

An Interdisciplinary Investigation of Lake Superior

by Terri Browning, Soo Township Elementary School

Target Grade & Subject: Gr. 4-8 Earth Science

Unit Overview:

This teaching unit, while designed for fifth graders, can easily be adjusted for grade 4-8 students. Its primary focus is earth science, especially the hydrosphere, but it is nearly impossible to leave out the geography and history of the area. In fact, my overall goal is to promote an understanding and appreciation of the complexities and interrelatedness of the many aspects of the Great Lakes, concentrating on Lake Superior. Beyond that, I hope my students will feel the respect and awe to motivate them to be responsible stewards of this essential resource in their lives.

It has been difficult to limit the scope and length of this unit. I have included more than five days of activities and still barely scratched the surface of possibilities. Separate lesson parts could be taught at different times in the same school day or scheduled for another day. To include all of these activities could easily take three to four weeks, depending on the time available and the students' interests.

After an introductory lesson including an informal assessment of previous knowledge, I will focus for a few days on the physical aspects of Lake Superior, followed by learning about the geography of the lake and its watershed. A simulation activity will illustrate the difficulty of cooperation when many diverse and widespread groups share a problem. I have included lab experiments and a guest speaker on water quality. Two additional days of activities focus on aquatic food webs and exotic species. The unit concludes with a cooperative learning activity called a "jigsaw" that will allow students to share learning about six different examples of human interaction with the lake.

Highly motivated students will have opportunities for extra credit through the "Real Science" idea that Kim Matthews presented during the institute on the Lake Guardian. Saturday field trips to do GLOBE Hydrology protocols, doing a macroinvertebrate survey of lake sediments, or labeling storm drains are just a few possibilities. Another exciting possibility for making these field science activities accessible to all students would be to secure funding for the cost of transportation for field trips. We will be looking for those opportunities.

Learning about the lake will not conclude at the end of one week or even two, however. Connections with other units of study will continue all year. For example, we will conduct GLOBE weather observations on a daily basis. We will learn about the Native Americans and the European explorers in social studies. We will read about the *Titanic*, Robert Ballard, and "Alvin," the remotely operated vehicle, in our literature books. In May, we will visit the Great Lakes Shipwreck Museum at Whitefish Point. In addition, I trust that my students will share my "thirst" to know more, far beyond the conclusion of this unit.

Objectives

At the end of this unit, students will be able to . . .

1. Show on a circle or bar graph the approximate percentages of salt water, ice, groundwater, and usable fresh water on the earth;
2. Write a story about the journey of a drop of water through the Lake Superior water cycle;
3. Demonstrate an understanding of Lake Superior's susceptibility to pollution by explaining how it compares to a skinned knee;
4. Explain how the Great Lakes modify air temperatures;
5. Draw a diagram of a simple aquatic food web beginning with the sun's energy and including at least four labeled organisms correctly showing the relationships between them;
6. Name and describe at least five exotic species in the Great Lakes and explain the results of their introduction into the ecosystem;
7. Label at least five key places, including cities, rivers, and landmarks, given a map of Lake Superior;
8. Identify the river drainage basin for their home or our school and follow the river on a map to either Lake Superior or Lake Huron;
9. Identify and explain at least one way they can prevent lake pollution or take action to help correct existing pollution using new knowledge gained from this unit.

Michigan Content Standards

Science Content Standards for Middle School

Ecosystems (LEC) III.5

1. Identify familiar organisms as part of a food chain or food web and describe their feeding relationships within the web.
2. Describe how organisms acquire energy directly or indirectly from sunlight.
3. Predict the effects of changes in one population in a food web on other populations.

Geosphere (EG) V.1

1. Describe and identify surface features using maps.
5. Explain how technology changes the surface of the earth.

Hydrosphere (EH) V.2

1. Use maps of the earth to locate water in its various forms and describe conditions under which they exist.
2. Describe how surface water in Michigan reaches the ocean and returns.
3. Explain how water exists below the earth's surface and how it is replenished.
4. Describe the origins of pollution in the hydrosphere.

Atmosphere and Weather (EAW) V.3

1. Explain patterns of changing weather and how they are measured.
3. Explain the behavior of water in the atmosphere.

Social Studies Content Standards for Later Elementary

Geographic Perspective Standard 2

1. Explain basic ecosystem concepts and processes.
2. Describe the location, use, and importance of different kinds of resources and explain how they are created and the consequences of their use.
4. Explain how various people and cultures have adapted to and modified the environment.

Geographic Perspective Standard 3

3. Explain how transportation and communication link people and communities.

Geographic Perspective Standard 4

5. Describe the Great Lakes ecosystem, and explain physical and human processes that act upon them.

Citizen Involvement Standard 1

2. Engage in activities intended to contribute to solving a local, state or national problem they have studied.

Learning Activities and Assessments

Day 1: Introductory Activities

Part A: Brainstorm Prior Knowledge

Using chart paper, write “Lake Superior” inside a circle near the middle. Elicit responses to the question, “What do you know about Lake Superior?” Generate a web to include the group’s previous knowledge, right or wrong. Tell students that some information may be changed as the unit progresses.

On another piece of paper, list questions that students bring up or want to know more about. Post both charts on the classroom wall to revisit as necessary. These two lists can also be generated in small groups, and then shared with the whole group.

Part B: Demonstration

Using the student worksheet “Were You Aware?” from *Water, Precious Water* (Allen, 1988, p. 2) or a simple bar or circle graph, ask students to color their predictions of how much salt water, frozen water, groundwater, and fresh water is on the earth. Conduct the large-group demonstration (Procedure – Parts 1, 2, 3A, and 4) from “All the Water in the World” in the *Lake Effects* binder from the Lake Guardian Institute (Great Lakes Aquarium, 1998, pp. 10-12).

Assessment: Revisit the worksheet and color in the percentages representing the actual data and compare. Check to see that their second graphs are accurate.

Part C: Literature - Read Aloud

During the next few weeks, read aloud from *Broken Blade* by William Durbin. It is an engaging adventure about a young voyageur and his travels through the Great Lakes.

Day 2: Lake Superior Features and the Water Cycle

Part A: Demonstration

Conduct the lesson “A Great Lake Superior” from *Lake Effects* (p. 13-14) as a demonstration for the whole class.

Assessment: Conclude by asking how Lake Superior is like a skinned knee (p. 35). Students could respond verbally or in writing.

Part B: Game

Teach the lesson and play the game in “The Incredible Journey” (*Lake Effects*, pp.15-17).

Assessment: Ask students write a “travel log” of the journey of a water drop or molecule including some of the water cycle locations from the game. As an alternative, students could draw a picture of their water drop’s journey.

Day 3: Geography

Part A: Mapping

Using a giant floor map of Lake Superior, yarn, and road maps for reference, find the rivers in the Lake Superior watershed. This activity, “More Than Just a Lake,” is also found in *Lake Effects* (pp. 25-28).

Assessment: Help students find your school on a county map. Determine its closest river. Which lake does it flow into? Challenge students to find out if their homes are in the Lake Superior watershed.

Part B: Map Matching Game

Do the “Lake Superior Geography Concentration” game (*Lake Effects*, pp.109-111) to familiarize students with similar pairs of geographic landmarks or communities.

Assessment: Students may then record these locations on their own map worksheet of Lake Superior (*Lake Effects*, p. 172).

Day 4: Cooperative Problem Solving

In the “Cooperative Clean-Up” simulation (*Lake Effects*, pp. 97-98), students will experience the difficulty and the frustration of trying to achieve a goal with the help OR the hindrance of others. Discuss the similarities to real issues of Lake Superior cleanup.

Assessment: Assign a paragraph in which students identify and explain at least one way they can prevent lake pollution or take action to help correct existing pollution using new knowledge gained from this unit.

Day 5: Lake Effects on Air Temperature

Part A: Experiment

With the whole class, do the “Heat Sink, Heat Source” experiment from the “Weathering Lake Superior” lesson (*Lake Effects*, pp. 29-33).

Part B: Application with Temperature Data

Use the Michigan mean temperature data chart on page 33 in *Lake Effects* to evaluate the differences in weather of communities located near the lake and inland communities.

Assessment: Ask students to explain verbally or in writing how the Great Lakes can moderate air temperatures. They should use the results of the experiment to help support their conclusions.

Day 6: Water Quality

Part A: Experiment

Read *The Magic School Bus at the Waterworks* (Cole, 1986).

Conduct the “Would You Drink This Water?” experiment (*Lake Effects*, pp. 94-96) as a class demonstration with student volunteers.

Part B: Guest Speaker

Invite someone from your local water treatment plant to speak to your class about how drinking water gets from your town’s water source to your tap, including the water filtration methods. (In Sault Ste. Marie, field trips to the water treatment plant, sewage treatment plant, and hydroelectric plant have not been allowed since September 11.)

Day 7: Aquatic Food Webs

Part A: Simulation

Do the “Lake Superior Circle of Life” activity from *Lake Effects*, pp. 48-49. “Holding the Circle Together” sounds like the safer option of the two choices suggested. Also review the connections between organisms in an ecosystem with the extension activity using a ball of yarn.

Assessment: To conclude the simulation, ask students to draw a diagram or poster of a simple aquatic web with labels.

Part B: Game

“Food Chain Tag” (*Lake Effects*, pp. 74-76) is a fun and active way to illustrate and act out the effects of bioaccumulation. It should be played outside, if possible, although it also works well in the gym.

Day 8: Biology

Part A: Benthic Macroinvertebrates Survey

Bring in a sample of sediments from Lake Superior and/or the St. Mary's River. Rinse, strain, and look for macroinvertebrates using a stereomicroscope with the help of handouts from the Institute and other reference materials (Josephs, 2000, pp. 35-40). Students should sketch, identify, and count what they find.

Part B: Plankton

Use a plankton net to get samples from Lake Superior and/or the St. Mary's River. Examine samples under a stereomicroscope. Look for phytoplankton and zooplankton using handouts, reference books, and the photos on the Institute CD to help with identification.

Day 9: Exotic Species

Introduce exotic species with Dr. Bill Swenson's video, if possible. Schedule the "Exotics" Educator Trunk from Pictured Rocks National Lakeshore in Munising for more reference material. Assign each student an exotic species to research as directed in the "Getting Acquainted with Aliens" activity from *Lake Effects* (pp. 52-55). Provide a copy of the "Exotic Species of Lake Superior Worksheet," reference materials, including the Sea Grant CD, brochures, and pamphlets. Students should have a class period to begin looking for answers to the specific questions listed on their worksheet.

Day 10: Exotic Species

Continue the "Getting Acquainted with Aliens" activity with an opportunity for students to share their learning with others who researched the same species. As an expert panel, they can present their information to the whole class. An alternative would be to allow the class to interview each panel about their exotic species.

Assessment: Students should complete the rest of their charts with information about all of the other species presented. Check to see that the information is complete and accurate.

Day 11: Cultural / Human Aspects of Lake Superior

Conduct a simplified "co-op jigsaw" activity (Kagan, 1997, p.19:12) to explore several different topics in an efficient and interesting way. Divide a class of 24 students into six groups of four students and assign each group an article or story about a different topic. I suggest Native legends, shipwrecks, lumberjacks, mining, voyageurs, and fishing. These groups read and study their topic until they all feel like "experts." Expert groups should also formulate two key questions to turn in to the teacher. These questions will be compiled into a quiz at the conclusion of Day 12.

Day 12: Cultural / Human Aspects of Lake Superior

Regroup students so that four learning teams are formed, composed of one expert from each of the six groups. Each expert is responsible for sharing his/her special topic, being sure to emphasize the key points.

Assessment: When all students have finished teaching their teams, administer the quiz made up of the student-generated questions.

Additional Assessments: In addition to the assessments embedded in the learning activities, students may also be evaluated by observations, including participation, attitudes, and informal student comments that may indicate comprehension of concepts or misunderstandings to be clarified.

Teacher Curriculum Resources and Background Information:

Allen, Maureen, et al. 1988. *Water, Precious Water*. AIMS Education Foundation, Fresno, CA.

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Kagan, Spencer. 1997. *Cooperative Learning*. Kagan Cooperative Learning, San Clemente, CA.

Mackinaw State Historic Parks. *Education Packet*. Mackinaw City, MI.

Monson, Bruce A. 2003. *A Primer on Limnology, Second Edition*. Water Resources Center, St. Paul, MN.

Shaw, Byron, Christine Mechenich and Lowell Klessig. 2002. *Understanding Lake Data*. University of Wisconsin Cooperative Extension.

U.S. Environmental Protection Agency. 1997. *Great Minds? Great Lakes!* Great Lakes National Program Office, Chicago, IL.

U.S. Environmental Protection Agency and Government of Canada. 1995. *The Great Lakes: An Environmental Atlas and Resource Book*.

Student Resources:

Bruchac, Joseph and Jonathan London. 1992. *Thirteen Moons on Turtle's Back: A Native American Year of Moons*. The Trumpet Club, New York.

Cole, Joanna. 1986. *The Magic School Bus at the Waterworks*. Scholastic, Inc., New York.

Great Lakes Coloring Book. 1987. Harbor House Publishers, Inc., Boyne City, MI.

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Holling, Holling C. 1941. *Paddle-to-the-Sea*. Houghton Mifflin Company, Boston.

Longfellow, Henry Wadsworth. 1992. *Hiawatha*. Scholastic, Inc., New York.

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Kozlak, Chet. 1979. *Ojibway Indians Coloring Book*. Minnesota Historical Society, St. Paul, MN.

Otto, Simon. 1999. *Grandmother Moon Speaks*. Thunder Bay Press, Lansing, MI.

Sproul, Gloria C. 1979. *Mishe-Mokwa and The Legend of Sleeping Bear*. Mishe-Mokwa Publications, Greenwich, CT.

Other Useful Resources:

Behrend, Carl. 2001. *More Legends of the Great Lakes (CD)*. Old Country Records, Munising, MI.

Biodiversity Around the Great Lakes (CD). 2002. Purdue Research Foundation, West Lafayette, Indiana.

Ecology of the Great Lakes Teacher Institute (CD). 2004. MTU, Houghton, MI.

Education Trunks. *U.P. Geology; Exotics; AuSable Lighthouse*. Pictured Rocks National Lakeshore, Munising, MI.

Exotic Aquatics on the Move (CD). 2001. Sea Grant.

Holling, Holling C. *Paddle-to-the-Sea (videotape)*. Lightyear Entertainment, New York.

Shipwreck: The Mystery of the Edmund Fitzgerald. 1995. Great Lakes Shipwreck Historical Society, Sault Ste. Marie, MI.

U.S. Environmental Protection Agency. 2001. *The Great Lakes Watershed, Version 3 (CD)*. Great Lakes National Program Office.

Water: Our Life and Heritage. Detroit Free Press Newspapers in Education, Detroit, MI.