

OBJECTIVES

After participating in this activity, learners will be able to:

- identify the Great Lakes and the bodies of water that connect specific Great Lakes with each other and with the Atlantic Ocean
- describe the three-dimensional geography of the Great Lakes, including elevations
- describe why locks are needed, and how a lock system works

ACTIVITY SUMMARY

Groups of learners work on a single Great Lake and connecting waterway and then come together as a class to construct a simple three-dimensional model of the Great Lakes. Individual groups also present their Great Lake and connecting waterway information.

BACKGROUND

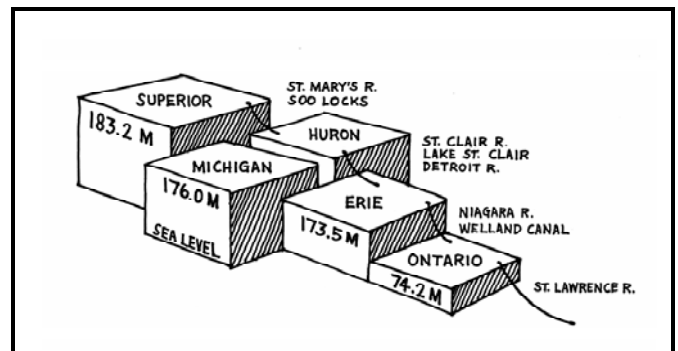
The surface of Lake Superior is about 600 feet (184 meters) above sea level. To allow ships to go from the Atlantic Ocean (0 feet elevation) to the Great Lakes and back for international trade, the United States and Canada have constructed a series of locks, channels, and canals that raise and lower ships to the level of the lakes, rivers, and ocean (Diagram 1).

For extreme changes in levels between the Great Lakes, lock systems were developed to raise and lower ships. To lower a ship which is in a lock, water is drained out of the lock. No pumps are needed until the operation is reversed,

and a ship needs to be raised.

Until the early 1800s, transportation between the lakes and ocean was very difficult. In 1825, the Erie Canal opened, more directly connecting Lakes Ontario and Erie with the Atlantic Ocean via the Hudson River and port of New York. In 1829, the Welland Ship Canal was constructed between Lakes Ontario and Erie to provide a shipping channel around Niagara Falls. (This canal was improved and enlarged several times from 1833 to 1919.) In 1855, the St. Mary's Falls Ship Canal (popularly known as the Soo Locks) connecting Lake Superior and Lake

DIAGRAM 1



Huron was enlarged to accommodate large lake-going vessels. Around the late 1800s to early 1900s, a 27-foot-deep navigation canal was dredged through Lake St. Clair from the St. Clair River Delta to the head of the Detroit River. The St. Lawrence Seaway was completed in 1959, opening the Great Lakes to medium sized, international, ocean-going vessels (Diagram 1).

Because of this navigation system, 80 percent of the world's cargo ships can now sail as far west as Lake Superior. Almost 200 million tons of international and interlake cargo are transported through the Great Lakes and St. Lawrence River and Seaway each year. Today, the main commodities shipped on the Great Lakes are iron ore, coal, limestone, and grain.

Not all changes as a result of the navigation system are positive. Opening the Great Lakes system to ships and navigation also opened the system to the invasion of exotic species. The arrival and impacts of exotic species created changes in the Great Lakes ecosystem, and many of these changes were negative. Increased industrial growth and development also led to environmental degradation, pollution, and loss of wetlands.

MATERIALS

- shapes of each of the Great Lakes to scale and made of reusable and markable material (example: laminated poster board with a foam core)
- washable markers (dependent on materials used)
- string
- tape
- materials to support the lake cutouts at various levels (books, Styrofoam® blocks)
- a different Great Lakes card for each group

- a different Connecting Waterways card for each group
- Michigan Sea Grant Extension Bulletins (maps) for the learners to use as reference materials

PROCEDURE

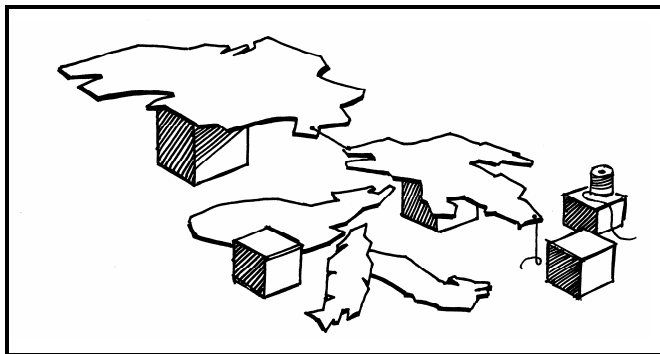
Day One

- 1) Introduce learners to the Great Lakes. Explain to them that they will be doing group projects that will be brought together as a class project to form the entire Great Lakes system.
- 2) Divide the class into six groups. Give each group a lake shape. (Count Lake St. Clair for the sixth group.) Pass out markers. Pass out one Great Lakes card and one Connecting Waterways card to each group.
- 3) Allow time for the learners to use reference materials (Michigan Sea Grant Extension Bulletins, maps, books), learn more about their lake, and mark information on their lake shapes.

Day Two

- 4) Have learners place their lake shapes into the proper geographical position and elevation. Pass out one string to each group (Diagram 2).
- 5) Discuss how boats move. Explain the concept of locks.
- 6) Assign each group a connecting waterway to research and put into place. (Provide connecting channel/

DIAGRAM 2



- waterway card with various questions.)
- 7) Put blocks into place.
 - 8) Have the learners present their lake and connecting channel as a group. Each learner in the group can identify and explain two places on the map, and answer one connecting channel question.

ASSESSMENT/EVALUATION

- Have learners complete the “Connecting Channels Quiz.”
- Give the learners a blank map of the Great Lakes basin and have them label all the Great Lakes and their connecting channels. (Or have the learners draw their own map.)



SOURCE

Modified by Jim Lubner, University of Wisconsin Sea Grant Institute; Nancy Link, St. Joan of Arc School, Michigan; and Kimberly Tanton, Detroit Edison, Michigan. Background material adapted from *The Life of the Lakes: A Guide to the Great Lakes Fishery* and “How do ships get from one lake to another?” in *Earth Systems—Education Activities for Great Lakes Schools: Great Lakes Shipping*.

ADAPTATIONS

- Have the groups switch cards and do the activity again.
- Visit the Detroit or St. Clair River to observe freighters. Try to determine what kind of cargo they are carrying. Do upstream ships travel faster than those traveling downstream? From what countries or states do the ships come?
- Continue the lesson with information on trade and/or settlement patterns on the Great Lakes.

COMPUTER EXTENSIONS

Great Lakes Education Program:

<http://www.msue.msu.edu/seagrant/>

The Great Lakes: An Environmental Atlas and Resource Book: <http://www.epa.gov/glnpo/atlas/intro.html>

U.S. Coast Guard Station St. Clair Shores, Michigan web site: <http://www.dot.gov/dotinfo/uscg/d9/stclair.html>

Great Lakes shipping schedules:

<http://www.oakland.edu/boatnerd/>

ADDITIONAL RESOURCES

Local Contacts

Local Navigation/locks office

Navy Sea Cadet Program—*Pride of Michigan*, docked on the Clinton River

U.S. Coast Guard Station—St. Clair Shores

U.S. Coast Guard Auxiliary—Algonac

Teaching Materials and References

Michigan Sea Grant. Obtain these publications from MSU Bulletin Office, 10B Agriculture Hall, MSU, East Lansing, MI 48824

(<http://ceenet.msue.msu.edu/bulletin>)

Lake Superior (Bulletin E-1866)

Lake Michigan (Bulletin E-1867)

Lake Huron (Bulletin E-1868)

Lake Erie (Bulletin E-1869)

Lake Ontario (Bulletin E-1870)

Clary, James. 1985. “Ladies of the Lakes.” *Michigan Natural Resources Magazine*.

Dann, S. L. 1994. *The Life of the Lakes: A Guide to the Great Lakes Fishery*. MICHU-SG-93-401, pp. 24–32. East Lansing, MI: Michigan Sea Grant College Program.

Edsall, T. A. and J. E. Gannon. 1991. *A Profile of Lake St. Clair*. MICHU-SG-91-701. Ann Arbor, MI: Michigan Sea Grant College Program.

Holling, Holling Clancy. 1941. *Paddle-to-the-Sea*. Boston, MA: Houghton Mifflin Co.

International Joint Commission. 1995. *The Great Lakes: An Environmental Atlas and Resource Book*. EPA-905-B-95-001. Chicago, IL: Environmental Protection Agency.

Ohio Sea Grant. 1997. “How do ships get from one lake to another?” *Earth Systems—Activities for Great Lakes Schools: Great Lakes Shipping*. EP-084, pp. 33–37. Columbus, OH: Ohio Sea Grant Publications.

Connecting Channels Quiz

LEARNER'S WORKSHEET

Name _____

Answers to the following questions are names of the main rivers, canals, and lakes that connect the Great Lakes together.

I am the link between Lake Ontario and the Atlantic Ocean. _____

I am a river between Lake Erie and Lake Ontario. _____

Ships get around Niagara Falls by using me. _____

I am the most downstream link between Lakes Huron and Erie. _____

I am the middle link between Lakes Huron and Erie. _____

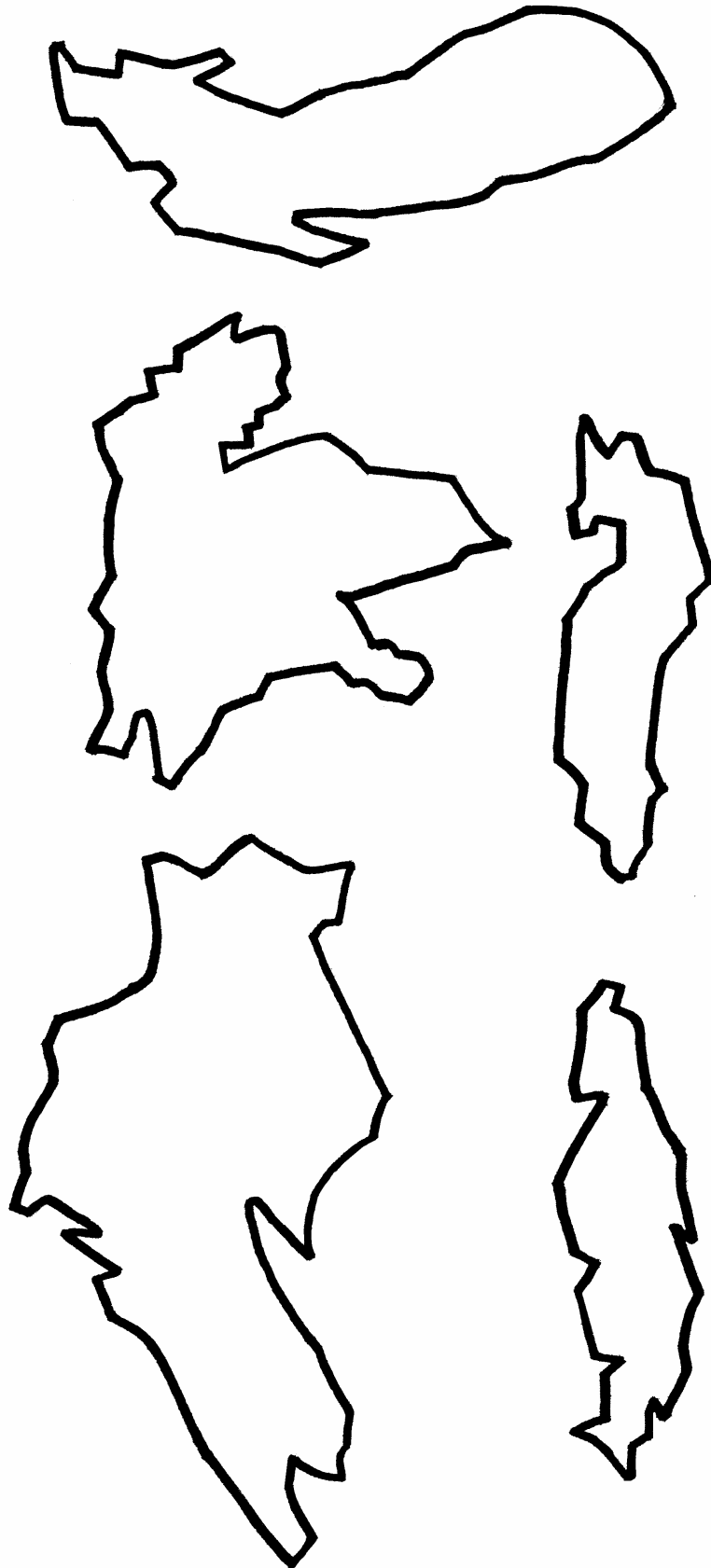
I am the most upstream link between Lake Huron and Lake Erie. _____

I am the river between Lake Superior and Lake Huron. _____

I am the lock system between Lake Superior and Lake Huron. _____

I am the straits between Lake Michigan and Lake Huron. _____

GREAT LAKES CONNECTIONS



Lake Superior

Locate these items or places on Lake Superior and write them on your lake shape.

- 1) Duluth, Minnesota
- 2) Marquette, Michigan
- 3) Thunder Bay Area of Concern
- 4) Superior, Wisconsin
- 5) Isle Royale National Park, Michigan
- 6) United States/Canadian border
- 7) Keewenaw Peninsula, Michigan
- 8) Whitefish Bay
- 9) St. Mary's River
- 10) Soo Locks

Use Extension Bulletin E-1866

Lake Michigan

Locate these items or places on Lake Michigan and write them on your lake shape.

- 1) Milwaukee, Wisconsin
- 2) Chicago, Illinois
- 3) Straits of Mackinac
- 4) Traverse Bay, Michigan
- 5) Escanaba, Michigan
- 6) Green Bay Area of Concern
- 7) Gary, Indiana
- 8) Door Peninsula
- 9) Manistee National Forest
- 10) Sleeping Bear Dunes National Lakeshore

Lake Huron

Locate these items or places on Lake Huron and write them on your lake shape.

- 1) Mackinac Island, Michigan
- 2) Georgian Bay, Ontario, Canada
- 3) United States/Canadian border
- 4) Saginaw River—Bay Area of Concern
- 5) Port Huron, Michigan
- 6) St. Mary's River and Soo Locks
- 7) Manitoulin Island, Ontario, Canada
- 8) Huron National Forest, Michigan
- 9) Au Sable River, Michigan
- 10) St. Clair River

Use Extension Bulletin E-1868

Lake Erie

Locate these items or places on Lake Erie and write them on your lake shape.

- 1) Toledo, Ohio
- 2) Detroit, Michigan
- 3) Windsor, Canada
- 4) Erie, Pennsylvania
- 5) Buffalo, New York
- 6) Detroit River Area of Concern
- 7) Long Point, Provincial Park, Canada
- 8) Niagara Falls, Ontario, Canada
- 9) Welland Canal
- 10) United States/Canadian border

Use Extension Bulletin E-1869

Lake Ontario

Locate these items or places on Lake Ontario and write them on your lake shape.

- 1) Rochester, New York
- 2) St. Lawrence River
- 3) Toronto Harbour Area of Concern
- 4) Welland Canal
- 5) Niagara Falls, New York
- 6) Bay of Quinte
- 7) St. Lawrence Islands (National Park)
- 8) Canoe Picnic Point, New York State Park
- 9) United States/Canadian border
- 10) New York State (Erie) Barge Canal

Lake St. Clair

Locate these items or places on Lake St. Clair and write them on your lake shape.

- 1) Clinton River
- 2) Metropolitan Beach, Michigan
- 3) Mt. Clemens, Michigan
- 4) Anchor Bay
- 5) Navigation Channel
- 6) St. Clair River Area of Concern
- 7) Peach Island, Provincial Park, Canada
- 8) Detroit River
- 9) Algonac, Michigan State Park
- 10) United States/Canadian border

Use *A Profile of Lake St. Clair* MICHU-SG-91-701

CONNECTING WATERWAYS

St. Lawrence Seaway

Research this Great Lakes connecting waterway and answer the following questions.

- 1) What two large bodies of water does the St. Lawrence Seaway connect?
- 2) At what sea levels/elevations are these two bodies of water? Which body of water is higher?
- 3) Why was it necessary to build the St. Lawrence Seaway?
- 4) What economic products do ships carry between states, Canada, and countries around the world?
- 5) Do you think exotic species came into the Great Lakes through the St. Lawrence Seaway? How?

CONNECTING WATERWAYS

Welland Canal and Niagara River

Research these Great Lakes connecting waterways and answer the following questions.

- 1) What two large bodies of water do these two waterways connect?
- 2) At what sea levels/elevations are these two bodies of water? Which body of water is higher?
- 3) What are the differences between the Welland Canal and the Niagara River?
- 4) Why was it necessary to build the Welland Canal?
- 5) How does the canal work for ships, and how does the lock system work?

CONNECTING WATERWAYS

Detroit River and Lake St. Clair Navigation Channel

Research these Great Lakes connecting waterways and answer the following questions.

- 1) What two large bodies of water does the Detroit River connect?
- 2) At what sea levels are these two bodies of water? Which body of water is higher?
- 3) What is the St. Clair Navigation Channel used for?
- 4) Why was it necessary to build the St. Clair Navigation Channel?
- 5) Why do you think the large cities of Windsor and Detroit developed along the Detroit River?

CONNECTING WATERWAYS

St. Clair River and Lake St. Clair Navigation Channel

Research these Great Lakes connecting waterways and answer the following questions.

- 1) What two large bodies of water does the St. Clair River connect?
- 2) At what sea levels are these two bodies of water? Which body of water is higher?
- 3) What is the St. Clair Navigation Channel used for?
- 4) Why was it necessary to build the St. Clair Navigation Channel?
- 5) How do you think the non-native zebra mussel was introduced into Lake St. Clair?

CONNECTING WATERWAYS

St. Mary's River and Soo Locks

Research this Great Lakes connecting waterway and answer the following questions.

- 1) What two large bodies of water does this waterway connect?
- 2) At what sea levels are these two bodies of water? Which body of water is higher?
- 3) Why do you think the St. Mary's River is an Area of Concern?
- 4) Why was it necessary to build the Soo Locks?
- 5) How does the lock system work for ships and barges?

CONNECTING WATERWAYS

Straits of Mackinac

Research this Great Lakes connecting waterway and answer the following questions.

- 1) What two large bodies of water does this waterway connect?
- 2) At what sea levels are these two bodies of water? Which body of water is higher?
- 3) What famous bridge was built to connect the lower and upper parts of Michigan?
- 4) Why are canals, channels, or lock systems not necessary for ships and barges in the Straits of Mackinac?
- 5) What economic products do ships carry between states, Canada, and countries around the world?