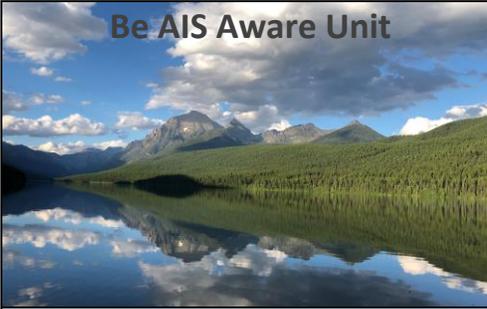


Be AIS Aware Unit



The Wonder Whys of AIS

Do you ever wonder why some aquatic species become invasive while others do not?

◆ Grade Level

Middle School

◆ Subject Areas

Life Science, Environmental Science, Ecology, and Human Impacts

◆ Key Topics

Aquatic invasive species, native species, non-native species, adaptations

◆ Duration

Preparation Time: 20 min

Activity Time: 2 x 50 min

◆ Setting

Classroom (Individual or groups)

◆ Skills

Gathering and applying information

◆ Standards

NGSS & MT Science Std.:

MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

LS2.A: Interdependent Relationships in Ecosystems
CROSSCUTTING CONCEPT(S):
Patterns

SCIENTIFIC & ENGINEERING PRACTICE(S):

Constructing Explanations

Common Core:

WHST.6-8.9: Draw evidence from informational texts to support analysis, reflection, and research.

Overview

Students will be introduced to five non-native aquatic invasive species (AIS) that are potential threats to Montana waters. This lesson will explore pathways of introduction, methods of dispersal, potential environmental impacts, distribution of these organisms, as well as, adaptations that make these species invasive.

Objectives

Students will be able to:

- explain what an aquatic invasive species is.
- identify the five traits that all AIS have in common.
- provide examples of AIS found in Montana.
- share how an AIS could impact their life.
- describe how to prevent the spread of AIS in Montana.
- use evidence to explain how interspecific competition occurs between aquatic invasive and native species.

Materials

Warm Up / Activity / Wrap Up

- Computer, projector, and student worksheets
- Each AIS Inquiry activity station contains:
 - 2 Information sheets and 1 distribution map for each species
 - 1 Northwest Montana Aquatic Species Guide
 - 1 AIS Threatening the Crown of the Continent Flipbook
 - 1 AIS Pocket Guide
 - 1 Montana Reference map
 - 1 Pressed AIS sample (stations #1 and #3 only)

Advanced Preparation

- Copy the student worksheets #1-2 (double-sided).
- Arrange the classroom (see teacher resources)
 - Ideally, half of the students rotate through stations #1-3 (flowering rush, zebra/quagga mussels, and Eurasian water-milfoil) separately from the other half of the class.
 - Initially place stations #4-5 (North American bullfrog and rusty crayfish) on the sides of the room.
- Prior to class, pre-load the Wonder Why of AIS presentation found on the associated thumb drive or on our website:

<https://flbs.umt.edu/newflbs/k12teachingmaterial>



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Background

Oceans, mountains, rivers, and ice sheets have historically served as physical barriers or **abiotic (non-living) factors** that limit the distribution of species across continents. Species can expand or shrink their natural geographic range in response to short or long-term environmental changes. However, people are providing the opportunity for **non-native species** to move into new environments outside of their natural range by bringing them along as we move from one place to the other across our planet. For example, wind, water, or animals can naturally disperse plant seeds. However, many aquatic invasive plants, such as Eurasian watermilfoil, can be **dispersed** when they hitch a ride by wrapping themselves onto a boat or trailer. These traveling fragments can dry out for long periods of time and still survive. As a result, invasive species are often thought of as a modern problem created by the mass movement of people from place to place.



Photo credit: Christian Fisher (CC BY-SA 3.0)

Curly-leaf pondweed can be found growing along the north shore of Flathead Lake. Late summer die-offs can create a 6-12" layer of rotting debris along the shoreline.

When aquatic invasive species are introduced to a new environment, they can create rapid changes to the physical or abiotic conditions of the water body, as well as **interspecific competition** with native species for available sunlight, food/nutrients, space, water, and prey. For example, curly-leaf pondweed grows in such dense patches that it disrupts the natural flow of water, decreases the amount of available sunlight for native plants, and produces large amounts of decomposing leaf-litter that leads to anoxic conditions when the plant dies-off in late summer. As a result, these curly intruders negatively impact the native populations of fish that need open water to hunt and the native plants that need light to grow. (see Online Resources for more detail)

Aquatic invasive species often have physical, chemical, or behavioral **adaptations** that help them successfully out-compete native species. In fact, all terrestrial and aquatic invasive species have five things in common: they grow fast, reproduce quickly, spread easily, can tolerate a wide range of environmental conditions, and outcompete other species. As a result, aquatic invasive species have great advantages over native species and can create **ecological disturbances** that alter the natural community of organisms found within an **ecosystem**.

Lesson Vocabulary

Abiotic factor– A non-living factor that affects where organisms are found within an ecosystem (ex. temperature, light, climate, etc.).

Aquatic invasive species – Aquatic, non-native species that cause economic or environmental harm.

Adaptation – Physical, chemical, or behavioral characteristics of organisms, which allows them to live in particular environments.

Biotic factor – A factor created by a living organism that affects other living organisms within an ecosystem (ex. predation, competition, etc.).

Dispersal – The spread of organisms in an environment.

Ecological disturbance – An event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment.

Ecosystem – The interactions between living (biotic) and non-living (abiotic) components in a particular environment (ex. a desert ecosystem).

Interspecific Competition – A form of competition in which two individuals of different species compete for the same resources in an ecosystem (ex. food, shelter, water, nutrients, sunlight, etc.).

Native species – An indigenous species historically found in an ecosystem.

Non-native species – A species that has moved outside of its natural geographic range.



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The Wonder Whys of AIS

Procedure

◆ Warm Up (30 minutes)

- Turn on the projector, display the Wonder of Whys AIS slide show, and pass out the student worksheets.
- Slide #2: Ask the students to share why water is important. Record answers on the board.
- Slide #3: Water is a sacred resource that is cherished by most indigenous people in the world. It provides a sacred home for deities and spiritual beings, a sense of place in every habitat across the planet, and it sustains all life on Earth. All organisms need it to survive. People use it as a source of food, wood, electricity, as well as a means of transportation (of humans, animals, and goods), waste removal, and recreation. People typically settle near sources of water and the quality of that water can become greatly impaired due to human activities. It is arguably the most valuable resource on Earth for our survival. Aquatic invasive species pose a direct and immediate threat to the quality of water in our inland lakes, ponds, wetlands, streams, and rivers.
- Slide #4: Of the 71% of the Earth that is covered with water, only 2% is in the form of freshwater. Only 0.3% of the total amount of freshwater on Earth is readily available in rivers, lakes, streams, ponds, and rivers. Most of the freshwater on Earth is locked up in the form of ice or contained underground. We need to protect the water that we have.
- Slide #5: Montana has a diverse community of mammals, birds, fish, amphibians, and invertebrates that need freshwater to survive. For example, the native bull trout and Westslope cutthroat trout both need cold, clean water with a variety of complex habitats to grow, forage, and reproduce.
- Slide #6: All terrestrial and aquatic invasive species have physical, chemical, or behavioral adaptations that help them to grow quickly, reproduce quickly, spread easily, and live in a wide range of conditions. For example, the flowering rush (*Butomus umbellatus*) is a reed-like plant that grows in shallow wetland areas. It typically establishes itself using vegetative spread from its rhizome (underground stem). The rhizome sends out new shoots and buds that can easily break off and disperse with water currents. The rhizomes can also break off and regrow in new areas. It grows from one to four feet in height in shallow, slow moving water. It quickly creates a habitat that promotes ambush predation rather than open shoreline habitat. It grows in dense layers along the shoreline that limit access to the water. It also provides unsuitable habitat for food, shelter, and nesting areas for native animals.
 - Students record the definition of an aquatic invasive species and the five traits that all AIS share.
- Slide #7: Many terrestrial and aquatic invasive species are first introduced to a new habitat through human activities. Spotted knapweed and dandelions are common terrestrial invasive weeds that can be found in Montana. Spotted knapweed was accidentally introduced into North America in the late 1800s in contaminated alfalfa and clover seed, and in soil used for ship ballast. Dandelions are native to Eurasia and, through time, they have spread to all other continents by human activities. Dandelion seeds use wind to disperse themselves. Both species spread easily by hitchhiking on human clothes and objects. All invasive species have pathways of initial introduction and methods of dispersal in a habitat. Ask students to share one weed that is hard to control in their yard. Alternatively, they can write it down on a post-it note to share with the teacher.

◆ The Activity (50 minutes)

- Slide #8: Explain to the students that they will use the provided materials at each station to identify and record the invasive organisms' physical adaptations, the pathways of introduction and methods of dispersal, the potential impacts, and the current distribution of each species in Montana.
 - The flowering rush, zebra/quagga mussel, and Eurasian watermilfoil (stations #1-3) should be required for all students to complete. Depending on time constraints, students may choose to



The Wonder Whys of AIS

learn about a fourth species or all five species.

- Divide the students in half, each half rotating through stations 1-3 on one side of the room. Students may work in groups or move freely between the activity stations.
- If time permits, have the students rotate through stations 4 & 5.

◆ Wrap Up (20 minutes)

- Slide #9: Students record common traits of the aquatic invasive species.
- Slide #10: Students record how aquatic invasive species could impact them or their family.
 - Ask students to share their ideas with a partner or with the entire class.
- Slide #11: Click the link on the slide to play the Flathead Lakers “Be a Montana Superhero” video.
 - Students record how they can help to prevent the spread of AIS.
- Slide #12: Students complete the “Summarize Your Understanding of AIS” writing prompt in the format below:
 - Claim (1 topic sentence); Evidence (2 sentences with supporting ideas); Reasoning (1 wrap-up sentence)

Teacher Resources

Assessment Options

Have students:

- **complete the AIS Inquiry activity stations** as described.
- **use evidence from the activity to write a 4-sentence paragraph** in response to the follow prompt:
 - *Interspecific competition is a form of competition in which two individuals of DIFFERENT species compete for the same resources in an ecosystem. Select one aquatic invasive species from this activity and explain how its physical, chemical, and/or behavioral adaptations help it to out compete native species in Montana.*

Modifications

- This lesson can be shortened to one 50-minute period by only completing slides 6 and 8 in the warm up, by only conducting 3 of the activity stations, and by assigning the final paragraph as homework.
- The number of species examined in the AIS Inquiry activity could be increased or decreased to accommodate students in need of either more or less work.
- The worksheets can be enlarged for students in need of larger text.

Extensions

Students can:

- **interview a family or community member or listen to the NPR Subsurface podcast on the impact of Zebra and Quagga mussels on the Great Lakes** (See Slide #13 in slide show) to get a personal account of how aquatic invasive species could impact the subject’s life.
- **create a collage** demonstrating the impacts aquatic invasive species.

Photo credit: Carl D. Howe (CC BY-SA)



2.5)

According to the online Montana Field Guide (2019), North American bullfrogs are native to the eastern United States to Minnesota, and eastern Colorado south to Texas. The bullfrog populations in the Bitterroot River and Flathead River basins have been established since the 1960s. They are insatiable feeders that prey upon ducklings, fish, mice, native frogs, and small turtles.



The Wonder Whys of AIS

Books

Elton, C. S. (2000). *The Ecology of Invasion by Animals and Plants* (new ed.). Chicago, IL: University of Chicago Press.
 Lockwood, J. L., Hoopes, M. F., & Marchetti, M. P. (2013). *Invasion Ecology* (2nd ed). West Sussex, UK: John Wiley & Sons, Ltd.

Online Resources

Montana Field Guide: <http://fieldguide.mt.gov/>
 Montana Fish, Wildlife and Parks Aquatic Invasive Species website: <http://fwp.mt.gov/fishAndWildlife/species/ais/>
 Yellowstone Coordinating Committee Aquatic Invasive Species Pocket Guide: https://docs.wixstatic.com/ugd/a0f00b_398521b0c8fc42acbc1226ea9c7a3110.pdf

Acknowledgements

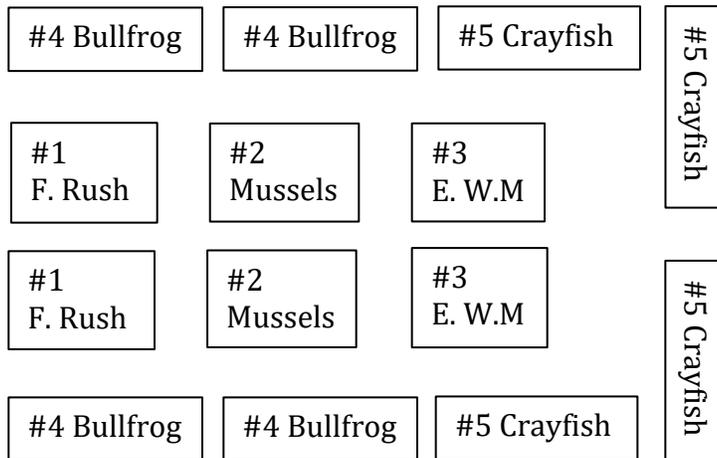
Many thanks to Hilary Devlin and teachers from Bigfork, Polson, Somers, and Whitefish for contributions to and comments on this lesson.
 Additional thanks to Ryan Alger for creating the FWP Montana Reference Map.



Photo credit: USFWS (CC BY 2.0)

According to the online Montana Field Guide (2019), rusty crayfish are native to the Ohio and Tennessee River basins. Rusty crayfish are an aggressive species that eats 2-3 times more than native crayfish. This species has not yet been found in Montana.

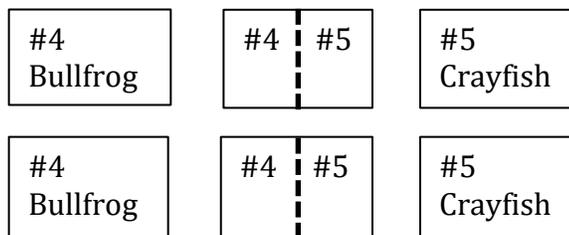
Recommended classroom set up for initial round of station rotations:



Initially, arrange the classroom so there are two sets of stations #1-3 in the center of the room so the class can be split in half to rotate through the first three stations.

Placing stations #4-5 on the sides of the room will allow the faster working students to move on to those stations at their own speed.

Recommended classroom set up for second round of station rotations:



Once all of the students have completed stations #1-3, the materials for stations #4 and #5 can be moved to the center tables.



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Warm Up

What is an aquatic invasive species (AIS)?

What are the five traits that all aquatic invasive species have in common?

-
-
-
-
-

AIS Inquiry

Use the materials to first complete the species in bold below. *If there is time, complete all five.*

Organism	What adaptations make it invasive?	Pathway(s) of Introduction and Methods of Dispersal	Impacts	Currently in Montana? (Y/N) If so, where?
Flowering Rush <i>Butomus umbellatus</i>				
Zebra/Quagga Mussel <i>Dreissena sp.</i>				
Eurasian Watermilfoil <i>Myriophyllum spicatum</i>				
North American Bullfrog <i>Rana catesbeiana</i>				
Rusty Crayfish <i>Orconectes rusticus</i>				



The Wonder Whys of AIS

Wrap Up

Student Worksheet (2 of 2)

Answer the questions below with complete sentences.

1. What do all of the aquatic invasive species in this activity have in common?
2. How do you fit in? How could an aquatic invasive species impact you or your family?
3. With the class, watch the Flathead Lakers “Be a Montana Superhero” video.
How could you help to prevent the spread of aquatic invasive species?

Summarize Your Understanding of AIS

Use specific EVIDENCE from this activity to write a 4-sentence paragraph in response to the prompt below. Be sure to include the following in your paragraph:

- Claim (topic sentence) Evidence (2 sentences with supporting ideas) Reasoning (wrap-up sentence)

Interspecific competition is a form of competition in which two individuals of DIFFERENT species compete for the same resources in an ecosystem (ex. food, shelter, water, nutrients, sunlight, etc.). Select one aquatic invasive species from this activity and explain how its adaptations help it to out-compete native species in Montana.



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