

How Big is a Crowd?

(Background and Teacher Activity)

BACKGROUND

The Great Lakes and the surrounding land provide many resources for the people who live in the area. Water for drinking and industry, fish for food, minerals and other resources are abundant. However, people change the landscape. They create wastes and add chemicals to the environment when they use resources, and these can be harmful. When many people are concentrated in one area, they may compete for resources. In addition, the wastes people generate tend to concentrate in the area immediately around them and may cause pollution problems.

This lesson can be easily adapted for informal education settings. Informal educators will want to focus on the “Explore/Explain” portion of the lesson where learners construct the lakes with string.

Objective: In this teacher-facilitated activity, learners will construct the five Great Lakes from string and use wrapped candy or peanuts in shells to investigate the impacts of population centers on Great Lakes fish production and water quality.

After completing this activity, students will be able to:

- compare the relative sizes of the five Great Lakes and their human populations.
- describe some of the problems that arise when many people depend on a limited resource.

Materials: Students will need a large working area
1 area per group

Five strings, each tied into a circle, to represent the lakes
(Add a piece of masking tape on each string with the lake name noted on it.)

Lake labels
1 set per group

Five paper bags labeled with lake names
1 set per group

100 (minimum) wrapped candies (if done inside) or peanuts in shells (if done outside)
1 set per group

Area, Population and Fish Production tables
1 for the teacher

Templates for materials are found at the end of the lesson instructions.

Subject/Grade Levels: Geography, Environmental Science

As written, this activity is appropriate for students in grades 4 – 8, but can easily be adapted and enhanced for high school students and adult learners.



Snap peas, edamame or string beans can be substituted for peanuts if nut allergies are a concern.

ALIGNMENT

Next Generation Science Standards:

DCI: ESS3.C Human Impacts on Earth Systems (grade 5, middle school)
CC: Patterns Graphs, charts, and images can be used to identify patterns in data.

National Geography Standards:

#3: How to analyze the spatial organization of people, places and environments on Earth’s surface (grades 4, 8)

Common Core State Standards:

ELA/Literacy Draw evidence from informational text to support analysis, reflection and research. WH ST.6-8.9
Math Recognize and represent proportional relationships between quantities. 7.RP.A.2

Great Lakes Literacy Principles:

#6 a,b,c,f The Great Lakes and humans in their watersheds are inextricably interconnected.

LESSON

Prior to the activity, prepare materials for groups that contain the five labeled strings, lake name cards and the five paper bags with wrapped candies or peanuts in shells. Cut lengths of string and tie the ends together to make loops proportional to the areas of the five Great Lakes (see chart below). Decide how many students will be “populating” each of the lakes according to the chart. Numbers are given for both United States and Canadian residents (U.S./Canada).

Divide wrapped candies or peanuts in shells into groups representing the proportional number of fish caught annually in each of the Great Lakes. You will need at least 100 candies or peanuts. One candy or peanut represents approximately 50 tons of fish. Label the five bags with the name of the five lakes and use the table to put the correct number of “fish” in each bag.

These notes should help with assembling materials:

	String Lengths Needed Group Size		Proportional Number of Fish Caught (candy or peanuts)*
	Less than 30	Greater than 30	
Lake Superior	8.5 m	11.0 m	8
Lake Michigan	6.0 m	7.5 m	35
Lake Huron	6.0 m	7.5 m	5
Lake Erie	2.5 m	3.0 m	50
Lake Ontario	2.0 m	2.5 m	2

* For groups of less than 25 people, you may want to halve these numbers.

Total Participants	Number of People U.S. / Canada							
	15	20	25	30	35	40	45	50
Lake Superior	0/0	0/0	0/0	1/0	1/0	1/0	1/0	1/0
Lake Huron	1/0	1/1	1/1	1/1	1/1	2/1	2/1	2/1
Lake Ontario	1/2	1/3	2/3	2/4	2/4	2/5	3/5	3/6
Lake Erie	4/1	6/1	8/1	8/2	11/2	12/2	13/3	15/3
Lake Michigan*	6/0	7/0	9/0	11/0	13/0	15/0	17/0	19/0

* Remember that Lake Michigan is the only Great Lake that shares no border with Canada.

Note: You may want to invite additional classes to share in this activity, especially if your group has less than 20 people in it. Larger numbers of participants better illustrate the differing concentrations in population throughout the Great Lakes region.

ENGAGE

This lesson, as a whole, can be used as an engagement activity for an entire unit on water pollution or Great Lakes geography.

1. Arrange the loops of string that represent the five Great Lakes into the approximate shapes of the lakes. Have students place the lake labels inside the appropriate loops.
2. Ask students if they know which lake is entirely within the U.S. (Lake Michigan). Then use masking tape to add a dividing line to each lake to show the four lakes that have both a U.S. and Canadian side.
3. Pose the following questions for a class discussion:
 - Have you ever visited a Great Lake? *Answers will vary.*
 - Which of the lakes has the largest area? Which has the smallest area? *Lake Superior; Lake Ontario*
 - Around what lake would you guess most people live? *Answers will vary.*

EXPLORE/EXPLAIN

4. Ask students which lake (Lake Michigan) likely has the most people living within its watershed. Then begin assigning the appropriate numbers of participants to the U.S. and Canadian sides of each of the lakes. (An alternative is to assign participants to each lake without specifying a country. In this case you do not need a border.) Each participant should put one foot on the string “shore” of the lake.
5. Pose the following questions for a class discussion:
 - Where are people closest together? *Lake Erie*
 - Did anyone have a hard time finding room to stand? *Most likely*
 - On which lake or lakes do you think the biggest cities located? *Lake Michigan (Chicago); Lake Erie (Cleveland, Buffalo, Detroit)*
 - What major US cities are along the shores of each lake? *Lake Ontario (Toronto, Kingston, Hamilton), Lake Erie (Buffalo, Erie, Cleveland, Toledo, Detroit), Lake Huron (Alpena), Lake Michigan (Chicago, Milwaukee, Green Bay), Lake Superior (Duluth)*
 - Which lakes have the largest and smallest populations along the shoreline? *Lake Michigan has the largest shoreline population and Lake Superior has the smallest shoreline population.*
 - Are more people living near the eastern or western lakes? *The eastern Great Lakes have more people living around them, but not the largest city.*
6. Pass the appropriate bag of “fish” around each lake. Each person takes ONE piece of candy or peanut each time the bag is passed to him or her until the bag is empty. (If you have no one assigned to Lake Superior, set aside that bag and do not distribute those “fish” in the other lakes.)
7. Pose the following questions for a class discussion:
 - In which lake did people catch the most fish? *Lake Erie*
 - Why do you think this is so? *Lake Erie is the southernmost, shallowest and warmest of the Lakes, thus it is more productive.*
 - How does the number of fish harvested from Lake Erie compare to that in the other lakes? *Approximately 25 times as many fish are caught in Lake Erie than Lake Ontario; 10 times as many fish caught in Lake Erie than Huron; more than six times as many fish caught in Lake Erie than Lake Superior; and almost twice as many fish caught in Lake Erie than Lake Michigan.*
8. People create waste when they use resources, and much of that waste is carried by water. Too much waste causes pollution problems. Open and eat your “fish.” Put the wrappers or peanut shells on the floor inside the loop of string that is your lake.
9. Pose the following questions for a class discussion:
 - What kinds of waste are generated when consuming resources? *Litter, oil pollution, thermal pollution from shoreline industries.*
 - In which lake is the waste most concentrated (greatest amount, closest together)? *Lake Erie*
 - Remember that the water from each lake flows into the lake downstream (in this case, to the east) of it. Which lake or lakes do you think might have the worst pollution problems? Why do you think this is so? *Lake Erie is the shallowest lake with the smallest volume of water. Waste is most concentrated in this lake.*
 - Discuss the concept of retention time with students. Retention time is the amount of time it takes for the water in a lake to be completely replaced. In which lake or lakes is water replaced the fastest and slowest? A table of retention times has been provided for reference.

Lake	Superior	Huron	Michigan	Erie	Ontario
Average Retention Time	191 years	22 years	99 years	2.6 years	6.0 years

Lake Erie’s short retention time of 2.6 years means water and pollutants in it can be cycled out quickly. Lake Superior’s long retention time of 191 years means pollutants can potentially stay in that lake for almost two centuries.

10. Have students work individually or with a partner to complete the student worksheet.

EXTEND

This activity models population distribution, commercial fish harvesting and concentration of pollutants. Research actual population and fish harvesting numbers, as well as lake volumes. Compare the actual numbers to the numbers used in the model.

See <http://www.epa.gov/greatlakes/atlas/gl-fact1.html>.

Students can further explore the effects of litter or chemical contaminants in the lesson *What are the impacts of beach litter?* Here students construct a web of factors that may increase or decrease as a result of beach litter. This lesson can be found at http://greatlakesliteracy.net/_downloads/activities/beach-litter-v3.pdf.

EVALUATE

Sample assessment questions include:

- Describe the relationship between population, resources and waste.
- While “fishing” in your lake, not everyone had equal numbers of “fish.” What could you have done to ensure all participants received an equal number of fish? *Sell or trade for other resources or services.*
- What are some ways that pollution could be reduced in the Great Lakes?
- What are some specific things you could do to reduce the amount of waste you produce?

An exit ticket integrating Common Core writing standards can be found at the end of the lesson.

ADDITIONAL RESOURCES

A variety of resources (websites, fact sheets, data sets, presentations, and additional lessons) about general Great Lakes topics can be found at greatlakesliteracy.net. Resources are organized by literacy principle.

Jointly produced by the Government of Canada and the U.S. Environmental Protection Agency, the *Great Lakes Atlas* provides a wealth of background information, maps and fact sheets on the Great Lakes. It can be accessed at <http://www.epa.gov/greatlakes/atlas/index.html>.

The Great Lakes Information Network is an up-to-date, online resource for Great Lakes information and issues. It can be accessed at <http://www.great-lakes.net/lakes/>.

SOURCES

This activity originally came from *Supplemental Curriculum Activities to Accompany Holling’s Paddle-to-the-Sea* by Marcia L. Seager, Rosanne W. Fortner, and Timothy A. Taylor.

Erikson, M., Mason, S., Wilson, S., Box, C., Zellers, A., Edwards, W., Farley, H., and Amato, S. 2013. Microplastic pollution in the surface waters of the Laurentian Great Lakes. *Marine Pollution Bulletin* 77: 177–182.

LAKE
SUPERIOR

LAKE
HURON

LAKE
MICHIGAN

LAKE
ERIE

LAKE
ONTARIO

Student Activity:

How big is a crowd?

Name _____

1. Which of the lakes has the largest area? Which has the smallest area?

2. Around which lake do most people live?

3. Around which lake are people closest together?

4. On which lake or lakes do you think the biggest cities are located?

5. What major cities are along the shores of each lake?

6. Which lakes have the largest and smallest populations?

7. Are more people living near the eastern or western lakes?

8. In which lake did people catch the most fish? Why do you think this is so?

9. Write a ratio to show the proportion of fish caught in Lake Erie compared to the other Great Lakes.

	Lake Erie : Lake Superior	Lake Erie : Lake Huron	Lake Erie : Lake Michigan	Lake Erie : Lake Ontario
Ratio				
Number of times more fish in Lake Erie				

Name _____

10. In which lake is the waste most concentrated (greatest amount, closest together)?

11. Remember that the water from each lake flows into the lake downstream (in this case, to the east) of it. Which lake or lakes do you think might have the worst pollution problems? Why do you think this is so?

12. What is retention time? In which lake or lakes is water replaced the fastest and slowest? A table of retention times has been provided for reference.

Lake	Superior	Huron	Michigan	Erie	Ontario
Average Retention Time	191 years	22 years	99 years	2.6 years	6.0 years

13. Write a ratio to show the proportion of retention times between Lake Erie and the other lakes.

	Lake Erie : Lake Superior	Lake Erie : Lake Huron	Lake Erie : Lake Michigan	Lake Erie : Lake Ontario
Ratio				
Number of times longer water stays in lakes other than Lake Erie				

How big is a crowd? Exit Ticket

Name _____

The following graphics show the concentration of microplastics (tiny pieces of plastic floating in the water) in three of the Great Lakes (Lake Michigan and Lake Ontario were NOT sampled), as well as the maximum depths of each Great Lake. Use the data to make a claim related to microplastic concentrations in the Great Lakes. Be sure to provide **reasoning** and clearly support your **claim** with **evidence** cited from the provided graphics.

Lake	Average Depth
Superior	483 ft
Michigan	195 ft
Huron	279 ft
Erie	62 ft
Ontario	283 ft

Distribution graphic from Erikson et al. 2013

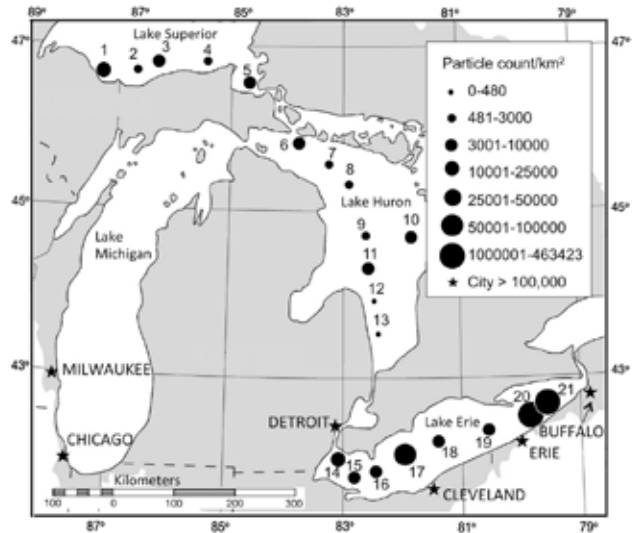


Fig. 1. Distribution of plastic particles by count for 21 samples collected in three of the Laurentian Great Lakes.

How big is a crowd? Exit Ticket

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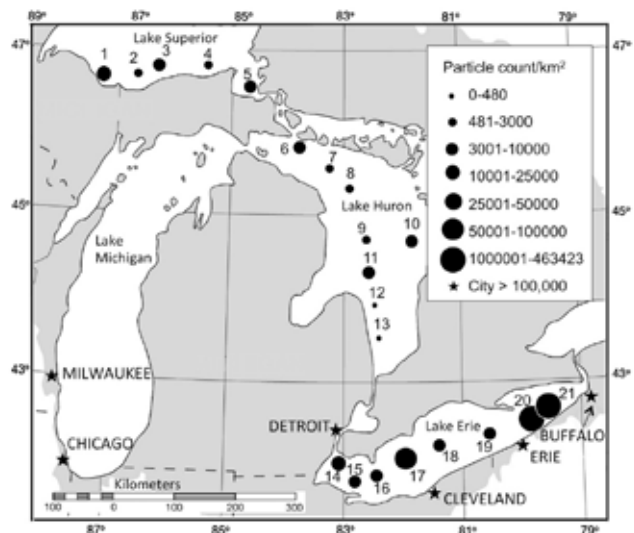


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