ask students (working in pairs) to respond to the questions in column 1 (column 2 is for additional notes and changes later in the lesson). Each student should fill out an activity sheet.
4. Discuss the responses that different groups listed for each question. As the discussion progresses, refer to the diagram. Ask students to add information and questions to think about in Column 2.
7. Conduct Part 2 of the *Three States of Water Demonstration* as a class demonstration.

### Explore

#### **Option 1:**

1. Have students conduct the *Water Level Investigation* in groups of two. Follow proper safety guidelines when using a hot plate. Make certain that students wear safety goggles when heating liquids.
2. Students should notice that ice melting in the container does not raise the water level since ice is less dense than liquid water.  
As water cools, the molecules pack together and it becomes more and more dense until it reaches 4° C. Any attempt to pack them closer together cause the molecules to repel each other; at freezing point, the molecules form a lattice structure, such as ice and snow, which is significantly less dense than liquid water. Ask students to think of things in their life that would be different if ice were more dense than liquid water.

3. Conversely, as water temperature increases, liquid water becomes less dense and expands. Student may or may not observe the water in the container expanding enough to overflow. Ask students if they notice water vapor escaping from the container? Did they detect a change in the shape of the water surface? Depending on the air temperature, evaporation rates change. Surface tension is also reduced as water is heated. This is a great time for them research some of the properties of water.

## Option 2

1. Ask students to design an investigation that will explore how temperature affects water level.

### **Explain:**

1. Access the most recent yearly State of the Climate Report from the National Climatic Data Center, <http://www.ncdc.noaa.gov/oa/climate/research/monitoring.html> . Prepare a transparency or PowerPoint slide of the graph, *Global Surface Mean Temp Anomalies*. Anomaly refers to a deviation from a normal or average and often is used when describing climatic data.

2. Based on the results from the *Water Level Activity*, ask students to propose and support ideas about the effect that increasing temperatures might have on ocean water levels. For example, as water temperature in the ocean increases, the volume expands and levels rise. As ice floating in the ocean melts, the level is not raised, however, as surface temperature increases, additional ice breaks off which causes an increase in ocean levels. Ask students to access data from the internet to see if their ideas are supported. (Example: [http://www.grida.no/climate/ipcc\\_tar/wg1/424.htm](http://www.grida.no/climate/ipcc_tar/wg1/424.htm) and <http://www.ipcc.ch/present/graphics.htm> ).

If you only have one computer in the classroom, consider projecting the screen and ask the class to direct the search.

3. Encourage students to suggest additional factors that influence ocean levels such as movement of the ocean floor, evaporation, subsidence, run off from snow melt, changes in currents, salinity levels and so on. It is important for them to realize that determining the cause of events is not simple.

### **Elaborate/Extend:**

1. Divide students in to groups of four. Ask each student to read one article:

“Sea-level rise is quickening pace,” January 19, 2006, *Nature Update (BioEd Online)*

<http://www.bioedonline.org/news/news.cfm?art=2287>

“Ocean currents flip out,” January 4, 2006, *Nature Update (BioEd Online)*

<http://www.bioedonline.org/news/news.cfm?art=2257>

“Ocean freshens up,” June 16, 2005, *Nature Update (BioEd Online)*

<http://www.bioedonline.org/news/news.cfm?art=1836>

“Amazon hit by worst drought for 40 years,” October 11, 2005, *Nature Update (BioEd Online)* <http://www.bioedonline.org/news/news.cfm?art=2094>

2. Ask each student to summarize the article they read and share the information with the group. Pass out the 3-2-1 Activity Sheet and ask each student to complete it based on all four articles.

## Evaluate

1. Ask each student to create an article or bio-political cartoon for the school newspaper concerning problems with any of the resources or processes within the water cycle.

## Going Further:

Use the internet to access data on sea level changes, climate changes, and coastal changes.

Explore questions such as:

Is the hydrological cycle (water) changing?

Are sea levels changing?

Is the climate becoming more variable?

Why is Antarctica important to all of us?

## Download PDF's

The Water Cycle and Global Warming Lesson Plan

Three State of Water

Why Should I Care?

Water Level Investigation

3-2-1 Worksheet

## Additional References:

Intergovernmental Panel On Climate. (2001). Climate change 2001: Synthesis Report. Retrieved 1-23-2006 from <http://www.ipcc.ch/pub/un/syrenq/spm.pdf>

NASA. (2006). Is sea level rising? Retrieved 01-23-2006 from <http://gcmd.gsfc.nasa.gov/Resources/Learning/sealevel.html>

NOAA. (2005). Global Warming. Retrieved 1-23-2006 from <http://www.ncdc.noaa.gov/oa/climate/globalwarming.html>

U.S. Environmental Protection Agency. ((2002). Global warming. Retrieved 1-23-2006 from <http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html>