Aquatic Invasive Species Education Project ENRICHMENT ACTIVITIES

The Great Swim puts your students through a fun interactive simulation of the lifecycle of a Chinook salmon and perils from invasives. *(3rd—12th Grades)*

Least Wanted is a fun physical game to get your students up and moving while learning all about sea lamprey impacts on lake trout. *(6th-12th Grades)*

Social Carrying Capacity is a role-playing stakeholder activity that illustrates the delicate balancing-act of caring for our resources. *(6th—12th Grades)*

It's Your Niche is a fun way to help your students research an invasive species and showcase their impacts in the environment. *(2nd—8th Grades)*

The Invisible Migration combines a little bit of tricky chemistry with a student model of the zebra mussel invasion. *(2nd—8th Grades)*

The Carp Conundrum tackle a Great Lakes problem with some STEAM inginuity. *(5th—12th Grades)*

As the State of Michigan strives to successfully prevent the introduction and spread of aquatic invasive species, and manage for those currently present, it recognizes the value of raising awareness through education and outreach to empower the public to assist with this effort. Outreach efforts create an informed public that generally understands aquatic invasive species issues, knows effective prevention practices, and can identify and report priority species. For that reason the enclosed aquatic invasive species educational

These activities were made possible through a grant provided by the Great Lakes Restoration Initiative

Michigan's Invasive Species Program is cooperatively implemented by the Michigan Departments of Agriculture & Rural Development, Environmental Quality and Natural Resources.

Aquatic Invasive Species Education Project

ENRICHMENT ACTIVITIES

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MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

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The Great Swim

Adapted from The Great Migration Challenge, Flying WILD

Activity Objective

Your students can reenact the life of a non-native salmon in Michigan, and live through the happy days and perils of a little salmon's journey.

Set Up

1. Print out Station cards and cut in half.
2. Using the masking tape, mount them around the room or schoolyard. (At least 5 ft apart)
3. Station 3, place two dice in a jar with a lid. (Symbol on station cards)
4. Stations 9, 13, and 15 place 1 die each in a jar with lid.
5. Stations 6 and 11, place circle stickers at the stations.
6. Station 15, place strings.
7. Create a chart on your white board or paper that looks like the example.

Caught	Died	Tagged	Spawned

Materials

- Great Swim half sheet game cards
- Masking tape
- 5 dice
- 5 plastic jars
- Circle stickers
- 6 inch pieces of string
- White board or large paper.

Grade Levels

Third through twelfth.

Time Needed

30 minutes

Classroom Instructions

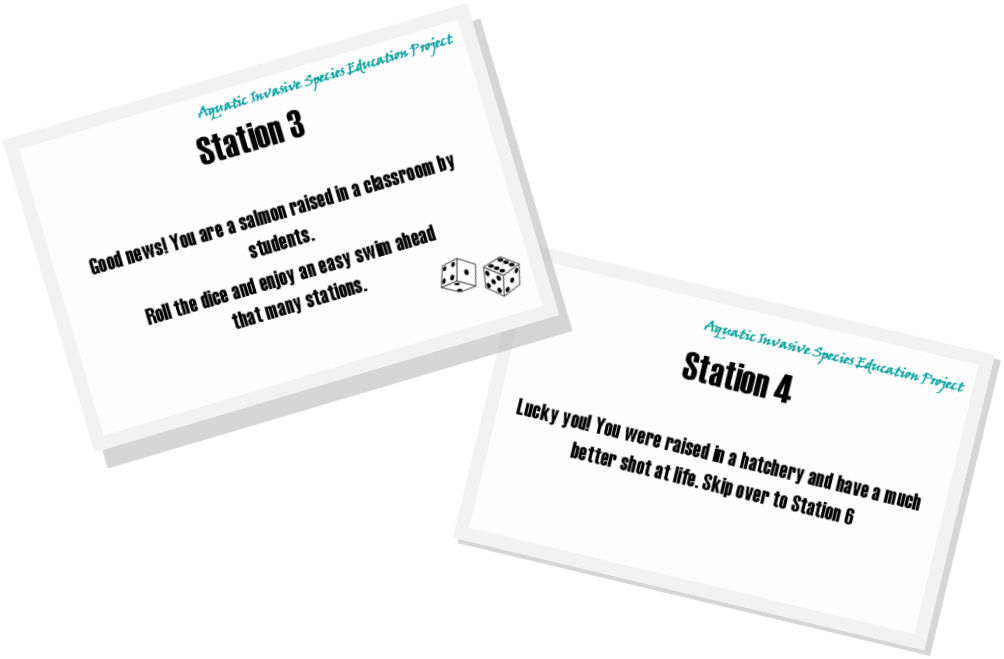
Review the lifecycle of Chinook salmon (video) with your students. How did non-native Chinook get to Michigan? Why are they not considered invasive? How does the Michigan Department of Natural Resources support the Chinook salmon population? What ecological niche do they take on?

Review the vocabulary list with students. Learn more about salmon in Lake Michigan.

To run the simulation

- Students can start on either Station 1, 2, 3 or 4. Students should read and follow the directions on each station until they complete the game.
- As the students complete the game, they should record their results on the chart. They can, and usually will, mark an X in more than one column.
- Upon completion, talk with the class about the results. Who was killed or harmed by an invasive?
- Repeat the game as many times as possible to start seeing trends in the data.

The Great Swim continued



Vocabulary

- Alewife
- Buttoned Up
- Eurasian Watermilfoil
- Fisheries Biologist
- Fry
- Hatchery
- Lamprey
- Natal Stream
- Phragmites
- Plankton
- Predacious
- Quagga Mussels
- Rusty Crayfish
- Spawn
- Tagged
- Zebra Mussels

High School Extensions

To simulate research by fisheries biologists, have your students run "replicates" of the game. Each student completes the game 3 times and records their data. Using the full classroom data for all 3 replicates, have students chart trends they are seeing in the data.

Leading Questions

- How many salmon were negatively impacted by an invasive species?
- Are the data points connected with a trend line? Or stand alone?
- What percentage of fish spawn successfully?
- Multiply each successful pair of spawning fish by 5,000 eggs. How many fertilized eggs were introduced to the Great Lakes system from your seasons?
- Multiply each successful spawning fish by 147.7 lbs (food needed to grow to adulthood). How much food did they use utilize from the ecosystem?
- Multiply the number of successfully caught fish by the average catch weight of 15 lbs. Compare the mass of fish caught, to the mass of food needed to raise those fish.

Station 1

Watch out fry! You narrowly escape a predacious diving beetle.

Crawl ahead 5 feet. Then move to Station 7.

Aquatic Invasive Species Education Project

Station 2

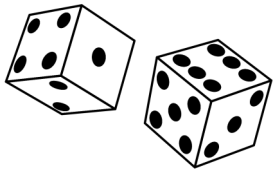
Good news! Plankton is plentiful and your little fry self is growing well.

Make a fishy face 10 times and move ahead 6 stations.

Station 3

Good news! You are a salmon raised in a classroom by students.

Roll the dice and enjoy an easy swim ahead that many stations.



Aquatic Invasive Species Education Project

Station 4

Lucky you! You were raised in a hatchery and have a much better shot at life. Skip over to Station 6

Station 5

Watch out for that invasive phragmites!

You get tangled in the roots and lose your way.

Act confused and wander back 3 stations

Aquatic Invasive Species Education Project

Station 6

Before you leave the hatchery you need to be tagged!

Place a sticker on your snout then move ahead 5 stations.

Station 7

Way to go!

Your little fry self has buttoned up and you are learning to eat plankton. Swim over 6 Stations.

Aquatic Invasive Species Education Project

Station 8

You made it to the big lake! But, you can't find plankton to eat because the invasive quagga and zebra mussels ate it all!

Rest and count to 40, then sneak ahead 3 stations.

Station 9

Bad news! An invasive rusty crayfish nipped your tail as you rested near the gravel.

Roll the die and move ahead that many stations.

Aquatic Invasive Species Education Project

Station 10

A gull snatches you up for his dinner.

Die dramatically and stand with your teacher.

Station 11

Fisheries Biologists catch you for research.

They tag you with a coded wire tag and let you go.

Put a sticker on your face and swim ahead 3 stations.

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Station 12

An invasive sea lamprey latches on to your side and makes you weak.

Crawl ahead 2 spaces.

Station 13

You find the perfect habitat out in the big lake.

Swim around in 4 circles while you eat invasive alewives happily. Roll the die and swim ahead that many stations.

Aquatic Invasive Species Education Project

Station 14

As you swim through some quiet water at the mouth of the river where you were born, you get tangled up in a mat of invasive eurasian watermilfoil and get way too warm.

Die dramatically and go stand with your teacher.

Station 15

A fisher catches you and takes a selfie.

He throws you back to catch another day.

Tie a string on your wrist and roll the die.

Move ahead that many stations.

Aquatic Invasive Species Education Project

Station 16

You have matured and start making your way back to your natal stream to spawn.

Swim ahead 2 stations.

Station 17

An eagle snags you out of the river for its dinner.

Die dramatically and go stand with your teacher.

Aquatic Invasive Species Education Project

Station 18

Fishers are lined up in the river to catch you! Flop on the line dramatically until she puts you in her cooler.

Go stand with your teacher.

Station 19

You reach the end point of your natal stream, spawn successfully and then die naturally.

Be happy that your babies will be the next generation of fish in the big lake!

Go stand with your teacher.

Aquatic Invasive Species Education Project

Station 20

You spawn in your natal stream and then hang out for awhile since you are tired. A fisher catches you and makes you her dinner. You have completed your lifecycle with a purpose.

Go stand with your teacher.

Least Wanted: The Invasive Sea Lamprey

Activity Objective

This activity will engage students in an active simulation of the relationship between native lake trout, the invasive sea lamprey, and the biological control of the introduced, non-native (non-harmful) Chinook salmon. This activity illustrates the importance of the early warning detection of invasive species (those that cause ecological, or economic harm) as they attempt to establish themselves in an ecosystem. It is a demonstration of a professional biologist's management of an invasive species before and after its establishment, and conveys the understanding that once an invasive population is established it remains indefinitely.

Materials

- Name tag print outs
  - "Invasive species" 1 per student
  - "Control" 1 per student
  - "First invasive species" 1 total
  - "Habitat biologist" 3 or less
- Chart paper and markers
- Cones for marking playing field boundaries

Grade Levels

Sixth—Twelfth

Time Needed

30 Minutes

Set Up

1. Print and cut out name tag cards.
2. Outline playing field with cones. (Approximately 50 yard square)
3. Set up chart paper.

Classroom Instructions

- Ask participants how they think the sea lamprey got into the Great Lakes and spread. Discuss.
- Tell the students they are going to simulate a sea lamprey entering a local native ecosystem (represented by a 50 yard square playing field), and the impact it has over five years.

How to run the simulation

Round 1

1. One student will be the "first invasive" sea lamprey (have them wear their card). The rest of the students represent lake trout. Ask all the students, the "first invasive" and the native lake trout to spread out on the playing field. (representing Lake Huron).
2. Chart "Year #1" using a bar graph, with one invasive and the total of the remaining participants as "X# of lake trout".

Least Wanted: The Invasive Sea Lamprey continued

Round 2

3. The goal of the "first invasive" student is to tag as many fish as possible. The fish try not to get tagged. If they are tagged, they must freeze with their arms out to their side.

4. Stop the round before all the fish are tagged. Ask those that are frozen to raise their hands. Give each an "invasives" tag to wear as they have been overtaken by lamprey. Chart these results on "year #2".

Round 3

5. Repeat for another 30 seconds with all the new "invasive" sea lamprey able to tag lake trout. Chart as "year #3".

6. Ask the class what they could do to stop or reverse the impact the invasive sea lamprey has had on the great lakes ecosystem. What can stop or slow the spread of invasives including the sea lamprey?

Round 4

7. Introduce a "habitat biologist", they tag "invasives" and hand them a "control" name tag. During the round, the "Control" tag makes the "invasive species" wander around confused, not tagging anyone. Examples of biological control may be introducing a new species like Chinook to control invasive alewives, or a chemical control like lampricide (TFM), there are even mechanical controls—sea lamprey traps.

8. Run a 30 second round and chart the results with the "invasives" and the "habitat biologist" both tagging species.

Did adding a biologist slow the spread of the invasive species?

Round 5

9. Add a second/third "habitat biologist" and chart "year #5" results.

Wrap Up Discussion

- Lead student discussion about the chart results.
- Lead student discussion about invasive, non-native, native (here in mid-1800s before European settlement exploded).

Habitat Biologist (fisheries management)	**Habitat Biologist** (fisheries management)
Habitat Biologist (fisheries management)	**Habitat Biologist** (fisheries management)
Invasive Species	**Invasive Species**
Invasive Species	**Invasive Species**
Invasive Species	**Invasive Species**

Biological Control	**Chemical Control**
Biological Control	**Chemical Control**
Biological Control	**Chemical Control**
Invasive Species	**Invasive Species**
Invasive Species	**Invasive Species**

Biological Control	Chemical Control
Biological Control	Chemical Control
First Invasive	

Social Carrying Capacity: AIS Edition

Activity Objective

Discuss how different interested parties affect the management of fisheries issues through a hands-on balancing act.

Materials

- At least 3, 20 foot lengths of rope, each tied to make a skinny, long oval (1 length of rope for every 2-4 students)
- Both Natural Resource Issue Cards and Stake-holder Cards Copy Me pages printed and cut out.
- Natural Resource/ Wildlife Issue Props

Grade Level

Sixth through 12th

Background

Wildlife management is defined as "the science and art of managing wildlife and its habitat, for the benefit of the ecosystem, the animals and humans. But how do fisheries biologists do that? They do it by following a few basic rules:

- Good management must be based on solid biological information.
- Good management must include the management of humans, because our activities affect the ecosystem.
- Good management must benefit plants and other animals, not just one species of wildlife.
- Good management must put animals' numbers at a level we can live with—not too many and not too few.
- Good management must balance animal numbers with the habitat (food, shelter, water and space) available for those animals.
- Good management must balance conservation (wise use) of the resources—not total preservation (non-use) of the resources.

Biological carrying capacity is the number of animals an area can support throughout the year without permanently damaging the habitat or starving the animals. Example—when there are too many animals for the habitat, the animals may eat too much of the vegetation that makes up its food and cover. Once that vegetation is gone, the habitat is damaged and the carrying capacity of the area goes down. With less habitat or poor habitat, the weaker animals will die from disease, starvation, predators or other causes. Fewer animals will be able to live there. As habitat is improved and food becomes more abundant (often initiated by DNR biologists), the carrying capacity goes up again.

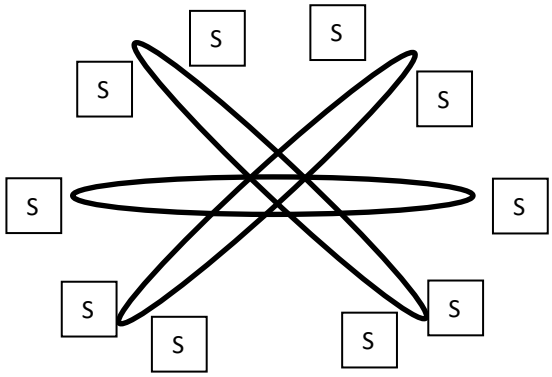
Social tolerance (Social Carrying Capacity/Cultural Carrying Capacity) is the number of animals the resource managers or public will allow in an area.

Social Carrying Capacity: AIS Edition Continued

Classroom Instructions

1. Have the students choose a natural resource issue that people may have varied or opposing opinions about (or introduce one). Examples can be found in the Issues Cards copy me pages. Discuss the scientific facts surrounding the issue and why controversy may be present.
2. Each student should choose one Stakeholder Card that they feel would have an opinion about the issue, and develop their position statement from that stakeholder's perspective. If there are more students than cards, students may pair up.
3. Place the Issue Card you've discussed in the middle of a table. One at a time have students announce which Stakeholder Card they chose, and present their position about the issue, then place their Stakeholder Card in a circle surrounding the Issue Card.
4. Ask the students if there is a way to balance the opinions of the stakeholders to fix the issue, or implement a unified strategy about the issue, if there are solutions list them. What happens if there are none?
5. Next, lay out the 3 ropes, with the centers over-lapping in a starburst pattern.

Stakeholder Card	Stakeholder Card	Stakeholder Card
Stakeholder Card	**Issue Card/ Picture**	Stakeholder Card
Stakeholder Card	Stakeholder Card	Stakeholder Card



6. Have the students choose another issue by selecting from your prop choices. For example, a stuffed salmon. Discuss the scientific facts surrounding the raising of salmon in hatcheries for the purpose of stocking the great lakes. Which lakes are successful? How do you balance the fishers need for more fishing opportunities?
7. Have each student or pair of students choose a Stakeholder Card to build a position statement, and have them state their position, then place their card at one end of a rope, so that each rope end ends up with at least one Stakeholder Card next to it-shown by the S boxes above.

Social Carrying Capacity: AIS Edition Continued

Classroom Instructions Continued

8. Place the stuffed animal on the nexus of the 3 ropes, have the students each grab an end of each rope next to their card.
9. Direct the students to work together to raise and balance the stuffed fish in the center of the ropes. Is it easy? What happens if you drop the bottom rope a few inches-which stakeholders does that rope represent? Are all stakeholders equal in this simulation? What happens if one rope goes off center? When is it easiest to balance the fish?
10. Ask the students if they know the definition for Biological Carrying Capacity. Ask them if they know what Social Carrying Capacity is? Explain that Social Carrying Capacity is often lower than the Biological Carrying Capacity—and ask them why?
11. Have the students run through another round with a familiar issue. Have them choose their Stakeholder Card and determine their position statement, and place their cards on the rope ends where they feel their impact fits (maybe animal rights activists and universities at either end of the bottom rope, with fishers and boat owners on the top rope), place a small toy boat on the center of the ropes.
12. Have them again manipulate the ropes to see if they can balance the boat, and discuss what happens to the social carrying capacity when the bottom rope is removed, or others move off center.
13. Have the students summarize what inferences they could make about future natural resource issues.

Elementary Extensions

With younger students, you can skip the stakeholder discussion portion of the activity and begin with the rope balance as a game. Have them wear the stakeholder cards as name badges, and have them work to balance the stuffed animal on the center of the ropes.

Discuss how there are a lot of people involved in helping our lakes to be balanced. Do they have people in their family that use or depend on the lakes? (Fishers, boaters, scientists, etc.)

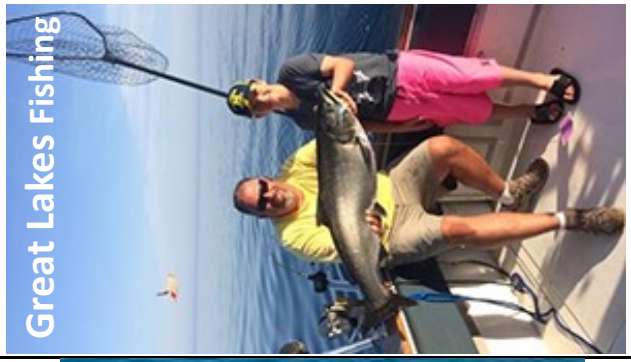
Use larger and smaller stuffed animals to make the game easier and harder. Are some species easier to make a decision about?

Boat Owner	Fishers
Law Enforcement	Media
Animal Rights Activist	Department of Natural Resources
Canadian Government	Department of Environmental Quality
Department of Agriculture and Rural Development	Stakeholders (Trout Unlimited, Steelheaders, etc.)

Universities	Local Community Citizens
Lakeshore Property Owners	Economic Development Agencies
Business Partners (oil, gas, minerals)	Retail Sales (Bait shops, sporting goods)
Local Businesses (restaurants, hotels)	Commercial Fishers
Other Great Lakes State Governments	Fisheries Commission

Introduced Salmon

Invasive Goby



Native Great Lakes Species

It's Your Niche

Activity Objective

Students will be able to define habitat and niche, and create business cards for native, non-native, and invasive aquatic species.

Materials

- 3"x5" blank index cards
- Coloring materials
- Animal ID guides/ posters/internet
- *Large paper

Grade Level

Second through eighth

Classroom Instructions

1. Review habitat with students (food, water, shelter and space in a suitable arrangement). Tell students that habitat can be considered an animal's address. Explain to students that in this activity they will be not only looking at animals' addresses, but animals' jobs (niche), as well.
2. Talk about roles in the environment. What makes an invasive species good at his job? (Reproduces fast/a lot, can eat anything/ more, flexible habitat, etc.) Invasive carp are a great example.
3. Discuss the neighborhood the students live in. Everyone has an address and most people have jobs. The job might be a role that a person plays in the community. Animals have roles in the ecosystem or community they live in. This role is called the animal's ecological niche. It includes such things as where and how it gathers its food; its role in the food chain; what it gives and does for the community; its habits, periods of activity, etc. It can also be described as what an animal does for a living. What happens if they are not there? What if someone steals their niche?
4. Allow students time to choose and research an aquatic species found in the Great Lakes. They should find out its niche and choose one thing this animal does well.
5. Their assignment will be to create a business card for that animal advertising its job in the community. To help them, you may want to bring in a few "real" business cards to look at.
6. Here is an example of an animal business card.
7. Business cards should include the following: name of animal, job title, company name, address, phone number, slogan and illustration or symbol for business.
8. Hang business cards on the bulletin board and call it "Whose Niche?" Discuss the ecosystem you have created. How do invasive species play a role?
9. *Extension—have students work to create billboards for their animals business on large paper.

T.F.M. Lamprey
Plasma Collection Services
1835 Lake Ontario Way
Welland, MI 41920
Call 1-800-we-slurp

Once we latch, we finish the job!

The Invisible Migration

Activity Objective

Students will understand how invasive species were able to travel from other continents, through the Atlantic Ocean, through rivers and canals and into the Great Lakes.

Materials

- Plastic model boats
- GloGerm or petroleum jelly
- Blacklight
- Name badge printouts on card stock or laminated
- String

Grade Levels

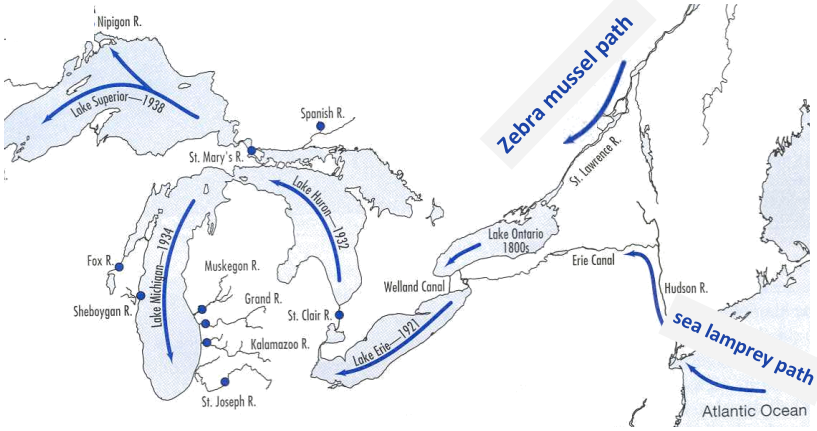
Second through Eighth

Set Up

1. Immediately prior to starting the game, coat the plastic boats with GloGerm or petroleum jelly. (Don't let students see you—surprise!)
2. Assign students name badges (up to 2 students per badge).
3. Utilize a map of the great lakes to familiarize the students with the geography. A Great Lakes basin map is available here: https://www.miseagrant.com/Great_Lakes_Basin_p/michu-11-705.htm

Classroom Instructions

1. Discuss with your students what invasive species are, and the many ways they got to the Great Lakes region (shipping, ballast water, canals, introduction, bait, accidental release, pet trade, etc.).
2. Can they give examples of animals that have come to our area this way? (Sea lamprey, zebra mussels, quagga mussels, Eurasian watermilfoil, red swamp crayfish, etc.)

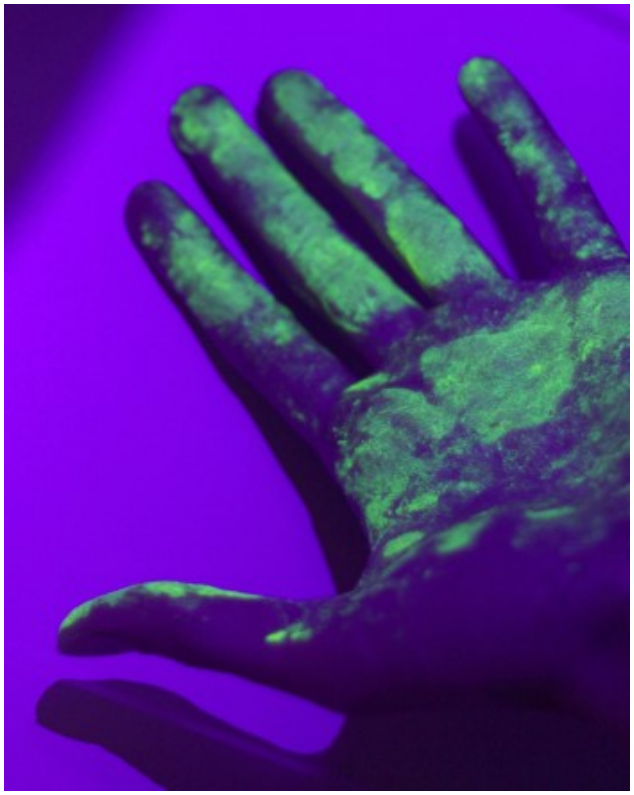


3. We are going to highlight the path of sea lamprey via the Hudson River and Erie Canal; or the zebra mussel introduction via the St. Lawrence Seaway and Lake Ontario. See an animated map of the zebra mussel invasion.
4. Have students wear their name badges and arrange themselves in the proper order from the Atlantic Ocean (where ships enter our waters) through the rivers and canals to the Great Lakes.

ZEBRA MUSSELS: Baltic Sea ~> Atlantic Ocean ~> St. Lawrence Seaway ~> Lake Ontario ~> ~> Welland Canal ~> Lake Erie ~> Detroit River ~> Port ~> Lake St. Clair ~> ~> St. Clair River ~> Lake Huron ~> St. Marys River ~> Lake Superior ~> Straits of Mackinac ~> Lake Michigan

The Invisible Migration continued

Activity Continued



5. Once students are arranged, have them hold hands with their peers on both sides.

6. Starting at the Atlantic Ocean, hand the coated boat to the first student. ***Students must touch the boat with both hands, pass it to the next student, then rejoin hands with them after they pass it on.*

7. If you have more than one boat to send through, start the next boat after the first goes halfway.

8. After the boats have sailed from the Atlantic Ocean all the way to Lake Michigan/Superior have the students let go of their peers hands.

9. Ask them what they think happens as the boats move through the rivers and canals into the lakes. Do they take invaders? The more boats the more invaders?

10. Turn off the lights and shine the backlight on the students hands. Did they pass invaders along and didn't know it? Were there higher concentrations in certain locations?

11. Run another round, but when the boat reaches the Detroit River, add more GloGerm at the port, then have them pass it on.

12. Recheck with the blacklight. What did adding more symbolize? (Exchanging ballast water)

*13. Run the simulation with different scenarios and discuss. Click here to see an animated map of the sea lamprey invasion https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?SpeciesID=836

SEA LAMPREY: Atlantic Ocean ~> Hudson River ~> Erie Canal ~> Lake Ontario ~> ~> Welland Canal ~> Lake Erie ~> Detroit River ~> Port ~> Lake St. Clair ~> ~> St. Clair River ~> Lake Huron ~> St. Marys River ~> Lake Superior ~> Straits of Mackinac ~> Lake Michigan

***Wash hands after.*

(You can even do an extension—checking their hands with the blacklight after washing to see how well they get rid of germs)

Atlantic Ocean

Baltic Sea

Erie Canal

Hudson River

Welland Canal

Lake Ontario

Lake Erie

Detroit River

St. Lawrence Seaway

Lake St. Clair

St. Clair River

Lake Huron

Straits of Mackinac

St. Mary's River

Lake Superior

Lake Michigan

The Carp Conundrum

Activity Objective

Students will be able to discuss the species of invasive carp that are threatening to enter the Great Lakes. Students will apply their knowledge of these species and their threat to our ecosystems, and design solutions to prevent invasive carp from entering our Great Lakes ecosystem.

Materials

- Laminated maps or posterboard
- Play dough
- Chenille stems
- Popsicle sticks
- Craft supplies
- Fine point dry erase markers

Grade Level

Fourth through 12th

Background

Invasive carp have been making their way up various rivers towards the Great Lakes for many years. This impending threat could completely disrupt the Great Lakes ecosystem and the 7 billion dollar fishery that relies on it.

Asian carp were imported from Southeast Asia to the Southern United States to help aquaculture and wastewater treatment facilities keep retention ponds clean. Flooding events and accidental release allowed these fish to escape into the Mississippi River and migrate north. As they reached the Illinois River, which is connected to Lake Michigan via a manmade connection called the Chicago Sanitary and Ship Canal—Michigan became more concerned and ramped up research efforts.

There are 4 species of invasive or "Asian carp" threatening the Great Lakes— *Black carp, silver carp, bighead carp,* and *grass carp*. All are fast growing, prolific feeders that out-compete native fish, and can leave a trail of environmental disruption behind. However, each species will impact the environment in different ways.

Grass carp have been previously found in Lake Erie and Lake Michigan, and are well researched, and monitored constantly. While their presence is not positive, their impact has been minimal. They feed on aquatic plants primarily, but will also feed on detritus, invertebrates, insects and small fish. They reduce food (aquatic plants) for other species and change the habitat. Also, their waste has a high nutrient level which can cause algae blooms.

Black carp are longer and more slender than their cousins. They like to spawn in turbulent areas, and feed on zooplankton as fry, and mollusks and crustaceans as adults. They have very strong pharyngeal teeth to crush through shells. They would impact native mussel populations as well as other species like fish, birds, otters, etc. that feed on mollusks. Black carp have not made their way to the Great Lakes yet.

The biggest threat comes from our next two species, that have not yet reached the Great Lakes.

The Carp Conundrum continued

Silver carp commonly weigh 20 pounds, but as much as 80. They can jump 9 feet or more out of the water when startled by boat engines, causing a hazard for people. They are a schooling species, and can be found grouped in large numbers. Silver carp feed on large quantities of phytoplankton, using specialized gill rakers to efficiently strain plankton out of the water. This ability allows them to outcompete native planktivorous fish.

Bighead carp are the largest, weighing 40 pounds when mature, but can reach up to 80. Bighead carp are voracious eaters and consume a wide range of zooplankton, detritus and small invertebrates. They lack a "true stomach," which requires them to feed almost constantly. Both of these factors create a fish that can easily outcompete a wide range of native species for food. Their impact on the Great Lakes food webs would be tremendous.

Asian carp species have no natural predators in North American waters. They produce many offspring, and overwhelm native fisheries when conditions are favorable.

Preventing Disaster

Researchers are using eDNA, or environmental DNA, to track the presence of these fish. This is genetic material that an animal leaves behind in the water in the form of scales, cells, feces, or mucus. This is a great tool that can sound the alarm for further research. Presently, eDNA cannot verify whether live Asian carp are present, or whether the DNA came from a dead fish, or contaminated gear, bilge water, storm sewers, etc.

Prevention of invasive carp is the best solution. Eradication of established populations is expensive, time intensive and not always successful. There are many state, federal and international entities seeking solutions that would prevent the carp invasion of the Great Lakes.

Current measures in place include dams, an electric barrier, and policies/laws to prevent transport and trade of these fish. Research on invasive carp movement, spawning, and measures to stop them are ongoing. Michigan held the Great Lakes Invasive Carp Challenge to let people across the country propose their solutions to the problem. *Cavitation bubbles, chemical water treatments for locks, water velocity barriers, fish imaging and sorting systems and many more ideas were submitted. **Sound and carbon dioxide are also being heavily researched as solutions.

Michigan, other Great Lakes states, the federal government and Canada are all working together to create a plan and funding to prevent the invasion of Asian carp into our Great Lakes.

Clickable Resources

- MI Invasive Species
- Carp FAQ
- eDNA
- Carp Challenge *
- Asian Carp Controls **

The Carp Conundrum continued

Setup

Utilizing the resources in this activity, videos, and websites, ask students what they know about Invasive carp. Discuss their current knowledge and expand on that using available resources.

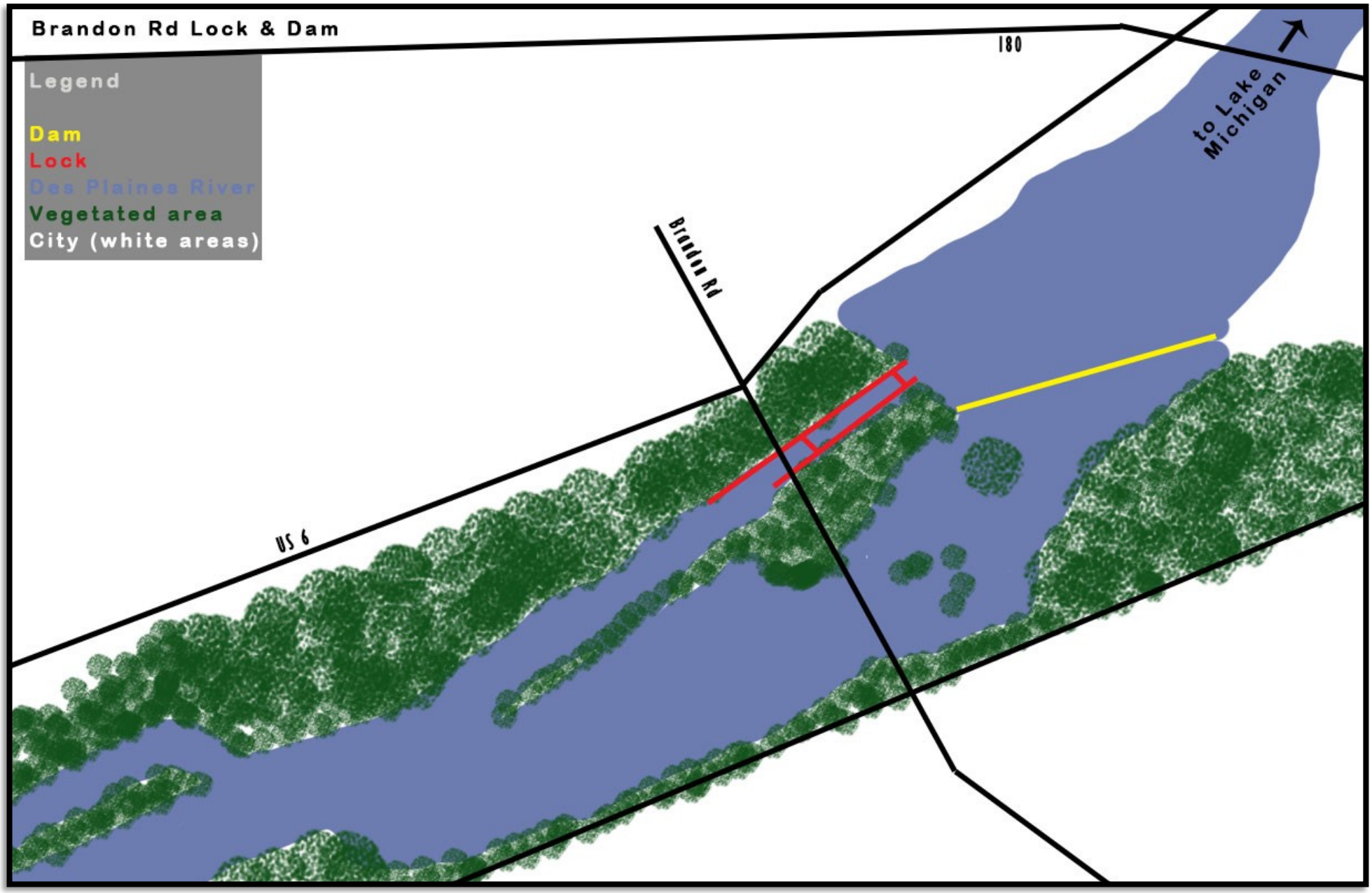
Print and laminate the Brandon Rd. Lock and Dam map. Break students into teams, each with a map and dry erase markers. Show your students the animated carp invasion map here https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?SpeciesID=549

Classroom Instructions

- Orient your students to the map of Brandon Rd. Lock and Dam. Project a map of the Great Lakes, then zoom in to Illinois, and then further to the area of Brandon Rd. Lock and Dam and its connection to Lake Michigan.
- Why is that a good place to focus? (It is a current bottleneck to flow). Why can't we just close down that waterway? (Money tied to transport of goods)
- With their groups: Brainstorm 4 ideas for blocking invasive carp from the Great Lakes. Students may use or combine methods they have heard about, or come up with their own.
- They should then narrow it down to their best defense.
- Where should their solution(s) be placed? They can utilize the provided map, or turn it over and draw their own.
- Teams should illustrate, model (using the craft materials) or describe their solutions on the map.
- Teams can utilize any solutions they choose. In the following class discussion they must defend their choices. Other students, as well as the teacher, should ask good questions and find flaws in the plan.
- After each team has presented their plan and has debated its merit, the full class should combine solutions to build/illustrate an action plan of the best set of solutions.
- Remember: stopping carp from moving through this one waterway is not the only solution needed. Education, signage, laws, and more will all be needed as well.

Extensions

Assign teams to tackle different pieces of the action plan. One team can design the infrastructure needed. Another team could outline laws that would need to be in place. And yet another could create an advertising campaign to get the message out. Options for extension work are endless.


Brandon Rd Lock & Dam
Legend
Dam
Lock
Des Plaines River
Vegetated area
City (white areas)
180
to Lake Michigan
Brandon Rd
US 6