

VISUALIZING CHANGES IN THE GREAT LAKES

BACKGROUND

Whenever people talk about the future, they form a mental image of what things will be like. They think about themselves and the things they know about, and in their imagination build a new picture of what they can expect. As we consider the impacts of climate change on the Great Lakes, there are a number of ways of visualizing those changes.

Teacher Activity A: Which Great Lakes factors will increase and which will decrease as a result of climate change?

Objectives: In this activity, students will construct a web of things that may increase or decrease as a result of a changing climate.

After completing this activity, students will be able to:

- List and explain many potential impacts of climate change
- Discuss various interpretations of the possible impacts of climate change

Materials:

Blank wall, bulletin board or a few large tables pushed together	1 per group
Tape or push pins if using a blank wall or board	50-75 per group
1 card labeled "INCREASE IN GLOBAL TEMPERATURE"	1 per group
40 cards labeled "MORE" on one side and "LESS" on the other side	1 set per group
35-40 scientific and social impact cards (templates included as teacher materials)	1 set per group

Time required: 1 class period

TEACHER'S NOTES

- Because of space, this activity can be done as a whole class or in large groups (i.e., 3 groups of 10 students in a class of 30). If used with small groups, impact cards and MORE/LESS words can be put on 3 X 5 note cards or small pieces of paper. This avoids the problem of students having to wait for their turn at the table/board, and it also results in many different maps that can be compared in group discussion.
- This activity can be used at various stages of a unit. For instance, it can introduce a new topic and relate it to previous ones or it can be a culminating activity to draw all aspects of a study together.
- Use one color paper for the MORE/LESS words and another color for the impact cards.
- While a variety of impact items are provided, feel free to add other scientific and social impacts as appropriate.
- Materials can be laminated for continuous use.

ALIGNMENT

National Framework for K-12 Science Education:

CC2: Cause and effect: Mechanism and explanation

Core Idea ESS2: Earth's systems

Core Idea ESS3: Earth and human activity

Great Lakes Literacy Principles:

#3e: The Great Lakes influence local and regional weather and climate.

#6e: The Great Lakes and humans in their watershed are inextricably interconnected.

Climate Literacy Principles:

#7b,e: Climate change will have consequences for the Earth system and human lives.

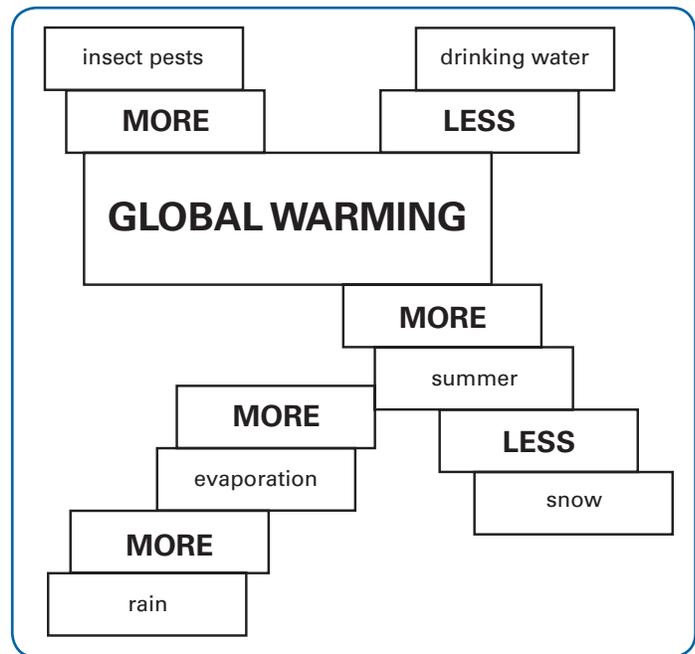
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ENGAGE

Pose to and discuss with students the following broad questions: How will things change in the Great Lakes region if the average global temperature increases? How will the various Earth systems (biosphere, hydrosphere, cryosphere, atmosphere, lithosphere) be affected?

EXPLORE

1. Determine whether the activity will be done as a whole class or in large groups.
2. Assemble materials by placing the MORE/LESS cards in a pile and spreading out the impact cards. Place the INCREASE IN GLOBAL TEMPERATURE label in the center of a large table or board.



3. Invite students to come forward one at a time to select an impact card that is a direct result of a previously placed card. They should then select either MORE or LESS as a connector between the two impacts and place them in the web to show a sequence of events. For example, the first student may decide that an INCREASE IN GLOBAL TEMPERATURE (center card) leads to MORE INSECT PESTS or LESS DRINKING WATER. Students must be able to justify the position of the cards they add and their choices of MORE or LESS impact.

EXPLAIN

4. As students use these cards, it will become apparent that there are various interpretations of the impacts. For instance, more weeds and insect pests would probably invade the region, and soil moisture would probably decrease if global warming occurred. However, annual temperatures would be higher and growing seasons longer. The net result could be either more or less crop production. Much would depend on the fertility of northern soils; where and when precipitation falls; and which crops are grown. Lead the class in a discussion of all interpretations.
5. If there are multiple groups completing the activity simultaneously, have groups prepare a written or oral presentation of their maps, analyzing the thinking about interrelationships that produced the array.

EXTEND

This activity, as written, focuses on *global* climate change. Have students consider the scientific and social impacts on a *regional* level (throughout the Great Lakes watershed). How would the organization of the web need to change to represent the impacts of climate change in the Great Lakes? Are there additional impact cards that could be added to the web?

EVALUATE

A suggested way to use this activity is as a pre- and post assessment for a unit on climate change. Have students construct the web prior to any discussion or activities and then again after learning. Students can take a picture of the concept map created at the beginning of a unit and compare it with the map produced at the end.

Sample evaluation questions

1. Select a chain of at least eight cards. Diagram the chain and give a possible explanation for the links illustrated.
2. List and discuss potential scientific and social factors which may be affected by an increase in global temperature.
 - Accept a large variety of answers for this question. Jobs would be created to help develop new crop seeds that could tolerate warmer, drier conditions. Farmers would need to adjust their crops and farming practices to respond to the changing conditions. Recreation facilities would need to change their structure for the longer summer season, lowered water levels and warmer temperatures. Fishers and manufacturers of fishing gear would need to be flexible because spawning areas for existing fish species may decrease and new species could become abundant. Companies that use toxic chemicals may need to adjust their procedures because increased temperatures and incidence of severe storms would cause airborne pollutants to travel further. The lowered lake and river levels would also greatly impact the shipping industry because boats would either be unable to pass through certain areas or would be required to carry a lighter load. This would have repercussions on the companies that use this method to transport goods.
3. How can the variety of interpretations of global warming impacts lead to uncertainty among policy makers? How do policy makers deal with such dilemmas?
 - Because scientists disagree on what the effects of global warming will be and the severity of these effects, it is not simple for policy makers to make decisions on related issues. They are forced to make difficult decisions based on differing hypothetical projections. The effects of global warming are also not straightforward: agriculture, for instance, in some areas may be improved but in other areas it will be damaged. For most changes, there would also be some groups that will come out the winners and others will be the losers. These uncertainties make decision making difficult.

ADDITIONAL RESOURCES

Union of Concerned Scientists: Great Lakes Communities and Ecosystems at Risk

<http://www.ucsusa.org/greatlakes/>

Impacts on Water: Our Nation's Vital Resource (one page handout explaining and illustrating the cascading effects of climate change in the Great Lakes region)

<http://www.ucsusa.org/greatlakes/pdf/glwaterresources.pdf>

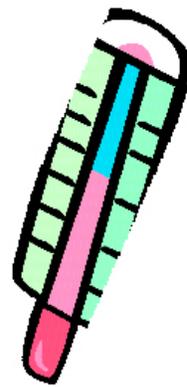
Climate Change in the Great Lakes Region

<http://www.great-lakes.net/envt/refs/cchange.html>

US Global Change Research Program

<http://www.usgcrp.gov/usgcrp/nacc/greatlakes.htm>

Increase in global temperature



MORE

LESS

MORE

LESS

LESS

MORE

LESS

MORE

evaporation

snow

drinking water

severe storms

insect pests

flooding

recreation

water pollution

winter

**biological
diversity**

ducks

income

fertilizer use

**shoreline
development**

extinction

lake levels

**lakefront
property**

rain

**toxic air
pollution**

electricity

fear

shipping

disease

soil moisture

pesticide use

people

wetlands

crop production

cooperation

fish

tourism

forests

**dredging of
waterways**

debate

summer

air conditioning

weeds

water diversion

drought

Teacher Activity B: What will people see on the long walk to the water's edge?

The shoreline of the Great Lakes, like the shores of other coasts, is remarkably varied, from sand dunes and beaches to rocky shores, high cliffs, wetlands, and urban waterfronts. A Google image search for a given state (e.g., "Ohio shoreline") will demonstrate this.

Like the shorelines of the world's oceans, Great Lakes shorelines are expected to change dramatically as global climate change impacts the Earth system. Unlike the rising sea levels of the marine coast, however, at least some areas of the Great Lakes are likely to experience dramatically lower water levels.



Lake Erie Shores & Islands

A complete lesson on Water Levels in the Great Lakes is included in this set. Basically, lake levels rise and fall depending on how much rain and snow falls on the lakes and in their drainage basin, and how much of the water evaporates. The relationship between precipitation and evapotranspiration is good for making predictions on an annual basis, but longer term views are necessary to see what is likely to happen over decades and centuries. Those are considered in the water levels lesson. Regardless, the shoreline of the Great Lakes is likely to look very different in years to come. This lesson invites visualization of how the shore will look in areas where water levels drop, but teachers may also want to consider shoreline impacts where lake levels rise.

What will be exposed as the nearshore waters recede? How far out from shore must we go to get the water depth we need? As water levels drop, the underwater shape of the lake basin (bathymetry) will determine whether a new beach is exposed or higher bluffs. Scientists and regional decision makers are now identifying the kinds of changes this may incur for the region. Examples include positions of marinas and private docks, and the amount of shipping that can go through shallower channels and locks. Cities that get their water supply from the lakes are calculating where new intakes will have to be, and fisheries managers are determining whether lost wetlands could impact the spawning of favorite fish. Many changes may come. We are just beginning to acknowledge the changes and imagine their effects on the life of the region.



Visit Lora County



John Nagy

ACTIVITY OVERVIEW

In this activity, students examine information about how climate change will likely impact the Great Lakes of North America and assume that they are in a part of the region experiencing a water level decline of over two meters! They listen to [or read] a story in which they imagine that they have spent a lifetime visiting the Great Lakes. With their “memories” and their science information, they describe the changes they have noticed in the Lakes during their lifetime.

Objectives: When students have successfully completed this lesson, they should be able to:

- visualize the appearance and condition of a Great Lakes shoreline with climate change;
- write clear, scientifically plausible essays about the changed shoreline; and
- demonstrate appropriate use of science language.

Materials (for any size class):

Individual writing supplies or word processor access
Great Lakes Then and Now Story
Internet access [optional]

Time required: one class period, or as homework

ALIGNMENT

National Framework for K-12 Science Education:

CC7: Stability and Change

Core Idea ESS3: Earth and human activity

Great Lakes Literacy Principles:

#2c: Lake level changes influence the physical features of the Great Lakes coast.

#8a: The Great Lakes are a source of inspiration, recreation, rejuvenation and discovery.

Climate Literacy Principles:

#7b: Climate change will have consequences for the Earth system and human lives.

ENGAGE

Look at various photographs of Great Lakes shorelines at the photo gallery provided by NOAA's Great Lakes Environmental Research Laboratory [GLERL], <http://www.glerl.noaa.gov/pubs/photogallery/>. Discuss the level of the water in relation to what is shown on the land. How close is the water? What is happening right on the shore?

EXPLORE

Read the personal story on the student worksheet aloud with the class and then allow time for individual students to write about how they visualize the new shoreline, comparing it to what they imagine (or remember). The writing may be assigned for homework to allow for reflection and careful composition.

EXPLAIN

Since this lesson is for imagining, attempts to explain may be conceptual and based on experience, or they may take the form of students doing Internet research about water level impacts on infrastructure and environment. This section of learning should be flexible to allow for student maturity, access to technology, and whether the class has done the Water Levels lesson in advance.

EXTEND

More people are aware of sea-level rise than of lake-level decline, and many credible Internet sites describe the mechanisms and impacts of climate change on the volume of the world ocean. To compare coastal issues, students may want to visualize what a walk to the new seaside would be like. Would it be a longer or shorter walk than before the climate began to change? What shoreline changes are likely to be observed at the students' favorite beach?

EVALUATE

Miller and Calfee (2004) developed a science-writing rubric with useful criteria for many writing experiences. It includes ways to compare science achievement, as well as written expression, and is available at http://nsta.org/main/news/stories/science_and_children.php?category_ID=86&news_story_ID=49933.

Perhaps more important than scoring the writing is to foster visualization. In considering the science and policy of global climate change, few people have stopped to envision how environmental changes, such as less lake water or rising sea level, will affect them personally. While environmental science on the scale of climate change is very abstract, this kind of activity brings to light the personal aspects. Students may be able to relate more to the science if they see that the changes to come are likely to be personal ones as well as those that make headlines. It is valuable to discuss the "Science in Personal and Social Perspectives" as fostered by the National Science Education Standards (NRC 1996) and to consider such lessons as part of science literacy.

REFERENCES

Miller, R., and R. Calfee. 2004. Making thinking visible. *Science and Children* 42 (3): 20–25.

USGCRP. 2003. Internet document from U.S. Global Change Research Program.

<http://www.usgcrp.gov/usgcrp/Library/nationalassessment/overviewmidwest.htm>

ADDITIONAL INTERNET LINKS TO ENHANCE THIS ACTIVITY INCLUDE

<http://www.great-lakes.net/envt/water/levels/hydro.html>

This page of the Great Lakes Information Network (GLIN) has current information about water levels and a clickable map of the lakes with recent data on water levels.

http://www.great-lakes.net/teach/envt/levels/lev_1.html

In the education section of GLIN, an online overview of water levels and impacts is presented. The section includes a map of the Great Lakes watershed, with the states and provinces identified.

<http://www.usgcrp.gov/usgcrp/nacc/greatlakes.htm>

U.S. National Assessment of the Potential Consequences of Climate Variability and Change. Region: Great Lakes. This is a link to the interpretation of climate variables in the region.

<http://www.glerl.noaa.gov/seagrant/glw/photos/Seiche/25October2001/EriePix.html>

This page has photo examples of a low-water event in 2001 on Lake Erie.

*Additional Great Lakes Climate Change lessons are available from Ohio Sea Grant.
Please call 614.292.8949 for more information.*

Student Activity B: A Long Walk to the Water's Edge

When your grandparents first bought land on the shore of the Great Lakes, it was very beautiful. The forest reached almost to the beach, and ended in some low rolling sand dunes you used to run across with your bare feet flying. From the dunes to the water's edge was barely a skip or two; then your toes could wiggle in the cool water as it swished over the smooth, rounded stones. Along the beach you searched for lucky stones and interesting driftwood to put in the treasure box under your bed.

In the corner of the lot was a low area where some cattails grew, and the water was quiet and warm. Tiny fish swam there, and a green heron came every morning to find a mouthful for breakfast. A big frog once startled you with its lightning leap and a splash into the water when you came too near. It was great then when the water was so close you could hear it from your open window at night, and the beach seemed only a step away. Whatever your grandparents paid for that place, it was worth it.

So now the old place welcomes you back with your own grandchildren. You've told them stories about how it was; the image is so vivid in their minds as they run toward the beach. Follow them. On the porch swing that night, your daughter wants to hear what her children saw, and what YOU saw today.



In the role of the grandparent and then the child, think about how things have changed since the climate got warmer and the water level dropped. Write two stories: one from the perspective of the grandchild and the other from the perspective of the grandparent. She might appreciate a picture, too—your mental photograph of then and now.