What’s so “Great” about these Lakes? Looking at the Impacts of Maritime Transportation
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Grade/Subject: HS Environmental Science elective class (grades 11-12).
Students will have had biology and often chemistry prior to taking this course. This course is set up to increase student awareness about the impact of the human animal on other organisms. Students are expected to understand that living and nonliving things interact in complex ways and that changes in the environment will impact the types of organisms found in an area. Students are asked to make many decisions regarding the concept of sustainability, dealing with both the responsibility to the environment and to human life. Students need to understand that they impact the environment through their everyday choices.

Lesson Overview: This lesson will be used to introduce students to the importance of the Great Lakes, contributing, both economically and environmentally, to the lives of people in the state of Michigan. Many students may have visited one of the lakes to camp, fish, or swim and have seen a large cargo ship moving far off in the distance. These students have not likely given thought to the connection between the goods and materials that these ships carry and their own lives.

This lesson will lend itself to the enhancement of my current unit on water. How water moves around the globe (forms, time, and location), its significance in supporting life, and the many potential/existing pollutants that threaten the integrity of this resource and the lives of millions of organisms are just a few of the topics currently covered.

I hope that by incorporating a lesson that deals directly with the integrity of a resource so close to them, students will be more inclined to take ownership of this resource. They will gain a sense of responsibility for the products that are produced from raw materials that travel on the Lakes, they will understand the economic impact of continued use of the Lakes for commerce, and will gain a sense of stewardship for the Lakes, wanting to be a part of finding solutions to current environmental issues that threaten not only the Lakes, but the economic stability of our state.

This lesson will take 2-3 class periods; ½ of day one to introduce and brainstorm, day two to research and create timeline; ½ - 1 of day three share (large group) and complete assessment (individually). Lesson is based on class length of 72 minutes.

Sources:
1. Internet Resources: History of Great Lakes
   - NOAA: http://www.glerl.noaa.gov/pr/ourlakes/economy.html
   - About the Great Lakes: http://www.aboutegreatlakes.com/stories.htm
   - About the Ports/Shipping: http://www.great-lakes.net/teach/business/ship/ship_1.html
4. Handout of blank Great lakes Region
Learning Objectives:

- Students will think about the Great Lakes importance to citizens living in the state of Michigan. They will create lists during a brainstorming session that could include recreation, health, food, transportation, and environmentally based ideas.

- Students will gather information about the Great Lakes shipping industry, creating a timeline of some major historical events and ways that they impacted the state of Michigan.

- Students will look directly at what types of materials are moved over the lakes system and how many of the resources directly impact our economy (i.e. – raw materials produced in Michigan Cities and needing to be moved via the lakes, where they go, why the lakes are the best mode of transportation).

- Students will anticipate potential environmental impacts of the shipping industry.

Michigan Content Standards Addressed

Science Content Expectations, HSCE:

Biology Standards: Looking at societal issues in with scientific scrutiny

B1.2B: Identify and critique arguments about personal or societal issues based on scientific evidence.
B1.2f: Critique solutions to problems, given criteria and scientific constraints.

Earth Science Standards: Looking at resources and their transportation; understanding the connection between the lakes makes them useful (necessary) in transporting resources and products to communities

E2.4d Describe the life cycle of a product, including the resources, production, packaging, transportation, disposal, and pollution

E4.1A Compare and contrast surface water systems (lakes, rivers, streams, wetlands) and groundwater in regard to their relative sizes as Earth’s freshwater reservoirs and the dynamics of water movement (inputs and outputs, residence times, sustainability).

Social Studies Content Expectations:

Content Standard 1: All students will describe, compare, and explain the locations and characteristics of places, cultures, and settlements. (People, Places and Cultures) Describe how major world issues and events affect various people, societies, places, and cultures in different ways

Content Standard 5: All students will describe and explain the causes, consequences, and geographic context of major global issues and events. (Global Issues and Events) Explain the causes and importance of global issues involving cultural stability and change, economic development and international trade, resource use, environmental impact, conflict and cooperation, and explain how they may affect the future.

English/Language Art Content Expectations:

STANDARD 1.5 Produce a variety of written, spoken, multi-genre, and multimedia works, making conscious choices about language, form, style, and/or visual representation for each work
CE 1.5.4 Use technology tools (e.g., word processing, presentation and multimedia software) to produce polished written and multimedia work (e.g., literary and expository works, proposals, business presentations, advertisements).

Materials Needed:

1. Computers with internet access
2. Paper/pen and pencil
3. Map of Great Lakes Region (one teacher copy labeled, student copies blank)
4. List of ports and resources produced in the state that move over Lakes
5. Access to video player/Video of Maritime history on Great Lakes
6. Worksheets (see below)

New Vocabulary:

Maritime
Cargo Ship
Port
Raw Material
Ballast
Dredging
Invasive Species

Focus Questions:

1. Do you rely on the Great Lakes to meet any of your needs?
2. Do you know what the ships that move about the Great Lakes are carrying? Where are they coming from/going to?
3. Does the movement of cargo on the Great Lakes impact your life? How?
   - What are the positive and negative impacts of the maritime industry on the Great Lakes
4. How does the state of Michigan depend on the maritime industry?

Lesson/Activity:

- Large group discussion/video introducing maritime transportation.
  - Class will begin with individual students completing a “survey/quiz” – Great Ships, Great Lakes: Did you know (Worksheet 1)
  - Upon completion – group will begin whole class discussion with intention of revisiting survey/quiz again to reassess at end of lesson. During this time, discussion will take place about what we rely on the Great Lakes for. Students will use Brainstorm Concept Map to place ideas (Worksheet 2)
A short video will be shown to students (The Great Lakes St. Lawrence Seaway System, Perspective of a Vital Waterway – 21.38 minutes) as a way to prepare them for researching for

A map will be presented that shows major ports as well as the raw materials imported and/or exported. (Visual Aide 1)

- Creation of Maritime Timeline (focus on raw materials moved, major changes in Cargo Carriers, Impact on Michigan Economy, Opening/Maintaining varies state ports). Students will be given access to a variety of Great Lakes shipping websites and will gather data to create a timeline. Timeline will be required to contain information on at least 3 raw materials imported/exported, 5 changes in cargo carriers (ship evolution), 4 major great lakes ports, the Soo Locks, the St. Lawrence Seaway (Welland canal), and environmental issues addressed (invasive species, dredging, water quality). They may cover additional items if time and room allows, the minimum must be addressed for full credit.

- Large group discussion will resume as students are randomly chosen to present their timelines and highlight some of the events they picked. Guiding questions will be used to get them to think about the overall importance of the lakes and maintaining their quality while still ensuring that shipping continues. These Questions can be written out so students can have a copy: How the cost and efficiency of Great Lakes shipping compares to other forms of transportation, such as rail and truck? How are the connection between Great Lakes and shipping meeting global needs for goods? How are the raw materials that are shipped from northern MN and northern Michigan to Detroit, Gary, Cleveland, and other ports to make steel which we all use in our everyday lives? How much revenue is generated through shipping on the lakes? Why is it important to protect the lakes, the locks, and the ports? Going back to survey – think about the questions and go over correct answers with the students.

- Assessment – Mapping, questions (both from above and the decision based question below)

**Assessment:**

Have students label their own map of the Great Lakes region (Worksheet 3) including naming the lakes, some of the major ports, the raw materials moved, and what cities are originate from.

They should be able to use the Decision-Making Model discussed earlier in the class to address the question: We can’t afford to get rid of shipping; How can I help balance the economic importance of the Great Lakes to our state and the environmental importance to the future health of organisms depending on the Lakes as a source of freshwater?

**Extension:**
The second lesson lends itself as a natural segue into further study about Great Lakes environmental concerns. If a short time is spent during this lesson discussing the negative impacts of shipping as a mode of transportation (brainstorming/inferring), students can step into a lesson exploring the reason, impacts, and options for these concerns.
Worksheet 1
Great Ships – Great Lakes: Did you know Survey
Adopted from Joan Chadde, Western UP Center for Science, Math and Environmental Education

Name _____________________________________ Date __________________ Hour _________

Find out how knowledgeable you are about Great Lakes shipping by taking this quiz.

1. Out of every $100 spent by Americans, how many dollars are involved with Great Lakes shipping?
   a. One dollar b. Five dollars c. Ten dollars d. Twenty dollars

2. One 1000-foot Great Lakes ship can carry the same amount of cargo as how many fully-loaded semi-trucks?
   a. About 50 trucks c. About 100 trucks
   b. About 1000 trucks d. About 2000 trucks

3. How much oil can be spilled or discharged by a Great Lakes ship without breaking the law?
   a. Not a drop c. Not more than 100 gallons
   b. Not more than a gallon d. Not more than 1000 gallons

4. How long does an ocean-going cargo vessel usually last?
   a. 20 years b. 30 years c. 50 years d. 80 years

5. Which of the following make up “The Big Three” cargoes carried by U.S. flag ships in order of tonnage on the Great Lakes? (place a 1, 2, and 3 next to your choices)
   a. __Limestone
   b. __Coal
   c. __Iron ore (taconite pellets)
   d. __Salt
   e. __Grain

6. What are the top 3 products shipped through the Soo Locks each year?
   a. __Limestone
   b. __Coal
   c. __Iron ore (taconite pellets)
   d. __Salt
   e. __Grain

7. A 1000-foot “laker” holds enough iron pellets to make how many automobiles?
   a. 500 b. 5000 c. 15000 d. 1 million
8. About how many dollars are lost when a 1000-foot Great Lakes cargo hauler must wait to dock, load, or pass through a lock?
   a. $500 per hour  
   b. $1000 per hour  
   c. $2500 per hour  
   d. 10,000 per hour

9. What percentage of the United State’s iron ore used in steel production passes through the Poe lock at Sault Ste. Marie, Michigan?
   a. 10%  
   b. 25%  
   c. 90%  
   d. None

10. What does it mean when a large ocean-going vessel (saltie) must “swish and spit” just like you do when the dentist cleans your teeth?
    a. That all the crew has to go brush their teeth right away  
    b. It’s time for the crew to wash the ship by “swishing” water over the deck and polishing it to a “spit” shine.  
    c. The water in the ballast tanks needs to be exchanged, either saltwater for freshwater, or freshwater for saltwater.  
    d. Time to clean out the cargo holds before loading grain.

11. Why can’t Great Lakes cargo ships travel throughout the world?
    a. U.S. Law only allows travel in the Great Lakes.  
    b. Great Lakes cargo ships can and do travel to all world ports  
    c. Great Lakes vessels are too large  
    d. Great Lakes vessels cannot withstand salty ocean water  
    e. 

12. How many hours does it take to load a 1000-foot Great Lakes ship with iron ore pellets
    a. As little as 4-hours  
    b. As little as 8-hours  
    c. Only ½ a day (12-hours)  
    d. One Day (24 hours)

13. What is “operation taconite” run by the U.S. Coast Guard at Sault Ste. Marie, Michigan?

14. What is the drop in elevation between each of the Great Lakes?
    a. _______Lake Superior to Huron  
    b. _______Lake Huron to Erie  
    c. _______Lake Erie to Ontario  
    d. _______Lake Ontario to St. Lawrence Seaway

15. What makes the St. Lawrence Seaway so important to the Great Lakes? What is one of its biggest limitations?
Worksheet 2

**Brain Storm** ~ How/Why are the Great Lakes important to Michigan citizens?

After creating a list of topic ideas (placed in circles), begin to develop those with details. Connect details to the correct topic circle.
Worksheet 3
The Great Lakes – St. Lawrence Seaway River System

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Visual Aide 1
The Great Lakes – St. Lawrence Seaway River System

http://www.great-lakes.net/teach/geog/intro/intro_2.html; 2010

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