

Out One Lake and In Another - How long does it take water to flow through the Great Lakes?

Water that is in a lake does not stay in that lake. Where does the water go? If you think about the water cycle, you will be able to figure out several places that it might go. The length of time that it takes for the amount of water in a lake to be completely replaced (enter the lake) is called retention time. Each of the Great Lakes has a different retention time. Lake Superior's retention time is much longer than the others: 194 years compared to just 75 years for Lake Huron, for example. Since the water mixes as it pours in and out, over the course of 194 years only half of the water in Lake Superior actually leaves.

OBJECTIVES

When you have completed this activity you will be able to

- Construct an appropriate model of the water flow of the Great Lakes.
- Define the concepts of retention time and replacement time and, describe how they are different.
- Discuss how Lake Superior affects the dynamics of water flow, retention time and flushing rates for the Great Lakes system and why this is important.



Earth Systems Understandings

This activity deals with ESUs 2 (stewardship) and 4 (interactions).

Source

Lake Effects, Early Fall, 1995 - A quarterly publication for and about Lake Superior education. Published by Lake Superior Center, 353 Harbor Drive, Duluth, MN 55802. Another version can be found in the *Supplemental Activities for Paddle-to-the-Sea* book.

Materials

Teacher has:

- Roll of duct tape
- Measuring cups
- Food coloring
- Eye dropper
- Scissors for each group
- Sinks or dish pans for each group

Students bring in:

- Paper milk cartons
 - half-gallon/2 liters (two per work group)
 - pint/500 ml (one per work group)
 - half-pint/250 ml (two per work group)

Teacher Notes

Length: Two class periods or 90 minutes

If you plan on using the activity *What would be the result of regulating the level of one of the Great Lakes?*, you may want to modify the equipment set up of this activity so that you can use the same set up for both activities.

PROCEDURE:**A. Construct models (Day One)**

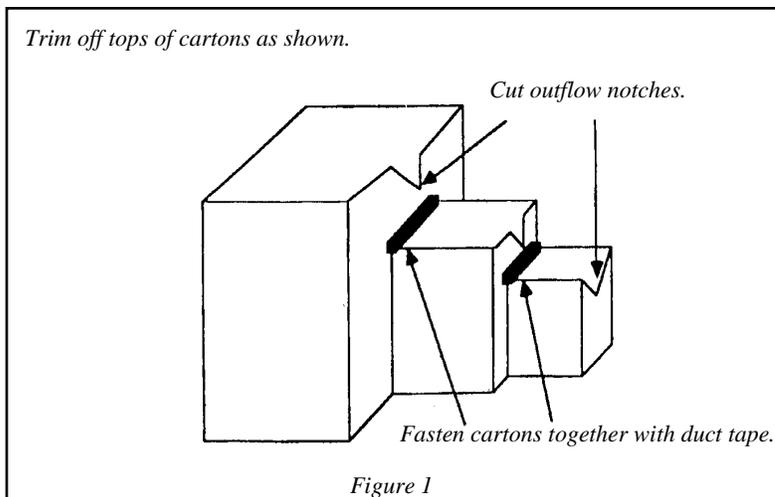
Work in groups of three as assigned by your teacher. You are going to build a model that demonstrates the water flow through the Great Lakes. Construct your Great Lakes model by following instructions given by your teacher. Use the diagram below and/or a model set up by your teacher as a guide to creating your model. Label the cartons from largest to smallest: “Superior,” “Huron,” “Erie.” Use your model and review the concepts of evaporation, precipitation and runoff with your group and/or class.

B. Demonstrate flow (Day Two)

Place your entire model inside a sink or dishpan to catch water that might overflow. Fill an extra half-gallon carton with water and pour it into Lake Superior. This represents 194 years of rain pouring into Lake Superior. Now pour another half-gallon in, very slowly. You should observe two things: the water pouring into the lower lakes and the water in Lake Superior replacing itself.

C. The problem with pollution: Lake Erie

With the cartons all full of water, add five drops of food coloring to your group’s “Lake Erie” half-pint container (or enough to significantly darken the water). Use another half-pint container to model Lake Erie’s replacement time of 2.5 years by pouring the half-pint directly into the Lake Erie carton.



1. Is the water in the Lake Erie carton clear? Why or why not?

Count how many 2.5 year flushing cycles it takes to make the Lake Erie water really look clear. Multiply the number of cycles by 2.5 years.

2. How many years does that represent?

In reality, it took Lake Erie about 15 years to clean itself out after pollution controls were installed in the early 1970s.

D. The problem with pollution: Lake Superior

Imagine that Lake Superior is polluted to the same extent (water as darkened) as Lake Erie.

3. Assuming it would take equally as many flushing cycles to clean Lake Superior out, how long would it take in real time given Lake Superior's 194 year retention time?

E. The problem with pollution: The Great Lakes system

4. Where does pollution go when it leaves one lake?

Toxins are being cleaned out from the Great Lakes. Locate the Gulf of St. Lawrence on a map or in an atlas.

5. Where is the Gulf of St. Lawrence?

One of the animals found living in the Gulf of St. Lawrence is the beluga whale.

6. Predict what you think might be happening to the beluga whales as a result of the interaction of humans and retention time / flushing rates of the Great Lakes.
7. Why is it important to the Great Lakes system to keep Lake Superior clean?

EXTENSIONS:

1. Take your model to lower grade classrooms and demonstrate the flow of the Great Lakes to younger students.
2. Investigate the beluga whales of the Gulf of St. Lawrence and present your findings to the class.

Answers

1. It will not be clear because only half of the food coloring will be gone.
2. Answers will vary from one group to another.
3. Answers will vary.
4. One place that pollution goes is downstream to another lake or river and eventually to the ocean. Other answers not examined by this activity are that pollution can get trapped in the sediment or it can be taken into the food chain.
5. East coast of Canada - Great Lakes water reaches the Atlantic Ocean.
6. Toxic chemicals have been found contaminating the beluga whales.
7. The "clean" water from Lake Superior helps to flush out the lower Great Lakes.