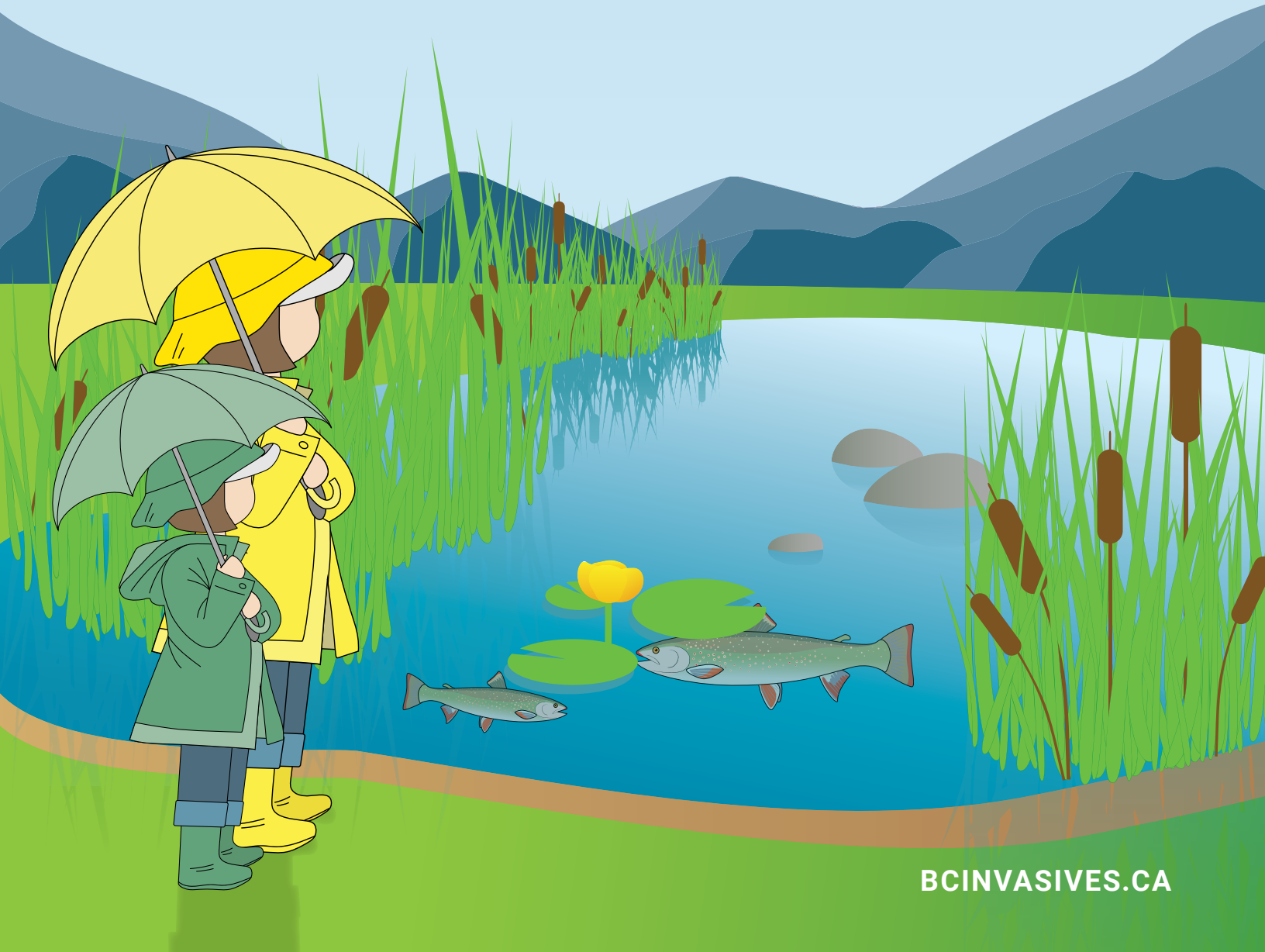




# AQUATIC INVADERS!

Connecting to and Protecting Our Waterways

An Activity Guide for  
Teachers and Outdoor Educators



# Introduction

Ready to explore and educate your students about nearby wetlands, lakes, streams, ponds, and other freshwater habitats? Then this resource is for you! Even if a freshwater habitat is not readily accessible to visit, each of us is connected to water as it flows through the watershed where we live, play, and learn. No matter where we are, we can all learn about and help protect freshwater habitats and biodiversity.

This Aquatic Invaders Activity Guide is suitable for formal school programs, as well as informal youth groups, camps, and recreation programming. Whether used in the classroom, the schoolyard, in a nearby green space or remote protected area, students will enjoy these hands-on activities and will be empowered to take action to protect freshwater habitats from harmful invasive species. While the activities are recommended for grades K to 8/ages 5 to 13, they can easily be adapted to suit other ages and audiences.

The Activity Guide includes helpful background information, species teaching cards, and a

variety of engaging activities to learn about aquatic invasive species, their impacts, and ways we all can help prevent their spread. You will find active games, art projects, place-based sensory awareness, research projects, scientific data collection and more! As students participate in the activities, they will be well on their way to becoming a “Healthy Habitat Hero”. Be sure to check out the Healthy Aquatic Habitat Hero Bingo Card provided in the Appendix and keep track of your progress as you explore the activities. When you are ready, test your knowledge and have some fun with the Aquatic Invaders Trivia Challenge!

Please visit our website for more resources to learn about and protect aquatic habitats. It includes eLearning courses, videos, aquatic invasive species field guides, stickers, and more.

All feedback and adaptations are welcome — please let us know how you have used these activities and your experiences with them.

*Thank you for your interest in invasive species!*

*We invite you to consider joining our community of supporters to help make invasive species education and ecological stewardship programming accessible across BC. Visit our website [bcinvasives.ca](http://bcinvasives.ca) to learn more.*



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**1-888-933-3722**

Charitable Registration #856131578RR0001

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Photos and fun facts about some common invasive species to BC found in or near waterways.

### **Appendix 2: Native Species Teaching Cards**

Photos and fun facts about some common native species to BC found in or near waterways.

### **Appendix 3: Healthy Aquatic Habitat Hero Bingo Card**

Use this as a stand-alone activity or to track your group’s experiences and learning as you work through this Guide.

# Information for Educators

## Background

“Knowing is the key to caring, and with caring there is hope that people will be motivated to take positive actions.”

- Sylvia Earle

Wetlands, ponds, streams and other aquatic habitats and their shorelines can be inspirational environments to learn about and experience. All living things need water to survive, and freshwater ecosystems are home to a great diversity of life — from fish, amphibians and invertebrates under the water, to plants on the surface, and birds and insects in the air. A wide range of plant and animal life is supported by waterways and found in adjoining terrestrial habitat. Wetlands and other freshwater habitats support biodiversity, help mitigate flooding and filter pollutants, give us food and drinking water, and provide many other critical ecological services.

Freshwater habitats are impacted by people's actions and activities, whether recreational, commercial, or industrial. Waterways form a network connecting surrounding landscapes within a watershed. Activities upstream and on adjoining lands — whether positive or negative — are reflected in the lakes, streams, and other bodies of water within that watershed. Invasive species have a negative impact. If introduced, they can spread throughout a water body and beyond, causing harm to communities and the environment.

More than 150 **aquatic invasive species** (AIS) have been identified in British Columbia,

many of which continue to spread. They cause considerable damage by clogging waterways, reducing habitat, outcompeting native fish and wildlife populations, and impacting recreation, fishing, and swimming. (See [bcinvasives.ca](http://bcinvasives.ca) or Appendix 1 for photos of some invasive species in and around BC's waterways.)

An **invasive species** in BC, such as Goldfish, is an organism that has been introduced, intentionally or accidentally, to a new area and spreads, causing negative environmental, economic, and social impacts. Invasive species can outcompete native species for their basic needs such as food, shelter, and space.



Goldfish and Eurasian watermilfoil; P. Corbett, Flickr



A **native species** to BC, such as Sockeye salmon, is one that naturally occurs in an area and has lived and evolved in a place over many thousands of years. Native species are part of the natural ecosystem, having coevolved with other competing species, predators, diseases, climate factors and other aspects of a region and an ecosystem.



**Non-native species:** Sometimes called **exotic species**. Not all species that come 'from away' are invasive! Many of our important food crops or garden plants, such as tomatoes, are non-native but do not easily spread beyond the area where they are cultivated. Remember: to be an invasive species, the organism is both non-native and causes harm to the environment, economy, or community.



## Some Types of Freshwater Habitats

**Wetlands:** Have saturated soils with plants growing in water during the growing season. There are many diverse types and classifications of wetlands, which can be distinguished based on their vegetation, source of water, and other characteristics. Some types of wetlands include marshes, bogs, fens, and swamps.

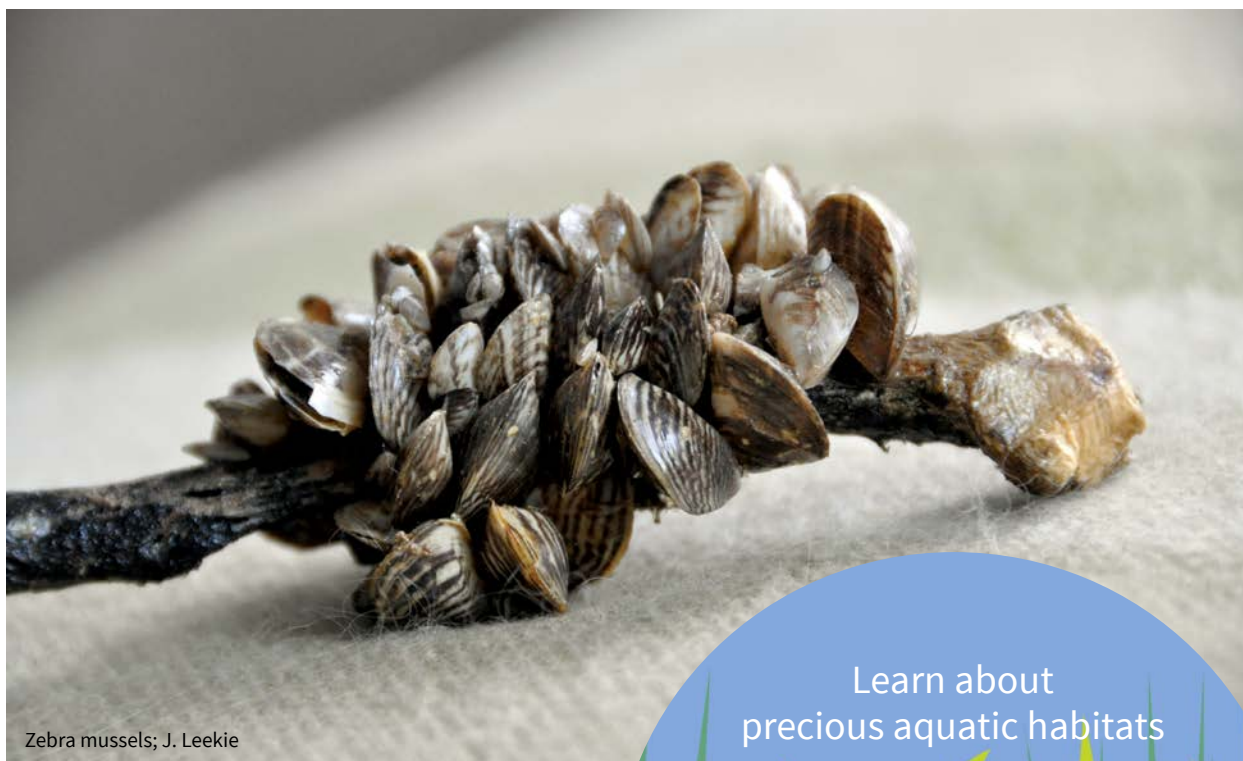
**Lakes:** Large, inland bodies of standing water surrounded by land.

**Ponds:** Inland bodies of water that are smaller than a lake. Ponds are typically less than two hectares and are shallow enough that sunlight can penetrate the deepest point, permitting the growth of rooted plants.

**River:** A body of water that flows downhill due to gravity. When rain falls on the land, some of it seeps into the ground or it becomes runoff, flowing downhill into rivers and lakes towards the ocean. Creeks and streams are flowing bodies of water that are shallower and narrower than rivers. Flowing water initially starts out in small, high elevation creeks, which merge to form larger streams and rivers.

## Invasive Species Characteristics

- They are prolific reproducers, producing numerous seeds, eggs or offspring.
- They can establish easily, often starting in disturbed habitats.
- They spread easily. Invasive animals can grow and reach maturity quickly. Many invasive plants can even grow from roots or stem fragments.
- They lack the predators and diseases that keep them under control in their native range. As a result, they often have traits that make them undesirable to predators (such as toxins or spines).



One **example of invasive species we are working hard to keep out of BC** are Zebra (*Dreissena polymorpha*) and Quagga (*Dreissena rostriformis bugensis*) mussels. Invasive mussels have invaded the Great Lakes in Ontario and are also found in Quebec and Manitoba, causing significant economic and environmental damage. They spread rapidly and establish in underwater infrastructure, such as hydroelectric intakes. Thanks to the efforts of many organizations and the cooperation of visitors and residents, Zebra and Quagga mussels have been prevented from entering BC's waters to date.

### How You Can Make a Difference

We can all make a difference and help protect the environment and our communities from invasive species by taking small actions. Teaching about invasive species and participating in the activities in this guide is one way to help! Getting outdoors and experiencing nature hands-on builds an emotional connection to place.

Learn about  
precious aquatic habitats

**CELEBRATE**  
**World Wetland Day**  
(February 2nd)  
**and World Water Day**  
(March 22nd)!

By becoming aware of nature around us, we notice when something is new, unusual, or out of place. Any of us can be the first to notice and report a new occurrence of an invasive species. Early detection can lead to action preventing greater spread and damage. Report invasive species using apps such as Report Invasives or iNaturalist (Join our project *I Spy and Identify*), or by using ISCBC's online form.

We can also make a difference by making small changes to our daily habits.

## Clean Drain Dry

To prevent the spread of aquatic invasive species such



**CLEAN  
DRAIN  
DRY**

as **Zebra** (*Dreissena polymorpha*) and **Quagga** (*Dreissena rostriformis bugensis*) **mussels**, **Freshwater jellyfish** (*Craspedacusta sowerbii*), and **Eurasian watermilfoil** (*Myriophyllum spicatum*), boaters, fishers, and anyone who enjoys being on the water can practice Clean Drain Dry by following these steps:

**CLEAN** off all plant parts, animals, and mud from boats and equipment (for example, boots, waders, fishing gear). Use a power wash station if available.

**DRAIN** onto land all items that can hold water (for example, buckets, wells, bilge, and ballast).

**DRY** all items completely before launching into another body of water.



Eurasian watermilfoil;  
A. Fox, Bugwood.org



Yellow flag iris; L. Scott



Bat caught in Burdock; K. Dzinbal



Goldfish; USGS, Bugwood.org

## Play Clean Go

Invasive plants and insects are expert hitchhikers, and we can inadvertently spread them from one place to another as they cling to our boots, clothing, vehicles, and gear. For example, **Burdock** (*Arctium* spp.) burrs are so clingy that native birds and bats can die when they get stuck in them. The tiny hooks on burrs that cling to fabric and fur inspired the invention of Velcro! We can prevent the spread by practicing Play Clean Go. Before and after you head out to **PLAY** outdoors, ensure you **CLEAN** your gear before entering and leaving a recreation site. Take some time to inspect and remove mud, soil, plants and insects from boots, gear, pets, and tires/vehicles. Then you can **GO** on the next outdoor adventure knowing that you helped prevent the spread of invasive species.



## Don't Let it Loose

Numerous invasive plants and animals spreading in BC, such as **Goldfish**

(*Carassius auratus*), **Yellow floating heart** (*Nymphoides peltata*), **Eurasian watermilfoil** (*Myriophyllum spicatum*), and **Yellow flag iris** (*Iris pseudacorus*), started out in garden ponds or in home aquariums. It is inhumane to release unwanted pets and in some instances is unlawful to introduce species into the natural environment. We can protect BC's biodiversity by making sure we are responsible pet owners. Never release animals into the wild, and do not dump aquariums or water garden debris into waterways or sewers. Instead, rehome the animal, and dry or freeze unwanted aquarium plants before disposing of them into the trash. Do not compost!



**DON'T LET IT LOOSE**



## PlantWise

Help protect natural habitats by being a responsible pond and landscape gardener.

Many plants sold in nurseries and grown in gardens, including **English ivy** (*Hedera helix*), **Fragrant waterlily** (*Nymphaea odorata*), **Russian olive** (*Elaeagnus angustifolia*) and **Butterfly bush** (*Buddleja davidii*), are invasive and can spread from the garden, impacting native species and their streamside (riparian) and aquatic habitats. Know what you grow. Be PlantWise. Learn about native and non-invasive — and equally beautiful! — plants from the Grow Me Instead Guide available on our website.



## Buy Local Burn Local

Insect pests, like

**Spongy moth**

(*Lymantria dispar* *dispar*) and **Spotted**

**lanternfly** (*Lycorma* *delicatula*), eat

trees. Their eggs, larvae or even adults could be hiding in firewood. It is important to only burn local firewood when you are camping, and not to transport wood from one location to another. Heat treated and pest-free firewood may also be available. This keeps invasive insects from spreading to new locations. By practicing Buy Local Burn Local, we can keep our forests healthy, in turn protecting our waterways from erosion, flooding, and sedimentation.



English ivy; M. Syvenky



Spotted lanternfly; L. Barringer, Bugwood.org



Fragrant waterlily; R. Routledge, Bugwood.org



Spongy moth; H. Lemme

# Take Action:

## Getting Your Hands Dirty to Help Your Local Waterway

Do you want to take action along a waterway in your community?

A stream, lakeshore, or wetland stewardship project is a great way for students to experience the environment and help protect it.

Stewardship projects offer active outdoor and place-based learning, community engagement, and opportunities for social responsibility.

Restoring and protecting a natural area can be an educational and rewarding way to make a real difference in your backyard!

Here are some tips to get you started.

1. **Find a nearby location and enjoy exploring!** Ask other educators or people in your community about nearby locations, as they may have useful tips on places and projects. If you do not have easy access to a waterway, consider your location within the watershed. Efforts made on land make a difference to water, too!
2. **Contact the land manager and get permission to go to the site.** It's important to know who owns or manages the property (municipal government, regional district, province, private landowner, or other manager) and ensure that your group is allowed to visit or do a project there. Although this step may take time, land managers are key to your project. They can let you know what types of activities are allowed at the site and ensure that you have permissions in place for your visit or project.



They may also be able to offer a guided site visit or suggest other community partners. Importantly, they may also be able to facilitate invasive plant removal projects and provide your group with guidance, tools, and proper disposal of plant material.

3. **Explore the site with students and connect them to place.** Visit the site multiple times with your group. Setting the emotional stage for taking the 'leap into action' comes from having the freedom to explore and observe. Have students create a nature journal to record personal observations on the geography, plants, and signs of animals.
4. **Empower students and spark their inquiry.** Support students so their interests and curiosities guide the project. What are they interested in learning and where do they think they can make a difference? Consider framing an inquiry and action project around a big question, like "How can I be a steward of this place?" or "How do invasive species impact this place?". Brainstorm types of stewardship work that would be interesting and appropriate at the site. Small groups could work together to produce project questions and consider opportunities, solutions, and actions to help solve an environmental issue, such as invasive species management.
5. **Dig deeper into learning.** Support student inquiries and dig deeper by getting to know the area using maps to understand its place within its watershed. Learn about and discuss the human history, uses, and impacts on the site. Connect with local First Nations to learn the name of the site in the local

language, the relationships with the land, and changes at the site since colonization. Try some plant identification using field guides and free apps, like iNaturalist or SEEK. Learn what invasive and native species are found at the site through your direct observations or online research. Connect with ISCBC! We can help you with this! [education@bcinvasives.ca](mailto:education@bcinvasives.ca)

6. **Partner and Collaborate!** Connect with a local naturalist, watershed enthusiast, or community group for the lowdown on local plants and animals. They might also help your group take action to remove invasive plants, plant native species, or help with other shoreline restoration projects. Partners can provide valuable leadership, expertise, skills, as well as the inspiration and guidance to get work done on the ground. **Your student group is a great asset to partner organizations!** Not only is ‘kid power’ awesome — many hands make light work — but students and schools are also great connectors, bridging local organizations with the greater community.

### Where to Find Partners for Stewardship Projects

- Regional Invasive Species Organizations
- Nearby high schools or colleges
- Local governments (city or regional district)
- Parks and protected areas (including city, regional district, provincial, national, or privately owned)
- Adult naturalist clubs (for example, BC Nature)
- Local environmental organizations and land trusts
- Watershed societies (for example, Watersheds BC, Stewardship Centre of BC, BC Lakes Stewardship Society)
- Department of Fisheries and Oceans
- “Friends of” groups
- Native plant nurseries
- And don’t forget us at ISCBC! Get in touch with our Education Team and we can help connect you to contacts in your region

# Tips for Effective Environmental Education

“In the end, we will conserve only what we love, we will love only what we understand, and we will understand only what we are taught.”  
- Baba Dioum

Learning about and experiencing the environment can create a life-long connection to nature and community. Yet environmental issues, such as invasive species, may be overwhelming; anxiety and hopelessness may prevent some people from engaging or taking action. As educators, we want to ensure that lessons are relevant and meaningful to each learner and that they inspire a deep connection to place and personal responsibility to the environment.

Research has shown there are some key elements that ensure the effective delivery of environmental education.

## **Avoid eco-anxiety**

Some ways to empower learners and reduce potential negative emotions include:

- Establishing a sense of collectiveness, which helps maintain optimism; a ‘we are all in this together’ approach.
- Balancing necessary negative information with solutions and positive paths forward. Behaviour change actions (Clean Drain Dry, Don’t Let it Loose, and other best practices described in the Background section) help to maintain a solution-focused approach to these topics and encourages students to stay optimistic.

## **Maintain a positive perspective on the field of science**

Science can be a polarizing topic for children and is often characterized by fear or avoidance rather than interest and passion. We want to ensure children have a positive learning experience. Sharing concepts in small parts that are easy to understand, communicating in an inclusive, non-intimidating way, and allowing for open discussion are all ways we can achieve this.

## **Ensure engagement to develop long-lasting take-home messages**

When students are engaged they are more likely to retain information and have a positive and fulfilling learning experience. Some ways to increase student engagement include:

- Centering lesson plans on discussion questions and participation.
- Encouraging discussion at an appropriate pace, relying on information discussed earlier in the lesson ensuring children can make meaningful connections.



## **Incorporate active learning strategies**

Active learning encourages deeper understanding and engagement in a topic. Some ways to encourage active learning include:

- Engaging in discussion before presenting the lesson to allow children to synthesize information independently.
- Including discussion questions requiring critical thinking.
- Challenging children to draw upon prior knowledge or experiences while participating in open discussions to encourage creativity in responses.

The activities within this Guide are intended to address all these elements by focusing on engaging, hands-on learning with a positive, action-oriented perspective. We include background concepts to introduce the activity, discussion/reflection questions, and ideas to extend the learning and take action. By setting a positive tone and relaying enthusiasm for the subject, educators can help ensure success.

We thank and acknowledge Samantha Marohn, ISCBC Youth Volunteer, for sharing her expertise on this subject. For more information, see:

Cao, S., MacDonald, K., Marohn, S., & Zhang, X. (2020, April 30). Ecological literacy in Riley Park : Community accessible lesson plans for elementary school aged children [R]. doi: <http://dx.doi.org/10.14288/1.0397012>

# Know Me, Know My Adaptations

By playing a ‘Who Am I?’ type of game, discover the adaptations of native and invasive plants and animals found in and around wetland habitats. Explore how adaptations help the organisms to survive and the ‘superpowers’ that give invasive species a competitive edge.

## CONCEPTS

All living organisms have evolved unique traits called adaptations that allow them to survive in their particular habitat. These adaptations ensure that they can find food for energy, stay safe from predators, and reproduce. Examples of adaptations include: colouring enabling a species to camouflage and hide from enemies; claws to open shells or nuts; webbed feet to move quickly through water; sharp spikes to protect from predators. As described in the Background section of this guide, invasive species have adaptations that allow them to outcompete native species for basic needs such as food, shelter and space. These ‘superpower adaptations’ allow them to spread rapidly and take over.

## MATERIALS AND PREPARATION

1. Your group will be divided up into species teams of approximately three members per team. No one will know their species identity or who is on their team.
2. Print images of native and invasive species. Find your own or use the images and quick facts in Appendix 1 and 2: invasive and native species found in or near freshwater habitats in BC. You will need as many different images as the number of teams, with three duplicates of each image. For older students you could use names of species instead of images.  
*For example, if you have 21 in your group, you will need to choose 7 different species images, making 3 copies of each so every student has an image.*  
*Choose more native species than invasives.*
3. Print one worksheet (at end of this lesson) for each species team.
4. Determine a way to secure species images and/or labels on students’ backs (e.g., clothes pins, safety pins).

## Superpower Adaptations!

American bullfrogs can lay up to 20,000 eggs. They are the largest frog in North America and eat anything they can fit in their mouths — even ducklings!

## PROCEDURE

1. Discuss the concept of species adaptations with the group and share some examples using the Adaptations Table provided.
2. Attach a species picture to each student's back.
3. Students walk around asking each other Yes / No questions to discover their secret identity and find their 'species matches.'
4. Once all students are in their species team of three, hand out a worksheet to each group, to guide them on figuring out the habitat of their species and its adaptations that help it to survive in its environment. (For example, Beaver / strong teeth).
5. Once they have enough time to work through worksheet questions, discuss invasive species and their characteristics for dominating the habitat, and ask if they can identify which ones are the invasives species.

## WRAP IT UP: REFLECTIONS AND EXTENSIONS

- Have each group give an example of an adaptation allowing a species to succeed in its habitat.
- Ask all students to help create a class list of 'superpower adaptations' of invasive species.

**EXTENSION:** Students choose one superpower that they can feature in a drawing of their species.

## TAKE ACTION!

Go outdoors to learn more about the native and invasive species in your neighbourhood, looking closely for adaptations. Make a field guide or outdoor signs to teach others about what plants live there and how they survive and thrive.

## Adaptations: What traits does an invasive species have that contribute to its spread?

	American bullfrog	Yellow perch	Eurasian watermilfoil
<b>PHYSICAL TRAITS</b> Such as size, colour, shape	<ul style="list-style-type: none"> <li>• Large size</li> <li>• Green and brown colour camouflages them from predators and prey</li> </ul>	Banded pattern camouflages young fish from predators	Long, slender, branching stem and feathery leaflets. Can produce an entire new plant when fragmented
<b>BEHAVIOURS</b> The species' behaviours that help it survive, and human actions that help it to spread	<ul style="list-style-type: none"> <li>• Can jump 10X their body length</li> <li>• Able to fling their tongue out and catch prey above and below the water</li> </ul>	<ul style="list-style-type: none"> <li>• People who like to fish introduce them (illegally) to lakes and ponds</li> <li>• Will migrate to new regions in search of food</li> </ul>	People accidentally move it to new locations on boat propellers, trailers, and fishing gear, or by dumping aquarium contents
<b>LIFE CYCLE</b> Such as life span, reproduction, dispersal	<ul style="list-style-type: none"> <li>• 20,000 eggs laid by one female</li> <li>• Long breeding season compared to other frogs</li> <li>• Tadpoles are large and take two years to develop into adults</li> </ul>	<ul style="list-style-type: none"> <li>• Spiral shaped strings of 15,000 eggs</li> <li>• Reproduces earlier than other fish</li> </ul>	Spreads from roots, seeds, buds, and plant fragments
<b>FOOD CHAIN</b> Who eats it, who it eats, diseases, parasites	<ul style="list-style-type: none"> <li>• Adults eat everything that can fit in their mouths: fish, other amphibians, ducklings</li> <li>• Adults eat animals that would prey on their tadpoles</li> <li>• May spread diseases to native amphibians</li> </ul>	<ul style="list-style-type: none"> <li>• Generalist omnivore, eating plants, invertebrates, other fish including young salmon</li> <li>• Known to carry parasites harmful to other fish</li> </ul>	Creates areas of still water that become breeding habitat for mosquitos
<b>OTHER</b> Including habitat preferences, or ecological changes that it benefits from	Can live in many types of wetland habitats, including small garden ponds, and migrate to other wetlands	Can live in freshwater habitats and estuaries (brackish water) and can tolerate a wide range of water temperatures.	Grows well in low oxygen and slow moving waters. Its spread makes water slower moving and lower in oxygen levels.



## Know Me, Know My Adaptations: Student Datasheet

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Group members:

1. Name of animal or plant:
2. Where does this plant or animal live in BC?
3. Describe its habitat.
4. How does the organism move around or spread?
5. Does the animal or plant have any predators? How does it try to protect itself from predators?
6. If it is an animal, what does it eat?
7. What are some ways the animal or plant is adapted to its environment?
8. Draw one of the species' 'superpower adaptations'.

# Rainy Day Watershed Walk

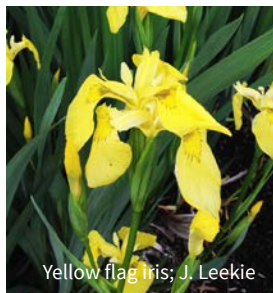
No matter where you are — in a city, a forest, or grassland — you are in a watershed. Collect data about flowing water in your schoolyard or neighbourhood and consider how to help protect freshwater habitats from invasive species and other impacts.

## CONCEPTS

Water is always moving through the water cycle. Some of the ways we observe water moving is through evaporation, precipitation, and when it runs over surfaces like a roof, driveway, or lawn. This is also called stormwater runoff. Since we all live in a watershed, how we treat the water in our home and community affects everyone and everything! Gravity moves water from high points to low points. While water flows, it can pick up pollutants like chemicals and litter, and can even spread invasive species!

## MATERIALS

- Paper and writing utensils to make maps
- Copies of the Map Legend
- Clipboards



Yellow flag iris; J. Leekie



Japanese knotweed; B. Stewart



Yellow floating heart;  
D. Cappaert, Bugwood.org



Himalayan balsam; MAL



Goldfish; W. Christ, Canva

## DID YOU KNOW?

### Invasive plants in the watershed

**Yellow flag iris** (*Iris pseudacorus*) can disperse to new areas by its floating seeds.

**Japanese knotweed** (*Reynoutria japonica*) can take root and grow from discarded plant fragments that spread to new areas by the rain. Large rainfall events can overflow ornamental ponds, transporting **Goldfish** (*Carassius auratus*) and aquatic plants, such as **Yellow floating heart** (*Nymphoides peltata*), to other bodies of water where they can thrive and take over.

Invasive plants also impact how water flows through the watershed. For example, **Himalayan balsam (Policeman's helmet)** (*Impatiens glandulifera*) is an annual plant that has shallower root systems than native plants in its habitat. When it dies back in winter it can lead to increased sedimentation and erosion along waterways. **Yellow flag iris** produces a thick mat of rhizomes (underground horizontal stems) that connect hundreds of plants, decreasing water flow and blocking wildlife access to and from water.

## PROCEDURE

1. Find out what watershed you are in by searching regional or municipal government websites and maps. Or enter your address on a map app and click “Show Terrain” to see the ridges and valleys that surround your school or home. Looking at these maps, can you predict where the water would flow? What is the closest water body to your house or school? Note that some urban areas drain directly to coastal shorelines via constructed storm drain networks.
2. Before it rains: Using symbols from the Map Legend provided, draw a map of your area. Include any water bodies or storm drains that are nearby. Option: divide the mapping area into sections and have different people work on each area. Then combine each section into one map.
3. Predict where the water will flow when it rains. Indicate water flow on your map with arrows. Can you determine where the water from the roof goes? What about the parking lot, basketball court, or other “impervious” surfaces? Test it out: watch where a ball rolls on these surfaces to see if you are right!
4. Use the Invasive Species cards (Appendix 1), field guides, online PlantWise guide, or ID apps to look for invasive species on the property. Don’t forget to check gardens and ornamental ponds! Draw any invasive plant locations on your map.
5. Next time it rains, go outdoors with your map, and see if your predictions were correct! Discuss reasons for discrepancies and adjust your map with new observations.
6. Are there any pollutants that water might pick up as it flows through the property? Any litter? What about invasive plants? What are

some things you can do to keep the water in your area clean as it travels to other bodies of water in the watershed?

### Younger student adaptation

Have students work in small groups to investigate sites of flowing water and observe what is in the water without touching it (especially if it is running off a parking lot). Construct tiny boats using sticks and leaves. Have boat races to see how far and where the boats travel. Draw pictures describing what the tiny boat might encounter along its journey. Discuss reasons why the schoolgrounds/your area should be kept clean and free from invasive species.

## WRAP IT UP: REFLECTIONS AND EXTENSIONS





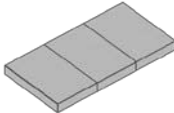

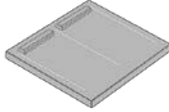







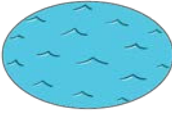




- **What is a watershed?** Be able to name the watershed where you live.
- **If someone lives far away from a lake, river, or other body of water, how can their actions make a difference to water quality? What is something that they might do to make water quality better or worse?**
- **How do invasive species affect water quality?**

## TAKE ACTION!

Based on your map and observations, decide what could be done to help clean up your watershed. You could promote litterless lunches, organize an invasive weed pull, or plant native species in a waterlogged spot. Get your group together, make a plan, and take action!

*Inspired by Rainy-Day Hike, in Project WET Curriculum and Activity Guide, Generation 2.0, 2011. Project WET Foundation.*

## Rainy Day Watershed Walk: Map Legend

	Building		Slow flow
	Trees		Fast flow
	Sidewalk		Storm drain
	Parking lot		Flower beds
	Downspout		Grass
	Trash can		Playground
	Natural litter (leaves, twigs, etc.)		Garden pond
	Water		Invasive plant
	Oil		Invasive animal
	Trash		



# Wetlands' Most Unwanted!

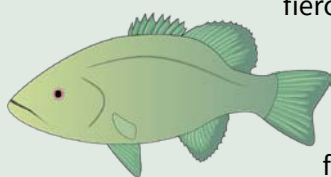
## DID YOU KNOW?

### Japanese knotweed

(*Reynoutria japonica*) can grow through asphalt! In some parts of the world where it is invasive, you cannot get home insurance if knotweed is on your property.



### Smallmouth bass (*Micropterus dolomieu*)



fiercely defend their nesting sites, preventing native fish from using the same habitat. They also have a large mouth and are not picky eaters, gulping up smaller fish, amphibians, crayfish and aquatic insects.

If the clear sap of **Giant hogweed** (*Heraclium mantegazzianum*) gets on your skin it can cause severe burns, painful blisters, and purple scars that can last for years!



A single flower spike of **Butterfly bush** (*Buddleja davidii*) can produce 40,000 seeds, which are dispersed by wind and water, allowing them to spread especially well in riparian areas where they negatively impact the soil that native plants rely on.

After researching invasive species occurring in or around waterways, create a WANTED for Crimes Against Biodiversity poster highlighting an invasive species threatening your region.

## PREPARATION AND MATERIALS

- For resources on aquatic invasive species, refer to field guides, ISCBC website: [bcinvasives.ca](http://bcinvasives.ca), and Appendix 1.
- Copies of the WANTED poster template
- Drawing materials

## PROCEDURE

1. **Research.** Have students research an invasive species found in or near aquatic habitats. The species might be one already in BC, or one that we want to prevent from being introduced.

Consider the following:

- **In what habitats is the invader found?** (e.g., lakes, rivers, ponds, ditches, forests near streams, riparian zones.)
- **What are its distinguishing physical traits?** (Colour, size, markings.)
- **How does it spread?** (By seeds, roots and stem fragments; eggs floating downstream or sticking to watercraft; hitching a ride with birds or people.)
- **What are its competitive traits and adaptations that allow it to become invasive?** (Being toxic or dangerous to would-be predators; eating large amounts, tolerating poor water quality; taking up space.) See some examples of adaptations in the activity “Know Me, Know My Adaptations.”

- **What native species are impacted by the invasive species? How does it impact the habitat?**
  - **How can it be stopped?** (Such as by practicing Clean Drain Dry or Play Clean Go.)
2. Draw a picture of the species or print a photograph.
  3. Summarize the researched information on the poster.
  4. Will there be a Reward? (Perhaps from the native species from the habitat?)

ISCBC would love to see your students' posters!  
Send photos to [education@bcinvasives.ca](mailto:education@bcinvasives.ca).

## WRAP IT UP: REFLECTIONS AND EXTENSIONS

- Have a group discussion or sharing of posters.  
**What are the most serious impacts?**
- Have a class quiz using interesting facts from the posters and/or using the Aquatic Invaders Trivia Challenge found in this Educator's Guide.
- Go outdoors to look for native and invasive species in your community.

## TAKE ACTION!

Share your posters with others in your community by displaying them in a public place or online.

# WANTED

 FOR CRIMES AGAINST BIODIVERSITY 

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**NAME:**

**CRIMES:**

**HOW YOU CAN HELP STOP THE SPREAD:**

**REPORT ANY SIGHTINGS TO ISCBC**

 **Invasive Species  
Council of BC**

# Vectors of Spread: 'Stop the Spread' Challenge

In hands-on stations, simulate how water moves through a watershed and how human activity can spread aquatic invasive species.

A **vector** is the 'agent' or means by which an organism spreads from one place to another. Wind, water, soil, people, pets and other animals are often responsible for spreading invasive species. Our recreational activities such as boating, fishing, hiking, and off-roading, can also be vectors of spread for invasive species.

## CONCEPTS

A watershed is an area of land where all the water that runs through it drains into the same place. Different watersheds are separated by hills or mountains. Two lakes close to each other may drain into different watersheds. Although they might seem like similar habitats, they may be composed of entirely different aquatic species. All the water bodies within a watershed are connected. Aquatic organisms do not typically travel between watersheds naturally; however, people sometimes move organisms from one

lake or river to another. Some of these activities include live fish bait being dumped into lakes; unwanted aquarium water, pets, and plants being released into ponds; and eggs and larvae of aquatic animals being transported in boat bilge water between lakes. If organisms moved to new watersheds happen to be invasive species, they can invade a whole new watershed, not just a single body of water.

One of the greatest problems with invasive species is their ability to quickly reproduce and spread from one area to another. Invasive species travel further with the help of many vectors like water, wind, clothing, pets, vehicles, boats, soil, and gravel, to name a few. Some aquatic animals,

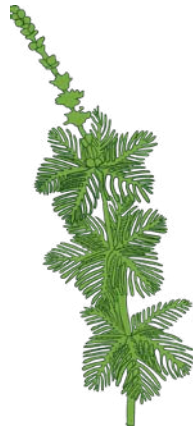
such as **Freshwater jellyfish** (*Craspedacusta sowerbii*) and **Zebra** (*Dreissena polymorpha*) and **Quagga** (*Dreissena rostriformis bugensis*)

**mussels**, have microscopic free-swimming larvae that can enter water-holding areas or bilges of boats to be transported far and wide. Some aquatic plants and animals can survive out of water for a surprisingly long time (up to 30 days for Zebra mussels!). This allows them to hitchhike on our toys, vehicles, equipment, clothing, and pets or livestock. That means





invasive plants and animals can be transported to new locations by mistake. Even a small fragment of a plant, like **Eurasian watermilfoil** (*Myriophyllum spicatum*) or **Parrot's feather** (*Myriophyllum aquaticum*), is enough to start a new colony. Hiking and walking the dog can also spread invasive plant parts and seeds that hitch a ride on boots, fur, clothing, and gear. These invasive species can be transported to riparian areas where they can impact habitats and species on land and in water. For example,



**Himalayan blackberry** (*Rubus armeniacus*) can displace native trees and shrubs along rivers and streams, where the invasive plant increases erosion and provides less shade along salmon-bearing streams.

To avoid accidentally transporting invasive species, we need to inspect and clean boats and vehicles, clothing and equipment before leaving an area — particularly if the area is known to have invasive species.

## STATION 1: Clean Drain Dry at the Lake

Students place toy boats in tubs of water to investigate how fragments of aquatic plants or aquatic animals can attach to watercraft and spread to another body of water. Students are challenged on how well they can clean, drain, and dry their watercraft to stop the spread.



## MATERIALS AND PREPARATION

### 1. Gather materials:



- Two large bins filled with water — labelled 'Lake 1' and 'Lake 2' (choose local water body names).
- Additional water sources will be needed to drain/refill one of the bins at the start of each round.
- Three to five miniature 'watercrafts' such as toy boats, or any floating material such as plastic bottles, trays, containers and lids (like a paddle board).

- Dried herbs, such as basil, sage, or dill weed (representing aquatic invasive plants or animals). Sprinkle 1-2 spoonfuls into only one of the 'lakes' (water bins); this is Lake 1.
  - Three to five tools for cleaning watercraft, such as spray bottles, brushes (old toothbrushes), sponges, and cloths.
2. Choose a location where two large bins/totes can be filled with water and drained multiple times (outside is ideal and have buckets of extra water on hand).
  3. Divide class into small teams of approximately five people. **NOTE:** This challenge can be done simultaneously by two teams (increases excitement) if you have enough materials to duplicate the station. Alternatively, each team can circulate through the station (renewing water in the 'clean lake' for each team) and results can be recorded by collecting data (such as by taking photographs) with one student designated as Inspector, to keep track of challenge results.
  2. Set the scene: Students are recreating at a local lake with boats, paddleboards, floaties, fishing gear, etc. and will use these watercraft and equipment in another lake the next day. Lake 1 has aquatic invasive species. The watercraft and gear must be completely free of invasive species (cleaned, drained, and dried) before leaving Lake 1. The Invasive Species Inspector will be on-site to inspect.
  3. Set timer for four minutes.
  4. Have the team play with watercraft in bin/ Lake 1 covered with dried herbs, followed by a good clean, drain, and dry of each watercraft until the team believes boats are free of invasive aquatic hitchhikers, within the four-minute time limit.



## PROCEDURE

1. Group Discussion and Brainstorm
  - **Where do people like to go to swim, float, and boat in your area?**
  - **What plants and animals do you think live in the waterways? Could there be invasive species?** (See Appendix 1 for some examples)
  - **What can people do to prevent the spread of plants and animals that we may not even see from moving from one to another on our watercraft and toys?** (Clean Drain Dry)
5. Have the Inspector ask that each watercraft be individually placed in bin/Lake 2 — the 'clean lake' — so everyone can see if they passed the test to stop the spread. Record results by counting the number of herbs transferred to Lake 2 or by taking a photo.
6. Refill clean water in Lake 2 to prepare for the next team. Add more herbs to Lake 1.

## STATION 2:

### Pond Jumpers in a Watershed Demonstration

Egg cartons or ice cube trays are used to represent watersheds, with coloured water illustrating how species can spread from lake to lake. Note: This can be done as an activity to demonstrate to your group, rather than setting up multiple times for many groups to trial.

### MATERIALS

- Two ice cube trays or plastic/styrofoam egg cartons
- Two colours of food colouring
- A 500 ml measuring cup
- A spoon
- Water
- A bin large enough to hold the egg cartons and other supplies
- Towel

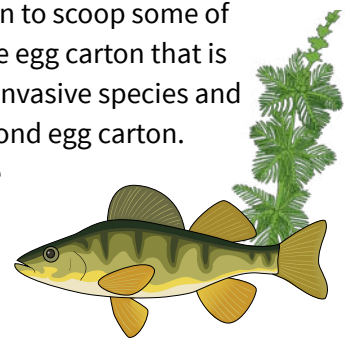
### DID YOU KNOW?

It is a glorious summer day and you are enjoying a swim at a lake. Suddenly, you are surrounded by hundreds of... jellyfish? Smaller than a thumbnail and not harmful to people, the Freshwater jellyfish, *Craspedacusta sowerbii*, was first found in BC in Killarney Lake on Vancouver Island in 1990. It has since been detected by community observations in more than 30 lakes in BC. The Freshwater jellyfish uses its stinging tentacles to paralyze and eat zooplankton and other small aquatic animals. Native to the Yangtze River Basin in Asia, the jellyfish has spread to every continent except Antarctica. While the ecological impacts of the jellyfish are not known, we can expect to see more of them with climate change. We can help prevent the spread of this new invader by practicing Clean Drain Dry.



### PROCEDURE

1. Fill both egg cartons with plain water.
2. Put one food colour in an egg cup in one of the cartons, to represent a native species.
3. Put some water in the measuring cup, adding a second food colour to represent an invasive species.
4. Pour the invasive species water slowly into the egg cup with the 'native species' and observe what happens.
5. Continue pouring slowly. When the water level reaches the tops of the egg cups, observe that the water in the cup with a few drops of food colouring changes colour and moves from cup to cup throughout the watershed.
6. Now use the spoon to scoop some of the water from the egg carton that is infested with the invasive species and put it into the second egg carton. This would be like transferring an invasive species like **Yellow perch** (*Perca flavescens*) or **Eurasian watermilfoil** (*Myriophyllum spicatum*) from one watershed to another.
7. Discuss what this transfer would mean in a real watershed. (Once a species is introduced to one body of water, it can travel through water systems to other water bodies.)



### STATION 3: PLAY CLEAN GO AND SEEDS IN OUR TREADS

At this station, students use toy vehicles and boots to illustrate how people can accidentally transport invasive species in the treads of their shoes/boots, horse hooves, pet fur, and on wheels of cars, bikes, and ATVs. Students are challenged to ‘Play’ in soil loaded with seeds, and then ‘Clean’ the boots and wheels before they can ‘Go’ to the next recreation site without transporting any invasive plants.



#### MATERIALS AND PREPARATION:

1. Gather materials:
  - Potting soil moistened with water (use a spray bottle) or create a muddy space about 1 square metre in area.
  - One to two cups of spice seeds such as fennel, cumin, or sesame seeds, that can be easily seen in mud. Spread the seeds on top of mud.
  - Two to three sandbox-type toy trucks or anything with wheels.
  - Large rubber boots for students to easily put on.
  - Approximately five brushes for cleaning wheels and boots. Toothbrushes or dish/sink brushes work well. PlayCleanGo boot brushes are available for purchase from ISCBC’s online store.
  - Optional: Long piece of cloth (such as an old bedsheet) to walk/drive toy trucks on top to view how seeds can disperse to new areas.

2. Choose an outdoor location with bare soil or an area that can get messy with wet potting soil.
3. Divide class into small teams of approximately five people. NOTE: This challenge can be done simultaneously by two teams (increases excitement) if you have enough materials to duplicate the station. Alternatively, each team can circulate through the station and results can be recorded by collecting data (such as by taking photographs) with one student being designated as Inspector, keeping track of challenge results.

#### PROCEDURE

1. Set the scene: Students are driving and hiking along muddy trails. It is the end of the day, but they cannot leave until their wheels and boots are all clean. Give examples of local invasive plants that have large numbers of windblown or sticky seeds, such as thistle, Butterfly bush, or Purple loosestrife. The Invasive Species Inspector will be on-site to inspect.
2. Set timer for four minutes.
3. Have the team play with toy trucks and walk boots through mud/seed patch followed by a good cleaning with brushes until the team believes they are free of ‘invasive terrestrial hitchhikers’ — within the four-minute time limit.







4. Have the Inspector look at each wheel and boot tread for signs of seeds to see if they passed the test to stop the spread. An option is to have a clean cloth or towel to 'drive' and walk on. Record results by counting remaining seeds.

## WRAP IT UP: REFLECTIONS AND EXTENSIONS

1. **What are some characteristics of invasive species that help them succeed in new habitats?**
  - Lack of natural predators
  - Fewer requirements for basic needs (food, water, shelter, room to grow)
  - Prolific reproduction
  - Effective methods of spread
2. **What are some examples of vectors of spread?**
  - Water, wind, boats and watercraft, people's clothing and footwear, pets, soil, and vehicles.
3. **What are some ways that people can prevent the spread of invasive species?**
  - Never dispose of aquarium water in household drains, sewers, ponds or ditches. Let the tank dry out on land.
  - Clean, drain, and dry boats and all watercraft (paddle boards, canoes, floaties) on land when you leave a body of water.
  - Don't Let it Loose. Never release fish or other pets into the wild or waterways.
  - Pick off any seeds and pieces of plants from boots, laces, clothing and pets, and dispose of them properly.
  - Wash vehicles and recreational equipment, including bikes, car and truck tires and bumpers, and ATVs.

**EXTENSION:** Go outdoors to a local body of water and observe the plants and animals on/ in the water and in the surroundings. Look for floating seeds or plant parts and 'hitchhikers' on boots, clothing, and gear.

## TAKE ACTION!

On your outdoor excursions, make sure to practice PlayCleanGo and Clean Drain Dry — and feel good that you are helping to protect special places from invasive species!



# Wetland Wonders

In this outdoor exploration, students use all their senses to tune in to nature, hone observation skills and spark curiosity about aquatic habitats. From their direct experiences, they consider positive and negative impacts on the environment, including invasive species.

## MATERIALS AND PREPARATION

### 1. Gather and print materials.

- Choose one of the two copies of the My Wetland Wonders Datasheet and make copies.
- Clipboards and writing utensils.

### Optional materials

- Hand lenses/magnifiers, hand spade or spoons for possible sub-surface investigations.
  - Collection containers (raid the recycling bin for clear plastic containers with lids and egg cartons) for close up/temporary viewing of small living organisms and non-living objects.
  - Native and invasive species cards (Appendix 1 and 2), or field guides and ID apps.
2. If possible, visit the field site in advance to identify the best places for sensory exploration, sheltered areas, and any natural hazards to avoid.

## PROCEDURE

### Class Discussion and Brainstorm

Share some information on the habitat. Discuss what makes this place special or different from nearby natural areas the children may be familiar with and what plants and animals might live there. Create a **Know-Wonder-Learn** Chart: What do you **Know**, what do you **Wonder**, and what did you **Learn**. Fill it out with your group.

### On the Field Trip

#### 1. Group Sensory Wake-Up Circle

(approximately five minutes). Depending on your group, and especially for older students, you may want to skip directly to step 2. Have everyone stand in a circle and tell them you will ‘wake up’ each of their senses to better explore and observe the environment before they go off to their own ‘sense spot.’ Remind them that we always have the most important tools with us to help explore and decode nature: our five senses. Even the best scientists rely on their senses to make new and important discoveries.

- **Start with Touch:** Rub your hands together vigorously to get the energy flowing. Stop and hold up your hands and feel the heat and tingling in your fingertips. Touch the ground at your feet and describe its texture/temperature/moisture. Rub your hands again and use that energy to wake up each of the other senses.

- **Hearing:** Transfer the energy from your hands to your ears and sense of hearing. Give instructions in a quiet whisper to encourage everyone to be silent. Cup your hands around your ears so that the area for capturing sound is enlarged, like a deer or bat. Try putting your 'ears' on backwards, cupping in the other direction to hear what is behind you. Close your eyes and listen for 20 seconds. How many different sounds did you hear?
- **Smell:** Rub your hands together again and transfer the energy to your nose. Drop your hands and then take a deep breath through your nose. Describe the smell and how it compares to other areas at home or school.
- **Sight:** Transfer the heat energy from your hands to your eyes. Cover your eyes and then remove your hands. Look up to the sky, then down low and close to the ground. Share something that you noticed that you did not see before. Do it again, but this time lying on the ground on your back to look up at sky/trees, then on your belly to look at the micro-world. Note: 'back and belly time' is another good opportunity to take deep breaths and smell again.
- **Taste:** Stick out your tongue like a snake and 'taste' the air. Catch a raindrop or snowflake on your tongue. Remind everyone that you won't taste anything today (until snack time)! Many berries, fungi, and leaves are toxic to people.

## 2. Time to Explore!

- Set boundaries of the exploration area.
- Pass out the Wonder Datasheets and clipboards and explain how each sense is needed to complete the sheet. Explain that you will start with sound, and everyone will need to be silent for one to two minutes once they have chosen their 'sense spot.'
- Have everyone find their own personal 'sense spot' where they will do the activity. Sense spots should be well-spaced out within the exploration area.
- Start off by having everyone in their sense spots, silently with their eyes closed and listening to the sounds around them (one to two minutes). Then they can draw or note some of the sounds on their Wetland Wonders Datasheet (Datasheet #1) or create a Sound Map (Datasheet #2).
- Encourage different perspectives, such as a 'bird's eye view' and 'slug's eye view'; use magnifiers if available. Gently feel textures of different plants, the moisture in the soil, smells of plants, bark, and flowers. Look for signs of living things like animal tracks, feathers, insects, and chewed leaves.
- Encourage and challenge the group to look for 'mysteries' — things they notice and observe using their senses, and what they wonder/are interested in learning more about. Allow for inquiry and investigation (some questions can remain as mysteries)!

Did you know that invasive Himalayan balsam produces so much nectar that it draws pollinators away from native plants?



### SOME EXAMPLES OF OBSERVATIONS OR 'MYSTERIES.' (find your own!):

- I notice there are many plants growing on the surface of the water in this area.
- What animal made that track and what was it doing here?
- Why do cattails make fluff and what is it?
- I heard a splash and saw a fish. I wonder why that fish jumped out of the water.
- I heard a croaking sound. What types of frogs live here?
- I found a floating seed at the water's edge. What plant does it come from?
- Why are there so many insects visiting the plant with purple flowers?

There's so much life in the wetland to discover! Keep your senses tuned in for some invasive species. You can help protect the wetland by reporting invasive species using iNaturalist, Report Invasives BC or on the ISCBC website.



### WRAP IT UP: REFLECTIONS AND EXTENSIONS

- After everyone had enough time to explore their sense spot and fill out their Wetland Wonders datasheet, learners join to 'pair-share'. Give each pair the opportunity to visit each other's sense spots to share one of their favourite observations and one of their mysteries.
- Gather everyone back together as a whole group to reflect upon and share their experiences. **What did they observe that they had not noticed before? Using their senses, what did they discover about the environment and what would they like to learn more about?**

### EXTENSIONS:

- If a KWL chart was made prior to the field outing, revisit the chart and fill out the last column (what was **Learned**).
- Compile all the wonder questions and consider which ones could be answered with more research and investigation.
- Make a class field guide to the wetland/aquatic habitat. Brainstorm as a group a list of all the native and invasive animals and plants observed at the wetland and others that could be found there.
- Compare two sense spots: one close to the water's edge and one in the riparian area or further inland.

### TAKE ACTION!

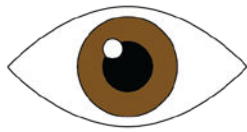
Address negative environmental impacts that were observed on site, such as a litter clean up, a weed-pull, native planting event, or an awareness campaign.

## Sensing Invasive Species at the Wetland



### LISTEN for:

- American bullfrogs: As you quietly walk along the water's edge, listen for a squeak-like alarm call and then a splash as bullfrogs jump into the water when they detect your presence or are disturbed. Adult males croak a sound like "jug-o-rum" in the spring and summer to attract females and establish territories.
- Whistles, chatters, and trills of flocks of European starlings.
- The splash of what might be invasive fish jumping out of the water (Smallmouth bass or Asian carp).



### LOOK for:

- Signs of Nutria (an invasive aquatic rodent, smaller than a beaver and larger than a muskrat): burrows in vegetated banks and floating platforms of aquatic vegetation up to a metre high.
- A rainbow of invasive plants
  -  Orange hawkweed flowers
  -  Yellow-flag iris flowers
  -  Look for green leaves in and on the water surface, like the lily pads of Fragrant water lily and Yellow floating heart, and the feather-like leaves of Eurasian watermilfoil
  -  Flower of Common periwinkle, Purple loosestrife and Butterfly bush; Berries of English ivy and Himalayan blackberry
  -  Flowering rush flowers, Himalayan balsam
  -  Fragrant water lily flowers, Russian olive leaves (silvery-white)



### SMELL:

- The almond scent of Flowering rush flowers
- Fragrant water lily's fresh, sweet, lemony scented flowers
- Sweet, honey-like scent from Butterfly bush
- Musty smell of crushed leaves of Himalayan balsam
- Cinnamon-sweet fragrance of Russian olive flowers



### FEEL:

- Burdock's rounded flower heads covered in Velcro-like hooked spines
- Waxy, thick, evergreen leaves of English ivy
- Spines on stems of Himalayan blackberry (watch out!)
- Coarse feathery leaves of Tamarisk
- Flat and rough leaf blades of Reed canary grass

**TASTE:** **With caution and only with expert adult identification and permission!** Some species may have toxic look-alikes and other edible species could be growing in contaminated soils or have been treated with pesticides.





- Himalayan blackberry berries
- Japanese knotweed stems
- Garlic mustard young leaves or flowers

# Wetland Wonders: Datasheet #1

Name: \_\_\_\_\_



Sketch or describe

 <b>What do you see?</b>	 <b>What do you smell?</b>
 <b>What do you feel?</b>	 <b>What do you hear?</b>

A MYSTERY. Describe or sketch something you noticed and wonder about!





## Wetland Wonders: Datasheet #2

Name:

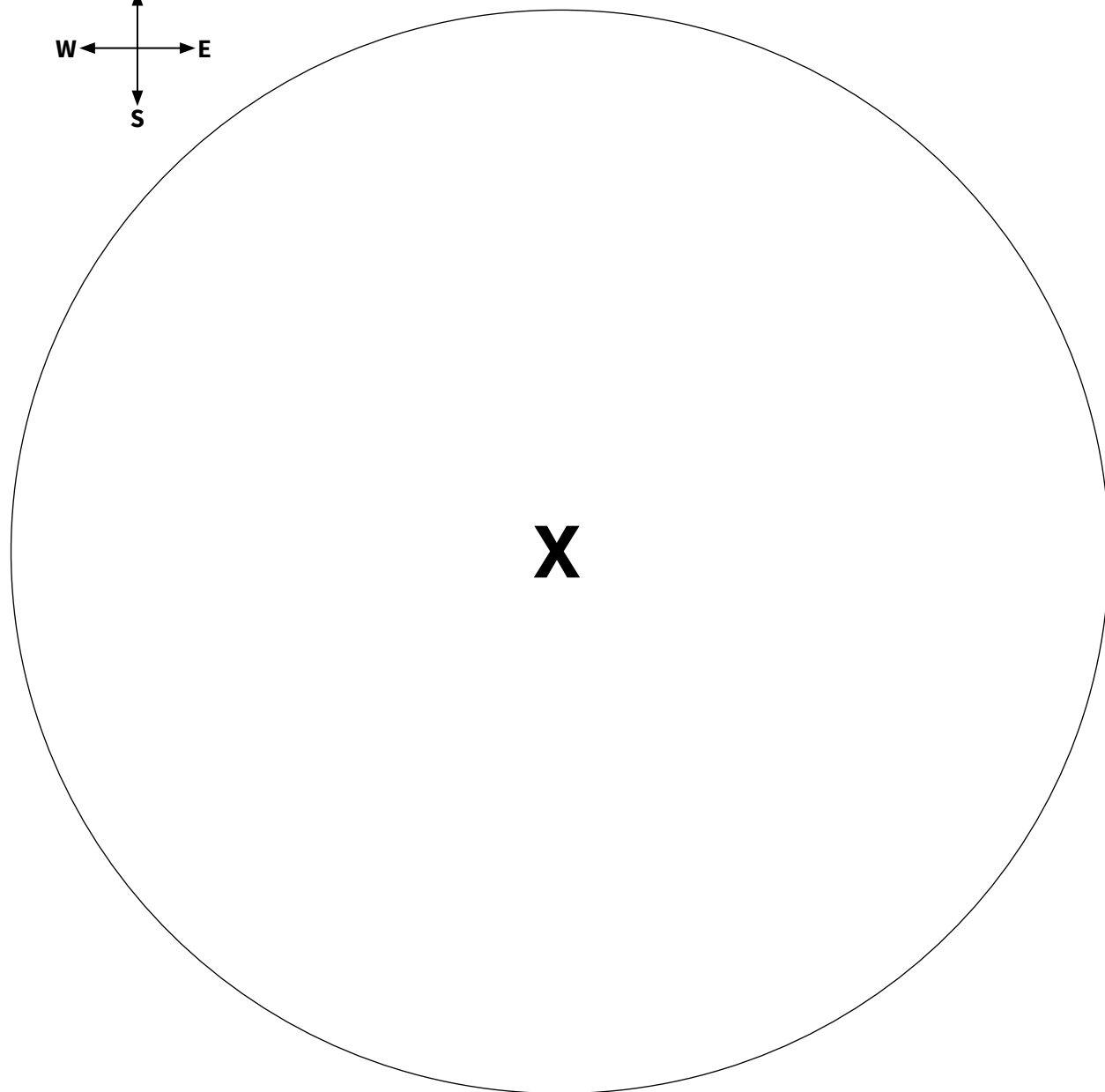
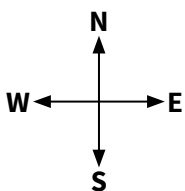
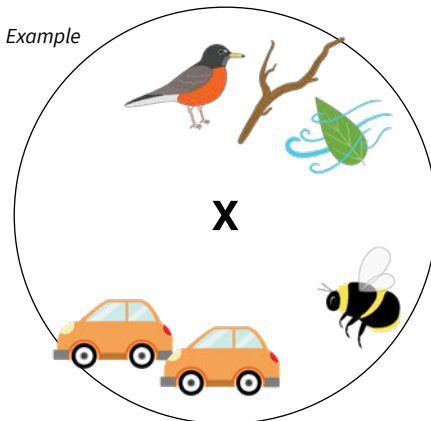
Date:

Location or site description:

### Sound Map

Sketch and describe your observations. Close your eyes and listen for three minutes. Every time you hear a sound, make a symbol/sketch to represent it in relation to where you are located (shown by the 'X' in the middle of the Sound Map).

Example



## Wetland Wonders: Datasheet #2

### What I see:

Up high:

Far away:

Down low:

Up close:

Colour Match: Can you find a match for every colour in the rainbow to plants and other natural objects?



Sketch of the most amazing thing I saw:

### What I smell:

Use as many descriptive words as you can. If the smell was a brand of perfume, what would you name it?

**Texture Hunt:** Find at least five textures in nature. Use adjectives or a sketch to describe them (for example bumpy, rough, smooth, etc.).

- 1.
- 2.
- 3.
- 4.
- 5.



*sharp*

**Species List.** List the organisms you observed. Circle any that are invasive species.

# Musical Mussels!



This is an active version of Musical Chairs. Students compete as aquatic species, experiencing how basic needs are met. They also learn how certain adaptations enable invasive species, like Zebra mussels, to outcompete native species for food, shelter, and room to grow.

## CONCEPTS

All animals need food, water, shelter, and space to survive. These are the main components of a habitat. Some animals have more specific needs than others (for example, some can be ‘picky eaters’). Aquatic habitats are diverse and animals may require different types of conditions, such as unpolluted, fast-flowing water with a high oxygen content. Others require calm waters and shade. All organisms need adequate space to grow and move, access to sufficient food and water, territory for mating, safe places to avoid predators or shelter from floods or other weather events. When their needs are not met, survival or reproduction is not guaranteed. If many individuals’ basic needs are not met, the population will decline. Invasive species have certain adaptations or characteristics that give them a competitive advantage over native species. Invasive species spread and take over by outcompeting native species for one or more habitat components.

**Zebra** (*Dreissena polymorpha*) and **Quagga** (*Dreissena rostriformis bugensis*) **mussels** are closely related freshwater mussel species native to the Baltic Sea in Europe. They were accidentally transported in ship ballast water as microscopic larvae, arriving in the Great Lakes in the 1980s, quickly spreading and taking over many lakes in North America. As adults, Zebra

and Quagga mussels feed by filtering plankton out of the water, reducing food available to native species. These small mussels cause huge problems. They can form large colonies, taking space from native wildlife, taking over fish spawning areas, clogging water pipes, and even increasing toxic algal blooms that affect the health of native wildlife. Management costs of Zebra and Quagga mussels are estimated to be over \$250 million dollars a year!

## MATERIALS AND PREPARATION

- Photocopy and cut out the 10 Musical Mussels cards.
- On 16 large sticky labels or pieces of masking tape draw ‘zebra-like’ black lines.
- On two sticky labels or pieces of masking tape print a “P” for predator. (Example predators of native fish could be river otters, eagles, loons, or bigger fish such as sturgeon, salmon, or pike).
- Assemble 10 chairs or ‘sit-upons’ in two rows of five chairs, back-to-back. (‘Sit-upons’ are outdoor seating pads made from grocery bags filled with folded newspaper and duct-taped shut.)
- Select music to play during the game. Optional: choose an aquatic theme — for example, tunes from Moana, The Little Mermaid, Finding Nemo, or Handel’s Watermusic.
- **Optional:** Make copies of Teaching Cards with photos and facts on Zebra and Quagga Mussels (Appendix 1) and relevant native species, such as Bull trout (Appendix 2).

## PROCEDURE

### Discussion

Introduce or review the concept of basic needs: all animals need food, water, shelter, and room to grow. Lead a brainstorming session with each student giving an example of a basic need in their lives. Have students share a time or situation when someone was unable to have a basic need met.

### Game

Explain to students that they will experience the struggle for survival through a version of Musical Chairs where each of the chairs represents all of an aquatic animal's basic needs (food, clean water, shelter, and room to grow). Students that find a seat when the music stops are able to meet all their needs.

### ROUND 1

1. Choose five students to be native fish (such as Bull trout, Dolly Varden, or Walleye) in a lake. Play one round of Musical Chairs as you normally would with the five students walking slowly around the 10 chairs and finding seats once the music stops.
2. Explain that due to their success at meeting their basic needs, the fish population can grow! Add five more students and play again.
3. Explain that again, due to the success of the fish meeting their basic needs, the fish population continues to grow and five more students join the game. At this point you will have more students than chairs. Five of the 'fish' will not be able to meet all of their basic needs (they won't get a chair). Those 'fish' would need to move to find food elsewhere or would not survive.



4. Play several more rounds, allowing students who have not played yet to participate. Ask questions throughout to prompt their understanding of the simulation. For example: What are the basic needs? What happens to those who don't have their basic needs met? What happens to those that do?

### ROUND 2

1. Explain: Zebra mussels are an invasive species accidentally brought to the lake. They have caused major damage in many lakes and waterways in Canada. They compete for the same basic needs as fish. If a player gets a card that shows that a Zebra mussel has taken a basic need, they must leave the lake along with the others whose basic needs couldn't be met.
2. Place a Musical Mussel card on three chairs, face down. Play a round and ask those landing on a card to share it with the class.
3. Retrieve all cards and shuffle. Explain that the Zebra mussels met their basic needs and have reproduced. So, this time place a card down on six chairs. Play the round again and note that reproduction in fish is not occurring due to dwindling basic needs. Again, those with Zebra mussel cards on their seats must leave the game.
4. Retrieve all mussel cards, shuffle, and place nine cards down on chairs. Play the round.
5. Retrieve all mussel cards, shuffle, and place 10 cards down on chairs. Play the round. Ask remaining student(s): How are you feeling? Ask the class: What do you think happens next? Do you think this could really happen in nature? How do you feel about Zebra mussels taking over the lake?

The next two rounds will give insight into how Zebra mussels can outcompete native species when there are no natural predators in their new habitat.

### ROUND 3

From the class group, 10 students take on the role of a native aquatic species: one is a Zebra mussel (identified with striped label/masking tape) and two are predators (“P” labels). Explain: During this round of Musical Mussels, predators walk around trying to tag the native species only. This is because predators do not like to eat Zebra mussels. When a predator tags a native species, that student must leave the game. Therefore, native species must try to both dodge the predators and get their basic needs met. (Note: as predators do not compete with the native species and Zebra mussels for the same basic needs, they will not try to get a seat when the music stops.)

### ROUND 4

Add two mussels for every mussel that found a seat (representing successful reproduction) or play another round with a new mussel if the one playing in Round 3 did not find a seat.

### ROUND 5

Double the number of successful mussels from the last round.

### ROUND 6

Allow two mussels to share one seat if all others are taken. Explain that Zebra mussels have small space requirements and live in colonies attached to one another by sticky threads they produce to stay on hard surfaces.

Continue until most or all of the basic needs (seats) are taken by Zebra mussels.

Discuss how the Zebra mussels were able to take over the lake and how we can prevent them from entering and spreading within BC waterways by practicing Clean Drain Dry.

### Success Story!

In July 2022, BC’s Conservation Officer Service intercepted and decontaminated a Zebra mussel-infested barge headed for BC’s Lower Mainland. As the service’s largest decontamination of invasive mussels to date, this proved a successful collaboration between provinces. It was also a major win in protecting BC’s precious freshwater habitats from a high alert invasive species.



## TAKE ACTION!

You can prevent Zebra and Quagga mussels from spreading to lakes near you.

Practice Clean Drain Dry! When on land and before you leave the body of water:

- **CLEAN** off all plant parts, animals, and mud from boat and equipment
- **DRAIN** all buckets, bilge, and other areas that hold water
- **DRY** all items completely before launching into another body of water.

Don't Let it Loose! Did you know that Zebra mussels have been found in moss balls from a home aquarium? Luckily it did not spread! That is why it is so important not to dump aquarium plants and waters outdoors in natural areas. Instead, dry and freeze all unwanted plants and dispose of them in the garbage.

## WRAP IT UP: REFLECTIONS AND EXTENSIONS

### Discussion questions

1. **What are the four basic needs of survival for all living things?** (Food, water, shelter/safety, and space/room to grow.)
2. **What happened to the native species competing with the invasive mussels? Why were the Zebra and Quagga mussels so successful?** (They are not eaten by predators, they need less space to live, and they produce many offspring.)











3. **How do Zebra and Quagga mussels affect people?** (Their populations grow quickly, and they take food away from native fish. This decreases fish abundance, impacting people. In addition, they clog water pipes and cling to boat hulls, ruin beaches and cut swimmer's feet with their sharp edges.)
4. **What can we do to stop the introduction and spread of Zebra and Quagga mussels and other aquatic invasive species in BC?** (Practice Clean Drain Dry. Do not dump aquarium contents down the drain or in waterways. Get your boat checked out for mussels at inspection stations.)

### EXTENSIONS:

- Make Don't Let it Loose posters to spread the word and protect BC's waters from invasive species. (Spread the Word, Not the Invasive Species activity in this guide.)
- Do a Zebra mussel maze or colouring sheet, downloadable from the ISCBC website (Activity and Games page).

*Inspired by Making Waves! Protecting Ontario's Aquatic Habitats. Grade 4 Curriculum Kit. Invading Species Awareness Program, Ontario Federation of Anglers and Hunters/Ontario Ministry of Natural Resources. 2021. [www.invadingspecies.com](http://www.invadingspecies.com)*

## Musical Mussels Playing Cards

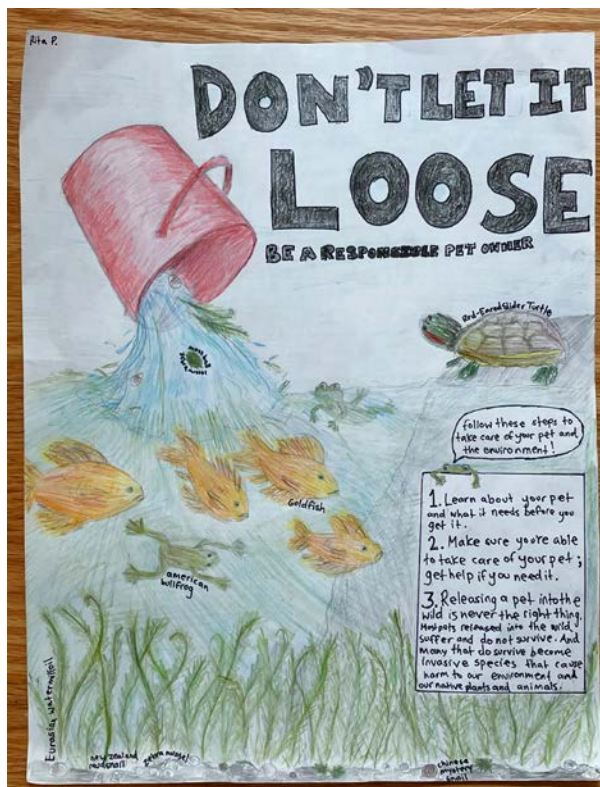
<p><b>You are meeting your basic needs!</b></p> 	<p><b>Zebra mussels are taking your food. You cannot stay!</b></p> <p>Basic Need Lost: FOOD</p> 
<p><b>Zebra mussels are crowding you out!</b></p> <p>Basic Need Lost: ROOM TO GROW</p> 	<p><b>The Zebra mussels on your back make it hard to move. This makes you vulnerable to predators.</b></p> <p>Basic Need Lost: SAFETY</p> 
<p><b>Because Zebra mussels eat so much, there is less food for you!</b></p> <p><b>Go away!</b></p> <p>Basic Need Lost: FOOD</p> 	<p><b>Your eggs will not hatch among Zebra mussels. Lay them somewhere else!</b></p> <p>Basic Need Lost: SHELTER</p> 
<p><b>Zebra mussels are crowding you out!</b></p> <p>Basic Need Lost: ROOM TO GROW</p> 	<p><b>Zebra mussels are taking your food. You cannot stay!</b></p> <p>Basic Need Lost: FOOD</p> 
<p><b>Your eggs will not hatch among Zebra mussels. Lay them somewhere else!</b></p> <p>Basic Need Lost: SHELTER</p> 	<p><b>Because Zebra mussels eat so much, there is less food for you!</b></p> <p><b>Go away!</b></p> <p>Basic Need Lost: FOOD</p> 

# Spread the Word, Not the Invasive Species!

Get creative and connect with community! Students create posters with the message 'Don't Let it Loose', representing best practices for aquarium/pet owners to prevent the introduction of aquatic invasive species into natural environments.

## CONCEPTS

Most aquarium fish, plants and invertebrates are not native to British Columbia. The release of aquarium pets into BC waters is illegal as they can have severe consequences on the environment and the survival of native species.



Poster by Rita Perlman, student in Victoria, BC

### Red-eared sliders (*Trachemys scripta elegans*)

are a popular turtle sold in pet stores as they look cute and irresistible when they are babies.



But they can live

more than 40 years in captivity and grow to the size of a dinner plate! If they are released into BC's aquatic habitats, Red-eared sliders compete with BC's only native freshwater turtle — the Western painted turtle (*Chrysemys picta bellii*) — for food, basking logs, and nesting areas. They are also carriers of Salmonella, a bacterium that can be easily transferred up the food chain.

### American bullfrogs (*Lithobates catesbeianus*)



are native to eastern North America and were brought to BC in the early 1900's to farm for their meaty legs. They have spread throughout

parts of BC and are outcompeting native frogs as well as eating them! Bullfrogs will eat almost anything they can fit in their mouth, including other frogs, salamanders, fish, and even small mammals and birds! Bullfrog tadpoles are large, making them an enticing pet for kids to capture and raise. Once they grow into adult frogs, they are usually released into new habitats, increasing their spread.



Parrot's feather;  
N. Loewenstein, Bugwood.org



Goldfish; US Fish & Wildlife, Bugwood.org



Koi; C. Liu, Canva



Brazilian elodea;  
R. Videki, Bugwood.org



Eurasian watermilfoil;  
C. Evans, Bugwood.org

Other examples of aquarium pets and plants that are invasive when released include: **Goldfish** (*Carassius auratus*), **Eurasian watermilfoil** (*Myriophyllum spicatum*), **Parrot's feather** (*Myriophyllum aquaticum*), **Brazilian elodea** (*Egeria densa*), and **Koi carp** (*Cyprinus rubrofuscus*).

Some aquarium species, such as exotic salamanders or piranha, may not become invasive if released in BC, but could have diseases or parasites that could infect native species.

We are all responsible for our aquarium pets and plants. To prevent the spread of invasive aquatic species, people can easily do the following:

- Never release or flush unwanted aquarium pets or aquarium water into natural waters, drainage ditches or sewers.
- Drain aquarium water on dry land.
- Return or donate unwanted aquarium fish, reptiles, snails and plants to a pet store, school, or other interested group.
- Contact a local aquarium club or the Canadian Association of Aquarium Clubs, and ask about a fish rescue program for unwanted aquarium pets.

## PROCEDURE

### Group Discussion and Brainstorm

- **Who has/has had an aquarium?** An aquarium is a simple, contained and created habitat, and the animals and plants that live in it (along with its human host) are a community. **Could this habitat survive without a human providing food, clean water with oxygen, and room to grow?**
- **What would you do if you had to move far away and could not look after your aquarium anymore? What will happen to the school's aquarium over the summer months? Why might someone think it would be a good idea to empty an aquarium into a local water system? Why might this be a bad idea?** Explain that plant and animal species sold in pet shops are very often non-native species. **What would happen if they were dumped into a pond?** See Background section for characteristics of invasive species and their impacts.
- Brainstorm together on how aquarium owners can best care for their pets and plants when they can no longer look after them. (e.g., donate to schools or seniors' homes, give back to pet stores, give to responsible friends, dry the plants out in the sun.)

### Creating the Posters

Explain to students that they will be creating a special poster to educate others on the importance of being a responsible aquarium



owner and should include at least one of these key messages:

- Releasing aquarium pets and plants into the wild is harmful to local habitats and native species!
- Never release or flush aquarium pets or water into drains, toilets, ditches, sewers, or natural waterways. Drain aquarium water on dry land — it can be really good for the garden!
- Do not flush dead pets. They could spread disease to native aquatic species.
- When finished with aquarium plants, dry them out in the sun, then put them in the garbage (not in the compost)!
- Donate unwanted aquarium fish, snails and plants to others, such as a pet store, school, or aquarium hobbyist. Advertise and offer them for free!

## Artistic suggestions:

1. Have students close their eyes and imagine they are swimming underwater in a pond or aquarium. **What do you see? Now swim down to the bottom. Is it lighter or darker there? Why?** Tell students they can adjust the lightness and darkness of the blue water in their painting by adding white or black paint. Define shade and tint for the students. (Suggest they start by painting the middle of the pond or aquarium in plain blue.)

2. **Describe the different textures in the water you were swimming in.** Explain that there are many things in a pond or aquarium that are not smooth. What can we do in our paintings to show different textures? Discuss (and demonstrate, if able) brush technique and the addition of sand to paint (mix it into the paint on the palette before applying) to create textures for pond and aquarium bottoms, plants and fish. (Optional: Students can also use materials like glitter for fish scales and wool for aquatic plants.)
3. Mark out a message space on the top or bottom of the posters with a ruler before handing them out. Messages can be written in when the painting is finished, using marker or pencil crayon.

## WRAP IT UP: REFLECTIONS AND EXTENSIONS

Have students explain the message they used on the poster to the class.

ISCBC would love to see your students' posters! Send any photos to [education@bcinvasives.ca](mailto:education@bcinvasives.ca).

## TAKE ACTION!

Connect with local exotic pet and aquarium shops and see if they would be willing to display the posters!



# Plant Diversity Field Study

Look closely at the abundance of native and invasive plants in your study area using two types of scientific sampling methods to collect data. Participate in community science by reporting invasive plants that you see.



## CONCEPTS

Plant diversity in wetlands, riparian (streamside) areas, and other habitats is important to both wildlife and humans. A wide variety of plants offers valuable habitat for many animals, providing more options for food and places to hide. If invasive species are introduced, they may take over and outcompete native plants, creating a *monoculture*, where only one species — the invasive plant — thrives.

A healthy wetland habitat includes a variety of plants native to the area. Species inventories and monitoring help us learn what is found in an area and how it changes over time. It allows us to notice, report, and take action to manage invasive species.

If you discover an invasive species, take action by reporting it so appropriate measures can be taken to prevent its spread. Reporting is fast and easy. Take photos and note your specific location. Upload the photos and information to websites or apps once you are back within cell or wifi range.

## TAKE ACTION!

Report Invasive Species.

- Use the Reporting form on the ISCBC website
- Report Invasives BC app
- iNaturalist app or website



Visit ISCBC's website for short video tutorials on how to observe and report invasive species!



**Purple loosestrife** (*Lythrum salicaria*) is a pretty perennial plant that spreads rapidly by seed and root fragments. A mature plant can produce up to 2.5 million tiny seeds that are dispersed by wind, mud, moving water, wildlife and humans. The plant grows quickly and produces thick, woody roots with dozens of shoots. It creates a dense web of thick stands, outcompeting the native vegetation that wildlife relies on and changes water chemistry and nutrient cycling.

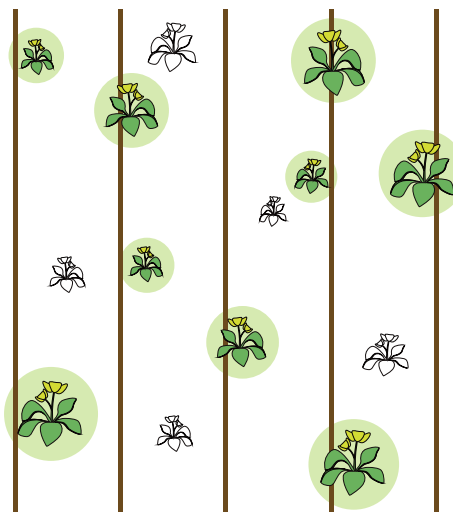
## MATERIALS AND PREPARATION

1. Divide the group into teams of approximately three to four students per group.
2. Two sampling methods can be used to collect data: linear transects or quadrats. Details on the sampling methods are described in the procedure section.
  - **Linear transects: Sampling along a line**, using minimum 5-metre-long lengths of string. A compass could be used to ensure that lines are parallel and straight (or you could ‘eyeball’ it).
  - **Quadrats: Random sampling within a study plot**, using Hula Hoops that are of similar size.
3. Divide the site to be sampled into areas marked by flagging tape or cones. Assign small groups to each area and provide each group with materials. Each group should have a copy of the Plant Diversity Field Study Datasheet (included in this activity), a clipboard, pencil and sampling materials (hula hoop or rope).
4. Also provide to each group plant ID aids (printed pictures, field guides, or ID apps) to help identify common plants at the site, including invasive plants. Prior to the field trip, you and/or your students may want to research common plants likely to be at the site, such as by using the ‘Explore’ section in iNaturalist to see what observations have been recorded.

## PROCEDURE

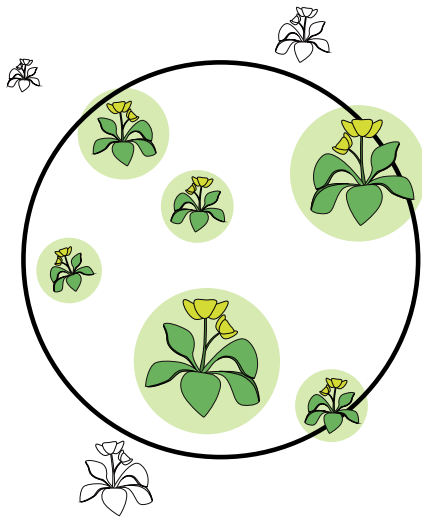
1. Sample the study site and collect data using one or both of the following methods. Use the Datasheet provided.

### Linear transects: Sampling along a line



- Students create parallel “lines” across the sampling area, using approximately 5-metre-long lengths of string.
- Count and record on datasheets the number of different plants along each line, tallying all plants touching the string or hanging over/under within one step (30 cm) on either side. It is not important to be able to identify every type of plant. Instead, note the types (tree, shrub, vine, grass, etc.) and focus on looking closely at features to help recognize similarities and differences between plants.
- Have each team repeat the process to sample two to three transect lines.
- Identify the most abundant plants along the transect, noting any invasive species or unusual plants. Take photos, sketch or collect a sample specimen (of only the most common species).

## Quadrats: Random sampling within a study plot



- Students sample the study plot by closing their eyes and randomly tossing a hula hoop within the study site. Unless the hoop is caught on something, no one should touch it once it lands.
  - On the datasheet, the team records the number and types of plants rooted within the hoop. It is not important to be able to identify every type of plant. Instead, note the types (tree, shrub, vine, grass, etc.) and focus on looking closely at plant features to help recognize their similarities and differences.
  - Each team repeats the process, sampling two to three quadrats.
  - Identify the most abundant plants in the quadrat, noting any invasive species or unusual plants. Take photos, sketch, or collect a sample specimen (of only the most common species.)
2. If possible, identify the most common species seen using field guides or apps.
- As a class, report any invasive species observed using Report Invasives BC, iNaturalist, or the ISCBC website.
  - Once each small group has completed their datasheet, compile all data into a group datasheet.

## TAKE ACTION!

Use your Plant Diversity Field Study as a jumping-off point for an action project at the site. If there are many invasive species at the site, connect with a partner to see if your group could participate in a weed pull. Return after your invasive plant removal efforts to repeat the field study sampling and compare the results!

## WRAP IT UP: REFLECTIONS AND EXTENSIONS

- **Why do people use sampling methods to learn what plants are in a study area?** (It is difficult to know every species found in a large area, so sampling allows us to get an idea of what is present at the site and its relative abundance or cover. It is also a way to learn about plants that are common or uncommon at a site, including invasive plants. Studying an area over time can be a means of monitoring the site's species to better care for it as changes occur.)
- **Discuss the two sampling methods and results.** Did the different samples and study methods have similar or different results? What plants were the most common? Did you notice a difference in the plots or transects when an invasive plant was abundant as opposed to when it was rare or absent?

**EXTENSION:** Create a class field guide to the site using the photographs, sketches, or specimens collected.

*Inspired by Tracking Plants and Keeping Track, in WOW! The Wonder of Wetlands: An Educator's Guide. Environmental Concern Inc. and Project WET International Foundation. 2003.*

## Plant Diversity Field Study Datasheet

Group #:

Date:

Names:

Sampling Method Used:    Quadrat (Hula hoop) ☐    Transect (line) ☐

Site Location and Description:

	Sample Number			
	1	2	3	TOTAL of all Samples
Type of Plant	Abundance (Number of Plants of Each Type in Sample)			
Trees				
Shrubs				
Vines				
Grasses				
Forbs				
Emergents				
Optional: Note abundance of specific species identified in the samples (common native or invasive plants; specific plants of interest)				
Species	Abundance (Number of Plants in Sample)			

What patterns do you notice in the data?

Try to identify some of the most common plants observed in your sample. Are they native or non-native? Are any known to be invasive species? List them below.

Sketch and describe one of the most common plants found in your sampling area.

Plant name:

Invasive Plant List

- 
- 
- 

Native Plant List

- 
- 
- 

## Types of Plants



**Tree:** A woody plant that has an elongated trunk and branches growing off the main stem.



**Shrub:** Under 20 feet tall when mature, often with more than 1 main stem.



**Vines:** Twines and climbs or leans on other plants for support. May be woody or perennial (like English ivy) or herbaceous and die back each year (like Bindweed).



**Grasses, Sedges, and rushes** are grass-like plants that are herbaceous (non-woody), with elongated stems and leaves, and flowers that may be small and not obvious. ID Tip: “Sedges have edges, rushes are round, grasses have joints all the way to the ground.”



**Forb:** A flowering plant that just lives for a season (herbaceous; not woody) and is not a grass.



**Emergent:** Plants that grow near the water's edge or along riverbanks and are rooted underwater, but their stems, leaves or other parts emerge above the water. Wetland emergent plants growing in spongy, saturated soils may be entirely underwater for part of the year.



# Aquatic Invaders Trivia Challenge

It's Trivia Time! You've done some activities and learned about invasive species, now challenge your students to a fun and entertaining quiz.

## MATERIALS AND PREPARATION

- Prior to the quiz, do other activities in this guide or have students research aquatic invasive species. Review the Background section and Appendices.
- Make a copy of the quiz questions. Add some of your own if there are other species or topics you would like to include.

## PROCEDURE

Possibilities for how to use the quiz questions:

- Individual responses (as an assessment).
- Create a Kahoot using the questions and have a competition.
- Get up and move! Designate areas/corners of the space as "A," "B," "C," and "D." Read out the questions and have everyone move to the corner that represents what they think is the best answer to the question.

## WRAP IT UP: REFLECTIONS AND EXTENSIONS

- What was the most difficult question? What was the easiest/the one that most people knew the answer to?
- Have students make up their own challenge questions based on their learning and quiz a partner!

## ANSWERS:

1. B	4. C	7. A	10. C	13. B	16. C	19. B	22. A	25. D
2. D	5. B	8. C	11. D	14. C	17. A	20. C	23. B	
3. A	6. D	9. D	12. B	15. A	18. D	21. C	24. A	

Choose the best answer to the following questions.

1. An invasive species is...
  - a. A plant that comes from Europe or Asia.
  - b. An organism that is introduced outside its native range and causes harm to people or the environment.
  - c. An issue that we can't control due to climate change.
  - d. Delicious!
2. Which is NOT a reason why wetlands and other aquatic habitats are important?
  - a. They have high biodiversity.
  - b. They absorb water and prevent flooding.
  - c. They clean the soil of pollutants.
  - d. They are one of the few habitats where invasive species can live.
3. What is NOT a characteristic of invasive species?
  - a. They can only survive where people can take care of them, like on farms and as pets.
  - b. They are prolific reproducers, producing numerous seeds, eggs or babies.
  - c. Many can grow from small pieces of roots or stems.
  - d. They lack natural predators and diseases in their introduced habitat.
4. Eurasian watermilfoil is an invasive aquatic plant that has been let loose from:
  - a. Zoos.
  - b. Pluto.
  - c. Aquariums.
  - d. Eurasian wetlands.
5. There are roughly how many aquatic invasive species in British Columbia?
  - a. 15.
  - b. 150.
  - c. 1,500.
  - d. 1.5 million.
6. Aquatic invasive species cause harm to people and the environment by:
  - a. Clogging waterways and water structures, like docks and pipes.
  - b. Reducing food and shelter for native species.
  - c. Impacting recreation like sport fishing and swimming.
  - d. All of the above.
7. Which is NOT true about Goldfish:
  - a. They are always a gold colour.
  - b. They can grow to the size of a football.
  - c. It's illegal to release them into the wild.
  - d. They stir up bottom sediment, making the water murky.
8. What is the best way to release an unwanted Goldfish?
  - a. Flush it down the toilet.
  - b. Let it go in your nearest pond.
  - c. Rehome it or donate it to a pet store or school.
  - d. Watch it swim downstream to the ocean.
9. Plants have evolved to spread quickly in disturbed and open ground that is often along watercourses. Which is NOT an example of an adaptation that helps an invasive plant to spread?
  - a. Burdock with spikes and tiny hooks on seed pods that were the inspiration for Velcro.
  - b. Himalayan blackberry has wide-spreading roots that increase flooding and erosion by preventing the growth of deep-rooted shrubs and trees.
  - c. Russian olive has berries that birds love to eat and spread through their droppings.
  - d. Salmonberry has early blooming pink flowers that are an important source of nectar to migratory Rufous hummingbirds.

10. Which of the following is NOT true about American bullfrogs?
  - a. I am the largest frog in BC, weighing up to a kilogram.
  - b. I have a big appetite, eating anything that will fit into my mouth.
  - c. I was first brought to BC to manage insect problems.
  - d. I am native to Eastern North America.
11. Because American bullfrogs are such big eaters, they pose a threat to BC's wetland wildlife such as the:
  - a. Northern red-legged frog.
  - b. Wood duck ducklings.
  - c. Western painted turtle.
  - d. All of the above.
12. Yellow flag iris is toxic to both humans and animals. What is a common symptom people may experience when exposed to the plant?
  - a. Hunger.
  - b. Skin irritation.
  - c. Ringing in the ear.
  - d. Extreme joy.
13. One reason why Yellow flag iris is invasive is because its seeds:
  - a. Fly far and wide during windy days.
  - b. Float and spread along water currents.
  - c. Pop from their pods in the heat of the sun.
  - d. Are eaten and spread by birds.
14. Which of the following lists includes an invasive species?
  - a. Bull trout, Pacific salmon, Red-winged blackbird.
  - b. Western painted turtle, Western toad, Four-spotted skimmer.
  - c. Canada goose, Beaver, Nutria.
  - d. Yellow pond lily, Sword fern, Common cattail.
15. A single Purple loosestrife plant can produce up to:
  - a. 2.5 million seeds.
  - b. Too many seeds for researchers to count.
  - c. 100 seeds.
  - d. Depends on their mood. A grumpy plant can only produce up to 1 million seeds.
16. Purple loosestrife plants can spread by seeds and:
  - a. Just by looking at them.
  - b. Petals.
  - c. Root & stem fragments.
  - d. Sap.
17. Yellow perch can be identified by:
  - a. An olive-green back, 7 thick dark stripes and a silver belly.
  - b. 3 eyes, 1 gill and a forked tail. It's a mutant species.
  - c. 3 dorsal fins and a large humpback.
  - d. An olive-green belly, 5 thin stripes and a silver back.
18. What is a serious impact of invasive Zebra and Quagga mussels?
  - a. They take food away from native fish.
  - b. They clog water pipes and cling to boat hulls.
  - c. They are not as tasty as native mussels.
  - d. Both A & B.

19. Which of the following is NOT a way to prevent aquatic invaders, like Zebra and Quagga mussels, from establishing in BC.
  - a. Make sure to clean, drain, and dry your boat and other aquatic gear.
  - b. Only eat local, native mussels.
  - c. Don't dump your aquarium water in local water bodies.
  - d. Use boat inspection stations.
20. Red-eared sliders:
  - a. Are BC's only native pond turtle.
  - b. Lay their eggs in the mud at the bottom of ponds.
  - c. Are pets that were let loose and are now invasive in BC.
  - d. Are mini burgers with ketchup on the bun, like red ears.
21. Freshwater jellyfish:
  - a. Have a painful sting.
  - b. Can grow to be the size of a dinner plate.
  - c. Have tentacles that sting and capture zooplankton.
  - d. Can spread by strong winds.
22. Nutria are aquatic rodents that impact habitats by:
  - a. Eating so much aquatic vegetation that they can turn a wetland into an open pond.
  - b. Eating trees and competing with native Beavers.
  - c. Spreading disease to native fish and wildlife.
  - d. All of the above.
23. What should anglers do with their fishing equipment to prevent the spread of aquatic invasive species?
  - a. Buy Local, Fish Local.
  - b. Clean Drain Dry.
  - c. Play Clean Go.
  - d. Don't Let it Loose.
24. Everyone can help prevent the spread of invasive species by:
  - a. Noticing nature in your community and reporting anything that looks new or unusual.
  - b. Turning off your electronic devices when not in use.
  - c. Taking shorter showers.
  - d. Biking and walking more.
25. To prevent invasive plants or insects from hitching a ride and spreading to a new location, one should:
  - a. Never pick up hitchhikers on the highway. It's illegal and dangerous!
  - b. Jump in the lake and towel off vigorously after you go for a hike.
  - c. Make sure to inspect boots, clothing and gear and remove any plants or insects when you get home.
  - d. Make sure to inspect boots, clothing and gear and remove any plants or insects before you leave the site.

# Additional Resources

Go to [bcinvasives.ca](http://bcinvasives.ca) for games, activities and additional information on aquatic invasive species, including the following.

## Species Profiles and Factsheets

- [Aquariums and Water Gardens](#)
- [Clean Drain Dry and Aquatic Invasive Species](#)
- [Don't Let it Loose](#)
- [Eurasian Watermilfoil](#)
- [Giant Hogweed](#)
- [Goldfish](#)
- [Himalayan Balsam](#)
- [Himalayan Blackberry](#)
- [Parrot's Feather](#)
- [Purple Loosestrife](#)
- [Water-based Recreation](#)
- [Yellow Flag Iris](#)
- [Zebra and Quagga Mussels](#)

## Field Guides and Research Collections

- [Research Collection on Aquatic Invasive Species](#)
- [Field Guide to Aquatic Invasive Species for British Columbia](#)

## Videos: @ISCBC on YouTube

- [Clean Drain Dry Playlist](#)
- [Kids' Questions Playlist](#)
- [Animated video about Goldfish](#)
- [Educator Webinar: Engaging Ways to Educate Students on Aquatic Invasive Species](#)

# Appendices

## Appendix 1: Invasive Species Teaching Cards

Photos and fun facts about some common invasive species to BC found in or near waterways.

## Appendix 2: Native Species Teaching Cards

Photos and fun facts about some common native species to BC found in or near waterways.

**Appendix 3: Healthy Aquatic Habitat Hero Bingo Card.** Use this Bingo card as a stand-alone activity or to track your group's experiences and learning as you work through this Guide.





**INVASIVE**

## Japanese knotweed

*Reynoutria japonica*

- I can grow through concrete and asphalt and cause significant damage to homes and roads.
- I was introduced to BC from Asia as a garden plant.
- I'm considered one of the top 10 worst invasive species in BC because I'm so hard to control.

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**INVASIVE**

## Common burdock

*Arctium minus*

- My burrs were the inspiration for Velcro because they hook onto everything including clothing and fur, which helps me to spread to new areas.
- My roots are commonly eaten in Asia.
- Birds and bats can die if they become tangled in my burrs.

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**INVASIVE**

## Common periwinkle

*Vinca minor*

- I am a popular garden plant because of my fast growth, shiny evergreen leaves, and pretty purple flowers.
- I can spread from gardens and form a dense ground cover, crowding out native plants in forests and along waterways.
- I am one of the top invasive plants still sold at garden stores in BC. Please don't buy me!

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## INVASIVE

### English ivy

*Hedera helix*

- I need little light and water and, unlike many plants, I do not go dormant and keep growing through winter.
- I am commonly planted in gardens, but can take over by growing quickly, forming new plants from root fragments, and by being spread by birds who eat my berries and spread the seeds to new locations.
- I form a dense groundcover, blocking light to native plants below. I can also climb and strangle trees.

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## INVASIVE

### Himalayan blackberry

*Rubus armeniacus*

- I grow as large and dense as a wall, blocking animal movement.
- I produce delicious berries that many types of animals eat, helping to spread my seeds.
- I increase flooding and erosion along waterways by preventing the growth of deep-rooted native shrubs.

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## INVASIVE

### Zebra & Quagga mussels

*Dreissena polymorpha* & *Dreissena rostriformis bugensis*

- I can lay up to one million eggs each year that become floating, microscopic larvae that are easily spread in water.
- I form large colonies on boats and structures in lakes where I love to eat all the plankton and algae.
- Help prevent me from spreading by cleaning, draining, and drying boats and other water gear and by visiting boat inspection stations.

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## INVASIVE

### Himalayan balsam

*Impatiens glandulifera*

- My flowers produce a lot of nectar, drawing pollinators away from the native plants around me.
- Some think my flowers are shaped like a British police officer's helmet, which explains my other common name, 'Policeman's helmet'.
- When my seed pods dry out they explode when touched and can spread my seeds up to 7 m away.

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## INVASIVE

### Nutria

*Myocastor coypus*

- You can tell me apart from native beavers and muskrats by my white whiskers and long, thin tail.
- I cause problems along dykes, in wetlands and other aquatic habitats by digging burrows in soil and devouring aquatic vegetation.
- My name in my home in South America is Coypu. I was brought to southern BC for the fur trade.

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## INVASIVE

### Freshwater jellyfish

*Craspedacusta sowerbii*

- I am about the size of a penny and although you won't feel it, I have stinging tentacles that I use to catch and eat zooplankton.
- When I am in my immature 'polyp' stage, I am about 2 mm tall and may attach to aquatic plants and animals.
- I am native to the Yangtze River basin in China but have spread to all continents except Antarctica.

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## INVASIVE

### Smallmouth bass

*Micropterus dolomieu*

- I was originally introduced into BC lakes for recreational fishing.
- I am a predator that feeds on smaller fish, amphibians, and insects.
- Despite my name, I have a big mouth! But unlike my Largemouth bass relatives, my upper jaw doesn't extend past my eye.

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## INVASIVE

### Red-eared slider

*Trachemys scripta elegans*

- I can carry diseases harmful to both humans and native turtles.
- I am best known for the red patch of colour behind my eyes.
- Don't let me loose! I was once a pet before I was released into the wild. Now I'm competing with BC's native Western painted turtle.

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## INVASIVE

### Purple loosestrife

*Lythrum salicaria*

- I take over wetland and aquatic environments where I block water flow.
- I am sometimes mistaken for native fireweed, which has flowers with 4 petals, while my flowers have 5-7 petals.
- I can produce 2.5 million seeds on a single plant and can also spread by root and stem fragments.

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## INVASIVE

### Feral pig *Sus scrofa*

- I am a large animal and can sometimes be aggressive, so remember to give me space.
- I am descended from wild boar, domestic pigs, or hybrids of the two. I have coarse, dark hair and sometimes even tusks.
- I like to live near water but often turn these areas into muddy wallows, damaging wetland ecosystems.

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## INVASIVE

### American bullfrog *Lithobates catesbeianus*

- I am the largest frog in BC. I can weigh up to one kilogram and measure up to 20 cm long.
- I have a big appetite, eating anything that will fit in my mouth, threatening many species at risk.
- I was first brought to BC to be farmed for my meaty legs.

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## INVASIVE

### Yellow flag iris *Iris pseudacorus*

- I am toxic to people and animals and may cause skin irritations for some.
- My thick roots restrict water flow, damage habitat, and crowd out native plants.
- My yellow flowers have 3 tongue-shaped petals with brown or purple veins on them. My stem is tall and smooth.

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## INVASIVE

### Yellow perch

*Perca flavescens*

- I can survive in a range of water temperatures, allowing me to establish in many lakes.
- I can carry diseases that are harmful to native fish species, including salmon.
- I am native east of the Rockies, but invasive in BC.

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## INVASIVE

### Russian olive

*Elaeagnus angustifolia*

- I am a small tree with silver leaves, yellow flowers, and olive-shaped berries. Birds and wildlife eat my berries so I spread through their droppings.
- I crowd out native riparian (streamside) vegetation including large trees like cottonwood.
- I can survive in wet and dry soil conditions and low temperatures.

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## INVASIVE

### Giant hogweed

*Heracleum mantegazzianum*

- Watch out! I produce a toxic sap that causes burns, blisters, and scarring.
- You can tell me apart from similar-looking native plants by my giant size. I can grow up to 5 m tall with leaves 3 m long and 1.7 m wide.
- My white flowers cluster and look like umbrellas.

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## INVASIVE

### Goldfish

*Carassius auratus*

- I am not always gold; sometimes I am silver or even muddy brown.
- It's illegal to release me into the wild! I can grow to the size of a football and cause great damage to wetlands and native wildlife.
- I make the water so murky that sunlight cannot reach underwater plants.

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## INVASIVE

### Yellow floating heart

*Nymphoides peltata*

- I grow in dense mats, preventing waterflow and disturbing sensitive habitat.
- My leaves look similar to a water lily, but my yellow flower grows tall above the water.
- I can spread from garden ponds to wetlands, so please don't plant me and report me if found!

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## NATIVE

### Beaver

*Castor canadensis*

- I am an 'ecosystem engineer'. I build dams that create ponds and wetlands, increasing biodiversity and creating habitats for birds, amphibians, fish, and many other species. I also help nutrients cycle through ecosystems.
- By creating and maintaining wetlands, I help to minimize flooding and store water during droughts.
- Some people consider me a nuisance because I chew down trees and make dams, creating water bodies in places where people might not want them.

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## NATIVE

### Canada goose

*Branta canadensis*

- You may hear my honking or see me flying with my flock in a 'V'-shaped formation.
- I can be found in a variety of habitats, including lakes, ponds, marshes and fields, parks and golf courses. I always make my nest near water.
- Many of us no longer migrate and spend the year on grassy lawns and fields and eating farm grains in the fall and winter.

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## NATIVE

### Water hemlock

*Cicuta douglasii*

- I grow in small patches in moist soils and wetlands, including along stream banks, wet pastures, and pond edges.
- All parts of me, including my roots and stems, are deadly to livestock and people.
- I am in the carrot family. Some of my close relatives also growing in wetlands, like Water-parsnip (*Sium suave*) and Cow-parsnip (*Heracleum maximum*), are important traditional food sources for Indigenous people.

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NATIVE

## Western toad

*Anaxyrus boreas*

- I am an amphibian spending part of my life in the water as a tadpole and the adult part of my life on land. You may even find me in your garden.
- When I migrate to or from my wetland habitat, I have the dangerous task of crossing roads, where many of us get run over by cars.
- As an adult, I eat many invertebrates and my tadpoles eat algae in the water.

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NATIVE

## Salmonberry

*Rubus spectabilis*

- Many First Nations know when the spring salmon run will begin based on the timing of when my fruit ripens.
- My early blooming pink flowers are an important source of nectar to migratory Rufous hummingbirds.
- My fruits can range in colour from pale yellow to bright red.

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NATIVE

## Western painted turtle

*Chrysemys picta bellii*

- I live in shallow ponds, lakes and wetlands that have basking logs where I can rest and warm up in the sun.
- I am named for the bright red and yellow colours on my bottom shell (plastron).
- My populations in BC have been declining due to loss of my wetland habitat and other factors, including competition with invasive Red-eared slider turtles.

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NATIVE

## Sword fern

*Polystichum munitum*

- I am a large, evergreen fern and grow in moist, shady forests. I can grow to 1.5 m tall!
- My leaves are traditionally used by Indigenous people to line cook pits, baskets, cover floors, and as bedding.
- You can tell me apart from other ferns by the forward-pointing 'thumb' shape of my leaflets, close to the leaf mid rib/stem.

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NATIVE

## Common garter snake

*Thamnophis sirtalis*

- I spend the winter hibernating underground in old mammal burrows or rocky crevices. I may share my winter den with many other snakes.
- Whether in forest, grasslands, in the mountains or in urban areas, I am most often found close to water where I hunt for frogs, slugs, salamanders, insects and even small fish.
- I am not harmful to people and don't have any venom.

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NATIVE

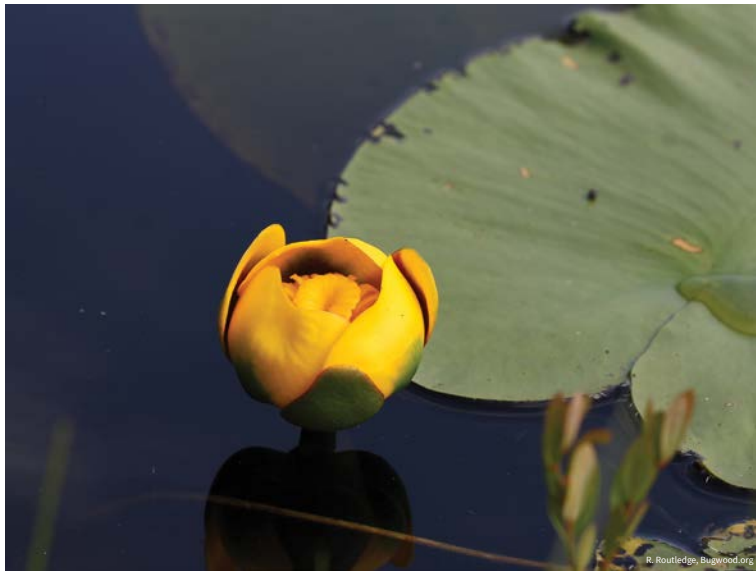
## Common cattail

*Typha latifolia*

- I grow in shallow water or wet soils in marshes, ponds, lakeshores, or even in wet roadside ditches.
- I form many tiny flowers on my dark brown 'cattail'. My pollen-producing flowers are on the top of the cattail and then fall off, leaving a bare spike. My flowers on the lower part of the cattail produce fluffy seeds that are spread by the wind.
- I provide habitat and food for many wetland animals, including fish, muskrats, waterfowl, and even people!

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**NATIVE**

## Yellow pond-lily

*Nuphar polysepala*

- You may find me growing in ponds and shallow lakes or in slow-flowing waterways.
- My floating heart-shaped leaves grow in a spiral around my thick stem and my flowers are yellow and sometimes tinged with green or red, up to 10 cm across.
- My roots (rhizomes) can grow 5 m long and are used traditionally as medicine to treat many illnesses, including colds, heart conditions, cancer, tuberculosis, and asthma.

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**NATIVE**

## Four-spotted skimmer

*Libellula quadrimaculata*

- Like all dragonflies, I begin my life as an egg laid on aquatic vegetation. When I hatch, I'm called a nymph and I live in the water, where I hunt aquatic insects, tadpoles and even small fish.
- I become a winged adult when I crawl out of the water and moult out of my exoskeleton.
- I catch mosquitoes and other insect prey while I fly.

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**NATIVE**

## Bull trout

*Salvelinus confluentus*

- I am a fish in the Salmon family, closely related to Dolly Varden and Arctic char.
- I live in cold, clear waters in high mountain headwaters, deep lakes or reservoirs, and coastal rivers. I am very sensitive to habitat disturbances and am considered a Species at Risk in BC.
- I eat aquatic invertebrates and zooplankton when I'm young, and other fish and fish eggs when I'm mature.

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## NATIVE

### Red-winged blackbird

*Agelaius phoeniceus*

- Males are unmistakable with our loud “conk-la-ree!” call and the bright flash of our red shoulder pads. Females are less often noticed with brown and white streaky colouring.
- Look and listen for me in moist environments including marshes, ponds, and wet roadsides.
- I weave my nests out of bark and leaves, placed among tall stems of plants like cattails, sedges, and willows.

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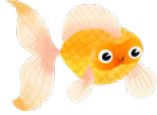

# Healthy Aquatic Habitat Hero Bingo

## H

## E

## R

## O

 <p>Take a Rainy Day Watershed Walk and listen to water.</p>	<p>Read a story about an animal that lives in the water.</p>	<p>Tell a friend or family member how they can help stop invasive species spreading by cleaning their boat and fishing gear. <i>(Clean Drain Dry)</i></p>	<p>Take a photograph of an invasive species. Identify it using ID apps or field guides.</p>
<p>Name and sketch an aquatic species native to BC.</p> 	 <p>Tell a friend a fun fact about aquatic invasive species.</p>	<p>Close your eyes and imagine you are in a kayak on a lake. Think of things you could feel, hear, smell and see. <i>(Wetland Wonders Activity)</i></p>	<p>Draw a healthy aquatic ecosystem. Choose an invasive species and talk about what would happen if it took over.</p>
<p>Use buckets of water, sprinkle one with herbs. Play with boats in both to show the spread of invasive species. <i>(Vectors of Spread Activity)</i></p>	<p>Learn 2 ways wetlands help our environment.</p> 	<p>Tell a friend about an adaptation that helps an animal or plant to survive in aquatic habitats.</p>	 <p>Draw a Don't Let it Loose poster about not releasing pets from an aquarium into the wild.</p>
<p>Write a poem or short story about a lake or river that is important to you.</p>	<p>Name a way you can help protect our lakes and rivers.</p>	 <p>Make an UNWANTED poster of an invasive species that can take over aquatic ecosystems.</p>	<p>Learn about an aquatic species important to Indigenous communities.</p> 