Great Lakes Activity Key

*** For ease of use during class the Teacher Key pages are numbered the same as the Student Activity Book pages.

I. Introduction

The Great Lakes were carved out of the earth by glaciers during the last ice age – about 20,000 years ago. They have a tremendous impact on many people's lives and health. The Great Lakes ecosystem is constantly exposed to new imbalances imposed by humans. The lakes serve as transportation for ship and barge traffic. The ships and barges often carry animals and plants from other places into the lakes. Many cities and farms border the lakes. Fertilizers and weed killers get into the lakes by running off from these farms and cities. The water quality of the lakes is directly affected by human activities. Because the lakes are so large, they have a significant impact on local weather.

Get Info Objectives

1. Name the Great Lakes
2. Graph monthly rainfall data obtained from a chart.
3. Determine the effects that imported species have on native animal and plant populations.

Gather Data Objectives

1. Interpret color-coded maps of Great Lakes data.
2. Graph monthly rainfall data obtained from a chart.
3. Determine the effects that imported species have on native animal and plant populations.

Application Objectives

1. Determine the relationship between the length of time wind has blown over water and the height of waves.
2. Write a paragraph describing Zebra mussels' economic influences.
3. Determine steps necessary to ensure the recovery of the Great Lakes ecosystem.

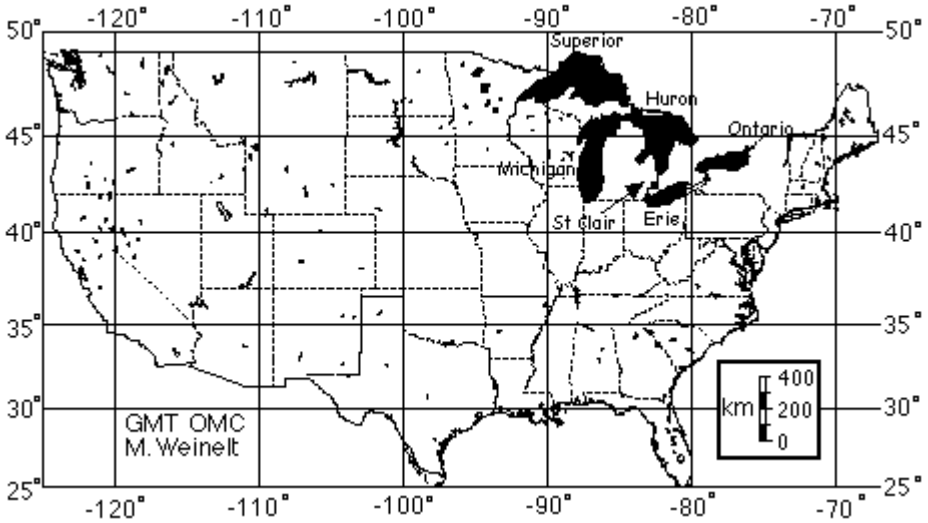
Before doing anything else, add the NOAA Research "Great Lakes" page to Bookmarks or Favorites on your browser.

- From the NOAA Research "Great Lakes" main page, click "Get Info."

II. Get Info

A. Names

1. Label the six Great Lakes in the picture below.



- Click on the "Names" site to check your answers.
- Click "Back" to return to the Great Lakes "Get Info" web page.

B. Location

- On the same map, use a ruler and the map scale to measure distance.

1. Draw a straight line from your city to the intersection (meeting place) of lakes Superior, Michigan, and Huron.

2. About how many kilometers are the Great Lakes from your house?

   answers will vary

3. How far from you are the Great Lakes in miles? One mile = 1.6 km.

$$\frac{\text{\# km from home}}{1} \times \frac{1 \text{ mile}}{1.6 \text{ km}} = _____ \text{ miles}$$

(answers will vary)

C. Alien Introductions

- Click on the "Foreign Species" site.
- Scroll down to the "Species Introduction" section.
- Read the section and answer the following question.

1. What do you think an "alien" or "foreign" species is?

A species introduced to a new area where it isn't found naturally.

2. What are some beneficial (helpful) effects on an area when an animal or plant from another area is introduced?

Provide food, game, beauty, control pests

3. What are some harmful effects on an area when an animal or plant from another area is introduced?

Compete with native species for food, habitat, prey on native species, bring diseases, introduce parasites.

- Click "Back" to return to the NOAA Research "Great Lakes" main page, or click "Return" at the bottom of the page.

- Click "Gather Data."

III. Gather Data

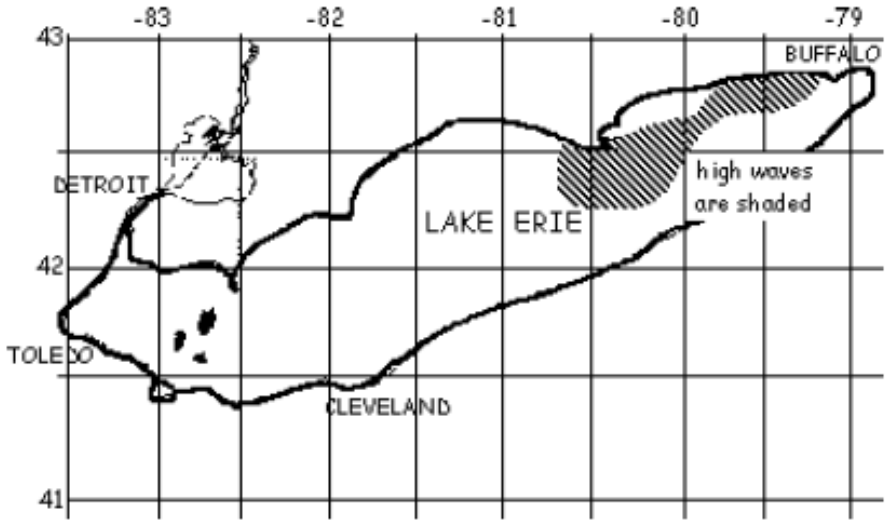
A. Wind Speed on Lake Erie

- Click on the "Lake Erie Wind Speed" site.

1. Predict which areas of Lake Erie will have the highest waves. Record your answer as a written description of the location relative to other parts of the lake.

The northern part of the northeastern part of the lake will have the highest waves. This part is just south of a small peninsula.

2. Draw the area of highest waves on the map of Lake Erie.



3. Why do you think these areas will have the highest waves?

The winds are highest in this area, so the waves should be highest here also.

4. Convert the highest wind speed from knots to miles per hour. (One knot is 1.15 miles per hour.)

$$\frac{25 \text{ knots}}{1} \times \frac{1.15 \text{ mph}}{\text{knot}} = 28.75 \text{ mph}$$

- Click "Back" to return to the Great Lakes "Gather Data.1" web page.
- Click on the "Lake Erie Wave Height" site.

B. Wave Height and Direction

1. Check on you prediction in #1 above. Was your prediction correct?

____Yes or no_____

2. How many feet high are the highest waves on Lake Erie?
   (one foot = 12 inches, one meter = 100 cm, one inch = 2.54 cm)

$$\frac{2.5 \text{ meters}}{1} \times \frac{100 \text{ cm}}{\text{meter}} \times \frac{1 \text{ inch}}{2.54 \text{ cm}} \times \frac{1 \text{ foot}}{12 \text{ inches}} = 8.2 \text{ feet}$$

- Click "Back" to return to the Great Lakes "Gather Data.1" web page.

C. Water Surface Elevation

- Click on the "Lake Erie Water Surface Elevation" site.
- This map uses elevation like a topographic map. Elevation means height above sea level. Higher elevations are higher above sea level.

1. What part of Lake Erie has the highest water elevation?

__The northeast corner of the lake has the highest elevation._____

2. What part of Lake Erie has the lowest water elevation?

__The southwest corner has the lowest elevation._____

3. What is the direction of water flow in Lake Erie?

___From the northeast to the southwest_____

4. What is the total difference in water elevation from the northeast end of Lake Erie to the southwest end?

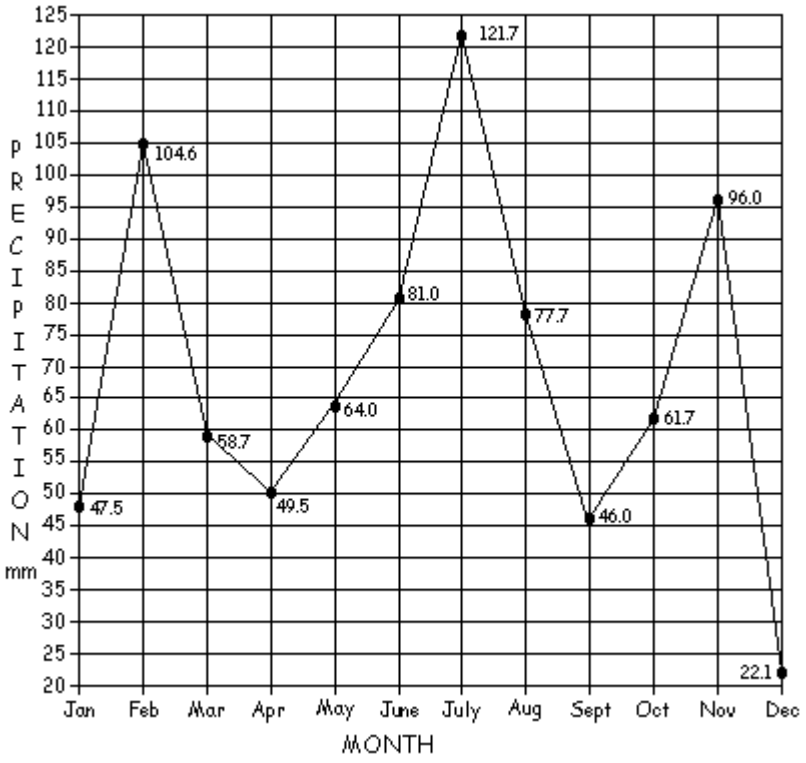
___.40 meters_____

- Click "Back" to return to the Great Lakes "Gather Data.1" web page.
- Click "Forward" at the bottom of the page.

D. Graphing Overland Precipitation

- Click on the "Lake Erie Precipitation" site.

1. Graph the precipitation during 1900.



- Click "Back" to return to the Great Lakes "Gather Data.2" web page.

E. Temperature Changes with Depth

- Click on the "Lake Ontario Vertical Temperature" site.
- This map shows you the water temperature at various depths of Lake Ontario. The picture in the right lower corner shows the whole lake with lines drawn where the four cross sections are taken.

1. What is the coldest water temperature in Lake Ontario? __2° C___

2. What is the range of depth at which the water is 8 degrees Celsius at cross section "C"?

___55___ meters to ____132___ meters

- Click "Back" to return to the Great Lakes "Gather Data.2" web page.

F. Effects of Foreign Species on Local Animals

- Click on the "Health Indicator" site.
- Click on the "amphipods" link to see what an amphipod looks like.
- Read the information and answer the following questions.

1. How is the "health" of Lake Michigan's water life populations measured?

__Many amphipods in the lake mud indicates a healthy lake._____

2. Why does the lack of amphipods affect the fish population?

___Fish eat amphipods_____

3. What do amphipods eat?

Amphipods eat diatoms.

4. Why do you think the amphipods are disappearing?

Zebra mussels are eating the diatoms and are better at it, so there are not enough diatoms to feed the amphipods.

- Click on and read the "Diporeia" site.
- Scroll down to the blue and white maps of the Diporeia population in Lake Michigan and answer the following questions.

5. When you compare the maps from different years, what can you infer (figure out) about amphipods' population? (Diporeia is a type of amphipod.)

The Diporeia population is decreasing

6. Why is it important to measure seemingly unimportant things such as the number of invertebrates in the mud at the bottom of lakes?

Invertebrates can be very sensitive to small changes in the environment. If we monitor their health and populations, we can judge how healthy the environment is. Also, other animals including humans are poisoned by many of the same things that kill invertebrates.

7. How do scientists make maps like these?

Measure the population of animals in an area over time. Assign a specific number of animals to be a certain color. Draw colors on the map to represent the number of animals.

- Click "Back" to return to the Great Lakes "Gather Data.2" web page.
- Click "Forward" at the bottom of the page.

G. Zebra Mussels – A Closer Look

- Click on the "Zebra Mussel" site.
- Scroll to the "Impacts" section, read the information and answer the following questions.

1. What problems do Zebra mussels cause?

Biofouling (living things fouling things up), increase drag on boats, sinking navigational buoys, fouling fishing gear, deteriorating dock pilings, corroding steel, and concrete structures

2. What good things have happened due to Zebra mussels?

Lake Erie's water is clearer than it used to be. More plants grow in Lake Erie since they can get more sunlight. The plants provide cover and act as nurseries for some species of fish.

- Scroll down to the "Methods of Control" section.

3. List the three methods of control you think are best. Write why you think these are the best methods.

Method - Methods chosen will vary.

All methods are listed here:

1. Chemical molluscicides including chlorine, chlorine dioxide
2. Annual removal with high-pressure washing / scraping them off
3. Dewatering / desiccation (freezing or heating)
4. Thermal (steam or hot water)
5. Acoustical vibration
6. Electric current
7. Filters, screens
8. Toxic coatings such as copper and zinc
9. Non-toxic coatings such as Teflon
10. CO_2 injection
11. UV light
12. Anoxia / hypoxia
13. Flushing
14. Biological agents (parasites, predators, diseases)

Why each method described above is best – Reasons will vary.

- Click "Back" to return to the Great Lakes "Gather Data.3" web page.
- Click on the "Zebra Mussels Biofouling" site to see examples of Zebra mussels biofouling and living on other mussels. This picture shows how Zebra mussels can block water pipes.
- Click the "Next slide" button. This picture shows how Zebra mussels live on and kill native mussels.
- Click "Back" to return to the NOAA Research "Great Lakes" main page, or choose "Great Lakes" from your Bookmarks or Favorites.
- Click "Application."

IV. Application

A. Wind Duration vs. Wave Height

- If you have completed the Forecasting activity in the Storms section, skip the wind barb section below.

- Click on the University of Illinois at Urbana-Champaign WW2010 Project Wind Barb site.
- Read about wind barbs. Once you understand how wind barbs work, click "Back" to return to the Great Lakes "Application.1" web page.

- Click on the "All Lakes Wind" site.

1. Describe both the direction of wind and the speed of wind on Lake Michigan. What is the overall pattern of wind speed and direction on the lake?

The wind is out of the north at about 10 knots except in the middle west and extreme south, where it is about 20 knots.

2. Describe the wind speed in different locations on Lake Michigan.

The wind speed is about the same over the lake.

- Click "Back" to return to the Great Lakes "Application.1" web page.
- Click on the "All Lakes Wave Height" site.
- Click the "Back" and "Forward" buttons on the web browser to compare the pictures.

3. Describe the wave height in different parts of Lake Michigan. What is the overall pattern of wave height?

The height of the waves increases toward the southern part of the lake.

4. What would you expect the relationship to be between the length of time the wind blows over the water and the height of the waves?

The longer the wind blows, the higher the waves are.

- Click "Back" to return to the Great Lakes "Application.1" web page.

B. Economic Impacts

1. Think about the harmful and beneficial effects of Zebra mussels. What are some ways Zebra mussels are economically important?

They foul pipes and damage industrial and power facilities. They cause drag on barges and ships. They affect fish and invertebrate populations, but they might actually do some good to some fish species. They create jobs for people who clean boat hulls and replace pipes..

- Click "Forward" at the bottom of the page.

C. Progress

The Great Lakes border not only the US, but also Canada. The water quality of the lakes affects both countries. We have to work together to provide a future for the lakes and the people who live on them. Both countries signed an agreement called "The Great Lakes Water Quality Agreement" that has helped us clean up the lakes.
- Click on the "State of the Lakes" site.

1. Overall, which lake had the highest concentration of phosphorous in 1991/92?

Lake Ontario had the highest concentration.

2. Which lake had the highest concentration of PCB's in fish?

Lake ___Michigan___had a PCB concentration of___23___ppm.

3. Which lake had the highest concentration of PCB's in gull eggs?

Lake ___Ontario___ had a PCB concentration of ___180___ ppm.

4. Which lake had the second highest concentration of PCB's in gull eggs?

Lake ___Michigan___had a PCB concentration of___160___ppm.

5. Compare the small inset map in the upper right corner to the larger map. Which areas show the greatest improvement between 1983 and 1991?

__Lake Ontario shows the greatest drop in phosphorous concentration.__

6. What does the graph of the PCB concentration at Mugg's Island show is happening over time?

The PCB concentration in gull's eggs is dropping steadily.

7. What do you think caused the trend in question 5 above?

The PCB's are not used any more, and the PCB that is present is being diluted, washed away, and degraded.

- Click "Back" to return to the Great Lakes "Application.2" page.
- Click "Forward" at the bottom of the page.

D. Long-term Recovery

- Click on the "Great Lakes Future" site.
- Read from "The Future of the Great Lakes" section to the bottom of the page.

1. What can we do to ensure the recovery of the Great Lakes' ecosystems?

Regulate toxic waste and waste disposal; control pesticide and fertilizer use; understand living resources of the lakes better; protect wetlands, forests, and shorelines better; rehabilitate degraded waste

2. How can we use maps of populations to help understand the living resources in the Great Lakes?

Maps of animal and plant populations can show us trends over time that could affect the environment.

- Click "Back" to return to the NOAA Research "Great Lakes" main page, or choose "Great Lakes" from your Bookmarks or Favorites.
- Click "Enrichment."

V. Enrichment Activities

A. Interviews

1. Interview a meteorologist about the specific weather conditions that are caused by the Great Lakes, especially in winter.

2. Talk with someone who has gone ice fishing and ask about what is caught, when is the best time to go, and what is used for bait.

B. Newspaper Activities

1. Using the weather section or map, keep a record of the daily temperatures or snowfall at cities around the Great Lakes vs. cities inland. What is the difference between inland and coastal cities' temperature and rainfall?

2. Collect news articles related to the health of the Great Lakes and summarize each article.

C. Research

1. Write a short report on how the Great Lakes formed. Include when they were formed, how long it took, and a diagram of what happened.

2. Find out who was the first European to see the Great Lakes.

3. Using a map, list all the major cities and their populations that border the Great Lakes. Add the total population of the cities.

4. Research Native American tribes that lived in the Great Lakes area.

5. Find out what industries are supported by the Great Lakes.

6. Find out why Chicago is called "The Windy City".

7. Research diatoms and find out what they are used for.

- Click forward at the bottom of the page.

D. Related Web Sites

1. Great Lakes Effects on Weather
http://www.met.fsu.edu/Classes/Met4301/reports/campbells.htm

2. Great Lakes Environmental Research Laboratory
http://www.glerl.noaa.gov

3. Great Lakes Atlas – tons of info and great pictures
http://www.epa.gov/glnpo/atlas/index.html

4. Native American tribal information
http://www.epa.gov/glnpo/atlas/glat-ch3.html#Native%20People

5. About Our Great Lakes
http://www.glerl.noaa.gov/pr/ourlakes/

6. Foreign Species
http://www.glerl.noaa.gov/pubs/brochures/invasive/ansprimer.pdf

7. Health Indicator
http://www.glerl.noaa.gov/pubs/brochures/dipoflyer/dipo.pdf