OHSU-EP-1533

Great Lakes Aquatic Invasive Species (AIS) Lesson Plan)

Teacher Activity

The Eerie Eight

What are the differences between native, non-native, and invasive species?
What are invasive species and why are they a problem?
What species have been introduced to the Great Lakes?
What is ballast water?
What are possible management practices to prevent further introduction of invasive species?

Background

Organisms (both plants and animals) that come from other places are known as non-native species. Often these species are unable to reproduce or survive in a new ecosystem so they do not cause issues. However, a select few are able to establish themselves as strong competitors restructuring the native ecosystem and wreaking havoc on the natural and man-made systems. These creatures are known as invasive species. Invasive species have arrived to the water of the Great Lakes in a variety of ways including but not limited to ballast water, intentional or accidental dumping, and barrier removal. Information about invasive species is important to scientists because it helps them manage the invasive species that are already in the Great Lakes and work with stakeholders to prevent further spread of future or current invasive species.

Objectives

In this Great Lakes Invaders Investigation students will learn the difference between native, non-native, and invasive species. Students will learn about invasive species introduced to the Great Lakes, how they were introduced, why these species are a problem, and various management practices that can be used to prevent further spread or introduction of aquatic invasive species.

After completing this investigation, students will be able to:

- Differentiate between native, non-native, and invasive species
- Identify Great Lakes aquatic invasive species and state why they are a problem
- Suggest management recommendations based on species characteristics

Grade Levels

5-8, biology, ecology, and/or environmental science

Time Required

Approximately 3 class periods or 3-3.5 hours

Materials

Pre-assessment worksheet	1 per student
Native and non-native definition cards	1 per student group
Native and non-native synonym cards	1 per student group
Invasive species definition cards	1 per student group
Invasive species worksheet	1 per student group
Invasive species website sheet	1 per student group
Attack Pack cards (from Attack Pack or printed from the web)	1 per class
Invasive species PowerPoint slides	1 per class
Ballast water PowerPoint slides	1 per class
Ballast water management worksheet	1 per student group
Post-assessment worksheet	1 per student
Poster guidelines	1 per student group
Computer and projector	1 per class
Laminator (to laminate cards for reuse)	1 per class
Masking tape (to tape cards on wall)	1 per class

Alignment

Next Generation Science Standards (NGSS) or State Science Standards Addressed

- MS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics
- MS-ESS3-3 Earth and Human Activity
- HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics
- HS-ESS3-4 Earth and Human Activity

Ohio's Learning Standards and Model Science Curriculum for Science

- Grades 5-8: Scientific Inquiry, Practice and Application
- Grade 5: Life Science (LS)

Ocean Literacy Principles

6: The ocean and humans and inextricably interconnected

D: Humans affect the ocean in a variety of ways. Laws, regulations, and resource management affect what is taken out and put into the ocean. Human development and activity lead to pollution (point source, nonpoint source, and noise pollution), changes to ocean chemistry (ocean acidification), and physical modifications (changes to beaches, shores, and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

G: Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

Great Lakes Literacy Principles

5: The Great Lakes support a broad diversity of life and ecosystems.

I: Life cycles, behaviors, habitats and the abundance of organisms in the Great Lakes have been altered by intentional and unintentional introduction of non-native plant and animal species.

6: The Great Lakes and humans in their watersheds are inextricably interconnected.

C: The Great Lakes are affected directly by the decisions and actions of people throughout its watershed which includes parts of the states of Illinois, Indiana, Michigan, Minnesota, Ohio, Pennsylvania, New York, and Wisconsin, the Canadian provinces of Ontario and Quebec, and tribal lands.

D: Local and national laws, regulations and resource management affect what is put into and taken out of the Great Lakes. Shoreline development and industrial or commercial activities lead to point and non-point source pollution. Humans have altered the biology of the lakes and the viability of species through harvesting, species introduction, and nutrient loading.

F: To ensure continued availability of Great Lakes assets, people must live in ways that sustain the lakes. Individual and collective actions are needed to effectively conserve and manage Great Lakes resources for the benefit of all.

8: The Great Lakes are socially, economically, and environmentally significant to the region, the nation and the planet.

D: Waterborne commerce moves millions of tons of cargo annually through the Great Lakes. Shipping is an economically efficient method of transporting raw materials, finished goods and agricultural products. However, shipping is also a vector for non-native species, several of which may be detrimental to the Great Lakes ecosystem.

F: The Great Lakes were dramatically degraded and challenged by human endeavors in recent times. Basic ecosystem processes have been restored through individual and collective efforts. Proper foresight and informed decision making will continue to make the Great Lakes a model of environmental protection, restoration and innovation.

English Language Arts Standards

- Comprehension and Collaboration: CCSS.ELA-LITERACY.SL.5.1
- Presentation of Knowledge and Ideas: CCSS.ELA-LITERACY.SL.5.4, CCSS.ELA-LITERACY.SL.5.5, CCSS.ELA-LITERACY.SL.5.6
- Comprehension and Collaboration: CCSS.ELA-LITERACY.SL.6.1
- Presentation of Knowledge and Ideas: CCSS.ELA-LITERACY.SL.6.4, CCSS.ELA-LITERACY.SL.6.5, CCSS.ELA-LITERACY.SL.6.6
- Comprehension and Collaboration: CCSS.ELA-LITERACY.SL.7.1
- Presentation of Knowledge and Ideas: CCSS.ELA-LITERACY.SL.7.4, CCSS.ELA-LITERACY.SL.7.5, CCSS.ELA-LITERACY.SL.7.6
- Comprehension and Collaboration: CCSS.ELA-LITERACY.SL.8.1
- Presentation of Knowledge and Ideas: CCSS.ELA-LITERACY.SL.8.4, CCSS.ELA-LITERACY.SL.8.5, CCSS.ELA-LITERACY.SL.8.6

Prior to the Lesson

1. Print out all necessary materials, cut out cards or have students cut out cards (laminate cards for re-use if desired).
2. Load the invasive species and ballast water PowerPoints.
3. Tape native and non-native definitions around the classroom.
4. Contact local Sea Grant program for access to an Attack Pack for invasive species cards and examples or print invasive species cards from Attack Pack website. seagrant.wisc.edu/wp-content/uploads/2018/12/AIAP_factsheet2018.pdf
5. Review the below videos and choose the one that is best for your timeframe. If you have time, play both videos.

Environmental Education Series – All About Water – Episode 4 – Lake Erie Food Web youtu.be/wk14CZ6GcNE **(4-minute video)**

Sue Bixler, Education and Outreach Specialist for Ohio Sea Grant and The Ohio State University's Stone Laboratory, introduces you to the state-threatened Lake Erie Watersnake. You will learn about this unique animal, what it eats, how it behaves, and the role round goby have played in helping this species rebound.

Coyote Peterson's Wild Field Trip video (ANGRY SNAKE Bites Fearless Girl!) youtu.be/lADvif3wv1M **(20-minute video)**

Coyote Peterson talks about Lake Erie Watersnake habitat, food sources, and research program being conducted by Ohio State's Stone Laboratory. Dr. Kristin Stanford, Education and Outreach Coordinator and Research Scientist for Ohio Sea Grant and Stone Laboratory, discusses her research and efforts to help this once federal endangered species make a comeback.

*** Coyote and his helper Sydney are collecting snakes for research purposes in this video and it does show them being bitten. No worries! They have protective gloves on their hands and the snake bites cannot hurt them. ***

Lesson

Engage

- Ask the following question: Have you heard about the Eerie Eight?
- Read this short poem to introduce the Eerie Eight.

The Eerie Eight have made their home in our mighty lakes so great.
Many of our favorites have become their dinner bait.
Today you will learn about those eight considered not so great,
can you help our scientists seal their ultimate fate?
Non-native are those who come from afar.
Did they hitch a ride on a boat or get dumped from a jar?
Invasive we call those we don't like at all.
So today we will learn how to plan their downfall.

- Show them the slide with the Eerie Eight on it.
- Have students complete pre-assessment worksheet independently.

Explore

Learn about invasive species.

1. Learn native and non-native definitions.
   - Eight invasive species are included so divide students into eight work groups.
   - Students will use the definition cards to determine the meaning of native and non-native species.
   - Tape the definition cards to the wall, hand each group the native and non-native cards and have them match these cards with the correct definitions on the wall.
   - Once they have chosen the correct definitions they can bring the definition cards back to the table with them to review as a class.
2. Learn synonyms for the words native and non-native.
   - Define synonym for the students. Synonyms are a word or phrase that means exactly or nearly the same as another word or phrase.
   - Using the native and non-native synonym cards have each group place their synonym cards face down on their tables.
   - One at a time each student will overturn two cards. If the two cards they select are synonyms with native and non-native they keep those cards. A native or non-native card must be drawn each time to count as a match.
   - Once all the cards have been matched review for correct answers as a class.
3. Learn the definition for invasive species.
   - Give each group the cards (out of order) for the invasive species definition.
   - Have each group correctly layout the definition for invasive species on their table.
   - Once everyone is finished review as a class.
4. Learn about ballast water.
   - Present the ballast water PowerPoint.
5. Learn about invasive species in the Great Lakes.
   - Give each group the invasive species worksheet and the Attack Pack cards.
   - Using the list of website suggested for each invasive species have groups conduct web searches to learn more about their invasive species and fill out the worksheet.
6. Learn how an invasive species has benefited a native species.
   - Play the *All About Water* video or *Coyote Peterson* video to show how round goby have become an important food source for the state-threatened Lake Erie Watersnake.
   - Discuss whether or not students think the round goby has helped Lake Erie Watersnakes rebound as a species.

Explain

1. Share invasive species with class.
   - Have each group present on their invasive species.
   - Pull up the invasive species PowerPoint during the presentation so the class can see images for each organism.
2. Apply what they have learned.
   - Fill out the ballast water worksheet with your group.
   - Review answers with class.

Elaborate

Take it one step further. Have each group create a poster on their invasive species to display.

Items to Include in Your Poster

- Common name of your organism.
- Scientific name of your organism. A scientific name of an organism is the name of the organism that consists of a genus and species name. It is always italicized and genus is capitalized and species is not.
- Map of where your organism originates from.
- Map of where you organism is now found in the United States.
- Color image of your organism.
- Characteristics used to identify your organism.
- Information on how the organism was introduced to the United States.
- Information on why the organism is considered invasive.
- Management recommendations for this organism.
- Credits for all images used.
- References section to give credit to information sites. Please include website used, date website was updated, and date you accessed the website.

Remember to use images and websites that end in .gov, .org, .net, or .edu as these are credible sites. Do not use websites or images from .com sites.

Evaluate

Using the questions from the pre-assessment review main lesson points with students by asking the questions below.

1. What are native species: **A species from the area where it is found.**
2. What are non-native species: **A species originally from somewhere else than where it is found.**
3. What are invasive species: **Non-native organisms whose introduction does or is likely to cause economic or environmental harm or harm to human health.**
4. What is ballast water? **Water in the hull of a ship that is used to stabilize the ship when traveling.**
5. Which species have been introduced to the Great Lakes through ballast water? (Choose all correct answers.)
   a) **Round goby**
   b) **Zebra and quagga mussels**
   c) Sea lamprey
   d) Rusty crayfish

Additional Resources

Ballast Water and Invasive Species
invasivespeciesinfo.gov/subject/ballast-water
greatlakesseaway.org/protecting-the-great-lakes-st-lawrence-seaway-1

Invasive Species
invasivespeciescentre.ca/learn/invasive-fish-and-invertebrates?gclid=EAIaIQobChMIyujUn6zq5gIVwoFaBR1lewNeEAAYASAAEgJR-_D_BwE
nature.org/en-us/about-us/where-we-work/priority-landscapes/great-lakes/great-lakes-aquatic-invasive-species-/?gclid=EAIaIQobChMIyujUn6zq5gIVwoFaBR1lewNeEAAYAyAAEgL0LvD_BwE&gclsrc=aw.ds
glerl.noaa.gov/glansis

Lake Erie Watersnake
respectthesnake.com
fws.gov/midwest/endangered/reptiles/lews/le-facts.html

Prevention
habitattitude.net
stopaquatichitchhikers.org

Use of the Attack Pack and Invasive Species in the Great Lakes
seagrant.wisc.edu/wp-content/uploads/2018/12/AIAPguide_2018.pdf

For teachers in the Great Lakes Region
Contact your local Sea Grant Program and request an Attack Pack. It will provide you with image cards and specimens for Great Lakes invasive species. If you cannot access an Attack Pack, use this link to download the invasive species information cards:
seagrant.wisc.edu/wp-content/uploads/2018/12/AIAP_factsheet2018.pdf

Ohio Sea Grant
ohioseagrant.osu.edu/products/6bdd5/ais-in-the-gl
ohioseagrant.osu.edu/products/4j7wz/ohio-field-guide-to-ais

New York Sea Grant
seagrant.sunysb.edu/articles/t/aquatic-invasive-species-home

Wisconsin Sea Grant
seagrant.wisc.edu/our-work/focus-areas/ais/aquatic-invader-attack-pack

Pennsylvania Sea Grant
seagrant.psu.edu/topics/aquatic-invasive-species/projects/ais-education

Minnesota Sea Grant
seagrant.umn.edu/ais/index

Michigan Sea Grant
michiganseagrant.org/topics/ecosystems-and-habitats/invasive-species

Illinois/Indiana Sea Grant
iiseagrant.org/work/aquatic-invasive-species

Great Lakes Region
cgll.org/for-educators/attack-pack-request
cgll.org/wp-content/uploads/2018/11/AIAP_factsheet2018.pdf

Ballast Water
youtube.com/watch?v=9g89KEbYd6I
youtube.com/watch?v=LTQiZ-hUzTM
marineinsight.com/tech/how-ballast-water-treatment-system-works

Jill Bartolotta, Ohio Sea Grant Extension Educator, 2020
Sue Bixler, Stone Laboratory and Ohio Sea Grant Education Specialist, 2020

Adapted from *Water Invaders*, an invasive species lesson plan created for the NOAA Teacher at Sea Program by Jill Bartolotta in January 2020

Native and Non-Native Definition Cards

Native and Non-Native Definition Cards Answer Key

Native: A species from the area where it is found.

Non-Native: A species originally from somewhere else than where it is found.

NATIVE	NATIVE
NATIVE	NATIVE
NATIVE	NATIVE
NATIVE	NATIVE

Native and Non-Native Definition Cards

A species from the area where it is found.	**A species from the area where it is found.**
A species from the area where it is found.	**A species from the area where it is found.**
A species from the area where it is found.	**A species from the area where it is found.**
A species from the area where it is found.	**A species from the area where it is found.**

Native and Non-Native Definition Cards

Native and Non-Native Synonym Cards Answer Key

Native=Indigenous

Non-Native=Alien, Foreign, Exotic, Non-indigenous

NON-NATIVE	NON-NATIVE
NON-NATIVE	NON-NATIVE
NON-NATIVE	NON-NATIVE
NON-NATIVE	NON-NATIVE

Native and Non-Native Definition Cards

A species originally from somewhere else than where it is found.	**A species originally from somewhere else than where it is found.**
A species originally from somewhere else than where it is found.	**A species originally from somewhere else than where it is found.**
A species originally from somewhere else than where it is found.	**A species originally from somewhere else than where it is found.**
A species originally from somewhere else than where it is found.	**A species originally from somewhere else than where it is found.**

Native and Non-Native Synonym Cards

NON-NATIVE	Non-indigenous Species
NON-NATIVE	Non-indigenous Species
NON-NATIVE	Non-indigenous Species
NON-NATIVE	Non-indigenous Species

Native and Non-Native Synonym Cards

NON-NATIVE	Exotic
NON-NATIVE	Exotic
NON-NATIVE	Exotic
NON-NATIVE	Exotic

Native and Non-Native Synonym Cards

NON-NATIVE	Alien
NON-NATIVE	Alien
NON-NATIVE	Alien
NON-NATIVE	Alien

Native and Non-Native Synonym Cards

NON-NATIVE	Foreign
NON-NATIVE	Foreign
NON-NATIVE	Foreign
NON-NATIVE	Foreign

Native and Non-Native Synonym Cards

NATIVE	Indigenous
NATIVE	Indigenous
NATIVE	Indigenous
NATIVE	Indigenous

Invasive Species Definition

Invasive Species Definition Answer Key

Invasive species are non-native organisms whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Invasive Species Definition Scrambled

introduction does or is
or harm to human health.
likely to cause economic
Invasive species are non-
or environmental harm
native organisms whose

Invasive Species Worksheet Answer Key: Zebra and Quagga Mussels

Common Name of Organism(s): **Zebra and Quagga Mussels**

Scientific Name of Organism(s): **Zebra Mussel (*Dreissena polymorpha*) Quagga mussel (*Dreissena bugensis*)**

How do you identify this organism? (You can use words, drawings, or both to answer this question.)

- **Both mussels can be up to two inches long.**
- **Zebra mussels have black striped shells that look like a zebra's stripes. Quagga mussels are grey to cream colored and do not have noticeable stripe pattern.**
- **Quagga mussels differ from zebra mussels in that they have an elliptical shape in cross section and don't have a flat ventral side.**

What type of water does your organism live in? (Circle all that apply.)

Freshwater Saltwater Brackish water (mixture of fresh and salt water)

Where does this organism come from?

Zebra mussels are native to Eastern Europe and Western Russia. Quagga mussels are native to the Dneiper River of Ukraine.

How did this organism get to the Great Lakes?

The ballast water of ships

Where is this organism found in the Great Lakes?

These mussels are found in all five of the Great Lakes and many inland lakes.

Why is this organism considered invasive? (Why is it a problem?)

- **Both mussels are a problem because they filter water, up to a liter per day, to eat plankton. Because there are lots of them in the lakes and they can eat a lot of plankton, the mussels compete with small fish for food.**
- **They also accumulate contaminants in their tissues as they filter water. These contaminants can be passed up the food chain to any fish or bird that eats one of these mussels.**
- **Both mussels easily clog water intake pipes preventing water from flowing through and they are very expensive to remove from clogged pipes.**
- **Their shells are very sharp and humans can easily cut their feet or hands on the shells.**

What is being done to control their spread?

- **With a permit, chemicals can be used to kill the larva on water intake pipes. If these chemicals were used in an open lake, they would also affect fish and native mussels.**
- **Remove any visible mud, plants, fish or animals before transporting your recreational water equipment and clean, drain and dry your equipment.**
- **Never release plants, fish or animals into a body of water.**

Answer Key Credit: Great Lakes Sea Grant Network. 2018. Attack Pack Aquatic Invader Fact Sheets.

Invasive Species Worksheet Answer Key: Sea Lamprey

Common Name of Organism(s): **Sea Lamprey**

Scientific Name of Organism(s): ***Petromyzon marinus***

How do you identify this organism? (You can use words, drawings, or both to answer this question.)

- **Sea lampreys are parasitic fish (in their adult form) that attach to other fish using their mouth that forms a sucking disk. Using rows of rasping teeth, they rasp through the victim's scales and skin, and then feed on its body fluids.**
- **They are brown to black in color and adults can be 12-24 inches long.**
- **Young lamprey (larvae) are small creatures that look like grey worms.**

What type of water does your organism live in? (Circle all that apply.)

Freshwater **Saltwater** Brackish water (mixture of fresh and salt water)

Where does this organism come from?

The Atlantic Ocean

How did this organism get to the Great Lakes?

They first invaded Lake Ontario through the St. Lawrence River in the 1800s. When the Welland Canal was modernized in 1919, the deeper channel between Lake Ontario and Lake Erie allowed lampreys to invade Lake Erie.

Where is this organism found in the Great Lakes?

Adults are found in all five of the Great Lakes and the juveniles live in the rivers that flow into the Great Lakes.

Why is this organism considered invasive? (Why is it a problem?)

- **Several types of native lamprey live in the Great Lakes region. Some are parasitic, but they rarely kill their host fish. In contrast, sea lamprey often kill their host, and a single sea lamprey can kill up to 40 lbs of fish in its lifetime.**
- **Sea lamprey feed on many commercially important native fish, such as lake trout. The lake trout harvest fell from about 15 million pounds to 300,000 pounds after sea lamprey invaded the Great Lakes.**

What is being done to control their spread?

- **The main method of control is applying a pesticide called TFM that kills lamprey larvae. Although it is successful, it is also expensive.**
- **Barriers have been constructed in streams to block the upstream migration of spawning sea lampreys. Most of these barriers allow other fish to pass through.**
- **Another method under investigation is to trick the lamprey and trap them by using a pheromone (chemical trigger) that male lampreys release to attract females during mating.**

Answer Key Credit: Great Lakes Sea Grant Network. 2018. Attack Pack Aquatic Invader Fact Sheets.

Invasive Species Worksheet Answer Key: Eurasian Ruffe

Common Name of Organism(s): **Eurasian Ruffe**

Scientific Name of Organism(s): ***Gymnocephalus cernuus***

How do you identify this organism? (You can use words, drawings, or both to answer this question.)

- **The adult ruffe is 4 to 6 inches long, and it is very slimy when handled.**
- **It is olive-brown to golden-brown on its back, and paler on the sides with yellowish undersides.**
- **It has a very large dorsal fin made up of two parts joined together. The front part is large and spiny with rows of dark spots. The back part is small and smooth.**

What type of water does your organism live in? (Circle all that apply.)

Freshwater Saltwater Brackish water (mixture of fresh and salt water)

Where does this organism come from?

The Eurasian ruffe is originally from fresh and brackish waters in parts of Europe and Asia.

How did this organism get to the Great Lakes?

It likely came to Lake Superior in ballast water.

Where is this organism found in the Great Lakes?

Lake Superior, Lake Huron, and Lake Michigan

Why is this organism considered invasive? (Why is it a problem?)

- **The ruffe is an aggressive fish, and it eats a variety of food that many native fish (walleye, yellow perch and other small forage fish) depend on for survival.**
- **A population of ruffe can grow rapidly. In warm water, the ruffe can mature and reproduce in a single year. The average female can produce around 100,000 eggs per season.**

What is being done to control their spread?

- **Never use ruffe as bait.**
- **Remove any visible mud, plants, fish or animals before transporting your recreational water equipment.**
- **Drain water out of your boat, live well, bilge and other equipment before transporting.**
- **Clean and dry anything that came in contact with water (boats, trailers, equipment, clothing, etc.).**
- **Never release plants, fish or animals into a body of water.**

Answer Key Credit: Great Lakes Sea Grant Network. 2018. Attack Pack Aquatic Invader Fact Sheets.

Invasive Species Worksheet Answer Key: Rusty Crayfish

Common Name of Organism(s): **Rusty Crayfish**

Scientific Name of Organism(s): ***Orconectes rusticus***

How do you identify this organism? (You can use words, drawings, or both to answer this question.)

- **Rusty crayfish have dark rusty-colored spots on each side of their backs, about where you would grab them to pick them up.**
- **They have large, smooth claws that vary in color from grayish-green to reddish brown.**
- **They also have black bands at the claw tips.**

What type of water does your organism live in? (Circle all that apply.)

Freshwater Saltwater Brackish water (mixture of fresh and salt water)

Where does this organism come from?

Rusty crayfish are native to the Ohio River Valley in Ohio, Kentucky and Tennessee

How did this organism get to the Great Lakes?

They probably entered the Great Lakes and inland waters through use as bait trade.

Where is this organism found in the Great Lakes?

They have been found in all rivers or inland lakes in states that border a Great Lake.

Why is this organism considered invasive? (Why is it a problem?)

- **The rusty crayfish is a very aggressive species that often displaces native crayfish.**
- **They are opportunistic feeders, which means they eat almost anything, including plants, fish eggs and small fish.**
- **They also reduce aquatic plant abundance and diversity by destroying plants as they feed.**

What is being done to control their spread?

- **Remove any visible mud, plants, fish or animals before transporting your recreational water equipment.**
- **Never use rusty crayfish as bait.**
- **Drain water out of your boat, live well, bilge and other equipment before transporting.**
- **Clean and dry anything that came in contact with water (boats, trailers, equipment, clothing, etc.).**
- **Never release plants, fish or animals into a body of water.**

Answer Key Credit: Great Lakes Sea Grant Network. 2018. Attack Pack Aquatic Invader Fact Sheets.

Invasive Species Worksheet Answer Key: Eurasian Watermilfoil

Common Name of Organism(s): **Eurasian Watermilfoil**

Scientific Name of Organism(s): ***Myriophyllum spicatum***

How do you identify this organism? (You can use words, drawings, or both to answer this question.)

- **Eurasian watermilfoil has 12-21 leaflet pairs, while northern watermilfoil, a native plant, typically only has 5-10 leaflet pairs.**
- **Dark green in color with small red flowers that sprout in mid-summer.**

What type of water does your organism live in? (Circle all that apply.)

Freshwater Saltwater Brackish water (mixture of fresh and salt water)

Where does this organism come from?

Native to Europe, Asia and North Africa

How did this organism get to the Great Lakes?

It was introduced to the United States between the late 1800s and the 1940s. It may have been brought intentionally as an aquarium decoration or as packing material for worms.

Where is this organism found in the Great Lakes?

It is found in all of the Great Lake states and their waterways.

Why is this organism considered invasive? (Why is it a problem?)

- **Eurasian watermilfoil grows to the surface so fast that it can reduce the amount of light in a lake or pond, shading out the native aquatic plants.**
- **Dense beds of Eurasian watermilfoil create more hiding spaces for small fish, so they are harder for larger fish to catch. When there are lots of little fish, they may not have enough to eat, so they stay small, a phenomenon called stunting.**

What is being done to control their spread?

- **Herbicides can be used, but they will also kill native plants.**
- **It can be cut, but all of the plant must be removed from the water to prevent it from spreading.**
- **Prevent the spread of Eurasian watermilfoil to other bodies of water by removing it from recreational water equipment, draining water from all equipment and cleaning and drying anything that came in contact with water.**
- **Never release plants, fish or animals into a body of water.**

Answer Key Credit: Great Lakes Sea Grant Network. 2018. Attack Pack Aquatic Invader Fact Sheets.

Invasive Species Worksheet Answer Key: Spiny Waterflea and Fishhook Flea

Common Name of Organism(s): **Fishhook Waterflea and Spiny Waterflea**

Scientific Name of Organism(s): **Fishhook waterflea (*Cercopagis pengoi*) and Spiny waterflea (*Bythotrephes longimanus*)**

How do you identify this organism? (You can use words, drawings, or both to answer this question.)

- **Waterfleas are small crustaceans.**
- **Both fishhook and spiny waterfleas are between 1/4 and 5⁄8 inches long, so it is difficult to distinguish them without magnification. Under a microscope, the fishhook waterflea has an angled tail with a loop near its end, while the spiny waterflea has a straighter tail and a bulbous egg pouch.**
- **Clumps of waterfleas look and feel like gelatin or cotton batting with tiny black spots.**

What type of water does your organism live in? (Circle all that apply.)

Freshwater Saltwater Brackish water (mixture of fresh and salt water)

Where does this organism come from?

Northeastern Europe

How did this organism get to the Great Lakes?

Ballast water

Where is this organism found in the Great Lakes?

All Great Lakes and the inland lakes of Great Lakes states

Why is this organism considered invasive? (Why is it a problem?)

- **Waterfleas eat and compete with native zooplankton, reducing their numbers and dominating the bottom of the food chain. Waterfleas aren't as nutritious as native zooplankton, and young fish can't digest them well.**
- **Waterfleas collect in masses on fishing lines and downrigger cables. These masses can clog the first eyelet of rods, damage a reel's drag system and prevent fish from being landed.**

What is being done to control their spread?

- **Inspect and remove gelatinous or cotton batting-like material from fishing lines. Waterfleas tend to collect where fishing lines meet a swivel, lure or downrigger ball connection (plucking like a guitar string helps).**
- **Drain water out of your boat, live well, bilge and other equipment before transporting.**
- **Clean and dry anything that came in contact with water (boats, trailers, equipment, clothing, etc.).**
- **Never release plants, fish or animals into a body of water.**

Answer Key Credit: Great Lakes Sea Grant Network. 2018. Attack Pack Aquatic Invader Fact Sheets.

Invasive Species Worksheet Answer Key: Silver and Bighead Carp (Asian Carp)

Common Name of Organism(s): **Silver Carp and Bighead Carp**

Scientific Name of Organism(s): **Silver carp (*Hypophthalmichthys molitrix*) and Bighead carp (*Hypophthalmichthys nobilis*)**

How do you identify this organism? (You can use words, drawings, or both to answer this question.)

- **Both silver and bighead carp have low-set eyes and a large upturned mouth.**
- **Their heads have no scales, and their bodies have very small scales.**
- **They can weigh more than 60 lbs and grow to more than 4 feet long.**
- **Bighead carp have very large heads compared to their bodies, which is how they were named.**

What type of water does your organism live in? (Circle all that apply.)

Freshwater Saltwater Brackish water (mixture of fresh and salt water)

Where does this organism come from?

Asia

How did this organism get to the Great Lakes?

- **Silver and bighead carp were legally imported by the federal government and pond fish farmers in the 1960s and 1970s to control algae in ponds.**
- **Flooding in the 1990s caused many ponds to overflow their banks, allowing these carp to escape into the Mississippi River basin. They have been expanding their range ever since.**

Where is this organism found in the Great Lakes?

The Illinois River, but they have not been found yet in the Great Lakes.

Why is this organism considered invasive? (Why is it a problem?)

- **Silver and bighead carp are filter feeders that can eat up to 20% of their body weight daily and are likely to out-compete native species. Silver carp mostly eat phytoplankton (microscopic plants), while bighead carp mostly eat zooplankton (microscopic animals).**
- **When startled by the noise of boat and jet ski engines, silver carp leap from the water, sometimes as high as 15 feet. They have knocked boaters and jet skiers unconscious and broken noses and windshields.**

What is being done to control their spread?

- **Don't use small Asian carp as bait.**
- **Asian carp are now established in the Mississippi River basin, and government agencies are trying to keep them from invading the Great Lakes. One of the main efforts has been installing a series of electric barriers in the Chicago Sanitary and Shipping Canal, an artificial waterway that connects Lake Michigan to the Mississippi River basin.**

Answer Key Credit: Great Lakes Sea Grant Network. 2018. Attack Pack Aquatic Invader Fact Sheets.

Invasive Species Worksheet Answer Key: Round Goby

Common Name of Organism(s): **Round Goby**

Scientific Name of Organism(s): ***Neogobius melanostomus***

How do you identify this organism? (You can use words, drawings, or both to answer this question.)

- **Round gobies slightly resemble a large tadpole with a big head, narrower body, frog-like raised eyes and thick "lips."**
- **Young round gobies are solid slate gray while adults also have black to brown spots. Spawning males are nearly black.**
- **Adult gobies are usually 3 to 6 inches in length, although they may grow up to 12 inches long.**
- **They have a single suction cup-like pelvic fin.**

What type of water does your organism live in? (Circle all that apply.)

Freshwater Saltwater Brackish water (mixture of fresh and salt water)

Where does this organism come from?

The round goby is native to the Black and Caspian seas in Europe.

How did this organism get to the Great Lakes?

Ballast water

Where is this organism found in the Great Lakes?

All of the Great Lakes

Why is this organism considered invasive? (Why is it a problem?)

- **Round gobies are very aggressive fish. They can displace native fish by eating up their food and taking over preferred habitat and spawning areas.**
- **Round goby populations can increase quickly.**
- **Gobies can survive in poor-quality water, which gives them an advantage over other fish. They also have a well-developed sensory system that allows them to detect small movements in the water. This allows them to feed in the dark, giving them another advantage over native fish.**
- **Round gobies are nuisances to fishermen because they steal bait off fishhooks, eat fish eggs and compete with small fish for food. However, round gobies like to eat another invasive animal: the zebra mussel.**

What is being done to control their spread?

- **Never use round gobies as bait.**
- **Remove any visible mud, plants, fish or animals before transporting your recreational water equipment and clean, drain, and dry equipment.**
- **Drain water out of your boat, live well, bilge and other equipment before transporting.**
- **Never release plants, fish or animals into a body of water.**

Answer Key Credit: Great Lakes Sea Grant Network. 2018. Attack Pack Aquatic Invader Fact Sheets.

Ballast Water Worksheet Answer Key

What is ballast water? (You can use words, drawings, or both to answer this question.)

Ballast water is water that is placed in the bottom (or hull) of an empty ship to stabilize the ship while in transit.



What are two techniques that are used to manage organisms found in ballast water?

- **Chemicals**
- **Ultraviolet light**
- **Deoxygenation**
- **Heat**
- **Acoustic or sound**
- **Electrical pulse**
- **Dumping freshwater ballast water in the ocean and up taking saltwater ballast water. Then dumping the saltwater ballast water into Great Lakes. (Only works if the organisms cannot survive in both freshwater and saltwater.)**

Name the four organisms that were introduced to the Great Lakes via ballast water.

1. Zebra and Quagga Mussels
2. Spiny Waterflea and Fishhook Flea
3. Round Goby
4. Eurasian Ruffe

Thinking about the techniques you have learned for managing ballast water, what management actions do you recommend to limit the spread of invasive species from ships entering the Great Lakes?

Any of the above ideas would work. UV is commonly used on ships. The water transfer option was being used fairly regularly but it was found that some of these species can survive in a variety of saline environments. Now other techniques are being used in conjunction with the freshwater or saltwater flushes.

Invasive Species Pre-Assessment Worksheet

Name: _____ Date: _____ Period: _____

Please provide the definition for the words below.

Native species:

Non-native species:

Invasive species:

What is ballast water?

Which species have been introduced to the Great Lakes through ballast water? (Choose all correct answers.)

a) Round goby
b) Zebra and quagga mussels
c) Sea lamprey
d) Rusty crayfish

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Great Lakes Aquatic Invasive Species (AIS) Lesson Plan)

Student Activity

The Eerie Eight

What are the differences between native, non-native, and invasive species?
What are invasive species and why are they a problem?
What species have been introduced to the Great Lakes?
What is ballast water?
What are possible management practices to prevent further introduction of invasive species?

Background

Organisms (both plants and animals) that come from other places are known as non-native species. Often these species are unable to reproduce or survive in a new ecosystem so they do not cause issues. However, a select few are able to establish themselves as strong competitors restructuring the native ecosystem and wreaking havoc on the natural and man-made systems. These creatures are known as invasive species. Invasive species have arrived to the water of the Great Lakes in a variety of ways including but not limited to ballast water, intentional or accidental dumping, and barrier removal. Information about invasive species is important to scientists because it helps them manage the invasive species that are already in the Great Lakes and work with stakeholders to prevent further spread of future or current invasive species.

Procedure

1. Go to your teacher assigned group.
2. Find the definition for native and non-native taped to the wall and match the correct definition to your native and non-native word cards.
3. Flip the synonym cards given to you by your teacher face down. Taking turns try to match the cards to find synonyms for native and non-native.
    a. For example, native and native are not synonyms. Native and local are synonyms.
4. Take the scrambled definition cards for the word invasive species and place the cards in the correct order.
5. Pay attention to your teacher as they teach you about ballast water.
6. Either using the website list below or the information card given to you by your teacher fill out the invasive species worksheet as a group. Be prepared to present your invasive species to your class.
7. Present your invasive species to your class.
8. Apply what you have learned. As a group complete the ballast water worksheet.

Invasive Species Worksheet

Group Names:

Common Name of Organism(s):

Scientific Name of Organism(s):

How do you identify this organism? (You can use words, drawings, or both to answer this question.)

What type of water does your organism live in? (Circle all that apply.)

Freshwater Saltwater Brackish water (mixture of fresh and salt water)

Where does this organism come from?

How did this organism get to the Great Lakes?

Where is this organism found in the Great Lakes?

Why is this organism considered invasive? (Why is it a problem?)

What is being done to control their spread?

Ballast Water Worksheet

Group Names:

What is ballast water? (You can use words, drawings, or both to answer this question.)

What are two techniques that are used to manage organisms found in ballast water?

1.

2.

Name the four organisms that were introduced to the Great Lakes via ballast water.

1.

2.

3.

4.

Thinking about the techniques you have learned for managing ballast water, what management actions do you recommend to limit the spread of invasive species from ships entering the Great Lakes?

Invasive Species Website Suggestions

Zebra (*Dreissena polymorpha*) and Quagga Mussel (*Dreissena bugensis*)
cisr.ucr.edu/quagga_zebra_mussels.html
seagrant.umn.edu/ais/mussel

Sea Lamprey (*Petromyzon marinus*)
glfc.org/sea-lamprey.php
oceanservice.noaa.gov/facts/sea-lamprey.html

Eurasian Ruffe (*Gymnocephalus cernua*)
seagrant.umn.edu/ais/ruffe
michigan.gov/invasives/0,5664,7-324-68002_73845-368391--,00.html

Rusty Crayfish (*Orconectes rusticus*)
seagrant.umn.edu/ais/rustycrayfish_invader
nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=214

Eurasian Watermilfoil (*Myriophyllum spicatum*)
dnr.state.mn.us/invasives/aquaticplants/milfoil/index.html
nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=237

Spiny Waterflea (*Bythotrephes longimanus*) or Fishhook Flea (*Cercopagis pengoi*)
dnr.state.mn.us/invasives/aquaticanimals/spinywaterflea/index.html
seagrant.umn.edu/ais/waterflea

Silver Carp (*Hypophthalmichthys molitrix*) or Bighead Carp (*Hypophthalmichthys nobilis*)
nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=551
nas.er.usgs.gov/queries/factsheet.aspx?speciesID=549

Round Goby (*Neogobius melanostomus*)
nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=713
seagrant.umn.edu/ais/roundgoby

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