**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/
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.

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)


COMPUTER EXTENSIONS
Great Lakes Education Program:
http://www.msue.msu.edu/seagrant/
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/

Michigan Standards: ss6, ss7, ss8, ss19, s1, s12, s13.

Skills: Description, Gathering Data, Interpretation, Investigation, Large Group, Listening, Mapping, Modeling, Reporting, Small Group.

Timing: Pre-cruise.

Charting the GLEP Course: Complete this activity before “Invader Species of the Great Lakes.”

Conceptual Framework Reference: IA1, IA2, IB1, ID1, ID2, IIB2, IIB3, IIIB2, IIIC1, IVC1.

Duration: Two Days. Day 1 = 30 minutes–1 hour; Day 2 = 1 hour.

Setting: Classroom.
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 CARDS

## 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

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

## 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

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### CONNECTING WATERWAYS CARDS

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<thead>
<tr>
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<tr>
<td>St. Lawrence Seaway</td>
<td>Welland Canal</td>
</tr>
<tr>
<td>Research this Great Lakes connecting waterway and answer the following questions.</td>
<td>and Niagara River</td>
</tr>
<tr>
<td>1) What two large bodies of water does the St. Lawrence Seaway connect?</td>
<td>Research these Great Lakes connecting waterways and answer the following questions.</td>
</tr>
<tr>
<td>2) At what sea levels/elevations are these two bodies of water? Which body of water is higher?</td>
<td>1) What two large bodies of water do these two waterways connect?</td>
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<td>3) Why was it necessary to build the St. Lawrence Seaway?</td>
<td>2) At what sea levels/elevations are these two bodies of water? Which body of water is higher?</td>
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<td>4) What economic products do ships carry between states, Canada, and countries around the world?</td>
<td>3) What are the differences between the Welland Canal and the Niagara River?</td>
</tr>
<tr>
<td>5) Do you think exotic species came into the Great Lakes through the St. Lawrence Seaway? How?</td>
<td>4) Why was it necessary to build the Welland Canal?</td>
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<td>5) Why do you think the large cities of Windsor and Detroit developed along the Detroit River?</td>
<td>5) How do you think the non-native zebra mussel was introduced into Lake St. Clair?</td>
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<tr>
<td>3) Why do you think the St. Mary’s River is an Area of Concern?</td>
<td>3) What famous bridge was built to connect the lower and upper parts of Michigan?</td>
</tr>
<tr>
<td>4) Why was it necessary to build the Soo Locks?</td>
<td>4) Why are canals, channels, or lock systems not necessary for ships and barges in the Straits of Mackinac?</td>
</tr>
<tr>
<td>5) How does the lock system work for ships and barges?</td>
<td>5) What economic products do ships carry between states, Canada, and countries around the world?</td>
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