AQUATIC INVASIVE SPECIES

MIDDLE SCHOOL CURRICULUM AND ACTIVITY GUIDE

SOUTH DAKOTA Game, Fish & Parks

South Dakota State University

AQUATIC INVASIVE SPECIES

ACKNOWLEDGEMENTS

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AQUATIC INVASIVE SPECIES

INTRODUCTION

Aquatic Invasive Species is often simplified to "AIS" and refers to those aquatic flora and aquatic fauna that are not native to an area and are likely to cause harm of some sort. The hope and reason for the creation of this series of lessons is to create a culture in South Dakota where the term "AIS" is commonly understood in households and "Slow the Spread: Clean. Drain. Dry." is at the tip of a person's tongue when asked what they can do to help.

Education is a powerful tool, and in the work of managing aquatic resources and recreation, education is foremost in making positive cultural changes to maintain and improve those resources for the next generation. The creation of this AIS curriculum came about as one avenue to help educate the public through focusing on school aged students by giving them real world situations and application to a novel, yet real world and pertinent problem.

HOW TO USE

The Aquatic Invasive Species: Middle School Curriculum and Activity Guide was created for educators to introduce their students to aquatic ecosystems and real-life problems caused by AIS. The curriculum is broken into 5 lessons, which can build upon each other starting at an introduction to ecosystems and moving to an understanding of government entities and their work.

The curriculum is intended for Middle School, defined as intermediary levels grade 6-8 with a focus on science education. Though the focus is science education, it has been written to span other subjects allowing for a cross-curricular feel. Each Lesson highlights the expected time for a lesson, key words for students to pull from the lesson, and South Dakota Education Standards that are encompassed in the lesson.

The curriculum can be used as a week's worth of education or lessons can be cherry picked to meet the needs of a specific unit. Educators may print copies of worksheets, scenarios cards, etc for students to use at their discretion.

Some lessons have alternate programming options if going outside is not an option.

If you like this resource, check out the Game, Fish and Parks Education Webpage: *gfp.sd.gov/education* to learn about more educational tools and opportunities that are available to you.

AQUATIC INVASIVE SPECIES

WHAT IS AN ECOSYSTEM?

SKILL LEVEL
6th-8th

KEY TERMS
Species
Population
Community
Ecosystem
Biome
Biosphere
Biotic
Abiotic
Food Chain
Food Web
Fishery
Benthic
Macroinvertebrates
Tolerant
Intolerant

EDUCATION STANDARDS
SD Science: MS-LS2-2
SD Mathematics: 7.SP

TIME NEEDED
50-75 Minutes

MATERIAL LIST
» Strainers, Nets, Kick Nets
» Tubs (for viewing Macroinvertebrates)
» Thermometer
» Benthic Macroinvertebrate ID Sheet (in Appendix)
» Doodle Sheet – Stream Ecology (in Appendix)
» Computer and/or projector
» Stream/Pond Ecology Worksheet

EXPECTED LEARNER OUTCOMES

» **OBJECTIVE 1:** Students will be able to define what an ecosystem is and explain how it differs from a species, population, community, biome, and biosphere.
» **OBJECTIVE 2:** Students will be able to explain and identify abiotic and biotic elements of an ecosystem.
» **OBJECTIVE 3:** Students will understand the unique characteristics of an aquatic ecosystem.

BACKGROUND

Before we jump into understanding Aquatic Invasive Species, it is crucial that we understand aquatic ecosystems. An **ecosystem** or an **ecological system** is all the living and nonliving elements that make up a specific geographic area. The living and nonliving characteristics in an ecosystem are linked together through a variety of systems and cycles. When these systems and cycles are interrupted or altered, they affect the health of the ecosystem.

Here in South Dakota, we have many terrestrial and aquatic ecosystems. For a complete list of these various ecosystems, check out the Wildlife Action Plan - Game, Fish and Parks - South Dakota (*gfp.sd.gov*).

VOCABULARY

Species
A group of living organisms consisting of similar individuals capable of exchanging genes or interbreeding.

Population
A group of individuals of the same species living and interbreeding within a given area.

Community
An interacting group of various species in a common location.

Ecosystem
A system that consists of biotic and abiotic components that function together as a unit.

Biome
A large naturally occurring community of flora and fauna occupying a major habitat.

Biosphere
The regions of the surface, atmosphere, and hydrosphere of the earth occupied by living organisms.

Biotic
Relating to or resulting from living things, especially in their ecological relations.

Abiotic
Physical rather than biological; not derived from living organisms.

Food Chain
A hierarchical series of organisms that depend upon the next as food.

Food Web
All the food chains in a single ecosystem.

Fishery
A fishing ground or area where fish are caught.

Benthic Macroinvertebrates
Invertebrates (e.g., crayfish, mayfly nymphs) that live on the bottom of streams, rivers and lakes and are visible to the naked eye.

Tolerant
Able to endure certain conditions (in the case of macroinvertebrates, this would be tolerance to pollution).

Intolerant
Sensitive or easily affected by adverse conditions (in the case of macroinvertebrates, this would be intolerance to pollution).

ACTIVITY PREPARATION

Begin the lesson by asking what students remember from their class lessons about **species**, **population**, **community**, **ecosystem**, **biome**, and **biosphere**. *Note:* If you have not covered this yet in class, now is the perfect time to introduce students to it with the understanding that the lesson will focus mainly on ecosystems.

Transition: Once you have reviewed species, population, community, ecosystem, biome, and biosphere, inform students you will be digging deeper into ecosystems.

ABIOTIC VS BIOTIC – 5 MINUTES

Break students into groups and take them outside. Have students spend 2 minutes sitting in an area and writing down all that they see. Ask students if they know what **abiotic** and **biotic** mean. To tease this out, ask students to think through "bio-" and further "biology," this will usually lead to discussion about life or living (connect to Latin). Then ask if they know what "a-" means (connect to the Latin). Based on this conversation, have students categorize their findings as abiotic or biotic.

Adaptation: If you are unable to take students outside, you can do the activity inside by having students think of their backyard, putting a picture on the board for them to think through, or showing a YouTube video of a landscape.

Transition: Now that students have had the opportunity to think through abiotic and biotic elements of an ecosystem, it is important to spend a little bit of time discussing food webs. A **food web** is a system of interlocking and interdependent food chains within an ecosystem. An example of this would be a mayfly nymph being eaten by a dragonfly nymph which in turn might be eaten by either a fish or a frog and a fish being eaten by an osprey and a frog being eaten by a snake.

FOOD WEB – 5 MINUTES

To demonstrate a food web, have each student pick an animal or plant that is located near a stream. Take a ball of yarn or a ball of twine and tell students you are going to be demonstrating interactions between species in an ecosystem. Have students stand in a circle and ask someone to start by holding the twine. Have that person say what animal or plant they represent. Then have someone different take the ball of twine from the person who would consume that animal or plant the original twine holder is representing (Note: Each student will be holding a piece of twine as you go through the process. Students should not let go of the twine, but simply pass the remainder of the twine). As the twine gets passed along it should begin to look like a web. Continue until each person is holding a bit of the twine.

Digging Deeper: If you would like to go past simply visualizing what a food web looks like, you can introduce problems to the food web. For example, while everyone is holding the twine in the web, remove a piece of the web, such as remove an animal. Have the students tighten the web, this can show how ecosystems can shift based on what is available. Another adaptation of this would be to have one person begin to lightly tug on the string and have each person tug on the string when they feel the tug. Mention that this tugging indicates the interconnectedness of the food web and how if one species is affected it can affect the whole food web. (*Note: Don't let the students "tugging" get too aggressive, inform students it is a gentle tug only*).

Transition: Inform students that you are now going to be exploring a specific aquatic ecosystem and recording your observations of that ecosystem. Ask students to be cognizant of what biotic and abiotic elements are present when they observe and explore the aquatic ecosystem.

EXTENDED LEARNING

For further learning, consider exploring:

» The South Dakota Wildlife Action Plan (*gfp.sd.gov/wildlife-action-plan*)

» Adding in information about the various cycles present in an ecosystem: Carbon Cycle, Phosphorous Cycle, Hydrologic Cycle, Nitrogen Cycle, Sulfur Cycle

» For more information and a lesson plan for Carrying Capacity see supplemental Lesson Plans.

» During the Stream Ecology, you can add pH and Dissolved Oxygen (DO) to introduce chemical tests to their learning.

STREAM OR POND ECOLOGY – 20 MINUTES

Bring the class to the edge of the water and hand each of them the provided stream/pond ecology worksheet. Have students begin the observation section. Ask them to use their senses to notice everything they can about the given area. Then as a group choose a volunteer to help with taking the aquatic bodies temperature, have students record this data.

Now that we have made observations, we are going to conduct an index to ascertain what types of species are in the water. Note any plants or animals, but also we will pay special attention to **Benthic Macroinvertebrates**. Pass out strainers and identification cards for the benthic macroinvertebrates. Allow students 5-10 minutes to search and then draw the group back together to discuss and count the types of species found. (Utilize the key in the Printables section to help in identification. You can also have the class visit: *waterbugkey.vcsu.edu* for another way to identify the invertebrates).

Adaptation: If you are unable to do this activity outside, you can utilize the indoor adaptation (see appendix A).

Transition: Inform students that you will be returning to the classroom to review your findings.

DOODLE SHEET EXPLANATION – 5 MINUTES

Back at the classroom, give each student a Doodle Sheet (see printable section) and work as a class to define abiotic and biotic. Then have students list out any abiotic or biotic species they noticed in the aquatic ecosystem. Work with students to define an ecosystem and review.

Optional Activity – Carrying Capacity – See Appendix B

REFLECTION

POST-ACTIVITY: DIAGRAMMING

» A good way to wrap up this lesson is to either as a class convert their data to a bar graph based on how many of each invertebrate was found. This could be accomplished on a white board or via an Excel spreadsheet. This will allow for another visualization of the information.

POST-ACTIVITY ALTERNATE: EXIT TICKET

» Prior to class ending, ask students to think of one new thing they learned about ecosystems from today's lesson. Inform students they will "have to" tell you the new piece of information they learned from class prior to exiting the room.

POST-ACTIVITY DISCUSSION QUESTIONS:

» What makes up an ecosystem? How does it differ from a community? How does it differ from a biome?

» What can interfere with the health of ecosystems and food webs?

APPENDICES

APPENDIX A: ACTIVITY PREPARATION - INDOOR ADAPTATION

STREAM OR POND ECOLOGY – 20 MINUTES

Inform students that they will be simulating a bioassessment of a stream utilizing common objects to represent Benthic Macroinvertebrates.

Display a photo of a lake or stream on a television for all to see or print off copies for students to view. Hand each student a stream/pond ecology worksheet and ask students to record in the observation section what they notice.

Note: for the air temperature, say it is 70°F or 21°C. For the smell section, say the area smells "earthy" and the water has no smell.

Now that we have made observations, we are going to conduct an index to ascertain what types of species are in the water. Instruct students that they will go to each station and utilize a strainer to "collect" samples. Student groups should spend a max of 20 seconds sampling the source. *Note, this works best if you have a sampling site per student group.

Setting up the collection site:

» Utilizing a 5-gallon bucket (per group), fill the bucket up about halfway with water.

» Put the following objects in each of the buckets (ie collection sites) so all are sampling the same type of water.

MACROINVERTEBRATE:	REPRESENTED BY:	# OF OBJECT PER COLLECTION SITE:
Mayfly	Yellow Beads	15
Stonefly	Small Paper Clips	35
Dobsonfly	Large Paper Clips	20
Caddisfly	Red Beads	20
Craneflies	White Beads	13
Dragonfly	Green Beads	20
Scuds	Black Beads	15
Midges	Blue Beads	20
Leeches	Thick Rubber Bands	15
Pouch Snails	Pennies	15
Tubifex Worms	Thin Rubber Bands	15

After sampling the source, have the students sit in their groups, categorize their **Benthic Macroinvertebrates** (utilizing the provided correlation chart below) and record their data on the provided sheet.

Allow 5-10 minutes for the index and group discussion. Then draw the group back together to discuss and count the types of species found.

*Adapted from Project Wet.

APPENDICES

APPENDIX B: OPTIONAL LESSON – CARRYING CAPACITY

CARRYING CAPACITY – 20 MINUTES

Introduction: When it comes to ecosystems, it is important to understand that each ecosystem has a certain carrying capacity. Carrying capacity refers to the population of a given species that a habitat can support without environmental degradation. It is the largest population that a unit of habitat can support on a year-round basis. Overpopulation of any particular species can push things out of whack, but underpopulation can be just as detrimental. Carrying capacity can fluctuate often, both seasonally and annually. Some of this can be caused by outside factors, such as natural disasters, rainfall or lack thereof, temperature changes, and human interactions.

CARRYING CAPACITY – 15 MINUTES (ADAPTED FROM PROJECT WILD'S "OH DEER")

In this activity break students into two separate groups: resources and Otters. Have students line up on either end of a field facing each other. Explain to them that half will be resources that otters need: food, water, and shelter and half of them will be osprey. The job of the resource is to choose to be one of the resources: food (represented by hands on their stomach), water (represented by hands on mouth), and shelter (represented by hands over head like a house). The job of the otters is to go and collect a resource. The otters are also to pick one of the resources they would like to collect: food, water, or shelter. To further simulate need not being based on availability of the resource, have otters and resources face away from each other. Both groups choose independent of knowing what the other wants. Each student resource or otter should choose what they want to gather or be individually. Tell students when you say "go" they are to turn around and see what is available. Otters can then go and run (or walk depending on your group) to collect the resource that matches the resource need they identified. (Note: students cannot change their resource or resource choice after seeing what is available). Students are to go down and tag the resource that matches there's and bring it back to their side. This simulates surviving another year, reproducing, and leading to more otters. If an otter cannot find a matching resource, they "die," and become a resource.

Repeat this activity multiple rounds and collect the data from each round. Depending on the way things go, you may end up with all the otters dying (can lead to good discussion on extinction and carrying capacity) or all the resources being used up (can lead to another good discussion on carrying capacity).

When collecting data during the activity, the following is all that is necessary:

YEAR (EACH "ROUND" OF THE ACTIVITY)	# OF OTTERS ALIVE/BORN AT THE END OF THE ROUND
0	_____ otters started out
1	
2	
3	
n	

After running a couple of rounds, go inside and map the results on a graph with the X-Axis being years and the Y-Axis being population. Discuss carrying capacity and what it looks like to overshoot it. Often it will oscillate at the carrying capacity.

This can lead to good discussions on J-Curves and S-Curves with population growth.

There are mathematical equations that resource managers use to determine the carry capacity of an ecosystem, but they can be a bit difficult to understand. Rather, it's more important for the students to understand that anytime a change happens in a population, it can impact the whole ecosystem.

PRINTABLES

1. Field Study
2. Macroinvertebrate Biotic Index
3. Doodle Sheet

FIELD STUDY

Name: _____

OBSERVATIONS

Date: _____ Time: _____
Location: _____
General Weather: _____, Air Temperature: _____

Surrounding area observations: _____
_____

Types of vegetation: _____
Types of animals (not Benthic Macroinvertebrate's):_____
_____
Smell of area: _____ Smell of water: _____

Water Observations:
- Clear/murky: _____
- Moving/still: _____
- Rocky bottom/silty bottom: _____

PHYSICAL TESTS

Water Temperature

What is the temperature of the water? _____

Biotic Survey

INTOLERANT INVERTEBRATES

Species Type						
Number of Species						

FAIRLY INTOLERANT INVERTEBRATES

Species Type						
Number of Species						

TOLERANT INVERTEBRATES

Species Type						
Number of Species						

Which type of invertebrate was there most of? _____

What could be some factors that would influence the findings? _____

Based just on the biotic survey is the water clean? Why or why not? _____
_____

CONCLUSIONS

Based on all our findings, tests, and observations, is the water clean? Why or why not?

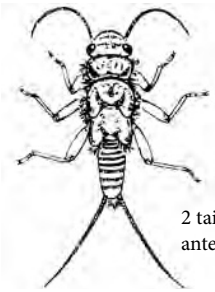
_____
_____
_____

If the stream/lake is polluted, brainstorm some possible sources of this pollution.

_____
_____

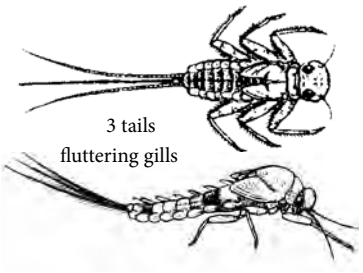
Macroinvertebrate Identification Key

GROUP 1 – Very Intolerant of Pollution



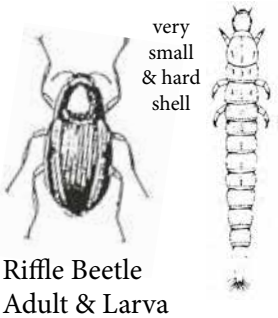
2 tails long antennae

Stonefly Nymph



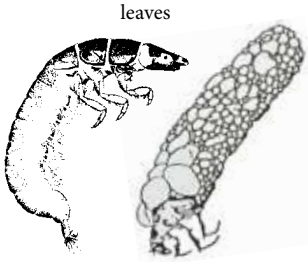
3 tails
fluttering gills

Mayfly Nymph



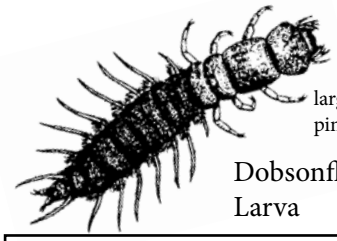
very small & hard shell

Riffle Beetle Adult & Larva



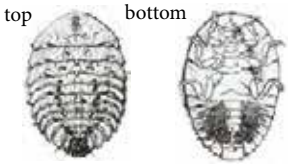
makes a case from twigs, rocks, leaves

Caddisfly Larva



large head & 2 pinchers

Dobsonfly Larva



top

bottom

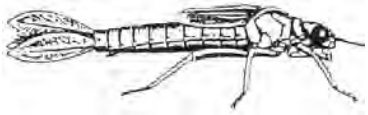
looks like a suction cup

Water Penny Larva

Right-Handed Snail

must be alive to count

GROUP 2 – Moderately Intolerant of Pollution



3 paddle-like (feathery) tails

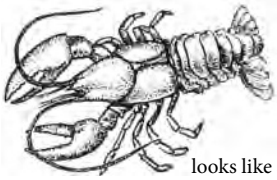
Damselfly Nymph

Dragonfly Nymph

no tails large eyes

flattened side-ways & swims on side

Scud



Crayfish

looks like a mini-lobster

Sowbug

flattened top to bottom (looks like a pill bug)

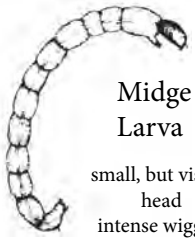
Cranefly

caterpillar-shaped, ringed

must be alive to count

Clam/Mussel

GROUP 3 – Fairly Tolerant of Pollution



Midge Larva

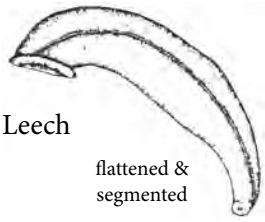
small, but visible head
intense wiggler

Planaria

2 eye spots & very small

one end is swollen

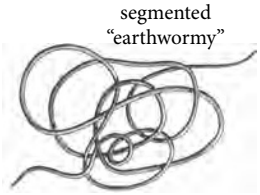
Black Fly Larva



Leech

flattened & segmented

GROUP 4 – Very Tolerant of Pollution

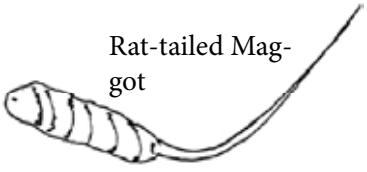


segmented "earthwormy"

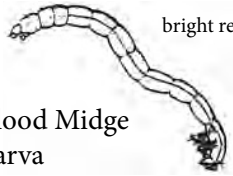
Aquatic Worms

must be alive to count

Left-Handed Snail



Rat-tailed Maggot



bright red

Blood Midge Larva

Abiotic

Examples

Biotic

Examples

"bio" comes from the Greek "bios" meaning living.

Ecosystem

Biosphere	→	Ecosystem	→	Community	→	Population	→	Species

AQUATIC INVASIVE SPECIES

WHAT IS AN AQUATIC INVASIVE SPECIES?

Activity adapted from Project WET's "Invaders!"

South Dakota State University

SKILL LEVEL

6th-8th

KEY TERMS

Aquatic Invasive Species
Native Species
Non-Native Species
Biodiversity
Threatened
Extinction
Competition

EDUCATION STANDARDS

SD Science: MS-LS2-1

SD Science: MS-LS2-4

SD Mathematics: 7.RP

TIME NEEDED

45-50 Minutes

MATERIAL LIST

» Laminated fish cards
» Plastic cups
» Plastic knives
» Plastic spoons
» Plastic forks
» Large binder clips
» Red pom-poms
» Black pom-poms
» White pom-poms
» 3'x4' piece of felt
» Bingo chips
» Timers

EXPECTED LEARNER OUTCOMES

» **OBJECTIVE 1:** Students will understand the natural balance of an ecosystem and identify the food web of a pond or stream.

» **OBJECTIVE 2:** Students will identify the resources needed for a species' survival.

» **OBJECTIVE 3:** Students will understand how invasive species can disrupt the balance of an ecosystem.

BACKGROUND

The National Invasive Species Council defines invasive species as "an alien (or non-native) species whose introduction does, or is likely to, cause economic or environmental harm or harm to human health." Aquatic invasive species includes plants and animals, and they cause significant disruptions to native ecosystems. Aquatic invasive species can outcompete **native species**, which impacts the biodiversity of the ecosystem, the local food chain and predator/prey relationships, and many other ecosystem processes.

Aquatic Invasive Species (AIS) includes both aquatic flora and aquatic fauna.

- Invasive aquatic flora are introduced plants that have adapted to living in, on, or next to water, and that can grow either submerged or partially submerged in water.
- Invasive aquatic fauna require a watery habitat, but do not necessarily have to live entirely in water

VOCABULARY

Aquatic Invasive Species
Freshwater or marine organism that has spread or been introduced beyond its native range and is either causing harm or has the potential to cause harm.

Native Species
Presence is the result of only "natural" processes; that is to say, not by human agency.

Non-native Species
Species that has been introduced by human action, either accidentally or deliberately, outside of its natural range.

Biodiversity
The variety of animals, plants, fungi, and microorganisms that make up our natural world.

Threatened
A plant or animal species generally perceived as likely, in the near future, to become endangered within all or much of its range.

Extinction
Termination of a kind of organism or of a group of kinds, usually a species.

Competition
The direct or indirect interaction of organisms that leads to a change in fitness when the organisms share the same resource.

BACKGROUND (Continued)

Why are invasive species an issue? There are a number of problems invasive species can potentially cause.

- **Prey on native species or compete with native species.**
- **Cause economic harm.**
- **Damage property and endanger people.** Invasive species can damage property and equipment, such as aquatic weeds tangling in boat motors. Trailing plant matter on boat propellers also pose a drowning hazard for swimmers.
- **Ruin habitat.** Invasive species can completely change a habitat for native species. Zebra and quagga mussels, for example, are notorious for adhering to any structures left in the water, especially pipes and boats. They'll even grow on and smother native shellfish! When invasive species take over a habitat, it can make recreation more difficult due to sharp shells on the beach (ie Zebra Mussels) or over vegetation gumming up motors (ie Eurasian watermilfoil or Curly Leaf). When invasive species take over, they can outcompete our native species and decrease the biodiversity and health of a habitat. They also decrease aethetic values.

Invasive species are a leading cause of **biodiversity** loss, second only to habitat loss!

While all species compete to survive, invasive species have specific traits that give them an advantage over native species. Some characteristics that they may have help invasive species are that they lack natural predators, occur in many areas, spread quickly, grow quickly, breed early, have many offspring, have a broad diet, and can often tolerate many different types of habitats . These characteristics can help these species outcompete native species for habitat. An invasive species doesn't have to have all of these traits to successfully invade new areas.

In South Dakota, there are several aquatic invasive species that natural resource managers are monitoring and working to determine their potential impacts. These species include zebra mussels, quagga mussels, Silver Carp, Bighead Carp, Rusty Crayfish, curly pondweed, Didymo and Eurasian Watermilfoil. Other invasive species known in South Dakota are European Rudd and Western Mosquitofish.

ACTIVITY PREPARATION

Refer back to Lesson 1 and the stream or pond ecology that the students completed. What types of organisms did the students identify? Were there any that they could identify as non-native or invasive?

Using the species found in the stream or pond ecology study, and removing any known invasive species, have the students draw a native food chain . Encourage them to be as creative as possible in their web, and see how many intricate relationships they can create.
Adaptation: if you have the space or would like the students to be more mobile, you can do a living web instead. Please see Appendix A for additional resources.

Animals need many resources to be able to survive. We can simplify the resources needed into four main categories: food, water, shelter, and space. Some species, require much more of a certain resource than others. For example, a mountain lion needs much more space per individual than a prairie dog.

Today, students will be able to participate in an activity that allows them to chart the population of a fish species over time. In doing this, students can begin to recognize the resources needed and may even be able to identify the limiting factor for their species.

REFLECTION

Post-activity discussion questions:

1. Were you able to compete with the other native species for resources necessary to your survival and reproduction?
2. Were you able to compete with the invasive species for resources necessary to your survival and reproduction? Why? What made the carp so successful?
3. What could be the consequences of organisms entering an ecosystem that have a competitive advantage over the native species?

EXTENDED LEARNING

Distribute a native species and invasive species to groups of students and have them research these species food and resource needs. Have students spend some time comparing and contrasting these needs.

Ask students: Which they think is the better competitor—invasive or native?

ACTIVITY PREPARATION (Continued)

Break the students into groups of five. If the numbers do not work out well, smaller groups can be used, however the supplies will need to be modified. Students will be assigned one of four native fishes or an invasive fish. Each native fish will need to gather enough food to survive each round using their particular mouth style. However, after approximately 3 rounds, an invasive species will be introduced.

Equipment per five-person group:

- 5 cups
- 2 plastic knives
- 1 plastic spoon
- 3 plastic forks
- 1 large binder clip
- 10 red pom-poms
- 12 black pom-poms
- 10 white pom-poms
- 3'x4' piece of felt
- 25 bingo chips
- 1 timer

In this activity, there are four native species. Each native species must gather enough food to survive using the tools they have in only one hand. The perch will have one plastic spoon, the bass has two knives, the bluegill has one fork, and the walleye has two forks. There will also be an invasive carp, which can use the binder clip to gather pom-poms.

Each native fish starts off with three lives, which are represented by the bingo chips. At the end of each round, the fish each need 5 pom-poms to survive. If they collect more than the 5 necessary pom-poms, they can gain a chip for each 3 additional pom-poms. This represents having enough resources to both survive (5 pom-poms) and perhaps reproduce (at least 3 additional pom-poms). For example, if the walleye collects 7 pom-poms in the allotted time, they do not lose a chip but they do not gain one which would indicate reproduction. However, if the bass collects 10 pom-poms, they would gain an additional bingo chip after that round indicating they had gathered enough resources to reproduce. If any fish loses all three bingo chips, they become extinct and can participate in future rounds as a carp using a binder clip.

It's important to recognize that in addition to different mouth parts, the species eat different things. Each native fish has a particular set of eating habits identified below:

- Perch eats only white pom-poms
- Walleye eats only white and red pom-poms
- Blue gill eats only black pom-poms
- Bass eats black and red pom-poms
- Carp eats anything

Have the students in each group of five randomly distribute their pom-poms on the felt. Each native fish has 30 seconds per round to collect their food using just one hand and their assigned tools. Have the students play approximately three rounds with only the native species competing for food, and then introduce the carp. Have the students compete with the carp for a couple rounds, and see what happens to their populations.

Adaptation for small groups: reduce the number of native species if groups are < 5.

NATIVE SOUTH DAKOTA SPECIES

BLUEGILL

YELLOW PERCH

LARGEMOUTH BASS

WALLEYE

INVASIVE SPECIES

BIGHEAD CARP

AQUATIC INVASIVE SPECIES

HOW AQUATIC INVASIVE SPECIES MOVE

SKILL LEVEL

6th-8th

KEY TERMS

Pathways
Natural Pathways
Human Intentional Pathways
Human Unintentional Pathways
Vector
Biological Control Organisms
Horticulture
Ballast Water

EDUCATION STANDARDS

SD Science:

MS-LS2-2
MS-LS2-5
MS-ESS3-3

SD English Language Arts:

6-8.RS2.2

TIME NEEDED

30-40 Minutes

MATERIAL LIST

» Laminated Confuddling Conundrum cards

EXPECTED LEARNER OUTCOMES

» **OBJECTIVE 1:** Students will be able to define at least 3 different ways that aquatic invasive species spread, specific to South Dakota.

» **OBJECTIVE 2:** Students will be able identify everyday actions that knowingly and unknowingly spread aquatic invasive species.

BACKGROUND

Aquatic Invasive Species (AIS) are species that are intentionally or unintentionally introduced into local bodies of water negatively impacting the ecosystem. But how are invasive species introduced?

Pathways are the means and routes by which invasive species arrive in new environments. These routes can further be broken into **natural pathways** (such as wind, currents, and other natural dispersal methods) and **human pathways**. Also of note are **vectors**. Vectors are biological transporters of AIS (Such as a duck landing in a lake, unintentionally picking up a veliger on it and dropping it off in another lake by landing in it. The duck acts as the vector that transports the veliger.).

Human pathways can further be broken into **intentional** and **unintentional**. Intentional human pathways are the result of deliberate movement of species such as the pet trade, **biological control organisms**, and **horticulture**. This movement may be good or bad dependent upon the impact of the species. Unintentional human pathways are the inadvertent movement of species as a byproduct of some other human activity such as **ballast** water discharge, imported plants as host to pests, movement of recreational watercraft, etc. This lesson will focus on human pathways of AIS spread as these are the pathways that students can impact with their behavior.

VOCABULARY

Pathways
The means and route by which invasive species are introduced into new environments.

Vectors
A pathway that is specific to movement/introduction to a new environment from a biological source (e.g., migrating duck).

Natural Pathways
Natural ways such as wind that invasive species spread.

Human Intentional Pathways
Deliberate move of nonnative species to a new environment.

Human Unintentional Pathways
The inadvertent movement of nonnative species as a byproduct of human action.

Biological Control Organisms
Use of living organisms to control a pest.

Horticulture
The practice of gardening, cultivation, and management.

Ballast Water
Water that is held in the ballast tank. Ballast tanks are used by vessels to control the stability of a ship, thus the water in these tanks can be increased or decreased to affect stability of the ship dependent upon the weight of the cargo. Ballast tanks or bladders are also found in newer recreational watercraft such as wakeboard boats.

ACTIVITY PREPARATION

Introductory Discussion/Probing Questions – 5 minutes

Begin the lesson by asking students: what are some ways aquatic invasive species move from one waterbody to another?

Notes/Prompts for Teacher:
- Animal distribution such as seeds attached to moving animals
- Natural movement, such as "going upriver"

Further probe, by asking, what are some ways humans could move aquatic invasive species ?

Notes/Prompts for Teacher:
- Ballast or livewell water in a boat
- Dumping unused bait
- Not cleaning boats and trailers between bodies of water
- Release of an unwanted pet
- Intentional planting of non-native species
- Not cleaning outdoor equipment before using in a new place (hiking boots, waders, beach toys, clothing, etc.)

Confuddling Conundrums Activity – 25 Minutes

Divide into small groups. Give each group one or more Confuddling Conundrum cards. You can:
- Give each group the same situation and allow for small group discussion.
- Give each group a different situation and allow time for small group discussion.
- Give each group several situations and let them work through the dilemma as a small group.

Bring the class together for a wrap-up discussion (possibly through presentation/ large group discussion).

REFLECTION

Create your own dilemmas and think about what you would do. Share your dilemmas with your classmates and discuss compare what others would do.

PRINTABLES

Confuddling Conundrum Cards

CONFUDDLING CONUNDRUM 1 Your family loves to canoe camp. Your favorite thing to do is travel from one lake to another. You don't mind the portages, but your dad's obsession with cleaning all the vegetation and aquatic animals off the canoe is driving you crazy. He even makes you clean the mud off your shoes! Now you are old enough to canoe on your own with some friends. You are leaving one lake for a new one. Do you clean the canoe?	Ok maybe dads can be a little unreasonable at times, but this time Dad has the right idea. Non-native plants and animals move easily from lake to lake on you, your shoes, clothes, packs, tents, canoes, pets, bait buckets, and anything else you use. If everyone was as careful as your dad, we might be able to control the spread of non-natives like zebra mussels and Eurasian watermilfoil.
CONFUDDLING CONUNDRUM 2 You and your friends are out fishing at your favorite fishing hole. While fishing off the dock has been traditionally good for you, the fishing today is just slow. You scan the lakeshore and see a spot you just know will have the "big one" and point it out to your friends. Your friends head off in the most direct route to the spot, but you hesitate, knowing there is a trail if you back track a bit. What do you do?	Shortcuts are tempting! But the plants growing on shores protect the area and provide valuable habitat. Taking shortcuts increase shoreline erosion. But that's not all! Once the native plants along the shoreline have been disturbed, the likelihood of invasive plants taking root is much higher.
CONFUDDLING CONUNDRUM 3 Your family likes to joke that you knew how to fish before you could walk. While you prefer lures, you enjoy experimenting with live bait. But at the end of the day, you are never quite sure what to do with leftover worms, larvae, crayfish, or minnows. One friend just dumps them in the water. What will you do?	If your friend jumped off a bridge, would you do that too? First, think about where you got the live bait. If you caught it yourself in the spot where you are fishing, it's okay to return it to the water. If you bought the bait at a bait shop or collected it from any other body of water, then you should dispose of any leftover bait in the trash or change the water and use the bait again. Never dump leftover worms on the ground. Improper disposal of live bait is one way that invasive species are spreading.
CONFUDDLING CONUNDRUM 4 You and your family are moving across the country. While your parents promised that you could restock your aquarium after the move, they won't let you move your fish. You offered them to your best friend, the science teacher, and a dozen other people. No one is interested. Now what are you going to do?	You might be tempted to release them in a local waterway. At least, you figure, they would have a chance. The truth is that they will either quickly die, or they will survive and pose a risk to the plants and animals already living there. If you can't find a hobbyist, museum, zoo, nursing home, school or anyone to take care of them, try and return them to the store for resale or trade. If that doesn't work, don't be tempted to bury them at sea! Ask a vet to put them to sleep or place them in water and put them in the freezer. This is considered a humane method of euthanasia.
CONFUDDLING CONUNDRUM 5 You and your family are taking a long hike into the forest. Dad parks at the trailhead and everyone gets ready to go. Just off the parking lot, there is a beautiful purple flower. Your mom picks one and sticks it in your hair. The hike goes great, but after a while the flower starts to itch. You carry it in your hand for a while, but it's all droopy and not that beautiful anymore. What do you do with it?	If you guess that the weed might be purple loosestrife, you could be right. You don't know for sure, though. It could be invasive; it could be endangered. However, invasives are a lot more common around parking lots where the soil has been disturbed and there is a lot of human activity. Now that you are far from the source, don't drop it on the ground and spread its seeds. Put it in a bag and throw it in the trash when you get home. Remember: it's best not to pick any wildflowers, ever.

AQUATIC INVASIVE SPECIES
MOST WANTED!

SKILL LEVEL
6th-8th

KEY TERMS
Threat

EDUCATION STANDARDS
SD Science:
MS-LS1-5
MS-LS2-2
MS-LS2-4
SD Social Studies:
7.SS.2
SD English Language Arts:
6-8.WHST.2
6-8.WHST.4
608.WHST.6
SD Fine Arts:
6-8.VA.Cr.1.1
SD Ed Tech:
6.ET.KC.1
7.ET.KC.1
8.ET.KC.1

TIME NEEDED
45-50 Minutes

MATERIAL LIST
» Computer for research
» GFP documents on AIS
» WANTED posters (Appendix C)
» Crayons, markers, etc. for designing poster

EXPECTED LEARNER OUTCOMES
» **OBJECTIVE 1:** Students will become familiar with a local AIS of concern
» **OBJECTIVE 2:** Students will be able to communicate their findings to their classmates either orally via a short presentation or visually through the creation of a WANTED poster

BACKGROUND
As discussed in previous lessons, aquatic invasive species (AIS) are on the rise in South Dakota. In this lesson, students will have the chance to become the expert on one species and then teach their classmates about it.

If this lesson is being done in conjunction with other lessons in this unit, very little background information is needed. However, if it is being used as a standalone lesson, please pull additional background information from Lessons 2 and 3 in the AIS curriculum.

ACTIVITY PREPARATION
Using the lists in Appendix A and B, identify the AIS that are local to your area. Either assign students to an AIS or allow them to choose. Be prepared for students to do independent research – whether that is using the GFP documents linked below or using their own searching. Print WANTED posters for students to fill in with information specific to their assigned AIS from Printables.

VOCABULARY

Threat
An activity or process that has caused, is causing or may cause the destruction, degradation and/or impairment of biodiversity and natural processes

ACTIVITY INSTRUCTIONS

Invasive Species Most Wanted Poster

Now that students have a few lessons on AIS under their belts, it's time for them to be the researchers. This lesson allows students to work independently or in small groups to become experts on a particular AIS and then share their knowledge back to the group.

1. Break students into small groups or have them work independently and either assign or let them choose their AIS to research.
2. Instruct students to prepare the WANTED poster, including answering the questions on the bottom and drawing a picture of their AIS.
3. If time allows, have each small group or individual teach the rest of the class about their AIS using their WANTED poster as a framework for their presentation.

REFLECTION

Lead a discussion on the following questions:

1. Which species presented today poses the most significant **threat** to native species and ecosystems? Why?
2. Which species is of the least concern? Why?
3. How might these AIS impact you personally?
4. What actions can you take to stop or slow their spread of the AIS that you researched?

EXTENDED LEARNING

If you prefer a longer wrap-up for this unit, it is possible to turn this lesson into a capstone project.

- Have students (or student groups) choose an Aquatic Invasive Species from the pre- created SD AIS list.
- Have students (or student groups) research their AIS species and answer the following questions:
  - » Define what their AIS is, where it originally came from, its natural predators (if applicable).
  - » The specific AIS's effect on the food web and local ecosystem (why is it so pervasive in its non-natural location).
  - » Most common way this AIS is spread and how the public can help slow the spread. (Also how was it originally spread)
  - » Describe the economic effect of this species (think through tourism, local infrastructure, etc.).
  - » What local and national agencies are doing about this specific species.
- Possible ways to have students (or student groups) present their findings:
  - » Option 1: Have students prepare a report and hand it in to their teacher.
  - » Option 2: Have students create an informational flyer, news article, PSA, etc.
  - » Option 3: Have students create a presentation (via PowerPoint or Presentation Board) to present to either their class or local agencies (e.g., GFP, FWS, among other interested parties).

SOUTHEAST SOUTH DAKOTA

Asian Clam (Invert; Lake Yankton)

Bighead Carp (Fish; Lower Big Sioux, James, and Vermillion rivers, Lake Byron/ adj Lake Mud)

Brittle Naiad (Plant; McCook Lake)

Curlyleaf Pondweed (Plant; Lake Hurley, Lake Mitchell, McCook Lake, Nelson Lake, Lake Yankton)

European Rudd (Fish; Interstate Lake)

Grass Carp (Fish; Lower Big Sioux, James, and Vermillion rivers, Lake Byron/ adj Lake Mud)

Silver Carp (Fish; Lower Big Sioux, James, and Vermillion rivers, Lake Byron/ adj Lake Mud)

Zebra Mussel (Invert; Lake Mitchell, McCook Lake, Lake Yankton)

NORTHEAST SOUTH DAKOTA

Bighead Carp (Fish; upper James River)

Curlyleaf Pondweed (Plant; Bigstone Lake, Blue Dog Lake, Lake Alice, Lake Traverse, Pickerel Lake, Roy Lake)

European Rudd (Fish; Lake Alice, Mina Lake)

Grass Carp (Fish; upper James River)

Silver Carp (Fish; upper James River)

Zebra Mussel (Invert; Blue Dog Lake, Clear Lake, Dahme Quarry, Enemy Swim Lake, Lake Cochrane, Lake Kampeska, South Rush Lake)

WESTERN SOUTH DAKOTA

Asian Clam (Invert; Angostura Reservoir)

Curlyleaf Pondweed (Plant; Angostura Reservoir, Herrick Lake, Lake Roosevelt, Rahn Lake)

European Rudd (Fish; Newell Reservoir)

BLACK HILLS SOUTH DAKOTA

Curlyleaf Pondweed (Plant; Angostura Reservoir, Canyon Lake, Rapid Creek, Sheridan Lake, Stockade Lake)

Didymo (Plant; Castle Creek below Deerfield Reservoir, Rapid Creek)

European Rudd (Fish; Horsethief Lake, Pactola Reservoir, Sheridan Lake)

Red-Rimmed Melania (Invert; Fall River)

Purple Loosestrife (Plant; Rapid Creek)

Zebra Mussel (Invert; Pactola Reservoir)

MISSOURI RIVER/CENTRAL SOUTH DAKOTA

(Oahe, Sharpe, Francis Case, Lewis and Clark reservoirs, Missouri River below Gavin's Point Dam)

Asian Clam (Invert; Francis Case, Sharpe, and Lewis and Clark reservoirs, Missouri River below Gavin's Point Dam)

Bighead Carp (Fish; Missouri River below Gavin's Point Dam)

Brittle Naiad (Plant; Lewis and Clark Reservoir)

Curlyleaf Pondweed (Plant; Dakotah Lake, Oahe, Sharpe, Francis Case, Lewis and Clark reservoirs)

Eurasian Water Milfoil (Plant; Oahe, Sharpe, Francis Case, Lewis and Clark reservoirs)

European Rudd (Fish; Oahe, Sharpe, Francis Case, Lewis and Clark reservoirs)

Flowering Rush (Plant; Lake Faulkton, Lake Louise)

Grass Carp (Fish; Missouri River below Gavin's Point Dam)

Purple Loosestrife (Plant; Sharpe, Lewis and Clark reservoirs)

Red Swamp Crawfish (Invert; Lewis and Clark Reservoir)

Rusty Crayfish (Invert; Lewis and Clark Reservoir, Missouri River below Gavin's Point Dam)

Silver Carp (Fish; Missouri River below Gavin's Point Dam)

Zebra Mussel (Invert; Francis Case, Sharpe, and Lewis and Clark reservoirs, Missouri River below Gavin's Point Dam)

FOR THE MOST UP-TO-DATE INFORMATION, VISIT
SDLEASTWANTED.SD.GOV

SOUTHEAST SOUTH DAKOTA

Asian Clam
Bighead Carp
Brittle Naiad
Curlyleaf Pondweed
European Rudd
Grass Carp
Silver Carp
Zebra Mussel

NORTHEAST SOUTH DAKOTA

Bighead Carp
Curlyleaf Pondweed
European Rudd
Grass Carp
Silver Carp
Zebra Mussel

WESTERN SOUTH DAKOTA

Asian Clam
Curlyleaf Pondweed
European Rudd

BLACK HILLS SOUTH DAKOTA

Curlyleaf Pondweed
Didymo
European Rudd
Red-Rimmed Melania
Purple Loosestrife
Zebra Musse

MISSOURI RIVER/CENTRAL SOUTH DAKOTA

(Oahe, Sharpe, Francis Case, Lewis and Clark reservoirs, Missouri River below Gavin's Point Dam)

Asian Clam
Bighead Carp
Brittle Naiad
Curlyleaf Pondweed
Eurasian Water Milfoil
European Rudd
Flowering Rush
Grass Carp
Purple Loosestrife
Red Swamp Crawfish
Rusty Crayfish
Silver Carp
Zebra Mussel

FOR THE MOST UP-TO-DATE INFORMATION, VISIT
SDLEASTWANTED.SD.GOV

WANTED

AQUATIC INVASIVE SPECIES

NAME:_____

LOCATION OF ORIGIN:_____

LAST SEEN:_____

MODE OF SPREAD:_____

PREFERRED HABITAT:_____

IMPACTS:_____

AQUATIC INVASIVE SPECIES

WHAT AQUATIC MANAGERS DO TO SLOW THE SPREAD

AIS PUBLIC SERVICE ANNOUNCEMENT

SKILL LEVEL
6th-8th

KEY TERMS
Aquatic Manager
WIDS
Public Service Announcement (PSA)
Regulation
Compliance
Wildlife Conservation Officer
Infested

EDUCATION STANDARDS
SD Science:
MS-ESS3-3
SD English Language Arts: 6-8.RST.4
6-8.WHST.2
6-8.WHST.4
6-8.WHST.6
SD Fine Arts:
6-8.VA.Cr.1.1
SD Ed Tech:
6.ET.CT.2
6.ET.KC.1
6.ET.KC.3
7.ET.CC.1
7.ET.KC.1
7.ET.KC.3
8.ET.CC.1

TIME NEEDED
45-50 Minutes

MATERIAL LIST
» Computer for research
» GFP documents on AIS
» WANTED posters (Appendix C)
» Crayons, markers, etc for designing poster
» Phone or recording device for capturing audio and video

EXPECTED LEARNER OUTCOMES

» **OBJECTIVE 1:** Students will become familiar with what aquatic managers are doing to slow the spread of AIS.

» **OBJECTIVE 2:** Students will be able to demonstrate their understanding of AIS preventative measures throughout the creation of a public service announcement (PSA) for their peers.

BACKGROUND

Aquatic invasive species (AIS) are on the rise in South Dakota. In this lesson, students will become familiar with actions aquatic managers are taking to slow the spread of AIS in South Dakota.

AIS can be very harmful to an aquatic ecosystem and can be difficult and expensive, if not impossible, to eradicate. Unfortunately, most AIS cannot be eradicated so slowing the pace of invasion or limiting spread is extremely important.

In South Dakota, an AIS specialist and **aquatic managers** use science and management techniques to determine measures to slow the spread of AIS as part of their efforts to promote healthy aquatic habitats and ecosystems. Monitoring, education, and law enforcement/regulations are several of the tools employed to slow the spread of AIS.

If this lesson is being done in conjunction with other lessons in this unit, very little background information is needed. However, if it is being used as a standalone lesson, please pull additional background information from Lessons 3 and 4 in the AIS curriculum.

VOCABULARY

Aquatic Manager
A professional that uses science and management strategies to promote and maintain healthy aquatic ecosystems.

Watercraft inspection and Decontamination Stations (WIDS)
Checkpoints where boaters are required to stop to make sure that they don't have any aquatic invasives on board.

Public Service Announcement (PSA)
A short message, broadcast, or video commissioned by a government agency or non-profit organization in order to raise awareness about an issue of public interest.

Regulation
A rule or directive made and maintained by an authority
Compliance: the action or fact of complying with a wish or command.

Wildlife Conservation Officer
Law enforcement officers who enforce the laws in place to protect wildlife and natural resources.

Infested
To cause a problem by being present in large numbers.

ACTIVITY PREPARATION

In this activity, students will have an opportunity to practice creating an educational Public Service Announcement about AIS. Students should gather information about AIS covered in past lessons and then search for examples of AIS advertisement including posters, radio adds, or television commercials.

ACTIVITY INSTRUCTIONS

Prior to the activity, have a discussion with students about what is being done on a local, state, and national level for AIS management. It is recommended you cover: monitoring, education, and law enforcement.

Monitoring
Monitoring refers to the continued observance of where aquatic invasives are and where they are not. Samplers placed below docks are one method used to monitor for zebra mussels. Samplers are simply pieces of PVC tubing that are placed in the water, often near docks, and left for a period of time. Often in the fall, they are retrieved and examined for zebra mussels. The absence of zebra mussels on all samplers in a lake indicates that there may not be mussels, but it is possible that they are in low enough density that they were not detected. However, if they are discovered at a locations then additional sampling is done which often involves examination of rocks, dock frames, and other structures. If zebra mussels are found in two locations, then a water is classified as "infested" and signs are placed at access areas and news releases are created to alert the public of the new infestation. Frequently-used infested waters can act as a gateway for the spread of zebra mussels to surrounding waters.

Another tool in monitoring for AIS is to engage the public, especially lakeshore residents. Initial detection of zebra mussels has often occurred when lakeshore residents pull their docks and boat lifts ashore in the fall in preparation for winter.

Game, Fish and Parks fisheries managers also monitor for invasive species during their annual adult fish population surveys. Rakes are used to collect samples of aquatic vegetation and rocks and other hard surfaces are examined for zebra mussels.

Education
Education is another tool used by GFP to help slow the spread of AIS. The public is often not familiar with the various types of AIS and the mechanisms behind the spread, detrimental effects and high costs associated with infestations. Poor awareness can lead to inadvertent spread of AIS.

One way that managers are educating the public is the "Clean, Drain, Dry" initiative. Boaters should **clean** all visible aquatic vegetation, animals, and mud off boats and trailers prior to leaving the landing. They should also rinse the outside of their boat off with high pressure, hot water and flush out their engine with hot water, if possible. Boaters should also **drain** all compartments capable of holding water on their boats. They should also **dry** their boats by allowing them to sit outdoors for 5 days or by wiping all moisture off their boat. Lastly, anglers should **dispose** of all bait into the trash once they are done. When storing live bait, all lake or river water should be drained and replaced with well water or treated tap water. Aquatic managers practice "clean, drain and dry" with their field operations to ensure that AIS is not spread to new waterbodies.

Various forms of media are utilized to spread the message of AIS prevention. Radio and television advertisement, billboards, signs, and even gas station television and ice bin wraps have been used to spread information on AIS. Creating lesson plans like these for use in our schools represent another effort to educate the public about AIS in order to help slow the spread.

Law enforcement and regulation

Use of law enforcement is another means of slowing the spread of AIS. In South Dakota all plugs must be removed from boats and all aquatic vegetation must be removed from trailers prior to leaving the landing of a body water. If water users decide to ignore these rules, GFP **Wildlife Conservation Officers** may issue them a citation.

You and your family may have been required to pull off the roadway while trailering your boat to a lake and watch an inspection of your boat or jet ski. These roadside checks occur at designated sites and are called **watercraft inspection and decontamination stations (WID stations)** Boats are inspected to make sure that there is no aquatic vegetation on the trailer and plugs are removed. Boaters are also asked a series of questions that help aquatic managers track movement between water bodies, especially from **infested** to uninfested waters. Law enforcement will stop boaters who chose not to stop for a WID inspection and issue them a citation.

WIDS serve to engage and inform the public on how to clean, drain, and dry. They also are helpful tools to be able to estimate boater compliance with **regulations** such as plug removal.

AIS Public Service Announcements

Students have now learned about the many different types of AIS and how they are managed. This activity will give them the opportunity to be creative and use their past research and pair it with their new findings during this activity. For this activity students will be creating a TV ad, radio ad, social medial post, or billboard/poster to notify and educate the public about AIS and how to slow the spread. The instructor may choose the length requirements for students who choose to create a TV or radio ad.

1. Break students into small groups or let them choose their partners. Students may also work alone independently if that is preferred.
2. Instruct students to work together or independently to research both AIS and what is being done to slow the spread.
3. Have students create their PSA while instructing them to be creative and work together.
4. If time allows have each small group present their PSA to the rest of the class.

Note: this section offers the opportunity to adapt and have students utilize technology, such as cell phones to record their PSA and show in front of the class.

REFLECTION

Lead a discussion on the following questions:

5. What is an aquatic manager?
6. What are the 3 main tactics being used to slow the spread?
7. Which tactic being used to slow the spread do you think works the best?
8. What actions can you take to stop or slow their spread?

ADDITIONAL RESOURCES

- Example of WIDS youtube.com/watch?v=Y1Gp2kjBwL8&list=PLauhOcAmn6dHdcqThgfAAsOh31RTkMIlz&index=7
- Example of aquatic invasive species PSA youtube.com/watch?v=S_FocdOTLgg&list=PL1A468B277F9A6E57&t=26s
- Example of AIS billboard (left)

Published by South Dakota Game, Fish and Parks

Last updated 12.13.2023

gfp.sd.gov/education