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Amazing AIS Adaptations

Do you ever wonder which adaptations make an aquatic invasive species more successful than others?

◆ Grade Level

Middle School

◆ Subject Areas

Life Science, Environmental Science, Ecology, and Human Impacts

◆ Key Topics

Aquatic invasive species, natural selection, adaptations

◆ Duration

Preparation Time: 20 min

Activity Time: 2 x 50 min

◆ Setting

Classroom (Individual)

◆ Skills

Applying information; Designing; Composing

◆ Standards

NGSS & MT Science Std.:

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

LS4.B: Natural Selection

LS4.C: Adaptation

CROSSCUTTING CONCEPT(S):

Patterns

Common Core:

WHST.6-8.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Overview

Students will design an imaginary aquatic invasive species (AIS), and explain how AIS have physical, chemical, and/or behavioral adaptations that help them outcompete other species.

Objectives

Students will be able to:

- design an imaginary aquatic invasive species.
- explain how their organism’s adaptations make it invasive.
- write an adventure story about an encounter with their imaginary aquatic invasive species, from the perspective of another species.

Materials

Warm Up/Activity

- Computer and projector
- Student worksheet #1-8
- Adaptation cards (22 animal and 14 plant/algae cards)
- Colored pencils

Advanced Preparation

- Copy the following worksheets:
 - Student wksts #1-4 (double-sided; 1 per student)
 - Student wksts #5-6 (double-sided; colored paper; 1 copy for each student creating and AIS animal)
 - Student wksts #7-8 (double-sided; colored paper; 1 copy for each student creating and AIS plant/algae)
- Adaptation cards are organized by habitat (color dots), by animals (black text), and by plants/algae (green text). Pre-select the habitats and organisms you plan to give to the students.
- Prior to class, pre-load the Amazing AIS Adaptations presentation found on the associated thumb drive or on our website: <https://flbs.umt.edu/newflbs/k12teachingmaterial>

TIP: See “Modifications” for additional photocopy and adaptation card selection suggestions!

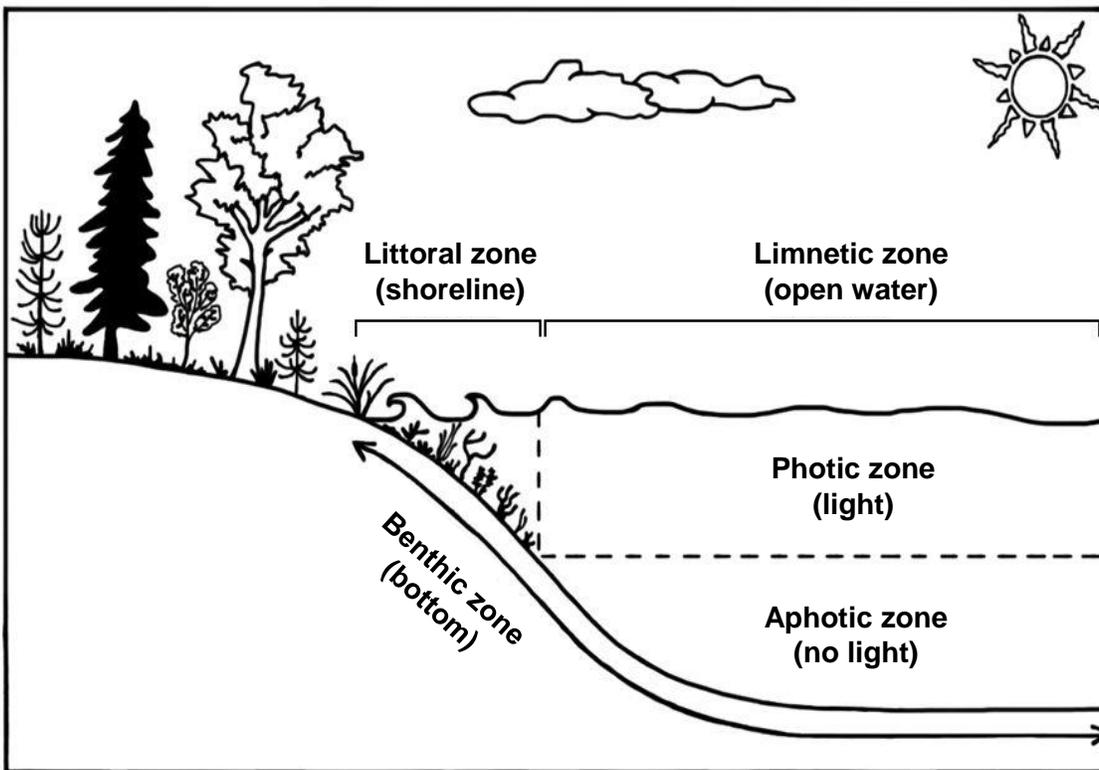


Amazing AIS Adaptations

Background

Montana has a variety of aquatic habitats that are home to diverse populations of animals and plants. Wetlands, rivers, streams, oxbow lakes, spring-fed ponds, and lakes represent a few of the common aquatic habitats that support our native wildlife.

Lakes contain a variety of habitats on different scales, and in different zones within the lake. For example, lakes can be classified into two basic habitats: open water and bottom areas. These two general regions of a lake can be further subdivided based upon the distance from the shoreline and the light intensity/depth. Light greatly impacts where the algae, plants, and phytoplankton can grow in lakes. Phytoplankton, the microscopic algae that drifts in the lake, must stay in the illuminated **photic zone** in order to receive enough light to photosynthesize. If these cells enter the dark **aphotic zone** by sinking lower than the 0.1% light intensity, they will not be able to survive. Similarly, algae and plants along the shoreline typically cannot grow past the illuminated shallows, or **littoral zone**, due to light limitation. In contrast, organisms that live on the bottom in the **benthic zone** do not always need light to survive. For example, the snails, crayfish, and worms that dwell on the bottom of our lakes are consumers that help to recycle the detritus (decaying organic matter) that falls to the bottom of the lake. Invasive quagga mussels have been documented to grow along the benthic zone in water deeper than 300 feet. There are also many organisms that move throughout the open water, or **limnetic zone**, to hunt for prey (ex. trout and zooplankton).



Each aquatic habitat also has a variety of physical or **abiotic factors** that impact where the organisms can live. Water currents, surface waves, dissolved oxygen, temperature, chemical composition, water pressure, water clarity, and nutrient concentrations are a few of the

many abiotic factors that can impact the populations of organisms in a lake.

All aquatic organisms have physical, chemical, and behavioral **adaptations** that help them survive in these diverse habitats. Aquatic invasive species' adaptations often make them invasive and difficult to control. For example, the American bullfrog's camouflage, large eyes, countershading, dorsoventrally flattened body shape, strong legs, slimy exterior, voracious appetite, and high reproductive rate help them to outcompete our native frogs for food, and are causing a large impact to the non-native habitats they invade in Montana.



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Amazing AIS Adaptations

Lesson Vocabulary

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

Behavioral adaptation – A behavior that can help an organism survive (ex. migration, hibernation, etc.).

Chemical adaptation – A chemical made by an organism that helps it survive (ex. a poison or hormone).

Natural selection – A process whereby organisms best fit for their environment tend to survive and reproduce.

Physical adaptation – A physical trait of an organism that helps it survive (ex. the changing fur of an arctic fox or hare).

Procedure

◆ Warm Up (10 minutes)

- Display the Amazing AIS Adaptations slide show on the projector and pass out student worksheets (#1-4).
- Slide #1: Start off by asking the following two questions:
 - Why are some species more successful than others?
 - What traits does this osprey have to help it to survive? (ex. hollow bones; sharp beak and talons; wing design to dive, lift back up, and soar; countershading; long legs to reach for fish; great eyesight; etc.)
 - Lead the discussion to introduce to the students the concept that organisms with traits that help them survive will be naturally selected to survive and reproduce. AIS are great examples of organisms that are naturally selected to survive based upon their adaptations.
- Slide #2: Students record the definition of an adaptation, and the adaptations for the zebra mussel and North American bullfrog on their worksheet (#1). Review these adaptations and remind the students that these traits help these invasive organisms survive and outcompete the native species.
- Slide #3: Here in Montana, we have a diverse community of native mammals, birds, fish, amphibians, and invertebrates that need freshwater habitats? (or fresh water?) to survive. Each of these animals has unique adaptations or traits that help them survive harsh winters, sunny summers, and the seasons in between. Students pick one animal and then list one physical, chemical, and behavioral adaptation that helps it survive.

◆ The Activity (80 minutes)

- Slide #4: Montana has a variety of complex aquatic habitats where animals and plants live. Explain that each student will be creating a new aquatic invasive species (AIS) that does not already exist, and that must be able to survive in one specific aquatic habitat. Explain that an organism living on the bottom of a lake would need different traits than one that swims freely throughout all habitats. So, the characteristics that the students give their AIS should make them invasive in their particular habitat.
- Slide #5: Review the different lake zones and habitats as the students record them on their worksheet.
- Ask the students to read the Project Summary (#2), Story Outline (#3), and Portrait (#4) worksheets with you as you read it aloud. Review the two required tasks and answer any questions. Be sure to explain that their story is written from the perspective of another animal that encounters their new invasive species.
- Pass out one adaptation card to each student, ask them to record the six items listed on the card in the space provided on the worksheet, and then collect the adaptation cards.
 - As the students record their traits, pass out one Story Planning worksheet (animal (#5-6) or plant/algae (#7-8)) to each student according to the card that they have been given.
 - Review the Story Planning worksheet and explain that it is a guide to help them create their organism. This must be completed before they begin to write their story.
- Slide #6: Give the students time to work!

❖ Optional Wrap Up (10 minutes)

- Ask volunteers to read their stories aloud to the class.

TIP: Students with similar habitats can work together to include each other's organisms in their stories.



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Amazing AIS Adaptations

Teacher Resources

Assessment Options

Have students:

- **complete the Amazing AIS Adaptations story and portrait** as described.
- **read their adventure story** to the class.

Modifications

- There are 22 animal cards (easy to moderate difficulty) and 14 plant/algae cards (high difficulty). We recommend giving the more challenging plant/algae cards to the higher-level students in your classroom.
- Eight different aquatic habitats are represented in the adaptation cards. The color dots on cards reflect the habitat. Particular habitats may be selected to provide some focus for the class or all of the habitats may be included.
- The portrait worksheet may be copied separately from the outline, especially if the teacher would like to display them in the classroom without the outline on the back.
- To easily distinguish them from each other while passing them out in class, it is helpful to copy the Story Planning worksheets (#5-6) in one color and the other Story Planning worksheets (#7-8) in another color.
- Students may work individually or in groups for this project.
- Worksheets can be enlarged for students in need of larger text.

Extensions

Students can:

- **build a 3-D model** of their aquatic invasive species using recyclable materials.
- **create a children's story** about their aquatic invasive species.
- **animate their story** about their aquatic invasive species.

Acknowledgements

This lesson was adapted from an animal adaptations lesson created by Kimberly Koopman at Kalaheo High School in Kailua, Hawaii. Many thanks to Hilary Devlin and Megan Chaisson for their contributions to this lesson.

Common aquatic animal adaptations:

Physical adaptations:

- Gills
- Fusiform (streamlined) body shape for open water species
- Dorsoventrally flattened body shape for bottom dwelling species
 - Countershading
 - Webbed appendages
 - Scales
 - Swim bladders
 - Fins, flippers

Chemical adaptations:

- Chemical digestion
- Mucous or slime
- Poisons/toxins
- Camouflage (proteins in skin)
 - Oily fur

Behavioral adaptations:

- Hunting behaviors
- Mating behaviors
- Evasive behaviors to avoid prey

Common aquatic plant/algae adaptations:

Physical adaptations:

- Submergent or emergent
 - Showy petals
 - Emergent flowers
 - Easily fragments
 - Floating leaves
 - Carnivorous

Chemical adaptations:

- Poisons/toxins
- Plant hormones

Behavioral adaptations:

- Phototrophic (grows toward light)
- Gravitrophic (grows downwards)
 - Movement with flagella



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Warm Up

What is an adaptation?

There are three major types of adaptations. See the examples below.

Physical adaptations: hollow bones in birds, hollow fur in polar bears, skin flaps on a flying squirrel

Chemical adaptations: proteins, poison, snake venom, melanin (protects your skin from UV light)

Behavioral adaptation: whale migration, lizards sitting in the sun, bird mating dance, bear hibernation

Fill in the adaptations below:

	Zebra mussel	North American bullfrog
Physical adaptation(s)		
Chemical adaptation(s)		
Behavioral adaptation (s)		

30 second brainstorm...Think of a physical, chemical, and behavioral adaptation for another animal.

Animal: _____

Physical: _____

Chemical: _____

Behavioral: _____

Label the diagram below with the following terms:

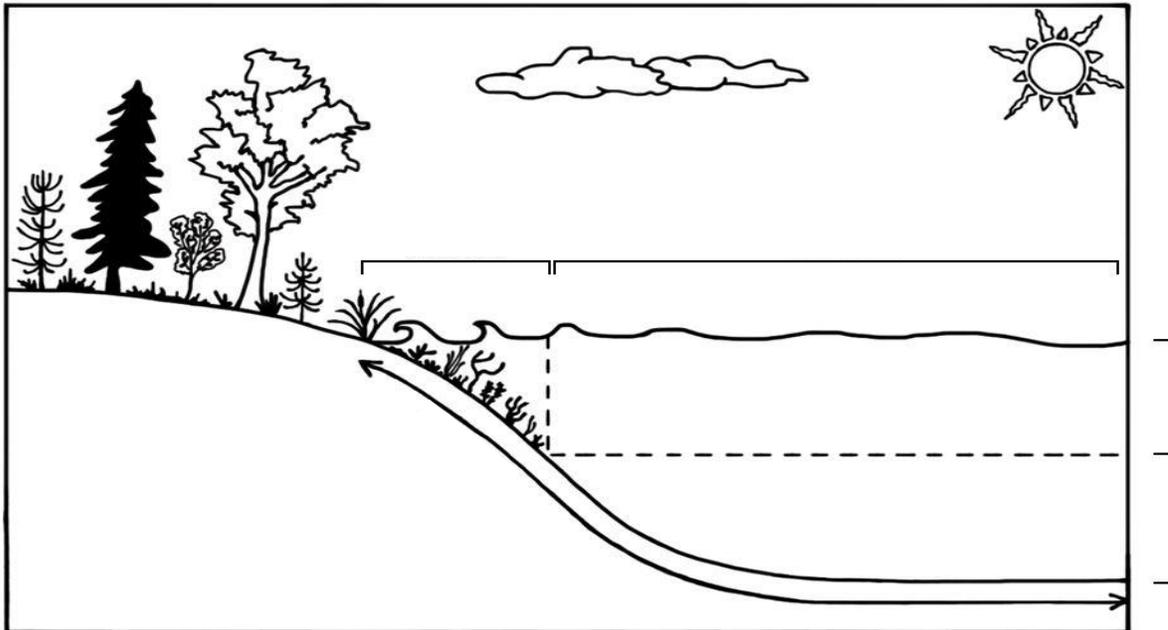
Photic zone (light)

Aphotic zone (no light)

Benthic zone (bottom)

Littoral zone (shoreline)

Limnetic zone (open water)



Project Summary

Student Worksheet (2 of 8)

All organisms have amazing adaptations that help them to survive and reproduce. Typically, only those organisms with advantageous traits will reproduce and carry their genes to the next generation. In this activity, you will be provided with specific adaptations for an aquatic invasive species (AIS). Using these traits, you will design an AIS that DOES NOT already exist, rather a creature of your imagination. Look over the two required tasks below.

TASK 1: Write a 1-page adventure story from the **perspective of another organism that encounters your aquatic invasive species** (ex. moose, osprey, beaver, duck, fish, human, etc.). This should include the invasive organism’s name, habitat, physical traits, food/energy source and means of energy collection, reproduction strategies, dispersal mechanism(s), and any other interesting facts. Describe how your organism’s adaptations allow it to live in a wide range of conditions, grow fast, reproduce quickly, outcompete other species, and disperse easily.

TASK 2: Draw an 8 ½” x 11” color portrait of the animal encountering your invasive organism in its habitat. Have fun, be creative, and surprise your classmates with your creation!

Record the 5 traits from your adaptations card below and then pick one extra trait:

Habitat:	Physical feature(s):
Energy/feeding:	Reproduction:
Dispersal:	Pick one extra trait or behavior:

Project Rubric

	Exceeds	Meets	Does not meet
Story content	<input type="checkbox"/> Explains in detail how the adaptations allow it to live in a wide range of conditions, grow fast, reproduce quickly, outcompete other species, and disperse easily.	<input type="checkbox"/> Describes briefly how the adaptations allow it to tolerate a wide range of conditions, grow fast, reproduce quickly, outcompete other species, and disperse easily.	<input type="checkbox"/> Does not clearly describe how the organism’s adaptations make it invasive.
Story format	<input type="checkbox"/> Entertaining adventure story <input type="checkbox"/> Perspective of the animal encountering the AIS. <input type="checkbox"/> Creative, descriptive title <input type="checkbox"/> Clear beginning, middle, & end <input type="checkbox"/> > 1 page in length <input type="checkbox"/> Neatly typed (1.5 spaced)	<input type="checkbox"/> Adventure story <input type="checkbox"/> Perspective of the animal encountering the AIS <input type="checkbox"/> Title included <input type="checkbox"/> Basic beginning, middle, & end <input type="checkbox"/> 1 page in length <input type="checkbox"/> Neatly handwritten	<input type="checkbox"/> Adventure story <input type="checkbox"/> Title not included <input type="checkbox"/> Story confusing <input type="checkbox"/> < 1 page in length <input type="checkbox"/> Illegible or poorly handwritten
	Exceeds	Meets	Does not meet
Portrait design	<input type="checkbox"/> Creative colorful design showing the animal and AIS in its habitat <input type="checkbox"/> All adaptations depicted; labeled <input type="checkbox"/> Organism name included	<input type="checkbox"/> Simple colorful design showing the animal and AIS in its habitat <input type="checkbox"/> All adaptations depicted <input type="checkbox"/> Organism name included	<input type="checkbox"/> Black & white design <input type="checkbox"/> <6 adaptations <input type="checkbox"/> Name missing

COMMENTS:



Story Outline

Title: _____

Attention grabber
(Call to adventure)

Introduce main character

Set the stage
(Time, place, mood, engage the 5 senses)

Rising action
(Main character faces a series of conflicts)

Handwriting lines for the first section of the story outline.

Climax
(Main character faces major problem and a main conflict arises)

Handwriting lines for the climax section of the story outline.

Falling action
(Main character finds a way out of the adventure)

Conclusion

Handwriting lines for the falling action and conclusion sections of the story outline.



A Portrait of: _____

Organism's name

Zoom in on ONE AIS adaptation! Explain!

* Include labels for the 5 traits from your adaptation card!



Story Planning Sheet – Animal

Student Worksheet (5 of 8)

Your task is simple: design your own aquatic invasive species. Describe your organism's traits and how your organism lives in its environment. Be thorough because you will use this outline to complete your one-page story! *Be sure to explain how your aquatic invasive species:*

- *Grows fast and reproduces quickly*
- *Spreads easily*
- *Outcompetes other organisms*
- *Lives in a wide range of conditions*

A. TYPE OF ORGANISM

What type of animal (ex. snail, mussel, crustacean (crayfish, zooplankton), fish, parasitic worm, amphibian, aquatic insect, etc.) is your aquatic invasive species?

B. HABITAT

Describe, in detail, your animal's habitat. Where specifically in the habitat does it live (shallow water along the shoreline, under rocks, along the bottom of a stream, attached to surfaces, within the photic zone, drifting with the currents, in the sediment, etc.)? Which abiotic or physical/non-living conditions (temperature, currents, light, wave action, etc.) impact where it lives? **What does it do to increase its ability to live in those conditions?**

C. PHYSICAL FEATURES

What does it look like? **How quickly does it grow and how big does it get?** How does it sense its environment (eyes, chemoreceptors to sense chemicals in the water, electromagnetic waves, etc.)? How does it blend into its environment (shell pattern, camouflage, warning coloration, etc.)? How does your animal move about? Appendages (limbs/legs), in groups, alone? When does it need to move? How does it use movement to catch prey or to avoid predators? Is it more active during a certain time of the year or day? How does the animal protect itself? From what does it need to be protected?



Amazing AIS Adaptations

Story Planning Sheet – Animal (cont.)

Student Worksheet (6 of 8)

D. ENERGY/FEEDING

How does your animal get energy? What does it eat? How does it get food? How does it feed its offspring? When does it eat? How often? Are there any special or unusual feeding behaviors? **How does it compete with other organism in the environment for limited food resources?**

E. REPRODUCTION

Does your animal reproduce sexually, asexually, or both? Does it have mating seasons or behaviors it uses to attract a mate? Does it use internal or external fertilization? Does it produce eggs or have live birth? If so, how many? **How often or fast does it reproduce?** Does it have spawning grounds? Is there any parental care of young? If so, how long does it occur and by whom?

F. DISPERSAL

How does your animal spread throughout the environment? Can it travel long distances? If so, how? Can it survive out of water for a period of time? If so, how long?

G. OTHER

Please describe all other important adaptations (traits and/or behaviors) the animal uses for survival. For example, does it migrate, hibernate, or change its coloration during the year? **Be creative and enhance its invasive characteristics!**



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Story Planning Sheet – Plant / Algae

Your task is simple: design your own aquatic invasive species. Describe your organism’s traits and how your organism lives in its environment. Be thorough because you will use this outline to complete your one-page story! *Be sure to explain how your aquatic invasive species:*

- *Grows fast and reproduces quickly*
- *Spreads easily*
- *Outcompetes other organisms*
- *Lives in a wide range of conditions*

A. TYPE OF ORGANISM

What type of plant, algae, or phytoplankton is your aquatic invasive species?

B. HABITAT

Describe, in detail, your organism’s habitat. Where specifically in the habitat does it live (shallow water along the shoreline, along the bottom of a stream, attached to surfaces, within the photic zone, drifting with the currents, etc.)? Which abiotic or physical/non-living conditions (temperature, currents, light, wave action, etc.) impact where it lives? **What does it do to increase its ability to live in those conditions?**

C. PHYSICAL FEATURES

General: What does it look like? **How quickly does it grow and how big does it get?** Does anything eat it? Does it produce defensive spines, chemicals, or toxins?

Plant: Does it grow close together or spread out? Does it have roots that anchor it to the bottom or does it float on the surface? Is it a fully submerged plant or does it partially emerge from the surface? What do its leaves look like?

Algae: Does it grow on the bottom, in floating mats, or is it plankton that drifts with the currents?



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Story Planning Sheet – Plant / Algae (cont.)

Student Worksheet (8 of 8)

D. ENERGY/FEEDING

How does it compete with other organisms in the environment for limited sunlight? How do its leaf and/or growth pattern help it to get as much sunlight as possible? What is its seasonal growth pattern? Does it grow earlier in the season and/or at a faster rate than the organisms? Does it shade other organisms?

E. REPRODUCTION

General: Does your organism reproduce sexually (with flowers) or asexually (via mitosis, such as fragmentation), or both? When does it reproduce (all year, seasonally)? **How fast does it reproduce?**
Plant: Does it produce flowers? If so, what do they look like, how many are produced, and when do they bloom? Does it have traits that attract pollinators? Does it produce seeds? If so, how many?

F. DISPERSAL

How does the organism spread throughout the environment? If it produces seeds, how do they spread (ex. water currents, attached to bird feathers, eaten and then dropped in feces elsewhere, etc.)? Does it fragment? Does it produce bulbils or vegetative tissue that can pop off and grow? Can it travel long distances? If so, how? Can it survive out of water for a period of time? If so, how long?

G. OTHER

Please describe all other important adaptations or traits the organism uses for survival. For example, does it form a symbiosis with other organisms, grow on the surface of other organisms, or change its grow pattern during the year? **Be creative and enhance its invasive characteristics!**



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