

Perspectives on Invasive Species in the Great Lakes: An Asian Carp Debate

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Grade/Subject: Grades 9-10, Biology

Lesson Overview:

Students will investigate aquatic invasive species, including the Asian carp, in order to understand their impact and consequences for the ecology, environment, and economics of the Great Lakes region, as well consider political and social issues. This lesson connects to my current curriculum by enhancing my ecology unit and taking it to the next level. My students now spend a number of days exploring current ecological issues, but invasive species is only one of ten topics studied. This activity will allow students to research and perform an in-depth exploration of the Asian carp as an invasive species and debate the various perspectives of the stakeholders involved in this real world issue. It is my hope that my students will gain an increased awareness of aquatic invasive species, their relevance to our region, and the consequences they are having on our ecology, commerce, and economics.

Sources Consulted:

Michigan Department of Education. *High School Science Content Expectations/ Biology*.
<http://www.michigan.gov/documents/Biology_HCSE_168202_7.pdf>. Accessed 2011 July 26.

Whitefish Point Lighthouse and Great Lakes Shipwreck Museum K-8 Lessons and Activities. Edited by Joan Chadde, Western U.P. Center for Science, Mathematics and Environmental Education, Michigan Technological University, pg. 132-133. (used for vocabulary)

International Association for Great Lakes Research. *Great Lakes—At a Crossroads*.
<http://wupcenter.mtu.edu/education/great_lakes_education/fact_sheet/IAGLR_factsheet_GL%20Crossroads.pdf>. Accessed 2011 July 26.

Websites for Student Use:

Time Magazine—“Asian Carp in the Great Lakes? This Means War!”
<http://www.time.com/time/health/article/0,8599,1962108,00.html>.

U.S. Fish and Wildlife Service—“Asian Carp”: <http://asiancarp.org/Documents/AsianCarp.pdf>

Great Lakes Fishery Commission—“Asian Carp”: <http://www.glfsc.org/fishmgmt/carp.php>

Time Magazine—“Lake Invaders” <http://www.time.com/time/magazine/article/0,9171,2010202-2,00.html>

National Invasive Species Information Center: <http://www.invasivespeciesinfo.gov/index.shtml> and
<http://www.invasivespeciesinfo.gov/aquatics/asiancarp.shtml>

Asian Carp Regional Coordinating Committee—“FAQs Asian Carp Control”:
<http://asiancarp.org/frequently-asked-questions/>

National Public Radio—“Asian Carp: Can't Beat Them? Eat Them”:
<http://www.npr.org/templates/story/story.php?storyId=5542199>

Michigan Department of Natural Resources—“Asian Carp Fact Sheet”:
http://www.michigan.gov/dnr/0,1607,7-153-10364_52261_54896-232231--,00.html

Chicago Breaking News Center—“U.S. Names Asian Carp Czar”:
<http://archive.chicagobreakingnews.com/2010/09/us-names-asian-carp-czar.html>

Tip of the Mitt Watershed Council—“Asian Carp”:
<http://www.watershedcouncil.org/learn/aquatic%20invasive%20species/asian-carp/>

U.S. Army Corps of Engineers—“Chicago Sanitary and Ship Canal Dispersal Barrier System”:
<http://www.lrc.usace.army.mil/AsianCarp/BarriersFactSheet.pdf>

Learning Objectives:

At the end of this lesson, students will be able to:

1. Explain how aquatic invasive species are introduced and spread throughout the Great Lakes.
2. Identify aquatic invasive species (i.e. Asian Carp) and their effect on the environment, ecology, politics, economics, and maritime industry/ commerce.
3. Analyze methods for controlling invasive species, reducing their negative impacts and continued spread.
4. Debate various perspectives of stakeholders regarding maritime policies/issues (i.e. Federal/State rules and regulations, environmental impacts, and economics).
5. Describe the importance of natural resource use and how the regional and U.S. economy are dependent upon Great Lakes shipping.

Michigan High School Content Expectations for Science

B1.2 Scientific Reflection and Social Implications

B1.2C Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.

B1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.

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.

B3.5 Populations

B3.5C Predict the consequences of an invading organism on the survival of other organisms.

B3.4 Changes in Ecosystems

B3.4C Examine the negative impact of human activities.

Materials Needed:

- Smartboard screen and projector (or just projector, overhead, etc.)
- “The Great Lakes—At a Crossroads” PDF file (for display of map on smartboard)
- “The Great Lakes—At a Crossroads” article handouts (one for each student)
- Copies of student handouts
- Computer access for research (at least one per student group, a computer lab would be ideal)
- Space in classroom area for circular seating arrangement during debate

New Vocabulary:

Inter-modal transportation: Moving cargo using more than one mode of transportation, such as truck, railway, ship, or plane.

Invasive species: Non-native species that are transported to a new area that typically have no natural predators (example: zebra mussels).

Maritime shipping: Transportation of cargo via waterways.

Port: A city or town with a harbor for loading/unloading ships.

Shipping: Transportation of cargo via water, road, rail or airplane using a freighter, train, truck, or plane.

Focus Questions:

1. What types of activities are the Great Lakes used for? (think about more than just recreation!)
2. Why is everyone so worried about the Asian carp getting into Lake Michigan?
3. What is an aquatic invasive species?
4. How do invasive species invade an area?
5. What other invasive species are threatening the Great Lakes?

Classroom Activities

Opener: Display the Great Lakes Drainage Basin map on the smartboard screen and ask students to make observations, think aloud, with a partner. Then, share out ideas as a class with each group of two students contributing at least one idea. Next, use the focus questions to initiate a classroom discussion to evaluate prior knowledge of students. Record ideas on smartboard in KWL graphic organizer format (K = what we know, W = what we want to know/questions, and L = what we learned). The L section can be filled out during classroom discussions and also after the classroom activities are complete. (see attached worksheet for students)

Interpreting scientific text: Pass out “The Great Lakes—At a Crossroads” article to each student. This resource will be utilized to introduce the topic of surface freshwater and its importance to the plants, animals, and people of Michigan and surrounding states. Students should “Talk to the Text” as they read by underlining or highlighting key ideas, writing comments and reactions in the margins, and overall interacting with the content on the page. This active reading technique allows students to engage with the text and better comprehend it through meta-cognition. I would inform students that this document is intended for use by scientists, legislators, and the public, and is therefore relevant from a scientific perspective, but also to society and the real world. After reading and interacting with the article, students will orally discuss why the Great Lakes are important economically and identify the four major ecological concerns within the Great Lakes Basin. Continue to add to the KWL organizer on the smartboard during this portion of the lesson.

Research Assignment: Inform students that the focus of the research assignment will be to explore the Asian carp as an invasive species and to identify the various sides of the debate surrounding this organism from ecological, environmental, economic, political, and social perspectives. As an introduction to their research, have students read the article “Asian Carp in the Great Lakes? This Means War!” at <http://www.time.com/time/health/article/0,8599,1962108,00.html>.

Using the Perspectives on Great Lakes Invasive Species organizer (see attached worksheet) students will perform further internet research to fill in this table with relevant information. A list of useful websites should be made available to students (see sources consulted section). It is important to define, discuss, and explain each perspective with students so they are informed and comfortable before they begin independent work. The instructor should monitor the work of students offering feedback, informal assessment, and suggestions.

Classroom Debate: The research assignment will be followed up by a classroom debate in which student groups will be given various roles as stakeholders in the Asian carp issue, and will be asked to discuss their perspective as part of a large group discussion. Pass out stakeholder roles to student groups depending on class size (two students in a group for a class size of 24, or three in a group for a class of 36, for example). Give students time to prepare their arguments in support of their perspective by performing further research on their stakeholder role. This can be recorded on the back of the Perspectives on Great Lakes Invasive Species organizer. The instructor should monitor the work of students offering feedback, informal assessment, and suggestions.

Assessment

Formative Assessment: During the discussions and time devoted to research before the debate, the instructor should be assessing the prior knowledge of students and their grasp of the concepts as the lesson activities progress. It is important to offer insight and feedback to students as they develop a working knowledge of the topics investigated. By mentoring students and pointing them in the right direction, they will gain confidence with the concepts, their assigned perspective, and be ready to debate with their peers. Accurate completion of the graphic organizers and stakeholders arguments can be assessed for graded points during the lesson activities.

Summative Assessment: During the debate itself, students can be assessed on their knowledge of the invasive Asian carp and the various perspectives investigated. Each student should be expected to contribute to the debate, and that can be recorded by the instructor for graded points. Following the debate each student will write an in-class one page personal response to the lesson activities in which they will be expected to display their knowledge of the impact of invasive species such as the Asian carp on the Great Lakes taking into account the environmental, ecological, economic, political, and social perspectives of this issue. These will be assessed for completion and accuracy by the instructor.

THE GREAT LAKES AND AQUATIC INVASIVE SPECIES

K (what you know)	W (what you want to know/questions)	L (what you learned)

PERSPECTIVES ON GREAT LAKES INVASIVE SPECIES

Perspective	General Information: Invasive Species	Specific Information: Asian Carp
<p>Environmental Impacts</p> <p>(abiotic factors, mode of entry, effect on water quality, shorelines, etc.)</p>		
<p>Ecological Impacts</p> <p>(biotic & abiotic factors, interaction with other organisms, effect on food chains/webs, etc.)</p>		
<p>Economic Impacts</p> <p>(effects on industry, trade, shipping, maritime transportation, imports, exports, etc.)</p>		
<p>Political Impacts</p> <p>(government control, rules, regulations, laws, etc.)</p>		
<p>Social Impacts</p> <p>(public opinion, water/land use practices, recreation, education, outreach, etc.)</p>		

STAKEHOLDER ROLES FOR ASIAN CARP DEBATE

U.S. ARMY CORP OF ENGINEERS—You are a member of the U.S. Army Corp of Engineers that is in charge of the Chicago Sanitary and Ship Canal Dispersal Barrier System used to keep the Asian carp out of Lake Michigan. The electrical barriers are currently the best tool to stop large-scale movement of Asian carp from the Illinois River into the Great Lakes via the Chicago Sanitary and Ship Canal, but you are conducting research studies to determine the overall effectiveness of the electrical barriers as well as other forms of containment for the Asian Carp.

MEMBER OF THE ASIAN CARP REGIONAL COORDINATING COMMITTEE—You are in charge of education and outreach for the Asian Carp Regional Coordinating Committee. It is your responsibility to educate the public and other interested parties about the threat of the Asian carp and what the Coordinating Committee and its affiliates are doing to protect the environment and economies of the Great Lakes Region.

GREAT LAKES MERCHANT MARINER—You work on a large shipping vessel which transports raw materials around the Great Lakes for use by factories and industry. The 1,000 foot vessel on which you work ships and delivers goods such as grain, coal, salt, iron ore, and general cargo from various cities in the Great Lakes region, including those that come out of the tributaries of the Mississippi River in Chicago. Your economic livelihood and your ability to provide for your spouse and three children rests on this industry and its continued use of the Great Lakes and surrounding waterways.

OWNER OF MARITIME TRANSPORTATION COMPANY—You own a large maritime shipping company that transports raw materials around the Great Lakes for use by factories and industry. Your many vessels ship and deliver goods such as grain, coal, salt, iron ore, and general cargo from various cities in the Great Lakes region. You routinely receive commodities such as grain in Chicago coming through the Mississippi and Illinois rivers, and are therefore dependent on the commercial freight shipping sent through the Chicago lock system. Your ability to keep your company going and its 500 employees paid rests on this industry and its continued use of the Great Lakes and surrounding waterways as a mode of transportation.

COMMERCIAL FISHERMAN ON LAKE MICHIGAN—You are a fisherman on Lake Michigan harvesting trout, salmon, and other fish that are abundant in the waters of this lake. You own a medium sized fishing vessel and employ three other men to help you maneuver the boat, riggings, and to haul in fish. The economic livelihood of you, your family (your spouse, a son, and a daughter on the way), and your three employees depends on your continued ability to fish in a profitable manner in Lake Michigan. You are very concerned about the Asian carp and its threat on the fishing industry of Lake Michigan. If the delicate food chains are disturbed by this invasive species, then the fishing industry could collapse, taking you with it.

MICHIGAN ATTORNEY GENERAL—You are the attorney general for the state of Michigan and are very concerned about the Asian carp issue and its potential economic and environmental consequences for your state. Federal authorities who control Chicago-area waterways have found evidence of Asian carp through sophisticated DNA tests. While the U.S. Army Corps of Engineers has said that allowing Asian carp into the Great Lakes would be an "ecological and economic disaster,"

neither Illinois or federal officials have acted to close shipping locks on these waterways that could keep the carp out of Lake Michigan. Therefore, you have filed a law suit against the State of Illinois and the federal government asking that the locks be closed until there is a plan to protect the Great Lakes.

U.S. REPRESENTATIVE FROM ILLINOIS— You are a member of the U.S. House of Representatives embroiled in the debate over the threat of the Asian carp. You want to protect and preserve the Great Lakes, its connecting waterways, and do what is right environmentally and economically for your home state of Illinois. You have introduced a bill that will call for the eventual separation of the Mississippi River from the Great Lakes, to prevent the invasive Asian carp from migrating between them. Researchers say the large fish have infested Chicago-area waterways and are threatening to enter Lake Michigan, where scientists say they could damage native fish populations.

U.S. SENATOR FROM MICHIGAN—You are a U.S. Senator embroiled in the debate over the threat of the Asian carp. You want to protect and preserve the Great Lakes, its connecting waterways, and do what is right environmentally and economically for your home state of Michigan. You introduced the Close All Routes and Prevent Asian Carp Today Act (CARP ACT), which directs the U.S. Army Corp of Engineers to immediately close several key waterways. The CARP ACT intends to provide a physical barrier that prevents the Asian carp — already prevalent in the Mississippi River — from advancing farther into the Great Lakes.

U.S. FISHERIES AND WILDLIFE BIOLOGIST—You have spent the last few years conducting extensive surveys of the tributary rivers and waterways between the Mississippi River, Illinois River, and Lake Michigan documenting the spread of the Asian Carp. It is your job to determine exactly where these invasive fish are living, and how close they are to entering Lake Michigan. Be ready to explain the methods you use to survey and locate these fish.

ENVIRONMENTAL CONSULTANT—You are an environmental consultant working with the Army Corp of Engineers to determine the effects of adding chemical poisons, such as Rotenone, to the Chicago Sanitary and Ship Canal and surrounding waterways to kill the Asian carp in that area. You are interested in determining what effects these chemicals have on not only the fish species, but also plants, algae, aquatic invertebrates, and humans, and whether this could be used as an effective control method for this invasive species.

ASIAN CARP SCIENTIST—You are a professor and researcher at a local university and are an expert on aquatic invasive species, especially the Asian carp. You are interested in learning more about its spread in U.S. waterways and its potential impacts on other forms of aquatic species. You have been asked to serve as a consultant to the U.S. Asian Carp Czar. You are eager to offer your expertise and advice on this important issue.

CITIZEN—You are a citizen who is interested in this issue from reading about it in the newspaper and news reports on the television. You want to become more informed about the Asian carp and its potential consequences on local waterways and aquatic ecosystems. You are eager to ask a lot of questions, and want to know what you can do to contribute as a local citizen. In addition, you are a recreational boater and fisherman, and are concerned about you or your children getting hurt by the crazy jumping Asian carp in the local rivers.