

GRADE 4 CURRICULUM KIT

# Making Waves!

PROTECTING ONTARIO'S AQUATIC HABITATS



# Making Waves!

## Protecting Ontario's Aquatic Habitats

### GRADE 4 CURRICULUM KIT

**A fun, informative, activity-filled teacher resource kit that introduces children to the concept of healthy habitats and communities and our role in protecting them from aquatic invasive species.**

#### **INCLUDES:**

Curriculum-linked, integrated activities in Grade 4 Science, Language, Physical Education and Art.

Lessons and warm-up activities designed to highlight curriculum expectations and terminology. Lessons have extensions, accommodations and ideas for evaluation.

Constructivist approaches and a variety of teaching strategies.



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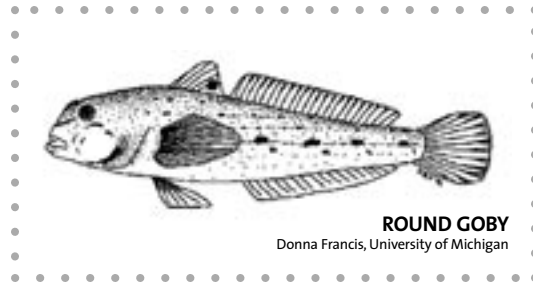
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# Introduction

**C**an you imagine what would happen if each of us, when unable to look after our aquariums, emptied the contents into a local lake? The impact on the lake and its inhabitants could be



**ROUND GOBY**  
Donna Francis, University of Michigan

are aggressive, extremely adaptable and have high reproductive rates.

Invasive aquatic species are introduced and further spread to Ontario lakes through several pathways. There are natural pathways

of species introduction such as wind, water currents or migration and there are human-assisted intentional and unintentional pathways of species introduction.

The following, human-assisted pathways are a concern when we refer to aquatic **invasive** species:

of species introduction such as wind, water currents or migration and there are human-assisted intentional and unintentional pathways of species introduction.

The following, human-assisted pathways are a concern when we refer to aquatic **invasive** species:

- Ballast water dumping by foreign ships;
- Release through poor aquarium and water garden practices;
- Release of species from live food fish vendors;
- Release of baitfish from one body of water into another;
- Unauthorized fish stocking and aquaculture; and
- Failure to undertake proper cleaning and equipment transfer procedures when boating or participating in other recreational water-based activities (i.e. snorkeling, diving, float planes).

Invading species are considered by many experts to be among the greatest threats to Ontario's biodiversity. Originating from other regions of the world or outside of their present or historic range, these species, due to an absence of predators, have the potential to reproduce at a rapid rate and take over a habitat. Their impact, in fact, can reach far beyond the deterioration of native species populations, habitats and ecosystems to impact our economy, human communities and even human health.

As students and teachers work through **Making Waves!**, we hope they will take these important messages home:

1. Habitats and communities are interconnected systems within which plants and animals

Using integrated lessons, **Making Waves! Protecting Ontario's Aquatic Habitats** illustrates the main concepts of the *Ontario Science Curriculum* – *Life Systems* strand, highlights the importance of stewardship and demonstrates specific actions we can take to protect our threatened wetlands and waterways from aquatic invasive species.

- depend on each other for health and survival.
2. Habitats and communities are impacted by human activity. At times this impact can be catastrophic and irreversible.
  3. Humans can reduce habitat and species loss by recognizing sources of harm and taking action to prevent that harm.
  4. Humans can aid habitats and communities further by sharing stewardship knowledge with friends, family and neighbours, ensuring everyone has the tools to care for our world.

## Who are we?

This teaching aid has been created for the **Invading Species Awareness Program** – a joint partnership of the *Ontario Federation of Anglers and Hunters* and the *Ontario Ministry of Natural Resources*.

Launched in 1992, the **Invading Species Awareness Program** is designed to address threats from aquatic invading species. This initiative aims to:

- Raise public awareness of invading species and encourage public participation in preventing their spread.
- Monitor and track the spread of invading species in Ontario waters through citizen reports to the Invading Species Hotline and the Invading Species Watch program.
- Conduct research on the impacts of invasive species and investigate methods of control.

The **Invading Species Awareness Program's** ability to effectively track, monitor and control invading species relies directly on public awareness and action. Without the concern, dedication and voluntary participation from the public, this conservation program would not be the success that it is. ***Making Waves! Protecting Ontario's Aquatic Habitats*** will help you understand the impacts of invasive species on habitats and ecosystems, and provide tools and strategies for you, your students and their families to help stop the spread of invasive species.

## For more information:

visit [www.invadingspecies.com](http://www.invadingspecies.com),  
email [invasivespecies@ofah.org](mailto:invasivespecies@ofah.org)  
or call the Invading Species Hotline at 1-800-563-7711.



# Overview

## Introduction to Making Waves!

All of the Earth’s habitats and species communities are essential for human survival. However, all are challenged with some form of habitat interference and at times, destruction. With public awareness and action, this potential can be greatly managed and reduced.

Through an introduction to invasive species, ***Making Waves!: Protecting Ontario’s Aquatic Habitats*** will familiarize Grade 4 students with

the concept of healthy habitats and communities, and demonstrate how our actions, as individuals, can have a meaningful influence on maintaining the balance within them.

***Making Waves!*** is a lesson package that revolves around the Ontario Curriculum’s *Science and Technology – Life Systems* strand with integrated lessons and warm-up/wrap-up activities that reach across many other subject/strand areas:

Subject	Strand
Science and Technology	• Life Systems
Social Studies	• Canada and World Connections
Language	• Writing • Oral and Visual Communication
Health & Physical Education	• Active Participation
The Arts	• Music • Visual Arts • Drama

(See: Full Expectations Listing for details on which Ontario Curriculum goals are met by this package.)

## Kit Objectives

***Making Waves! Protecting Ontario’s Aquatic Habitats*** will:

1. Meet curriculum expectations through lessons developed with Constructivist and Experiential teaching philosophies in mind – allowing students a deeper understanding and greater ownership over the knowledge they are gaining.
2. Teach Science concepts through integrated activities, different learning styles and strategies, multiple intelligences and differentiated instruction.
3. Meet the current teaching trend of integration – combining various subject areas in one lesson so as to represent the comprehensive nature of “real life”.
4. Enable children to understand new concepts by making connections to previous experience and to the world around them.

# Learning Goals

In this unit, students will gain:

## KNOWLEDGE BY...

- Exploring the concept of healthy habitats and communities: plant and animal species balanced in their roles within the food chain and their relationship with their environment;
- Determining what an invasive species is and what its main characteristics are;
- Exploring adaptations as they relate to native and non-native species; including why invasive species adaptations are harmful to Ontario aquatic communities;
- Becoming familiar with different types of invasive species;
- Determining ways humans have influenced habitats, including the many ways we have introduced invasive species to aquatic habitats;
- Determining methods of environmental stewardship as it relates to invasive species; and
- Exploring ways to involve their community in invasive species prevention behaviours.

## ENDURING UNDERSTANDING BY...

- Exploring concepts related to **healthy habitats** and communities;
- Recognizing our role in maintaining healthy habitats and communities (**stewardship**); and
- Learning tools to maintain healthy habitats and communities, and protect against the spread of invasive species (**action**).

# Curriculum Expectations – Quick Reference

The following table provides “expectations at a glance” for the Ontario Grade 4 Curriculum. This will enable you to determine how *Making Waves!* fits into your planning.

Activity	Enduring Understanding	Subject Area/Strand				
		Science	Social Studies	Writing	Physical Education	The Arts
<b>WARM-UP/WRAP-UP ACTIVITIES</b>						
<b>A Change Over Time</b>	• Healthy Habitats • Stewardship	😊				
<b>Fridge Fiasco</b>	• Healthy Habitats	😊				
<b>The Preventable Problem</b>	• Healthy Habitats • Stewardship • Action	😊				
<b>Songs for An Ecosystem</b>	• Healthy Habitats • Stewardship • Action	😊				😊
<b>LESSONS</b>						
<b>Know Me, Know My Habitat</b>	• Healthy Habitats	😊				
<b>Sun Block</b>	• Healthy Habitats • Stewardship	😊			😊	
<b>Changing Chains</b>	• Healthy Habitats • Stewardship • Action	😊		😊		
<b>Aquarium Ownership is an Art</b>	• Healthy Habitats • Stewardship • Action	😊				😊
<b>Musical Mussels</b>	• Healthy Habitats	😊		😊	😊	
<b>Tough Ruffe</b>	• Healthy Habitats	😊			😊	
<b>Stow Aways and Crafty Ways</b>	• Healthy Habitats	😊	😊	😊		
<b>The Ultimate Species</b>	• Healthy Habitats • Stewardship	😊		😊		



## Lesson Overview - Quick Reference

WARM-UP/WRAP-UP ACTIVITIES				
Title	Purpose	Time	Materials	Group Size
<b>A Change Over Time</b>	By comparing altered pictures of the same habitat, students will discuss how habitats can change over time and the influences for change	20 min.	BLM: <i>Habitat Transition</i>	Class/Pairs
<b>Fridge Fiasco</b>	By considering their own experience with food, students will engage in a discussion that introduces them to the concept of a disturbed food chain and its impacts.	15 min.	–	Class
<b>The Preventable Problem</b>	This comparison activity of “problems” and “preventions” encourages students to recognize that seemingly innocent actions can have great impacts on habitats and communities.	25 min.	BLM: <i>Problems and Preventions</i>	Class/ Groups of 4
<b>Songs for An Ecosystem</b>	Students will create a song to describe how humans can protect aquatic habitats.	30 min.	Invading Species Song	Groups/Pairs

LESSONS					
Title	Description	Time	Materials	Assessment Opportunities	Group Size
<b>Know Me, Know My Adaptations</b>	By playing a “Who Am I?” type game, students will learn to identify plant and animal <b>adaptations</b> and explore how these may relate to specific habitats and communities.	50 min.	BLM: <i>Cottage Country's Most Unwanted</i> , BLM: <i>My Adaptations Checklist</i> , BLM: <i>Predator, Plant and Prey</i> , tape, chart paper, markers	Using a checklist, teachers can evaluate student understanding of adaptation and habitat by observing <b>group work</b> and <b>individual student response</b> during the discussion.	Class
<b>Sun Block</b>	In this active game, students will emulate the transfer of <b>food energy</b> in a lake habitat. They will gain an understanding of <b>how both non-living factors and living creatures affect an animal's ability to survive</b> . Students will predict outcomes, and compare scenario's between a healthy habitat and one disrupted by an invasive plant species.	50 min.	Pinnies, pylons, craft sticks, hula-hoops, whistle, clipboard, pencil, poster paper	Students can design a <b>storyboard</b> illustrating and explaining what happens in a lake when an invasive species is introduced.	Class

Title	Description	Time	Materials	Assessment Opportunities	Group Size
<b>Changing Chains</b>	Students will create <b>food chains</b> from familiar animal and plant species and examine the impacts on these food chains when environmental problems and invasive species disrupt them.	2 x 50 min.	Cue cards, chart paper, markers, tape	Teachers can evaluate <b>group work</b> while students are working together on their food chains and tables. Further language evaluation can be done on student <b>articles</b> .	Groups of 4 – 6 students
<b>Aquarium Ownership is an Art</b>	Students will learn that when they release aquatic pets and plants into local waterways there can be <b>subsequent impacts on habitats and communities</b> . Students will take action by creating educational posters to put in pet shops and city aquariums that remind the public of their responsibilities as pet owners. As an art activity, this project will be used to explore tint, shade and texture.	50 min.	BLM: <i>Pet Shop Poster Messages</i> , cardboard, paper, paint, paintbrushes, sand, water, scrap paper, example posters	<b>Posters</b> can be evaluated for art concepts (tint, shade and texture). <b>Presentations</b> will indicate whether students recognize the need for human action to protect against the impact of invasive species.	Class to groups
<b>Musical Mussels</b>	In this version of Musical Chairs, students will <b>role-play</b> aquatic animals to discover <b>adaptations</b> and factors that enable invasive species (zebra mussels) to spread throughout the Great Lakes and Ontario's inland waters.	50-70 min.	10 chairs, BLM: <i>Musical Mussel Cards</i> , mailing labels, music	Students can be evaluated on their <b>written statement of the game's objectives</b> , including their understanding of: community, habitat, basic needs, the struggle for survival, native species and invasive species.	Class
<b>Tough Ruffe</b>	In this active <b>simulation</b> , students will demonstrate the <b>struggle for survival</b> as experienced by perch in a lake habitat. Students will predict outcomes, and compare scenarios between a healthy habitat and one disrupted by an invasive species, the Eurasian ruffe.	45 min.	Hula hoops, watch, pinnies, whistle, BLM: <i>Tough Ruffe Game Cards</i>	Evaluations can be done on student <b>written responses</b> to the questions outlined in the Checks for Understanding section.	Varies
<b>Stow-Aways and Crafty Ways</b>	Students will learn how the <b>Great Lakes and other waterways</b> are linked. Using an atlas to identify various locations where the invasive species, round goby, have been sighted, students will both extrapolate the possible routes members of these species have used to get to their present location, and predict future spread.	70 min.	BLM: <i>Map of Ontario</i> , atlases, Canada and World Map, pencil crayons, paper, pop bottle, basin, duct tape, water, BLM: <i>Round Goby Investigation Background</i> , 4 x \$2 coins	Teachers can evaluate student knowledge of Ontario waters, mapping vocabulary (province, latitude, longitude, etc.), cardinal and intermediate directions, non-pictorial symbols and the use of colour in legends on the <b>invasive species spread map</b> . Additional assessment can be performed on prediction and communication skills as displayed in the <b>investigative report</b> .	Class
<b>Ultimate Species</b>	In this culminating activity, students will demonstrate their understanding of <b>habitats</b> and <b>adaptations</b> of species by creating their own ultimate invasive species.	2 x 40 min.	BLM: <i>Cottage Country's Most Unwanted</i> , legal-sized paper, drawing utensils, chart paper	Using the <b>Rubric provided</b> , teachers can evaluate student Ultimate Species creature descriptions for Science, Language and Art requirements.	Class

# Warm-up/Wrap-up Activities

## 1. A Change Over Time

By comparing altered pictures of the same habitat, students will discuss how habitats can change over time and what the changes and influences for change are.

## 2. Fridge Fiasco

By considering their own experience with food, students will engage in a discussion that introduces them to the concept of a disturbed food chain and its impacts on those that rely on it.

## 3. The Preventable Problem

This comparison activity featuring problems and their preventions encourages students to recognize that seemingly innocent actions can have great impact on habitats and communities.

## 4. Songs for an Ecosystem

Students will create a song to describe how humans can protect aquatic habitats.  
(Note: This is best used as a wrap-up activity.)

# A Change Over Time

**PURPOSE:** By comparing altered pictures of the same habitat, students will discuss the influences and changes that can alter habitats over time.

**TIME:** 20 minutes

**PROCEDURE:** Photocopy the Blackline Masters: *Habitat Transition* (3 pages in all), depicting the same habitat under three different scenarios. Hang the pictures up for students to see (or pass out sets of photocopies). Ask the students to determine what the pictures represent and to discuss what is occurring in each picture. (This can be done in groups or in a *Think, Pair, Share* format.)

- What do you think is happening in each picture?
- What signs do you see that show a healthy/unhealthy habitat?
- Looking at each picture, what do you think occurred to make this habitat change?
- In each picture, what is the effect on the animals and plants?
- In each picture, what is the effect on humans?
- Discuss the human role in the habitat transition.
- Can you make any predictions based on this series of pictures?

**EXTENSION:** Choosing a habitat of their choice, students could draw a series of pictures that show the transition of a local habitat (schoolyard, forest, classroom, pond, downtown – not home or neighbourhood) from healthy to unhealthy or vice versa.

**ENSURING UNDERSTANDINGS:** Understanding concepts related to healthy habitats; recognizing our role in maintaining healthy habitats (*stewardship*).

**EXPECTATIONS:** 4S1, 4S2, 4S3, 4S15, 4S18

**NOTE TO TEACHER:** This activity could be delivered as a wrap-up activity to ensure students have an understanding of the main concepts of the *Science – Life Systems* unit.

# Fridge Fiasco

**PURPOSE:** By considering their own experience with food, students will engage in a discussion that introduces them to the concept of a disturbed food chain and how it impacts those that rely on it.

**TIME:** 15 minutes

**MATERIALS:** 10 slips of scrap paper

**PROCEDURE:**

1. Tell students that “today” is grocery shopping day. Ask them to generate a list of their 10 favourite food items covering all 4 food groups. As suggestions are made, print them on the blackboard and each on a slip of paper. Place the slips of paper in a container.
2. Explain: A family of greedy gluttons has moved into the neighbourhood. They have a huge appetite and wads of cash. They get to the grocery store ahead of you and buy out all but three of the food items.
3. Have students draw seven of the food items from the container of slips and cross these items off of your blackboard grocery list. As the items generated are student favourites, have fun and make a big deal out of removing the items from the list.
4. Explain: As the greedy glutton family have moved in for good, it looks as though these 3 items will be all that you can eat from now on. (Note: There are no other grocery stores in your community!) You buy the items that are left.
5. Ask students: *How do you feel about eating the food that remains? How would you feel in two weeks? One year?*
6. Explain: The grocery store runs out of two items and you are now left with only one.
7. Draw two more items from the container and scratch them off the list. You are now left with only one item. *What could happen to your body over time if you ate only this one item?* Remind students about the 4 food groups, if necessary (unbalanced diet and poor nutrition, hunger, lethargy and starvation, for example). *How would this diet affect your schoolwork? Relationships? Family and school life?*
8. Explain: Two new members are added to your family, however, the amount and type of food available from the store remains the same. Ask: *How does this impact you and your relatives?*
9. Explain: This situation is one that native species can experience when new, stronger, invasive species enter the food chain and devour their food. The impact on the native species, its community and habitat can be severe.

**ENSURING UNDERSTANDINGS:** Understanding concepts related to healthy habitats.

**EXPECTATIONS:** 454, 4518

**NOTE TO TEACHERS:** Ensure you phrase this activity in a manner that does not highlight students who may have limited access to appropriate quantities of food on a daily basis. Do not ask for example: What do you have in *your* fridge? What did *you* have for lunch?

# The Preventable Problem

**PURPOSE:** This comparison activity, featuring problems and their preventions, encourages students to recognize that seemingly innocent actions can have great impact on habitats and communities. Students will demonstrate this understanding verbally and through the use of drama.

**TIME:** 25 minutes

**PROCEDURE:** Cut Blackline Master: *Healthy Habitats – Problems and Preventions* into slips for distribution. Put students into pairs and provide them with either a problem or a prevention. Ask students to find their match and discuss amongst themselves how following the prevention ensures they will have no problem. *If we did this (prevention)... then this wouldn't happen (problem).* Have groups share their discussion with the class. Ask them to predict what would happen if they didn't apply the prevention (**prediction**). Ask them for examples from their own lives (**connection**) that demonstrate how they can impact their habitat through the choices and actions they make.

**EXTENSION:** Students could dramatize their problem and solution.

**ENSURING UNDERSTANDINGS:** Understanding concepts related to healthy habitats; recognizing our role in maintaining healthy habitats (**stewardship**); learn of tools for maintaining healthy habitats and communities, and protecting against invasive species.

**EXPECTATIONS:** 4S1, 4S3

# Songs for an Ecosystem

**PURPOSE:** Students will create a song to describe how humans can protect aquatic habitats. This activity will allow students to communicate their understanding of the roles humans play in protecting habitats and communities.

**TIME:** 30 minutes

**PROCEDURE:** In small groups, students will change the words to a familiar tune to describe how invasive species introduced by humans can affect habitats or what can be done to prevent invasive species from entering habitats. Words can be written and performed from the point-of-view of a native species, invasive species or a human.

Songs like, “When the Saints Go Marching In”, “Oh Susanna”, “When You’re Happy and You Know It” or even tunes from contemporary songs can become memorable odes to being responsible to our aquatic habitats. Encourage students to remember their new ditties by performing them for each other, their family, another class or the school.

Example: (This is one verse of a song that is sung to the tune from “American Woman” by the Guess Who and the full version can be found in the Blackline Masters on page 57.)

Invading species, stay away from me  
Invading species, you spiny water flea  
Don’t come hangin’ around my shore  
I don’t want to see your hooks no more  
I got more important things to do  
Than spend my time cleaning boats of you  
Now mussel, I said stay away,  
Gobies, listen to what I say.

**EXTENSION:** Consider extending this warm-up into a drama lesson by introducing actions, costumes and props.

**ENSURING UNDERSTANDINGS:** Understanding concepts related to healthy habitats; recognizing our role in maintaining healthy habitats (*stewardship*); learn of tools for maintaining healthy habitats and communities, and protecting against invasive species.

**EXPECTATIONS:** 4s1, 4a3, 4a18

**NOTES TO TEACHER:** *Songs for an Ecosystem* is best used as a wrap-up activity.

# Lesson Plans

## 1. Know Me, Know My Adaptations

By playing a “Who Am I?” type game, students will learn to identify animal adaptations and explore how these may relate to survival in specific habitats and communities. In addition, students will be introduced to the concept of invasive species.

## 2. Sun Block

In this active game, students will emulate the transfer of food energy in a lake habitat. They will gain an understanding of how both non-living factors (sunlight) and other living creatures (producers and consumers) affect an animal’s ability to survive. Students will predict outcomes, and compare scenarios between a healthy habitat and one disrupted by an invasive plant species.

## 3. Changing Chains

Students will create food chains from familiar animal and plant species and examine the impacts on these food chains when environmental problems and invasive species disrupt them.

## 4. Aquarium Ownership is an Art

Students will learn that when they release aquatic pets and plants into local waterways there can be subsequent impacts on habitats and communities. Students will take action by creating educational posters to put in pet shops and city aquariums that remind the public of their responsibilities as pet owners. As an art activity, this project will be used to explore tint, shade and texture.

## 5. Musical Mussels

In this version of Musical Chairs, students will role-play aquatic animals to discover adaptations and factors that enable invasive species (zebra mussels) to spread throughout the Great Lakes and Ontario’s inland waters.

## 6. Tough Ruffe

In this active simulation, students will demonstrate the struggle for survival as experienced by yellow perch in a lake habitat. Students will predict outcomes, and compare scenarios between a healthy habitat and one disrupted by an invasive species, the Eurasian ruffe.

## 7. Stow-Aways and Crafty Ways

Students will learn how the Great Lakes and other waterways are linked. Using an atlas to identify various locations where the invasive species, the round goby, have been sighted, students will both determine the possible routes members of these species have used to get to their present location, and predict future spread.

## 8. The Ultimate Species

By creating their own ultimate species, students will demonstrate their understanding of animal and plant adaptations as influenced by their habitat and community, and determine what types of adaptations make a species invasive.



# Know Me, Know My Adaptations

**PURPOSE:** By playing a “Who Am I?” type game, students will learn to identify animal **adaptations** and explore how these may relate to survival in specific **habitats** and **communities**. In addition, students will be introduced to the concept of **invasive species**.

**SUBJECT / STRAND:**

Grade 4 Science –  
Life Systems

**DURATION:**

70 minutes

**GROUP SIZE:**

Class to groups

**SETTING:**

Classroom (desks  
moved to side,  
if possible)

**EXPECTED OUTCOMES:** This activity culminates in group work and a presentation in which students display their understanding of species adaptations and how they contribute to species survival. In addition, students explore the concept of invasive species as it relates to specific adaptations.

**MATERIALS:** Blackline Master: *Who Am I?*, masking tape, Blackline Master: *Predator, Plant and Prey*, chart paper, markers, Blackline Master: *My Adaptation Checklist*

**ENDURING UNDERSTANDINGS:** Understanding concepts related to healthy habitats

**EXPECTATIONS:** 4S1, 4S2, 4S4, 4S5, 4S7, 4S8, 4S10, 4S13, 4S18

**PROCESSES OF SCIENCE:** Classifying, communicating, inferring

## Lesson Sequence

### Prior:

1. In a prior class, prepare students for *Know Me, Know My Adaptations* by:
  - Ensuring they understand the following terms: **habitat, community, adaptation, predator and prey** (see Glossary).
  - Explaining that they will enter the next lesson under an *oath of silence* and will have an

animal species taped to their back by the teacher as they enter.

2. Make 3 - 4 photocopies of Blackline Master: Who Am I? Cut into cards – one for every student. Ensure there are 3 – 5 students per species group.

3. Photocopy the Blackline Master: My Adaptation Checklist. One for every student.

4. On a the chalkboard, write the following:

**Goal #1:** Discover your species' adaptations.

**Goal #2:** Find all members of your species.

**Goal #3:** As a group, link your adaptations to your habitat and community.

5. Prepare the Blackline Master: Predator, Plant and Prey as appropriate. (For example, make an overhead for students to refer to, photocopy for students to reference, or simply explain this version of Rock, Paper, Scissors through a demonstration.)

## Procedure:

1. Part I: As students walk into the classroom, tape a "Who Am I?" sign to their back. Ensure students maintain their *oath of silence* except when following the question part of the activity.

2. Explain the rules:

- Students will circulate around the room and meet up with a fellow student. Once together in a pair, the students will play *one round of Predator, Plant and Prey*, to determine who gets to ask an adaptation question. (This is a version of *Rock, Paper, Scissors* – see the Blackline Master: Predator, Plant and Prey.)
- Using the Blackline Master: My Adaptation Checklist, the winner of **Predator, Plant and Prey** creates a question for the other student. For example, "Do I have strong teeth?" As they go around the room, students will fill out the checklist.
- Students can only ask one question per encounter, then they must move on to another student to discover their next adaptation. Encourage students to ask questions from the checklist in random order.
- Each student has 4 adaptations they must uncover (**Goal #1**). These are the clues to their

identity. As they move about the room, students must not share the identities of the other species they see. The only thing spoken is an adaptation question, and a yes or no.

- When students think they know all of their adaptations they must sit down. They must not interact with any other students at this time.
- Only when there are two people left are these two allowed to continue asking each other questions until they have determined their adaptations.

3. Run activity. Once everyone is sitting, ask students to remove the signs from their backs and put them in a safe place (like a pocket, for example) where they can refer to them if needed. Proceed with second part of lesson.

4. Part II: Students must walk around the classroom in silence and find all the members of their species by miming and gesturing their adaptations (**Goal #2**). When students have found all members of their species group and maintaining their *oath of silence*, they must sit down collectively to indicate that they have found one another. (Note: Let students know how many group members they should expect to find. This will depend on *the class size*. For example, "There will be 6 groups of 4 and 2 groups of 5.")

5. Choose a facilitator and a recorder for each group. Hand out chart paper and markers.

6. In their species groups, ask students to discuss and record how they think the **adaptations** of their animal relates to its **habitat** and/or **community**. (For example, if their species has strong teeth, how does this help them in their habitat and community?) This is **Goal #3**.

## Our Species is: American Beaver

ADAPTATION	HOW OUR ADAPTATIONS HELP US SURVIVE IN OUR HABITAT OR COMMUNITY.
Strong teeth	Our strong teeth help us take down large trees to build our dams and lodges, and they help us to eat shoots and small trees.

### Closure/Checks for Understanding:

Once the species groups have completed the posters (example above), representatives can present their species to the class. The representative will explain how their group interprets their species' adaptations in relation to its habitat and community. Class discussions can be encouraged as to whether the group adaptation interpretations are appropriate.

At the end of the activity, introduce the concept of **invasive species** in general terms: that they are not originally from the habitat, which can mean that they lack predators, and that they have adaptations that enable them to survive at a higher rate than a habitat's native species. Explain that **3** of the **9** species in the classroom are invasive (sea lamprey, rusty crayfish and round goby). In a discussion, determine with the students which species they think these are based on the adaptations they've listed and the descriptions given.

### NOTES FOR TEACHER:

Just like you and I, an animal or plant needs a comfortable place to live. This place, called a **habitat** (it begins with an "h" like *house* and *home*), provides a species with the things it needs to survive: food, shelter and water, for example. A group of plants and animals that live together as a group of interdependent organisms, inhabiting the same region and interacting with each other, is called a **community**. This community, along with the habitats and the non-living things around it, like air, water, soil and rock, are called an **ecosystem**.

Habitats and ecosystems have very specific conditions that influence what types of food, shelter and water are available to living things. These conditions are not necessarily suitable for all species. The needs met by the conditions of a desert, for example, are vastly different from those that are available in your local pond.

Species and communities that have come to survive

in specific habitats and ecosystems have traits that are suitable to their surroundings. These are called **adaptations**. These **adaptations** greatly help in their **struggle for survival**, that is, in finding food energy, keeping safe from predators and reproducing. Examples of adaptations include: a colouring that enables a species to hide from enemies; claws that help them open a particular type of available shell or nut; webbed feet that can propel them quickly through water; a colourful plumage that lures a potential mate; and sharp spikes or a bad taste that protect from predators.

**Native species** are those plants and animals whose origins are in the particular habitat they are residing in. They have adapted over many thousands of years to specific conditions, developing and maintaining a healthy balance with the other animals and plants that share the habitat (community). **Non-native species** are those that did not originate in the habitat

it has been introduced to. These species have been brought to their new habitat mainly through human-related activity. Non-native species that have very robust adaptations, that is, adaptations that give them a survival advantage over native species, do harm to native species and their ecosystems, and have an economical impact are considered **invasive species**. These species are often able to live in many types of habitats; their adaptations ensure their survival and growth rates are generally greater than those of other species. Their exceptional survival and reproductive rate often causes a negative change to the entire habitat. (See also: *Background Materials and Glossary*.)

### **EVALUATION:**

Teachers, using a checklist, can evaluate group interactions, presentations and class discussions for student understanding of **adaptation**, species survival, **community** and **habitat**.

### **ACCOMMODATIONS:**

This activity meets the needs of visual and kinesthetic learners through movement, species card support and supplemental blackboard work. Students who need to write their adaptations down while circulating, can do so on a scrap piece of paper. Those that need further assistance can be paired with a stronger student at the beginning of the activity. Also to note, as students will ultimately form groups based on which card they are assigned, teachers can identify and determine appropriate group membership as required.

### **EXTENSIONS:**

For homework or in-class reflection assign students to write a short paragraph about their species using the listed adaptations. Students can then defend why they believe their species is invasive or non-invasive.

For teachers wishing to add a research component, students can create a species brochure for habitat visitors. If their species is invasive, they can refer to **[www.invadingspecies.com](http://www.invadingspecies.com)** to get more information.

# Sun Block

**PURPOSE:** In this active game, students will emulate the **transfer of food energy** in a lake habitat. Through emulating the transfer of food energy in a lake habitat, students will gain an understanding of how both non-living factors (sunlight) and other living creatures (**producers** and **consumers**) affect an animal’s ability to survive. Students will predict outcomes, and compare scenarios between a healthy habitat and one disrupted by an invasive plant species.

<b>SUBJECT / STRAND:</b> Grade 4 Science – Life Systems, Health and Physical Education	<b>DURATION:</b> 50 minutes	<b>GROUP SIZE:</b> Class	<b>SETTING:</b> Gym or field
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**MATERIALS:** 3-6 pinnies (pinafore aprons) of one colour, 1 pinny of a different colour, 4 pylons, 500 craft (Popsicle) sticks, 4 hula-hoops, whistle, clipboard, pencil, paper, one poster labelled “Sun” and another labelled “Algae” (optional)

**ENDURING UNDERSTANDINGS:** Understanding concepts related to healthy habitats; recognizing our role in maintaining healthy habitats (*stewardship*).

**EXPECTATIONS:** 4s1, 4s2, 4s3, 4s5, 4s6, 4s12, 4s16, 4s18, 4p15, 4p26, 4p35, 4p36

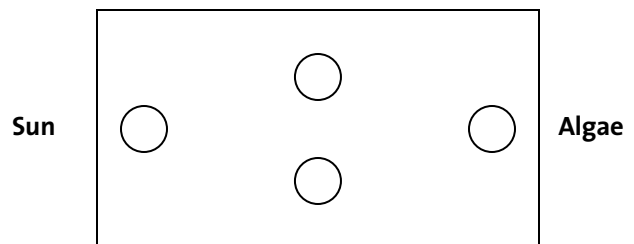
**PROCESSES OF SCIENCE:** Constructing models, identifying and controlling variables, predicting

## Lesson Sequence

### Prior:

1. Mark off a basketball court-sized rectangle with a pylon at each corner. This area will be your lake.
2. Place the “Sun” sign and a hula-hoop at one end of the rectangle. This is the surface of the lake. Put 500 craft sticks, representing the sun’s energy, inside this hoop.

3. At the other end of the rectangle, the bottom of the lake, place the “Algae” sign and another hula-hoop.



- In the middle of the rectangle lake, place 2 hula-hoops 3 m apart. These will represent 2 fish stomachs.

### Procedure:

**IN CLASS** (Optional). Introduce the plant species, **European frogbit**. Show students a picture of the plant as found on the *Blackline Master: Cottage Country's Most Unwanted* or in the background materials available with this kit.

Tell students they will be role-playing to model:

- a healthy **food chain**, and
- a **food chain** invaded by European frogbit

### GYM/FIELD

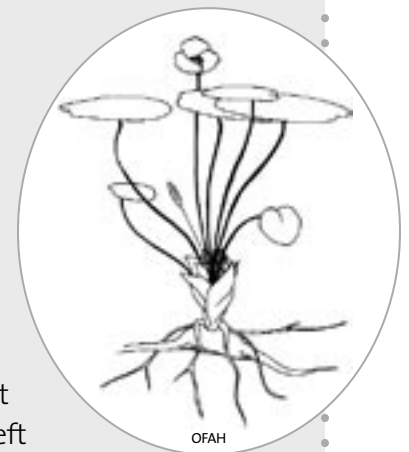
- Gather the class and explain that they will be modeling a healthy **food chain**. Assign 3 – 6 students (depending on group size) to be the **fish** (provide them with pinnies) while the remaining students will be **sunrays**.
- Explain that the job of the **sunrays** will be to transfer the sun's energy, *one craft stick at a time*, from the "Sun" to the "Algae". *The algae convert the sunlight energy into food energy that fish can eat.*
- The **fish** will eat the algae. They will do this by taking *one craft stick at a time*, from the "Algae" to a fish stomach. (NOTE: Fish cannot get food - craft sticks - directly from the sun, as they do not **photosynthesize**.)
- With sunrays starting at the sun hoop, and fish starting at the algae hoop, whistle to begin. Run the game until all the sticks have been taken from the sun. This will indicate that the sun has set for Day #1. Ask: *What is the significance of the sticks that are left in the algae hoop?*
- Record the number of sticks in the plant and fish stomach hoops. Return all the sticks to the sun hoop for Day #2.

## A Bit About... EUROPEAN FROGBIT

European frogbit (*Hydrocharis morsus-ranae*) is a floating aquatic plant that looks like a miniature water lily. It has heart-shaped leaves averaging about three centimeters in diameter and small white flowers with a yellow centre. It can be found in wetlands or quiet, shallow, lake bays in southern Ontario, Quebec, New York and Vermont.

European frogbit harms lakes by floating on the top of the water and blocking out needed sunlight. The sunlight is food energy for the algae (**producers** in the food chain) that grow below the water's surface. Without energy, the algae don't grow and the fish (the **consumers** in the lake) are left with less food energy.

European frogbit can get into healthy habitats due to human mistakes. Boaters can bring it into healthy waters on their boats and motors without realizing it. Anglers may introduce it unknowingly if they empty a bait bucket containing the plant into the aquatic habitats they are fishing in. Hobbyists may dump the plant from their aquariums and water gardens into local waters without realizing the harm this may cause. Being careful while enjoying our lakes, streams and wetlands can go a long way towards keeping them healthy.



6. Gather the class again and explain that this time the food chain will be disrupted by an invasive species called **European frogbit**. It got into our lake accidentally. Ask: *Does anyone know how it may have gotten there?* (See *A Bit About...*)
7. Select one sunray to take on the role of European frogbit (provide with pinny).
8. Explain:
  - Frogbit can tag sunrays and take their energy (craft stick). (See: *A Bit About...*)
  - Because the frogbit lives at the top of the lake, it must catch only sunrays that are between the sun and the fish stomachs. Sunrays cannot be tagged when they are between the fish stomachs and the bottom of the lake.
  - Once sunrays are tagged, they will become part of the European frogbit by linking arms or joining hands. *This new sunray energy has allowed the frogbit to grow!* (If the students have difficulty catching the sunrays, have the sunrays run in a straight line only –

- from the top of the field to the bottom.)
- if sunrays step outside the lake boundaries they automatically become part of the frogbit.
  - When the frogbit chain has 4 people, it breaks up into pairs. *This is one way European frogbit reproduces. When one plant gets too big, segments from it break off and form a new independent plant.*
  - European frogbit plants continue to tag sunrays, breaking off when a foursome is created.
  - Sunrays continue to bring food from the sun to the algae at the lake bottom. They cannot stop or stay waiting in the bottom half of the lake due to their fear of being caught by the frogbit. Fish continue to collect food from the algae and put it into their stomachs.
9. Ask students to **predict** what will happen. *Will the fish collect more food or less?*
  10. Start Day #2 and run until there is no energy left to transfer.

### Closure/Checks for Understanding:

Return to the classroom. Post the results:

	DAY 1 No European Frogbit	DAY 2 European Frogbit
Amount of food in plant (algae)		
Amount of food in fish stomachs		

Have students interpret the data and reflect on their experiences by answering the following questions (orally or in writing in science workbooks or journals):

- On which day did the algae in the lake get the most energy from the sun?
- On which day did the fish get the most food?
- Do you think fish and algae can survive in a lake with European Frogbit? Why or why not?

- In a real lake what could you do to stop European Frogbit from affecting other species?

### When discussing the last point, consider:

The sun cannot stop giving off sunlight energy and will continue to feed all plants, including European frogbit. Therefore frogbit, an invasive species, must either be removed, or, better yet, prevented, from entering lakes.

**What we can do!** Learn what European frogbit looks like and make efforts to ensure that it doesn't get into healthy lake ecosystems. Individuals can make sure boats, motors and boat trailers are thoroughly cleaned and all plant matter is removed; any plants found should be put into the garbage. Drain all water from boats and never dump plants from one lake into another. In addition, we must be careful not to purchase frogbit inadvertently from

garden stores and or use it in water gardens as sometimes garden plants may be transferred into the wild. If you have a water garden, it is always a good idea to buy native aquatic plants to prevent an accidental release of exotic species. If you do buy exotics, over-winter your plants indoors or dispose of them in the garbage at the end of the season.

**Make waves! Everyone can help keep our aquatic habitats healthy!**

## NOTES FOR TEACHER:

European frogbit is a free-floating aquatic plant native to Europe and Asia and originally introduced to Ontario when it escaped from the Central Experimental Farm in Ottawa in the mid 1930s. It is now found in several lakes and watersheds in southern Ontario and has spread to southern Quebec and northern New York and Vermont. It looks like a miniature water lily with heart-shaped leaves and small white flowers with a yellow centre. European frogbit floats on the surface of wetlands or the quiet bays of lakes. It reproduces quickly, forming dense mats of plants at the surface of affected waters. The mats of frogbit hinder recreational boating and swimming, and disrupt the food chain by preventing sunlight from getting to plants and algae growing deeper down in the water.

Algae - also known as phytoplankton - are microscopic plants that serve as a base for the food chain. In this very important role, they support a wide variety of consumers, including fish. Algae are usually used as indicators of aquatic health because of their high sensitivity to change in environmental factors, such as light, nutrients and temperature. Like land plants, algae fix carbon through photosynthesis. By hindering algae growth, frogbit reduces the amount of vital energy to higher levels of the food chain.

In the autumn, European frogbit can change the composition of a lake by removing necessary oxygen. During the fall months, frogbit breaks apart and decomposes, dropping to the lake bottom. When huge amounts of vegetation decompose all at once, dissolved oxygen levels in the water are depleted. If there is not

enough oxygen, fish and other aquatic organisms can die.

European frogbit can be spread to new water bodies on propellers and other aquatic equipment. It can also be transferred to the wild from aquarium and garden ponds, as it is one of the many exotic species of aquatic plants that are sold in the water garden trade. Presently, there are few ways to control frogbit; removal by hand has been only a temporary solution.

**Report sightings or obtain more information on invading species by calling the Invading Species Hotline at 1-800-563-7711 or visiting [www.invadingspecies.com](http://www.invadingspecies.com)**

## EVALUATION:

Students design a storyboard illustrating and explaining what happens in a lake when European frogbit is introduced. Include a story box that shows how to prevent European frogbit from taking over a lake.

## ACCOMMODATIONS:

Have several students volunteer to act out the game before it begins so students have a visual example of what to do.

## EXTENSIONS:

Students may want to adapt the game so that they are measuring the amount of food in the plant and the fish stomachs every 30 seconds or by altering the number of fish and/or European Frogbit. The data can then be graphed and compared.



# Changing Chains

**PURPOSE:** Students will create **food chains** from familiar animal and plant species then examine the impacts on these food chains when environmental problems and invasive species disrupt them.

<b>SUBJECT / STRAND:</b> Grade 4 Science – Life Systems	<b>DURATION:</b> 2 x 50 minutes	<b>GROUP SIZE:</b> 4 -6 students	<b>SETTING:</b> Classroom
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**EXPECTED OUTCOMES:** Building on their knowledge of nature and the animal world, student groups will create their own food chains. This will demonstrate their understanding of the necessary progression of a food chain and the interdependence of the species within it. Students will then explore how this relationship is affected when outside influences disrupt the food chain. The activity wraps up with a class discussion on stewardship, followed by a descriptive article prepared by each student.

**MATERIALS:** Cue cards (~100), chart paper, markers, tape

**ENDURING UNDERSTANDINGS:** Understanding concepts related to healthy habitats; recognizing our role in maintaining healthy habitats (*stewardship*); tools for maintaining healthy habitats and protecting against invasive species.

**EXPECTATIONS:** 4S1, 4S2, 4S3, 4S5, 4S6, 4S17, 4S19

**PROCESSES OF SCIENCE:** Classifying, communicating, inferring, identifying and controlling variables, interpreting data

## Lesson Sequence

### Prior:

1. Draw the following table on chart paper and post for student reference.

<b>HEALTHY HABITATS</b>	(List Healthy Food Chains)	Notes:
<b>HABITAT PROBLEM:</b>	(List Disturbed Food Chains)	Notes:
<b>INVASIVE SPECIES:</b>	(List Invaded Food Chains)	Notes:

- Review the following terms with students: **producer, consumer, herbivore, carnivore, omnivore** and **foodchain**. (See Glossary.) Ensure students have an understanding of how a food chain works.

## Procedure:

- Divide your class into groups of 4 – 6.
- Ask each group to brainstorm on what plants and animals can be found in *and* around a local pond. (Be sure they include smaller organisms – such as algae, worms, snails, and mosquitoes – and humans.)
- Provide 12 cue cards to each group and ask them to label and draw one plant or animal species per card.
- Ask groups to indicate on each cue card whether the animal is a producer, consumer, herbivore, omnivore or carnivore. Some species may have more than one label (ex. carnivore and consumer).
- Provide each group with one piece of chart paper on which they will draw a table like the one displayed.
- Using the cards as a guide, ask each group to create as many food chains as they can and record them in the square beside the title, “Healthy Habitats”. Species cards can be used more than once. Ask students to write any observations they have of their healthy habitat food chains in the adjacent “Notes” box.
- As a class, brainstorm different types of disturbances that could happen to their local pond habitat. Discuss how these disturbances might impact the species living there. Together pick one disturbance and determine what species may disappear from the habitat and ultimately their food chain/s. (Examples: spraying for mosquitoes; building a busy new building that may scare off shy mammals living around the pond; dumping garbage into the pond, building a busy road that requires part of the pond to be drained).
- Ask students to remove the affected species from their set of cards. Ask students to record the type of disturbance, new chains and observations on their chart paper.
- Students should then return the removed cards to their sets.
- Explain to the class that you will now be introducing the invasive fish species, round goby, to the pond habitat. It is not native to this habitat. *What is an invasive species?* Explain or re-iterate that invasive species have few natural predators in their new habitat and that they often have adaptations that make them highly successful. Share the adaptations of round goby, the type of environment it lives in and the impact it has on ponds.
- Ask: *How do you think it got into our local pond?* Explain to the students that invasive species are introduced to habitats through human error. In this case, we’ll say it was when someone was using round goby as bait and dumped them into the local pond. Considering the impacts of this species, determine together which plants and animals will be affected. Students should remove these from their sets.
- Ask students to make as many food chains as they can with their new set, record them on the chart and make notes.
- Discuss:
  - How many food chains did you make in each scenario? Were there differences between the food chains of each scenario? What were they?*

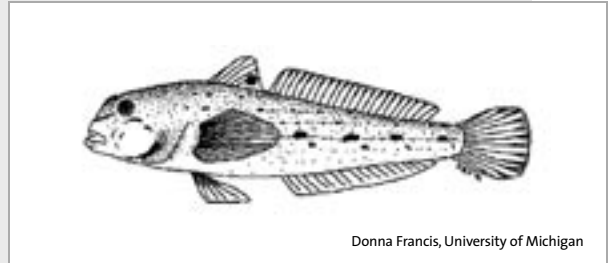
## A Bit About... ROUND GOBY

The round goby is a spotty brown fish that lives on lake and river bottoms. Their unique adaptation, a suction-cup-like fin on the bottom of their belly, helps them stay put in fast moving currents!

Round goby were brought accidentally to the Great Lakes in the ballast water of ships from Eastern Europe.

It is believed they have also spread by anglers who mistakenly used them as bait and released them into un-invaded waters after fishing. (Using round goby as bait is illegal!)

Round goby are aggressive; they compete with native fish for food (including insects) and eat their fry (baby fish) and eggs! They can also spawn several times in one season so that wherever they're found, they can quickly become the most abundant fish in the area. (For example in Lake Erie round goby can reach densities of over 125/cubic metre—that's like having over 100 round goby in your bathtub!)



Donna Francis, University of Michigan

- *What other observations did you make?*
- *Is there a problem with removing a few species from a habitat?*
- *Which scenario could humans have helped to avoid?*

Explain how seemingly innocent actions, such as dumping bait into the pond, can have as drastic an effect as building a bridge. This is because when you add an invasive species to a habitat, you can alter the existing food chains, affecting many plants and animals.

- *Which type of species do you think would find it easier to survive: Producer? Consumer? Omnivore? Herbivore? Carnivore? Why?*
- *Explore whether there could have been solutions to the habitat problem that may have protected the food chain.*
- *Explore other ways invasive species can get into an aquatic habitat and how this can be avoided.*

### Closure/Checks for Understanding:

Ask students to write a descriptive article of what happened to their local park habitat. Encourage them to include:

- A description of the original healthy habitat
- An explanation of the habitat problem and the impact on local species
- The introduction of an invasive species and its impact on the habitat
- The role of humans both in *creating* and *solving* both situations.

## NOTES FOR TEACHER:

The round goby is an invasive aquatic species that is originally from Eastern Europe. This mottled brown fish has a feature unique to its species. On the underside of the goby, the pelvic fins join to form a suction-cup like disk. This appendage allows them to stay on a river or lake bottom in fast current. Round gobies feed on insects, small fish, fish eggs and other small organisms.

The round goby was introduced to the St. Clair River via ballast water in the late 1980s. It is now found in all of the Great Lakes and have recently been discovered in inland waters of Ontario. Where they have been introduced, round gobies have become very abundant. The aggressive round goby can spawn several times a year, grow up to 25 cm and compete with native bottom-dwelling fish species. These characteristics indicate the potential for impact on native fish species.

It is important to prevent or slow the spread of round gobies into Ontario's inland waters. The following preventative measures can help to reduce the spread of round goby and other invasive species:

- Remove any visible plants or animals from boats, trailers and boating equipment before leaving any body of water. Once you've left the boat launch, ensure you either: rinse the boat and equipment with hot water; or hose it down with a high pressure spray; or dry the equipment for at least 5 days before using it again.
- Drain water from the motor, live well and bilge before leaving the body of water.
- Empty bait buckets on land or in the garbage. It is illegal to release baitfish from one body of water into another or to use round goby as bait.

**Report sightings or obtain more information on invading species by calling the Invading Species Hotline at 1-800-563-7711 or visiting [www.invadingspecies.com](http://www.invadingspecies.com)**

## EVALUATION:

Teachers can evaluate group work while students are working together on their food chains and tables. Further evaluation can be done on the student articles.

## ACCOMMODATIONS:

Ensure student groups are balanced for behaviour and tasks. Consider assigning students to roles that either support their learning style (i.e. drawing species pictures) and confidence, or challenge them if appropriate. Use of chain cards provides for kinesthetic and visual learners, group discussions accommodate auditory learners. Article writing can be supported as required.

## EXTENSIONS:

Visit a local pond or aquatic habitat prior to the lesson. Ask students to see how many different plant and animal species they can identify in and around the pond. Take along a local naturalist to help identify some of the species present and determine their role(s). Are any of these invasive species? Do they see any disturbances affecting the pond habitat?

Students could create a classroom field guide for the local pond. Using a digital camera, students could take photos of a chosen species, research it and create a page or two for the class book. Students would indicate characteristics and adaptations, and identifying whether the species was a: consumer or producer, and carnivore, herbivore or omnivore.

# Aquarium Ownership is an Art

**PURPOSE:** Through the creation and distribution of educational posters, students will demonstrate their understanding of responsible pet ownership and the importance of being an active community member.

**SUBJECT / STRAND:**

Grade 4  
The Arts – Visual Arts;  
Science – Life Systems

**DURATION:**

2 x 50 minutes

**GROUP SIZE:**

Class

**SETTING:**

Classroom

**EXPECTED OUTCOMES:** Students will learn that when they release aquatic pets and plants into local waterways there can be subsequent impacts on habitats and communities. With this knowledge, students will then create and distribute posters that educate the public on their responsibilities as pet owners. As an art activity, this project will allow students to express tint, shade and texture.

**MATERIALS:** White paper for painting, tempera paint, sand, 1 cardboard square or plastic palette per student, brushes, water, scrap paper, pencils, rulers, examples of public information posters, Blackline Master: *Pet Shop Poster Messages* (overhead or photocopy), overhead projector as needed. (Optional: additional art materials to explore texture such as wool, glitter, tissue paper, pipe cleaners, etc.)

**ENDURING UNDERSTANDINGS:** Understand concepts related to healthy habitats and communities; recognize our role in maintaining healthy habitats and communities (stewardship); learn of tools for maintaining healthy habitats and communities, and protecting against invasive species.

**EXPECTATIONS:** 4s3, 4s16, 4a31, 4a35, 4a39, 4a41, 4a42, 4a43

**PROCESSES OF SCIENCE:** Communicating

## Lesson Sequence

### Prior:

1. Write the following definitions on the board:

**Tint:** adding white to a colour to create a lighter hue

**Shade:** adding black to a colour to create a darker hue

2. Write the following poster requirements on the board and cover until ready to view:

### Pet shop posters will:

- Include a large aquarium or pond in tints and shades of blue
  - Explore texture with brush strokes and sand
  - Communicate a message to the public about aquarium pet **stewardship**
3. Make an overhead of or photocopy Blackline Master: Pet Shop Poster Messages.

### Procedure:

1. Ask: *Who has or has had an aquarium?*  
An aquarium is a very simple, contained and created **habitat**, while the animals and plants that live in it (along with its human host) are a **community**. To class: *Describe the aquarium food chain. Could this habitat survive without human interaction?*
2. Ask: *What would you do if you had to move far away and couldn't look after your aquarium anymore? Why might someone think it would be good to empty an aquarium into a local water system? Why could 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?* If they are potentially **invasive species**, like the banded mystery snail, fanwort (an aquatic plant) or goldfish, they:
  - Have few natural enemies or predators!
  - Reproduce quickly and often!
  - Adapt to many conditions!

- Out-compete native species for food and habitat!
- Can eat many types of food!

(Note that some aquarium species like turtles such as the red-eared slider or fish like piranha may not be invasive but could have disease or parasites that could infect our native species.)

*Ask: How does this compare to their life (role in the food chain) in the aquarium?*

3. In two separate columns on the chalkboard, brainstorm the following questions:
  - i. *How can aquarium owners 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.)
  - ii. *How as a class can we let people know about careful aquarium care?* (Prompt: “create posters for pet shops”, if needed.)
4. Explain to students that they will be creating a special poster for pet shops that will educate citizens on the importance of being a responsible aquarium owner. Explain that it must contain one message from the Blackline Master: Pet Shop Poster Messages. (Have on overhead ready or hand photocopy out to students – these can be collected later for re-use.) Go over the messages together to ensure that students understand them.
5. Ask students to 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 that they will adjust the lightness and darkness of the blue water in their painting using white paint and black paint. Referencing the chalkboard, define **shade** and **tint** for the students. (Suggest they start by painting the *middle* of the pond or aquarium in plain blue.)

6. Ask: Describe the different textures in the water you were swimming in. Explain that there are many things in a pond or aquarium that aren't 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.)
7. Ask students to choose a poster message and using shade, tint and texture, create a picture depicting it (Refer to the poster requirements listed in PRIOR #3). (NOTE: Students should ensure there is message space on the top or bottom of their poster by marking it out ahead of time with a ruler. Messages can be written in when the painting is finished with marker or pencil crayon.)

## Closure/Checks for Understanding:

Once posters are complete, have students present to the class explaining how the message they've chosen is depicted in their poster. Ask them to also address the art techniques they used.

Determine a method for delivering the posters to local pet shops. Please inform our program of your efforts so that we can track where posters are being displayed. We would be grateful, if you would consider sending some of your students' posters to the *Invading Species Awareness Program* to help us develop educational materials.

### Invading Species Awareness Program

4601 Guthrie Drive  
P.O. Box 2800  
Peterborough, ON K9J 8L5  
1-800-563-7711  
invasivespecies@ofah.org  
www.invadingspecies.com

## NOTES FOR TEACHER:

Most aquarium fish, plants and invertebrates are not native to Ontario waters. By releasing them into open waterways, these species could establish beyond their native range and have notable consequences on the environment.

An example is that of the **red-eared slider**, a popular turtle species sold in pet stores. Red-eared sliders look cute and irresistible when they're babies but can grow to dinner plate size as adults. All turtles require a lot of care and investment when kept as pets to ensure that they do not get stressed and suffer from disease or infections. When released into Ontario's aquatic habitats, red-eared sliders may compete with native and endangered turtles for food and nesting areas. They are also carriers of *Salmonella*, a bacterium that can be easily transferred up the food chain.

**Fanwort** is a popular, aquatic plant sold at pet stores. Though its origin is sub-tropical, it can survive in our climate. If released into the water supply (even in

tiny pieces) it can reestablish itself, taking over aquatic habitats. Fanwort can form dense stands of plant matter that crowds out native plants and interferes with boating and swimming. By crowding out native plants, fanwort can alter fish communities, disrupting food chains in shallow lakes and streams.

Exotic, tropical fish species such as the **pacu**, **oscar**, and **piranha** have been discovered in provincial waters. Contrary to popular belief, these fish can adapt to cold water. Warm water outflows from factories are thought to increase their chance of survival in winter.

You are responsible for your aquarium pets and plants. The release of aquarium pets into Ontario waters is illegal. You can help prevent the spread of non-native aquatic species by doing 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 or a school.
- Contact a local aquarium club or the Canadian Association of Aquarium Clubs, at (905) 682-2991 ([www.caoac.on.ca](http://www.caoac.on.ca)) and ask about a fish rescue program for unwanted aquarium pets, or contact the **Invading Species Hotline at 1-800-563-7711**.

### **EVALUATION:**

Posters can be evaluated for art concepts (tint, shade and texture) while presentations will indicate whether students recognize the need for human action to protect against the impact of invasive species. Students should be able to make connections to healthy habitats and communities discussed in previous activities and provide specific examples of what aquarium owners can do to protect local habitats.

### **ACCOMMODATIONS:**

In this lesson, students challenged by language can relay their science knowledge through art. Chalkboard definitions, the blackline master and a painting demonstration by the teacher will support visual learners and learners with special needs.

### **EXTENSIONS:**

This lesson can lead into a monochromatic painting lesson (paintings that are all one colour using tints and shades) as required by the Grade 4 Visual Arts curriculum.

Instead of creating posters, some students can be put in groups of 5 with each member assigned to a specific message. Together the group can compile a pet store “cash register” book – student brochures that can be read by customers while in line. Students can then research specific pet stores in their area and write them a letter requesting the display of their book.



# Musical Mussels\*

**PURPOSE:** In this version of Musical Chairs, students will compete as aquatic species to show how basic needs are met. This activity will highlight how certain adaptations enable invasive species to outcompete native species to attain water, food, shelter and room to grow.

**SUBJECT / STRAND:**

Grade 4 Science –  
Life Systems,  
Health and  
Physical Education

**DURATION:**

50 – 70 minutes

**GROUP SIZE:**

Class

**SETTING:**

Classroom

**EXPECTED OUTCOMES:** In this demonstration activity, students will show how an animal’s adaptations can provide an advantage in its goal to meet basic needs. Engaged participation by students is necessary to gain the experience required to complete a write-up that describes the game’s outcome and includes the words: community, habitat, adaptations, basic needs, native species and invasive species.

**MATERIALS:** 10 chairs, Blackline Master: *Musical Mussels*, mailing labels, music

**ENDURING UNDERSTANDINGS:** Understand concepts related to healthy habitats and communities.

**EXPECTATIONS:** 4S1, 4S2, 4S3, 4S4, 4S16

**PROCESSES OF SCIENCE:** Observing, inferring, predicting, classifying, communicating, constructing models

## Lesson Sequence

**Prior:**

1. Photocopy and cut: Blackline Master: Musical Mussels into 10 card-sized pieces.
2. With a marker draw stripes on ~16 mailing labels.
3. Print a “P” (for predator) on 2 labels.
4. Assemble chairs in two rows of 5 chairs, back to back.

5. Select music to play during the game. Optional: choose an aquatic theme - for example tunes from *The Little Mermaid* or *Finding Nemo*.

## Procedure:

1. Introduce or review the concept of **basic needs** such as food, water, shelter, and room to grow. Indicate that all animals, including humans, must meet these needs to survive.
2. Ask students to imagine being unable to get something that was a basic need (like having no water while playing soccer on a hot summer day, or not being able to get undercover during a rainstorm). Ask: *Can you think of a situation where a human or animal has gone without getting a basic need?*
3. **GAME I:** Explain to students that they will experience the struggle for survival through a version of Musical Chairs. Each of the chairs will represent *all* of an aquatic animal's basic needs (food, clean water, shelter and room to grow). Therefore, students that find a seat when the music stops are able to meet all their needs.
4. Choose 5 students to be native fish (such as trout or yellow perch) in a lake. Play one round of Musical Chairs as you normally would with students walking slowly around the 10 chairs and finding seats once the music stops.
5. Explain that due to their success at meeting their basic needs, these 5 students are able to reproduce. Add 5 more students and play again.
6. Explain that again, due to the success of the fish meeting their basic needs, reproduction occurs and five more students are added to the game due to reproduction. After this round, not all of the fish are able to meet their needs. Five must leave to find food elsewhere or perish.
7. 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 that don't meet their basic needs? What happens to those that do?*
8. 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.
9. Explain: Zebra Mussels are a non-native (new to the area) species accidentally brought to the lake. They compete for the same basic needs as the fish do. 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 who couldn't meet their basic needs.
10. Retrieve all cards and shuffle. Explain that the zebra mussels have got enough basic needs to reproduce, this time place a card down on 6 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.
11. Retrieve all mussel cards, shuffle and place 9 cards down on chairs. Play the round.
12. Retrieve all mussel cards, shuffle and place 10 cards down on chairs. Play the round. Ask remaining student(s): *How are you feeling? Are you worried? Ask the class: What do you think would happen next? Do you think this could really happen in nature? How do you feel about zebra mussels taking over your lake?*
13. **GAME II:** Ask: *Why might it be easier for zebra mussels to reproduce and take over a habitat (and therefore gain access to basic needs) compared to the fish? List all answers on the*

board. Explain that the next two rounds will give insight into some of the reasons zebra mussels can outcompete native species.

14. **ROUND I:** From the class group, choose 10 students to take on the role of a native aquatic species, 1 zebra mussel (identified with striped mailing labels) and 2 predators (“P” labels). Explain: during this round of Musical Chairs, predators will **walk** around and try to tag the native species **only**. This is because predators don’t like to eat zebra mussels. When a predator tags a native species, that student must leave the game. Therefore, natives species must try to both dodge the predators and get their basic needs met. (Note: As predators don’t compete with the native species and zebra mussels for the same basic needs they will not try and get a seat when the music stops.) Play one round.
15. **ROUND II:** Add two mussels – representing successful reproduction – for every seat-finding mussel or try again with a new mussel if the one playing doesn’t make it.
16. Play again, doubling the number of successful mussels from the last round.
17. Play again, allowing 2 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.

## Closure/Checks for Understanding:

Discuss game observations with students. Ask: *What happened to the native species competing with the zebra mussels? Why were the zebra mussels so successful?* (They are not sought by predators, they need less space to live, and they produce many offspring.)

Explain that zebra mussels (and other invasive species) have adaptations that make them very successful in nature and enable them to expand throughout Ontario’s waterways. Ask: *How do you think zebra mussels affect humans?* (Because their populations grow quickly, they take food away from native fish. This decreases fish stock and impacts humans. In addition, they clog water pipes and cling to boat hulls, ruin beaches and cut swimmer’s feet with their sharp edges.) *How do you think we can manage them and prevent their spread?* (Take care to ensure they don’t get into new habitats.)

Ask students to answer the following in writing:

- Explain how the ability of the native aquatic species to fulfill their basic needs (*food, shelter, room to grow and safety*) was affected once the zebra mussels came along. (Review cards if necessary.)
- List and explain 2 reasons why zebra mussels can survive more easily than native species.
- Include the words: community, adaptation, habitat, basic needs, native species and invasive species.

## NOTES FOR TEACHER:

Zebra mussels are fingernail-sized mussels with a yellow-striped brown and cream shell that live an average of 2 – 3 years. They originate from the Black and Caspian Sea area of Asia. It is believed that they were brought to the Great Lakes in the ballast of ships in the early to mid 1980s.

Female zebra mussels can produce up to one million eggs per season. The tiny offspring called veligers, spread by floating in water currents or by being inadvertently transported by humans to other waterbodies. When they are about 3 weeks old the zebra mussels settle down onto a firm surface. They eat by filtering phytoplankton (algae) out of the water at great rates. Phytoplankton is a primary food source for young fish and zooplankton. The filtering changes the habitat by allowing more sunlight to penetrate deeper which can force light sensitive fish such as walleye into deeper water and can also encourage the growth of aquatic plants. Therefore, by entering a native food web, zebra mussels can have a great impact on a species community.

Zebra mussels have all the adaptations to make it a highly successful invasive species. As well as producing a great many offspring, zebra mussels require very little space to grow, are able to survive in a wide range of environmental conditions and have few predators.

As well as negatively impacting native habitats, zebra mussels clog water pipes and canals, slowing or stopping water flow. They harm swimmers' feet because of the razor-sharp edge of their shells. They can infect predators such as duck and fish species with contaminants that may be present in their body after filtering contaminated water. (This contamination can subsequently make its way up the food chain if these species are in turn consumed by a higher predator.) Often fish cannot spawn in areas covered with zebra mussels. Buoys covered with zebra mussels can get so heavy they sink.

Once zebra mussels are in a lake, there is no way to control or eradicate them so preventing their introduction is critical. To prevent the spread of invasive species such as zebra mussels it is important to:

- Remove all aquatic plants, mussels or other visible organisms and put them in the garbage.
- Drain the water from your boat, including the

motor, live well, and bilge.

- Do not release live bait! Empty your bait bucket on land, or freeze or salt for later use.
- Remove organisms you can't see on your boat by:
  - Rinsing with hot water; or
  - Spraying with high-pressure water; or
  - Drying it in the sun for 5 days.

## EVALUATION:

Teachers can evaluate written statements to determine student understanding of the:

- ability of native aquatic species to meet their basic needs,
- influence of zebra mussels on the ability of native aquatic species to meet their needs, and
- how the adaptations of the zebra mussels benefit them in their struggle for survival.

Students can also be evaluated for their understanding of: community, adaptation, habitat, basic needs, the struggle for survival, native species and invasive species.

## ACCOMMODATIONS:

Students unable to easily participate in the game can operate the CD/tape player or put cards on the seats for students. The teacher can familiarize students by reading aloud and explaining each of the cards before using them in the game. Children can be chosen to participate together based on similar physical abilities.

## EXTENSIONS:

Ask students what they can do to control and prevent zebra mussels from spreading. Change the game by adding cards that reflect these ideas. Discuss why they work or don't work.

Have students research what humans can do to prevent the spread of zebra mussels. They can start by reviewing the information they find on:

**www.invadingspecies.com**. In groups or pairs, students can then list on a large piece of chart paper, steps to invasion prevention. They can then decorate their list and send it to a local marina, sport shop or bait dealer for display.

# Tough Ruffe

**PURPOSE:** In this active simulation, students will demonstrate the **struggle for survival** as experienced by yellow perch in a lake habitat. Students will predict outcomes, and compare scenarios between a healthy habitat and one disrupted by an invasive species, the Eurasian ruffe.

**SUBJECT / STRAND:**

Grade 4 Science –  
Life Systems,  
Physical and  
Health Education

**DURATION:**

45 minutes

**GROUP SIZE:**

Class

**SETTING:**

Gym or schoolyard

**EXPECTED OUTCOMES:** In this activity, students will demonstrate, analyze and compare the variables that affect the struggle for survival of a native and invasive species. Students will then, in discussion and/or in a written assignment consider strategies species may use when disadvantaged within their habitat. Further investigation will provide an opportunity for students to consider whether they believe this type of scenario could play out in a real life setting.

**MATERIALS:** 5 hula hoops, 4 same colour pinnies, 1 pinny of a different colour (with optional cardboard spine attached), 4 pylons (if outside), Blackline Master: *Tough Ruffe Game Cards*, whistle

**ENDURING UNDERSTANDINGS:** Understanding concepts related to healthy habitats

**EXPECTATIONS:** 4S1, 4S2, 4S4, 4S7

**PROCESSES OF SCIENCE:** Constructing models, predicting, inferring, communicating

## Lesson Sequence

**Prior:**

1. Photocopy *Blackline Master: Tough Ruffe Game Cards* (1x) and cut into game pieces.
2. Distribute 4 hula-hoops randomly throughout the play area. (If playing in the schoolyard, mark off boundaries with pylons.)

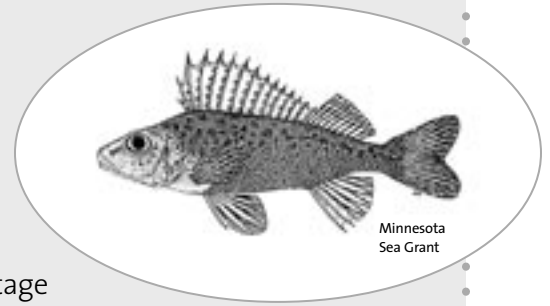
## Procedure:

1. Gather the class for a discussion and an explanation of the activity rules.
2. Ask: *Have you ever been in a race where there were kids who were faster than you? What happened? What was your reaction? What if the prize was a slice of pizza and you hadn't had dinner? How would you feel physically?*
3. **ROUND I** Explain: In the first part of this simulation participants will experience the **struggle for survival** for a fish called the **yellow perch**. Yellow perch live in Ontario lakes. Like all species, they have to find enough food to provide them with the energy to move and mature. They must also ensure they have clean water, enough room to grow and shelter from predators and bad conditions.
4. Give the following instructions:
  - Four students will represent yellow perch while the remaining students will represent elements in their habitat and community.
  - The yellow perch, each starting in one of the hula-hoops, will circulate in the “habitat” and collect as many cards as they can until the whistle blows. To survive, each yellow perch must have 2 cards representing each essential item: food, clean water, shelter and room to grow.
  - The students making up the habitat and community will each have two cards. Each card will represent an essential item the yellow perch needs for survival. These students will walk around the playing area slowly, holding their cards so that they can't be read.
  - When a yellow perch arrives at an element, s/he must come to a complete stop and ask, “*What do you have to help me survive?*” The element then quickly reveals his or her card(s), face down or empty hands. If the element-holding student has more than one card, the yellow perch can choose which one to take (without seeing it first). If the yellow perch cannot use the card, s/he must move on and leave the card behind.
- Once a needed card is found, the yellow perch must take it back to his or her hula-hoop before searching for more cards. Only one card can be transported at one time.
- In their **struggle for survival**, the yellow perch may come across a wildcard. Review wildcards with students (Caught! Slimed! Jackpot! Eaten!).
- The whistle will be blown after 3 minutes.
5. Select 4 students to be yellow perch and have them each stand in a hula-hoop.
6. Distribute the cards to the rest of the students. Ask them to start walking slowly around the playing area.
7. Run the game. Give participants a “30 seconds to finish” warning and provide a 10 second countdown to the end.
8. Briefly review the results of the game:
  - *How many yellow perch survived?*
  - *What were the biggest challenges participants faced during the game (discuss the wild cards if necessary)?*
  - *How is the game similar or different from the experiences of fish in a real lake?*
 (Time permitting, the game can be run again with different students in the role of yellow perch.)
9. **ROUND II.** Explain: An invasive species called a ruffe (rhymes with “tough”) has entered our lake.
10. Gather and redistribute the game cards. Place the fifth hula-hoop on the playing area. Select one student to be the ruffe and wear the other colour pinny. Have him or her stand in the empty hula-hoop.

## A Bit About... THE RUFFE

The ruffe, an invasive fish species, now lives in Lake Superior, Michigan and Huron in the same habitat as the yellow perch and eats similar food. Ruffe were brought to Ontario waters unknowingly in ship ballast (the ballast is the water contained in a ship that helps to maintain its stability).

Ruffe have adaptations that give them a competitive advantage over native species. They can see their prey in poorly lit conditions and they have sharp spines on their gills and fins that make them less desirable to predators and competitors.



11. Give the following instructions:

- In this next round of the game the ruffe will play by the same rules as the yellow perch in that they too need 2 cards of each item to survive.
- However due to their competitive advantage, s/he can collect up to two cards from each element and s/he is not affected by the wild-cards: *Eaten!* or *Caught!*

12. Before blowing the whistle, ask students to predict what will happen in this version of the game.

- *Which fish will have enough food to survive?*
- *Identify some new strategies that might be used in this game (e.g. perch could communicate with each other about where certain cards are).*

13. Run the game. (Time permitting, run the game again, with different students in the yellow perch and ruffe roles).

14. Compare the first round to the second round:

- *How many fish survived?*
- *What were their challenges and experiences?*

### Closure/Checks for Understanding:

Answer the following questions as a group or in writing:

- *Describe the struggle for survival when only the yellow perch was seeking food.*
- *How was the struggle for survival different when played with the ruffe?*
- *Ask students if this game is a good way to show what happens in real habitats? Why or why not?*
- *What strategies could perch have used to get food? How would those affect their survival? Could this happen in their habitat?*

## NOTES FOR TEACHER:

Yellow perch are a small (10-24 cm) fish that generally live near lakeshores at shallow depths. Yellow perch feed in the morning and evening on benthic insects (insects that live underwater in and around lake bottom sediment), worms, crayfish and other small fish. They are a popular catch with anglers.

Ruffe are a small fish, first discovered in North America in Lake Superior near Duluth, Minnesota and now found in Thunder Bay. Ruffe feed heavily on many foods that are also eaten by yellow perch, trout-perch and other native benthic-feeding fish. They also eat the eggs and young of whitefish and perch and out-compete those species in their search for food by being able to see prey under poorly lit conditions. In areas near Thunder Bay and Duluth they have become the most abundant species. This is compounded by the fact that ruffe have no value to commercial and recreational fisheries.

## EVALUATION:

Evaluation can be done on student written responses to questions in the Checks for Understanding section.

## ACCOMMODATIONS:

Ensure students with similar physical abilities compete against each other. Have students who are challenged by verbal instructions participate in the game after the first round so they can see other players in action.

## EXTENSIONS:

Have students write a creative piece reflecting the experience of the perch. Have students create a report that compares the food source, shelter, life cycles of the yellow perch to ruffe.



# Stow-Aways and Crafty Ways

**PURPOSE:** In this mapping and prediction activity, students will explore the various ways invasive species can migrate throughout the waters of Ontario and how humans contribute to this destructive migration.

**SUBJECT / STRAND:**

Grade 4 Science –  
Life Systems,  
Social Studies

**DURATION:**

70 minutes

**GROUP SIZE:**

Class

**SETTING:**

Classroom

**EXPECTED OUTCOMES:** Using research data that identifies where invasive species have been sighted, students will both infer how these creatures have spread throughout Ontario waters and predict their future movement. This activity will demonstrate the ability to interpret and label maps while an accompanying written report will indicate compilation and reporting skills.

**MATERIALS:** Blackline Master: *Map of Ontario*, atlases, Blackline Master: *Round Goby Investigation – Background*, a map of Canada and the World for teacher, pencil crayons or markers, notebook or piece of paper per student, large plastic pop bottle, basin, water, duct tape, 4 x \$2 coins.

**ENDURING UNDERSTANDINGS:** Understanding concepts related to healthy habitats

**EXPECTATIONS:** 4Z27, 4Z40, 4Z42, 4Z47, 4Z50, 4S1, 4S3, 4S4, 4S16, 4S27, 4S8

**PROCESSES OF SCIENCE:** Predicting, hypothesizing, interpreting data, inferring

## Lesson Sequence

### Prior:

1. Cut a large 2 litre plastic pop bottle in half lengthwise so that it look something like a ship's hull with the bow at the lid end. Keep the lid on the bottle or duct tape over the end so that water will not fill the bottle through the neck. Duct tape 4 x \$2 coins ("toonies ") onto

the bottom end opposite the cap area. (As well as balancing the bottle's weight, the coins will act as a keel).

2. Fill a plastic basin full of water.

3. Photocopy the following blackline masters – one for each student:
  - Blackline Master: Map of Ontario
  - Blackline Master: Round Goby Investigation Background
4. (Optional) Write the following on the board:
  - released from a ship’s ballast;
  - following natural waterways;
  - as pets released into the wild;
  - accidental bait release;
  - on a boat; *and*,
  - released from a market.

### Procedure:

1. Brainstorm on how people, different food products or wildlife get to and around Canada. Focus on less obvious methods, for example: how could people with little or no money move about this country? How could food, not transported by truck, get around Canada? Allow students to be creative in their answers.
2. *Ask: How do you think a foreign aquatic species would get into the Great Lakes from Europe?*
3. Ask students to come around the basin. Place the empty plastic pop bottle in the water and explain that it will represent a ship. Demonstrate how easy it is to upset the ship.
4. Fill the half bottle with approximately 3 cm of water. Show that it is now more difficult to upset the boat. *Ask: Why is this the case?* Explain that ballast is needed to help stabilize ships in rough and stormy seas (see *A Bit About...*).
5. *Ask: How might ballast play a role in transporting foreign species?* Explain that the introduction of many non-native species has been linked to ships dumping their ballast water taken from far away ports into Ontario waters. Once in the Great Lakes, these ships may travel from port to port within the Great Lakes further taking on or dumping ballast water into these areas and thus continuing the spread of exotic species.
6. On the world map, ask a student to show a ship’s route from a port in Europe across the Atlantic Ocean to Lake Ontario.
7. Explain to the class that the spread of round goby, a foreign, invasive species, can be traced to the dumping of ballast water into the St. Clair River in Ontario (show river’s location relative to the Great Lakes) in 1990 from European ships. Today, the species is now found throughout the Great Lakes system and some inland locations.
8. Distribute an atlas, a Round Goby Investigation Background sheet and a Map of Ontario to each student.
9. Tell students that in this mapping project they will take on the role of an **investigative ecologist**. Their challenge is to determine how round goby may have spread from the site they were originally released (the St. Clair River) to places they, as **investigative ecologists**, have discovered them at later dates (refer to Reported Sightings table). In addition, they must use their skills to predict where the round goby will be in the future.
10. Referring to the table, explain that students must determine the path the species took over time to get to each of the listed locations.
11. As an example, ask students to use their atlases to find *Reported Sighting #1*. Ask students to label this location on their map of Ontario and include:
  - a. a small **fish symbol** indicating where the Reported Sighting was, and
  - b. the **year of the reported sighting**.

## A Bit About... BALLAST

There have been sightings of exotic species in Lake Ontario since the 1830s! In fact, over the last 180 years, scientists have identified over 180 exotic or non-native species in the Great Lakes! These species have entered the Great Lakes primarily through the release of ship ballast water and to a lesser extent from species migration through shipping canals that connect the Great Lakes to each other and to the Atlantic Ocean. Some of these exotic species have also entered the Great Lakes when released intentionally by people.

**Ballast water** refers to the water carried by large, ocean-going vessels to stabilize them on rough waters during their ocean journey. This water – along with the small plants and organisms living in it – is sucked into the bottom of boats while in their home ports. Many of the species within the ballast water are able to survive the ocean journey. On the ship's arrival to the Great Lakes, the water is emptied. The species will continue to survive if the weather and environment is similar to where they originated. These same species can continue to be transported within the Great Lakes as ships continue to fill up and empty ballast water as they move from port to port. With the increase in global trade has come an increase in non-native species “hitch-hiking” their way into and around the Great Lakes basin.

The introduction of aquatic invasive species into the Great Lakes basin has also been the result of the building of shipping canals over the last two centuries. Sea lamprey, for example, were first observed in Lake Ontario in the 1830s. Niagara Falls acted as a natural barrier preventing species from invading lakes Erie, Huron, Michigan and Superior. However when the Welland Canal was deepened in 1919, this allowed species such as the sea lamprey to gain access to the rest of the Great Lakes (not to mention larger, ocean-going vessels). As more canals were built, including the Trent-Severn Waterway and the Rideau Canal, more pathways were provided for non-native species to travel into other Ontario lakes and waterways.

12. Once done, ask students to find the location of *Reported Sighting #2*. Again label the body of water and put the year of the sighting.
13. Have students find *Reported Sighting #3*, label and date it all the while considering how it may have arrived at this location. Repeat this process until all reported sightings have been completed.
14. Instruct students to draw a pathway that the round goby might have taken from *Reported Sighting #1* to *Reported Sighting #2*. Explain to students that round goby must either travel through natural waterways or across land with help from humans (see *Notes to Teacher* and refer to the provided list).
15. Have students predict where round goby will be located in 2010 and 2015 by labeling future sightings and possible pathways. (A different colour may be used with a reference in the legend). Remind students that round goby can spread from any of the locations where they have already been sighted. There are no wrong answers.
16. Tell students they will now write up their INVESTIGATIVE ECOLOGIST REPORT. Decide together what the report headings will be.

Ensure students include:

- how and where the round goby first came to Canada,
- what route they took and how they traveled over the years, and
- predict where the round goby will be by 2010 and 2015 and how it traveled there.

## Closure/Checks for Understanding:

Have students share highlights and predictions from their reports and allow a discussion to take place as appropriate.

## NOTES FOR TEACHER:

For information on the round goby, see lesson “Changing Chains”.

Foreign animal and plant species have spread throughout Ontario in a number of different ways:

- **In a Ship’s Ballast**  
See *A Bit About...*
- **By Following Natural Water Routes**  
Exotic species have followed natural waterways when the habitat they have ventured into has supported their basic needs.
- **As Pets and Plants Released into the Wild**  
Some animal and plant species, sold for aquariums or water gardens, have caused great harm when owners have released them into the wild.
- **As Bait Released from One Water Body to Another**  
Many people don’t realize that releasing live bait after fishing into lakes and rivers is a way of introducing potentially harmful species to new habitats.
- **Stocking Fish in a Lake Without a Licence or a Great Escape**  
Some species that are native to Ontario but not native to a particular area can have the potential to become invasive and alter ecosystem functions. This can happen when people naively think they improve a fishery by releasing species such as rock bass, black crappie or even pike. Escapes can also happen from aquaculture facilities with the potential for introducing potentially harmful species to new habitats. You should always consult the MNR

before stocking or raising fish in the wild.

- **On a Boat**  
Invasive species can find their way into other waters by clinging to boats, trailers or equipment or hiding out in areas like motors, bilge, or live-wells in commercial and recreational boats.
- **From the Marketplace**  
Exotic food species are meant to be eaten, not to be released. Some are aggressively invasive and when set free into Ontario’s aquatic habitats, will cause harm.

**(See *Background Materials* for more information.)**

\*\* Although the round goby was not spread by *all* these methods throughout Ontario waterways, it is important that students recognize these methods of transmission and explore their possibility in the mapping project.

## EVALUATION:

Teachers can evaluate student knowledge of Ontario waters, mapping vocabulary (province, latitude, longitude, etc.), cardinal and intermediate directions, and pictorial symbols and use of colour in legends. Additional assessment can be performed on prediction and communication skills.

## ACCOMMODATIONS:

For students with learning challenges consider limiting the Report Sightings to an appropriate number. Pre-labeled maps can be used to further assist students.

# The Ultimate Species

**PURPOSE:** Each student will create their own aquatic species designing adaptations that will determine how it eats, how it moves, where it lives and how it stays safe. On completion, students will compare their species, collectively identifying those with adaptations that indicate their potential to be invasive.

**SUBJECT / STRAND:**

Grade 4 Science –  
Life Systems, Language  
(Optional: Art)

**DURATION:**

2 - 3 x 50 minutes

**GROUP SIZE:**

Class and groups

**SETTING:**

Classroom

**EXPECTED OUTCOMES:** Students will demonstrate their understanding of what an adaptation is and how it relates to species' life within its community and habitat. In **Part 1** of the activity students will create their own ultimate species, which they will document in a written summary accompanied by a labelled illustration. In **Part 2**, students will gather in habitat groups, presenting and comparing their species in order to identify those with adaptations that identify their potential to be invasive.

**MATERIALS:** 11" x 17" paper, drawing utensils (pencil crayons, etc.), Blackline Master: *Cottage Country's Most Unwanted*, chart paper, markers

**ENDURING UNDERSTANDINGS:** Understanding concepts related to healthy habitats and communities; recognizing our role in maintaining healthy habitats and communities (*stewardship*).

**EXPECTATIONS:** 4s1, 4s2, 4s3, 4s7, 4s8, 4s10, 4s16, 4s18, 4e1, 4e2, 4e5, 4a31

**PROCESSES OF SCIENCE:** Inferring, classifying, communicating, constructing models

## Lesson Sequence

### Prior:

#### Day #1:

- Write on the board:
  - What I Eat (Food/Energy)
  - How I Move
  - How I Stay Safe
  - Where I Live
- Write on the board, with room for brainstorming: lake, stream and wetland.

#### Day #2:

- As a heading, write the following aquatic habitats on a piece of chart paper: wetland, stream or lake. Post these three habitat sheets around the classroom.
- Photocopy Blackline Master: *Cottage Country's Most Unwanted* (2x), cut and separate into habitat groups.

### Procedure:

#### Day #1

- Ask: *What does "ultimate" mean? If we were to make up the term, "ultimate species", what would it mean to you?*
- Ask students to brainstorm on plants or wild animals that seem to be able to live in many different habitats. Some examples may be: gulls, ducks, mosquitoes or raccoons.
- Choose one of these species and draw it on the board. Discuss and label its key **adaptations** – characteristics that make it successful in specific habitats. Remind students that adaptations have a purpose (For example, a frog has spots to help it camouflage itself). Refer to the generated brainstorming list on the board and explain that different adaptations can help an animal eat a particular type of food, move faster, be safer (avoid predators) or live in a particular type of home.

For example: Raccoons are not fussy about what they eat, they have hands that can pick up and tear apart any type object to get at food (from shells to garbage cans), they can live on the ground or in a tree, and their coat keeps them warm in winter and camouflaged when moving around at night.

- Tell students that they will be using what they have learned about **habitats, communities** and the **adaptations** to create their own ultimate species! The organism they create must have extraordinary adaptations enabling them to live very well in an Ontario aquatic habitat (lake, stream, wetland). Tell students to use their imagination to create their ultimate species as long as they can explain why they chose their particular adaptations for aquatic environments.
- Brainstorm a few characteristics of each aquatic **habitat** to get students started on what is required to live in them. Note them on the appropriate habitat sheets posted around the room.

Note: Differences between different types of aquatic habitats can seem subtle. Here are some examples to share with your students:

- A plant or animal living in a wetland may have to survive changing water levels over the seasons. Wetlands can be very wet or quite dry if there is a drought.
- Some streams have fast moving water while lake water moves slowly.
- Shallow lakes tend to have warm temperatures in the summer that are good for fish like bass, while deep lakes tend to remain cool in the summer which is good for fish like trout.

Explain that the specific plant and animal **community** a species lives with also influences its adaptations. (For example: A pointy beak allows the woodpecker to bore underneath bark to reach its food, tree-dwelling insects; an otter's webbed

feet allow them to swim more effectively; a beaver's tail helps propel them through the water.)

6. Hand out 11" x 17" paper and ask students to fold it in half lengthwise. One side will be used to draw and label their ultimate species, while the other side will be used to describe their species in writing.

7. Ask students to choose a habitat (stream, lake or wetland) and print it on the top of their Ultimate Species sheet. Then, referring to the four headings written on the chalkboard, ask them to write a short paragraph indicating the adaptations that make their species well adapted to its habitat and community:

- How and What I Eat

*What does your ultimate species eat? How does its mouth, hands, feet, tail or fins help it capture and eat its food? Or is your species a photosynthesizing producer?*

- How I Move

*How does your ultimate species move through the habitat? Does it move quickly? How? Or is it attached to a rock or rooted in the sediment? Does it have seeds that spread by floating?*

- How I Stay Safe

*Can your ultimate species move fast to avoid being eaten? Can it camouflage itself? Can it hide away from predators? Does it have a hard shell that protects it? Sharp spines?*

- Where I Live

*What kind of area does your ultimate species like to live in? Deep water? On a log? In rapids?*

8. Once students have determined their species' adaptations, they can draw their creature in its habitat. Provide students with enough time to finish their Ultimate Species.

## Day #2

1. Once projects are complete, review the term **adaptation** with the students. Ask: *Can you give me an example of an adaptation in an animal that is familiar to all of us?* (For example, ducks have webbed feet that they use like paddles to move fast in water; mosquitoes have wings that allow them to fly in many directions, thus avoiding the "swat").

2. Explain that **aquatic invasive species** are species that come from somewhere else and have been accidentally introduced by humans into Ontario's aquatic habitats.

Invasive species have **adaptations** that give them an advantage over native species. Their "super power" adaptations can include:

- a. the ability to eat a wide variety of foods,
- b. the ability to live in and adapt to a wide variety of habitats and/or conditions (ex. warm or cold temperatures, murky water, etc.),
- c. the ability to grow quickly (often faster than native species),
- d. the ability to avoid being eaten in their new community, as they are often not recognized as food by native species,
- e. having special protective adaptations (such as extra hard spikes on fish or a hard shell on a crayfish),
- f. some plants have the ability to make new plants from a small piece of themselves or can produce millions of seeds

3. Ask: *What could happen to a community of species and its aquatic habitat when a new "ultimate" invasive species moves in?*

4. Provide examples of invasive species from the Blackline Master: *Cottage Country's Most Unwanted*. (Good examples to use are: the rusty crayfish, purple loosestrife and the zebra mussel).

5. Drawing their attention to the habitat signs around the room, ask students to take their ultimate species project and go to their species' habitat area (wetland, stream or lake). (Students will be discussing their ultimate species with their habitat group. If some groups are too large break them up into 2 or 3 smaller groups.) Assign a group facilitator and secretary.
6. Within their habitat group ask each student to present their Ultimate Species, sharing 2 - 3 adaptations related to its habitat, movement, safety, and food source. Ask students to write these on the chart paper provided.

## Closure/Checks for Understanding:

To each group distribute samples (from *Cottage Country's Most Unwanted*) of an invasive species that lives within the group's specified habitat. Have students discuss the adaptations listed on the samples, comparing them to their own. Provide the group secretary with chart paper and markers to make notes of the group's observations. Ask:

- *What does their ultimate species and the invasive species have in common?*
- *What is different?*
- *Does your group have any ultimate species that could be considered invasive due to the impact it could have on their community and habitat? Explain.*

Ask students from each group to share their group's discussion with the whole class.

## NOTES FOR TEACHER:

There are many non-native species living in the habitats around us. Evolving in a foreign environment, non-native species have adaptations suited to meet the resources of a community and habitat different from the one in which they are introduced. These species become invasive when they take away habitat and food from native species to an extent where they do harm to the environment and economy. The adaptations of invasive species are particularly competitive as they may:

- Have few natural predators, disease or parasites to keep their numbers in balance,
- Reproduce quickly and often,
- Adapt to many conditions,
- Be able to migrate (and therefore spread) easily,
- Be *generalists*; they can eat a variety of foods and live in a variety of habitats; and
- Often defend themselves well or are particularly aggressive predators.

Invasive species are harming lakes and rivers of Ontario, at times seriously affecting native species and their habitat. By taking action to prevent the spread of invasive species (see *Actions to Stop Species Invasion, Background Information*), we can ensure that aquatic

habitats and communities remain healthy and vibrant for all to enjoy.

**Report sightings or obtain more information on invading species by calling the Invading Species Hotline at 1-800-563-7711 or visiting [www.invadingspecies.com](http://www.invadingspecies.com)**

## EVALUATION:

Teachers can use the rubric provided to evaluate the ultimate species activity based on Science, Language and Art requirements.

## ACCOMMODATIONS:

Prior to creating their ultimate species, have students brainstorm with a partner to ensure they understand the task.

For the ultimate species activity, students that are challenged by writing tasks may work in pairs or focus on getting their ideas across through their drawing. Have students help each other with labeling and supply a list of key descriptive words on the blackboard.



**EXTENSIONS:**

Students may be more inclined to choose an animal over a plant when creating an ultimate species.

Encourage students who would like a challenge to consider choosing a plant.

Ask students to write a paragraph explaining how their ultimate species and habitat will be doing in 10

years time. Will it still be living where they originally thought it would? Has it found new food sources? Is it the only organism at its level in the food chain (i.e. the only plant, the only herbivore, the only carnivore)? What will its habitat look like?

# Ultimate Species Rubric Name: \_\_\_\_\_

Criteria/Levels	1	2	3	4
<b>Creativity and Effort</b>	<ul style="list-style-type: none"> <li>Few original ideas</li> <li>Incomplete</li> </ul>	<ul style="list-style-type: none"> <li>Some original ideas and creativity</li> <li>Some effort is shown</li> </ul>	<ul style="list-style-type: none"> <li>Ideas are original and creative</li> <li>Solid effort is shown</li> </ul>	<ul style="list-style-type: none"> <li>Very original and unique ideas</li> <li>Extra care and effort are apparent</li> </ul>
<b>Content</b> How and what I eat How I move How I stay safe Where I Live	<ul style="list-style-type: none"> <li>Adaptations don't help the creature eat, move, stay safe and find shelter</li> <li>Creature does not suit habitat and community</li> </ul>	<ul style="list-style-type: none"> <li>Some suitable adaptations are present</li> <li>Creature's adaptations somewhat suit it's habitat and community</li> </ul>	<ul style="list-style-type: none"> <li>At least 4 suitable adaptations are clearly identified</li> <li>Creature is well suited to its habitat and community</li> </ul>	<ul style="list-style-type: none"> <li>6 or more suitable adaptations are well identified</li> <li>Adaptations are very well suited to the creature's habitat and community</li> </ul>
<b>Communication</b>	<ul style="list-style-type: none"> <li>Not enough detail is given</li> <li>Sentences are incomplete</li> </ul>	<ul style="list-style-type: none"> <li>Written description somewhat detailed</li> <li>Contains some sentences</li> </ul>	<ul style="list-style-type: none"> <li>Uses suitable words to describe adaptations</li> <li>Full sentences used</li> <li>Well expressed</li> </ul>	<ul style="list-style-type: none"> <li>Uses a variety of words to describe adaptations</li> <li>Full sentences used; well structured in paragraph form</li> <li>Superior expression</li> </ul>
<b>Drawing</b>	<ul style="list-style-type: none"> <li>Drawing doesn't show what is in written description</li> <li>Incomplete</li> </ul>	<ul style="list-style-type: none"> <li>Drawing shows some details of the written description</li> </ul>	<ul style="list-style-type: none"> <li>Drawing shows the details of the written description</li> </ul>	<ul style="list-style-type: none"> <li>Drawing clearly and creatively shows the details of the written description</li> </ul>
<b>Comparison Chart (shared group mark)</b>	<ul style="list-style-type: none"> <li>Does not explain what adaptations the invasive species and the ultimate species share and don't share</li> <li>Incomplete</li> </ul>	<ul style="list-style-type: none"> <li>Shows the differences between the invasive species adaptations and ultimate species adaptations</li> </ul>	<ul style="list-style-type: none"> <li>Clearly compares invasive species adaptations and ultimate species adaptations</li> <li>Tells of important habitat and community characteristics that affect the ultimate species</li> </ul>	<ul style="list-style-type: none"> <li>Expertly shows what invasive species share and don't share with the ultimate species (adaptations)</li> <li>Clearly explains the role of the invasive species and ultimate species in the community and habitat</li> </ul>

Overall Level:    1    2    3    4    **Comments:**

# Lesson Support Materials

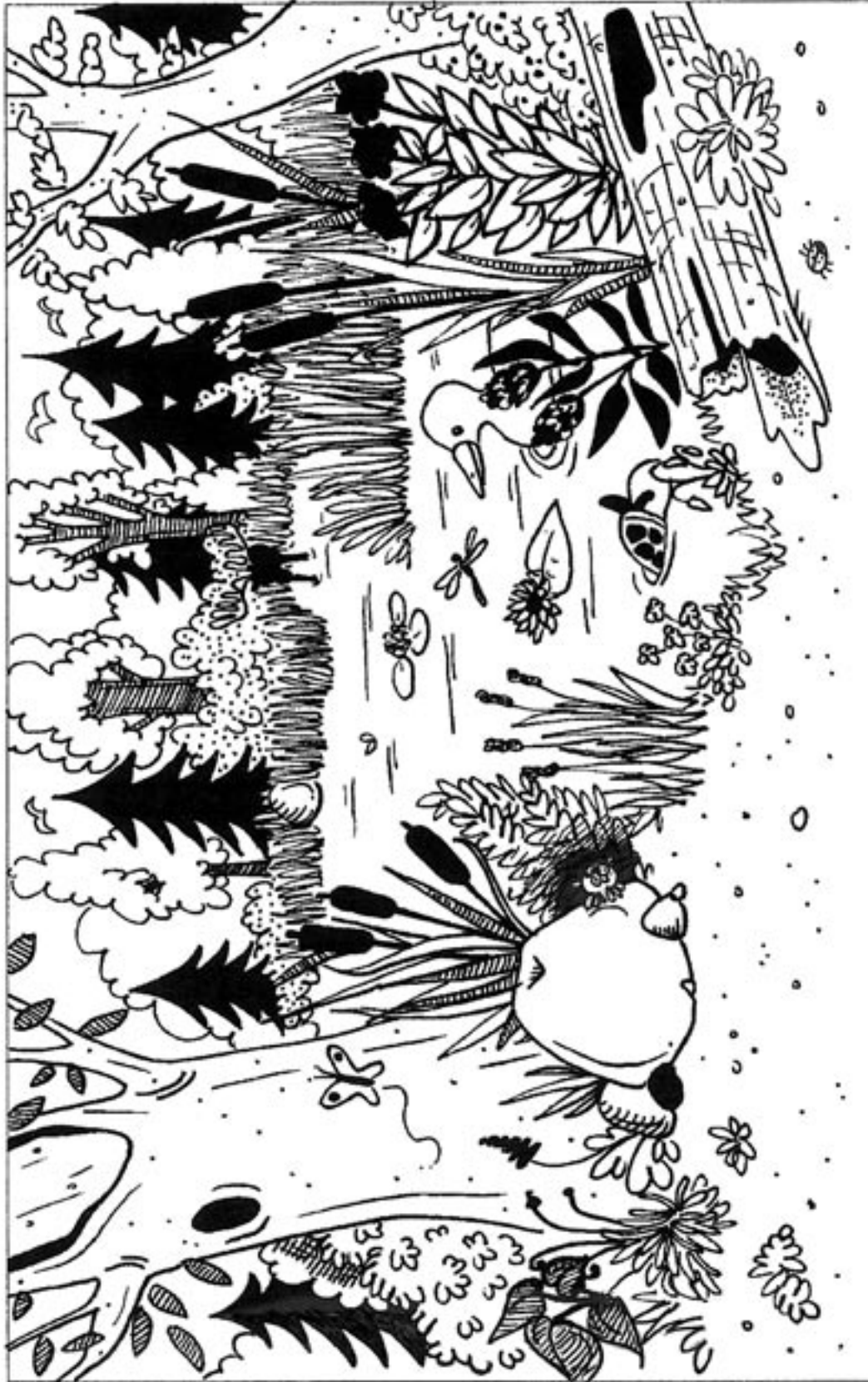
## Blackline Masters

1. HABITAT TRANSITION	
• Used in Warm-Up Activity: <i>A Change Over Time</i> – 3 pages	51
2. HEALTHY HABITATS – PROBLEMS AND PREVENTIONS	
• Used in Warm-Up Activity: <i>The Preventable Problem</i> – 3 pages	54
3. INVADING SPECIES SONG	
• Used in Warm-Up Activity: <i>Songs for an Ecosystem</i> – 1 page	57
3. WHO AM I?	
• Used in Lesson: <i>Know Me, Know My Adaptations</i> – 3 pages	58
4. MY ADAPTATIONS CHECKLIST	
• Used in Lesson: <i>Know Me, Know My Adaptations</i> – 1 page	61
5. PREDATOR, PLANT AND PREY	
• Used in Lesson: <i>Know Me, Know My Adaptations</i> – 1 page	62
6. PET SHOP POSTER MESSAGES	
• Used in Lesson: <i>Aquarium Ownership is an Art</i> – 1 page	63
7. MUSICAL MUSSELS CARDS	
• Used in Lesson: <i>Musical Mussels</i> – 1 page	64
8. TOUGH RUFFE GAME CARDS	
• Used in Lesson: <i>Tough Ruffe</i> – 3 pages	65
9. MAP OF ONTARIO	
• Used in Lesson: <i>Stow-Aways and Crafty Ways</i> – 1 page	68
10. ROUND GOBY INVESTIGATION BACKGROUND	
• Used in Lesson: <i>Stow-Aways and Crafty Ways</i> – 1 page	69
11. COTTAGE COUNTRY’S MOST UNWANTED	
• Used in Lesson: <i>Ultimate Species</i> – 5 pages	70

# Habitat Transitions



# Habitat Transitions



# Habitat Transitions



## BLM - Healthy Habitats – Problems And Preventions

Julio has just finished his lunch. He has lots of waste left including juice boxes, wrappers and bags.

Pack a litterless lunch. Use plastic containers and fresh ingredients. Don't pack items that use lots of packaging.

Melissa and her family are moving to another country. She decides to release her pet fish into the local pond. The fish get big quickly and take over the local habitat.

When you can't look after your pet fish anymore give them to a friend, school or return them to the pet shop. Always drain aquarium water on dry land.

Connor's family goes boating. They explore one weedy lake and then drive to another. Their boat is covered with aquatic plants from the first lake. When they put it into the second lake, the plants are released. These plants grow quickly and clog the second lake.

Before leaving a lake or river, carefully check your boat and remove any plants and animals you see! Once you are home, rinse your boat with the garden hose, or leave it to dry in the sun for 5 days.

Mackenzie missed her school bus because she couldn't find her mitts and scarf.

Avoid a last minute dash by preparing ahead of time. Lay out all of the items you will need the next day, the night before.

Omar and Madison go fishing. They catch only 1 fish and have lots of bait left over. They empty it into the local river where it invades the native food chain.

If you have leftover bait after fishing, store it for next time in the freezer or take it back to the store.

Yin-Yee planted a new garden with many species including a pretty plant called purple loosestrife. Soon the loosestrife pushed out all of her other plants and started to spread into her neighbour's garden.

Before buying plants for a garden, ask experts what species are from Ontario. Only plant those that grow locally. Don't bring exotic species into a garden where they can become a nuisance and take over!

Olaf falls asleep during his math lesson everyday. He misses important information and does poorly on his test.

Keeping a regular sleeping schedule is good for the body and mind. By getting plenty of rest, you will be refreshed and awake for the next day.

Eric buys live crabs at the food market because he thinks they would make a cool pet. He doesn't know what to feed them and they start to get sick.

Don't take live animals sold at food markets home to be pets - they are meant to be eaten. Never, ever set them free.



**Anna Marie forgot to bring in her field trip money to school and missed out going to the Science Centre.**

**Write down important information in one place and check it regularly. Using a calendar or a day planner will help to remind you about special days, homework and school activities.**

**Sydney didn't want to work on her big social studies project. Although she liked the subject, she wanted to play with her friends more. The day before it was due, Sydney realized that she hadn't even started it! She rushed home and stayed up late trying to put it together. She found it frustrating and didn't do as good a job as she knew she could.**

**If you know you have a big assignment to do, start working on it ahead of time. Not only will you enjoy it more but you won't be trying to finish it, in a panic, at the last minute.**

**During his last class of the day, Henry watched as the clouds darkened over his school. By the time he left, it was pouring down rain and he was not prepared for it. He was drenched and shivering with cold as he ran home in his light clothing. A day later he got sick.**

**Ontario's weather changes often and quickly – especially in the fall, winter and spring. To ensure you stay warm and dry, check radio, television or Internet weather updates before leaving home and dress as necessary.**

## BLM - Invading Species Song

Invading species, gonna mess your lake  
Invading species, they gonna mess your stream  
Invading species gonna mess your lawn  
Invading species gonna mess your pond  
Say I,  
Say N,  
Say V,  
Say A,  
Say D,  
E,  
Say R,  
Say S,  
Invading species gonna mess your lake  
Invading species gonna mess your stream  
Invading species gonna mess your lawn

Invading species, stay away from me  
Invading species, you spiny water flea  
Don't come hangin' around my shore  
I don't wanna see your hooks no more  
I got more important things to do  
Than spend my time cleaning boats of you  
Now mussel, I said stay away,  
Gobies, listen what I say.

Invading species, get away from lakes  
Invading species, for all our sakes  
Don't come climbin' around my dock  
Don't wanna see you under rocks  
Rusty claws can camouflage  
But keeping you is against the law  
Now crayfish, I said get away  
Invading species, listen what I say.

Invading species, said get away  
Invading species, listen what I say  
Don't come hangin' around my stream  
We work so hard to keep them clean  
I don't need your Eurasian ruff  
I don't need your frogbit stuff  
Purple loosestrife fills the ditch  
Foreign beetles like to hitch  
Now millfoil, get away from me  
Invading species, never let them free.

Go, gotta get away, gotta get away  
Now go go go  
Gonna leave you, rudd  
Gonna leave you, snakehead  
Bye-bye  
Bye-bye  
Bye-bye  
Bye-bye  
You're no good for here  
I'm no good for you  
Gonna kick you outta here.  
Tell you what I'm gonna do  
You know I'm not gonna take you  
You know you're not gonna go  
You know I'm not gonna take you  
You know I'm not gonna take you, goby  
I'm not gonna leave baitfish  
Goodbye, invading species  
Goodbye, invading fish  
Goodbye, invading plants  
Goodbye, invading bugs ...

## BLM Healthy Habitats – Who Am I?



Great Lakes Fishery Commission

### SEA LAMPREY

I am a sea lamprey. I live in the Great Lakes now but migrated from the Atlantic Ocean. I attach myself to the body of fish (especially lake trout) by my mouth and feed on their flesh and blood. I have few predators in North America, unlike in Europe, where humans eat me. I find it hard to survive in polluted waters.

1. I have strong teeth.
2. I have a very rough, sharp tongue.
3. My mouth is like a suction cup.
4. I have a long, tube-like body.

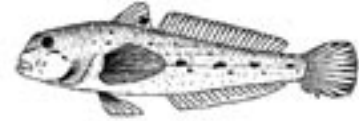


Bell Museum, University of Minnesota

### RUSTY CRAYFISH

I am a rusty crayfish. I live in lakes, ponds and streams. I am an aggressive omnivore that needs to eat a lot. I eat a wide variety of aquatic plants and animals. I have fewer predators compared to other crayfish. I find it hard to survive in polluted waters.

1. I have a hard shell.
2. I have a speckled body (rusty patches).
3. I have large, strong claws (with black tips).
4. I grow large in size (compared to other crayfish).



Donna Francis, University of Michigan

### ROUND GOBY

I am a round goby. I live in rivers and lakes. I eat many types of small aquatic species, including the eggs of my fellow fish and can survive in many types of waters. I can spawn (reproduce) up to six times in one season—this is a lot for a fish!

1. I have a speckled body.
2. I lay many eggs.
3. I grow quickly.
4. I have a fin shaped like a suction cup on the bottom of my body.



Robert Savannah, USFWS

### SNAPPING TURTLE

I am a snapping turtle. I live in slow moving and shallow waters, like lakes and wetlands. I “snap” at my prey to catch them. They include: fish, crayfish, frogs, tadpoles and aquatic plants. Birds, raccoons, skunks and foxes prey upon my eggs and babies – few survive.

My greatest predators are humans who eat me or hit me accidentally with their cars. I am shy and very sensitive to habitat destruction.

1. My strong mouth is shaped like a pointed beak.
2. I have a long spiked tail and sharp claws.
3. I have a hard shell.
4. I am good at being motionless



Charles Douglas

### GREAT BLUE HERON

I am a great blue heron. I live along the wooded shorelines of lakes, rivers and wetlands. I feed on fish and frogs in shallow water. I have few predators as an adult but raccoons and some birds will eat my eggs and babies

1. I have a long neck.
2. I have a strong, pointed beak.
3. I have long legs.
4. I am good at being motionless.

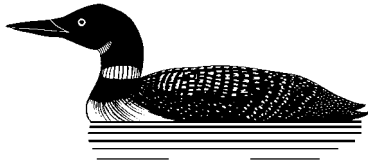


Charles Douglas

### AMERICAN BEAVER

I am an American beaver. I live in shallow bays, rivers and streams surrounded by forest. I build dams and lodges with medium-sized trees and eat small trees and shoots. My natural predators are: wolves, lynx, and bears, and I’m used by humans when they trap me for my fur.

1. I have large, strong teeth.
2. I have a large, flat tail.
3. I have a thick, oily coat.
4. My nostrils close underwater.



OFAH



Oakland Zoo



© Curtis Atwater

### COMMON LOON

I live in and beside lakes. I eat fish that I catch by diving to great depths. As an adult I have few predators. My chicks stay safe from raccoons, bears and gulls by sitting on my back. I am harmed by water pollution and habitat destruction.

1. I have webbed feet.
2. I can stay underwater for a long time (up to 3 minutes).
3. I have a long, sleek body.
4. I am heavy (my bones are solid so that I can dive deep for fish).

### NORTHERN RIVER OTTER

I am a northern river otter. I live along wooded shorelines, of lakes, rivers, ponds and wetlands. I eat fish, frogs, and crustaceans. My natural predators include the wolf and I am used by humans who trap me for my fur. I am also harmed by water pollution and habitat destruction.

1. My nostrils close underwater.
2. I have a thick, oily coat.
3. I have webbed feet.
4. I have a long, sleek body.

### LAKE TROUT

I am a lake trout. I live in cold, deep lakes. I grow slowly and my eggs hatch at specific water temperatures. I eat smaller fish. My flesh is tasty to animals (including sea lamprey and humans). Polluted waters are very hard on me.

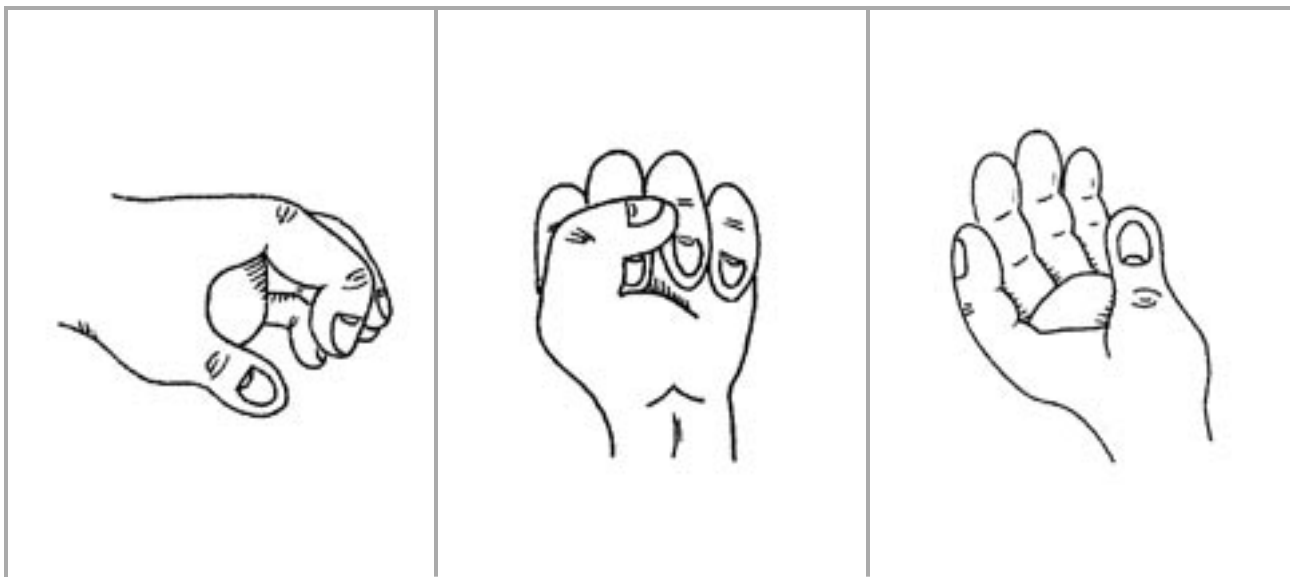
1. I have strong teeth.
2. I have a speckled body.
3. I grow large in size.
4. I have a large flat tail (that helps me swim very fast to catch my prey).

## My Adaptations Checklist

My name is:	My species is:	
	Yes	No
Webbed feet		
Rough tongue		
Nostrils close underwater		
Spiked tail		
Heavy body		
Strong claws		
Oily coat		
Long neck		
Grows quickly		
Suction cup on the bottom of my body		
Hard shell		
Mouth like a suction-cup		
Good at being motionless		
Can stay underwater for a long time		
Long legs		
Strong teeth		
Large in size		
Lays many eggs		
Sleek body		
Pointed beak		
Flat tail		
Speckled body		

# Predator, Plant and Prey!

(Rock, Paper, Scissors)



## **PREDATOR**

(fang hand)

## **PREY**

(fist)

## **PLANT**

(spike hand)

Predator eats prey!



Predator and prey compete – predator wins.

Prey eats plant!



Prey and plant compete – prey wins.

Plants safe from predator!



Predator and plant compete – plants wins.

## Pet Shop Poster Messages

# CREATE YOUR OWN or CHOOSE ONE:

Releasing aquarium pets and plants into the wild  
is harmful to local habitats!

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!

Burials on land are better than burials at sea. Don't flush dead pets away.  
They could harm our habitats!

When finished with aquarium plants, dry them out in the sun and  
put them in the garbage (not in the compost)!

Donate unwanted aquarium fish, snails and plants to a pet store,  
school or aquarium hobbyist. Advertise and offer them for free!



## BLM – Musical Mussels Playing Cards

**You are meeting  
your basic needs!**

**Zebra mussels are taking your  
food. You can't stay!**

**(Basic Need: FOOD)**

**Zebra mussels are  
crowding you out!**

**The zebra mussels on your back  
make it hard to move. This makes  
you vulnerable to predators.**

**(Basic Need: ROOM TO GROW)**

**(Basic Need: SAFETY)**

**Because zebra mussels eat so  
much, there is less food for you!  
Go away!**

**Your eggs won't hatch among  
zebra mussels. Lay them  
somewhere else!**

**(Basic Need: FOOD)**

**(Basic Need: SHELTER)**

**Zebra mussels are  
crowding you out!**

**Zebra mussels are taking your  
food. You can't stay!**

**(Basic Need: ROOM TO GROW)**

**(Basic Need: FOOD)**






**Your eggs won't hatch among  
zebra mussels. Lay them  
somewhere else!**

























**Because zebra mussels eat so  
much, there is less food for you!  
Go away!**

**(Basic Need: SHELTER)**

**(Basic Need: FOOD)**

# BLM – Tough Ruffe Game Cards

<p><b>food</b></p> 	<p><b>shelter</b></p> 	<p><b>clean water</b></p> 	<p><b>room to grow</b></p> 
<p><b>food</b></p> 	<p><b>shelter</b></p> 	<p><b>clean water</b></p> 	<p><b>room to grow</b></p> 
<p><b>food</b></p> 	<p><b>shelter</b></p> 	<p><b>clean water</b></p> 	<p><b>room to grow</b></p> 
<p><b>food</b></p> 	<p><b>shelter</b></p> 	<p><b>clean water</b></p> 	<p><b>room to grow</b></p> 
<p><b>Caught!</b></p> <p>An angler has just caught you! Return to your hula-hoop and stay there.</p>	<p><b>Slimed!</b></p> <p>Garbage has been dumped into your lake habitat. You're now too sickly to get more cards. Return to your hoop and get better.</p>	<p><b>JACKPOT!</b></p> <p>This very healthy habitat card is worth four cards of your choice in your struggle for survival!</p>	<p><b>Eaten!</b></p> <p>You've been eaten by a big fish! Return to your hula-hoop and stay there.</p>

<p><b>food</b></p> 	<p><b>shelter</b></p> 	<p><b>clean water</b></p> 	<p><b>room to grow</b></p> 
<p><b>food</b></p> 	<p><b>shelter</b></p> 	<p><b>clean water</b></p> 	<p><b>room to grow</b></p> 
<p><b>food</b></p> 	<p><b>shelter</b></p> 	<p><b>clean water</b></p> 	<p><b>room to grow</b></p> 
<p><b>food</b></p> 	<p><b>shelter</b></p> 	<p><b>clean water</b></p> 	<p><b>room to grow</b></p> 
<p><b>food</b></p> 	<p><b>shelter</b></p> 	<p><b>clean water</b></p> 	<p><b>room to grow</b></p> 
<p><b>food</b></p> 	<p><b>shelter</b></p> 	<p><b>clean water</b></p> 	<p><b>room to grow</b></p> 

food



shelter



clean water



room  
to grow



food



shelter



clean water



room  
to grow



food



shelter



clean water



room  
to grow



food



shelter



clean water



room  
to grow



food



shelter



clean water



room  
to grow



food



shelter



clean water



room  
to grow



# Map of Ontario



## Round Goby Investigation – Background

As an Investigative Ecologist, your job is to figure out how the invasive fish species, the round goby, has spread throughout the waters of Ontario and where it may spread to in the future. The activities below will assist you in your investigation.

1. Locate and label the following bodies of water on your map of Ontario: St. Lawrence River, Lake Ontario, Lake Erie, Lake St. Clair, St. Clair River, Welland Canal, Niagara River, Niagara Falls, Lake Simcoe, Lake Superior, Lake Michigan, Lake Huron, Hudson Bay, James Bay, Trent Severn Waterway, Rideau Canal, Georgian Bay and the Ottawa River.
2. Using the following table, locate and label round goby sightings on your map of Ontario. Draw a small fish symbol (and include it in your legend) and its related year, to show your sighting location.

YEAR	LOCATION
1990	<b>St. Clair River</b>
1993	<b>Detroit River</b>
1993	Grand River, Ohio, <b>Lake Erie</b>
1994	Goderich, <b>Lake Huron</b>
1995	<b>Welland Canal</b>
1995	Duluth, Minnesota, <b>Lake Superior</b>
1996	Beaver Island, <b>Lake Michigan</b>
1998	Grand Bend, <b>Lake Huron</b>
1999	Hamilton, <b>Lake Ontario</b>
1999	Port Severn, <b>Georgian Bay</b>
2001	Burlington, <b>Lake Ontario</b>
2002	Owen Sound, <b>Georgian Bay</b>
2003	Hastings, <b>Trent-Severn Waterway</b>
2004	Cornwall, <b>St. Lawrence River</b>
2006	Pefferlaw, <b>Lake Simcoe</b>

3. When writing your INVESTIGATIVE ECOLOGIST REPORT, consider the following ways that invasive aquatic species can spread: *in a ship's ballast; following natural waterways; as pets released into the wild; accidental bait release; on a boat; and, released from a market.*

## BLM - Cottage Country's Most Unwanted

### THE TEENY MEANIE MUSSEL!

Alias: Zebra Mussel

**WANTED FOR:** Clogging water pipes, ruining beaches, crowding out clams, hurting swimmer's feet, hogging food and harming lake habitats!

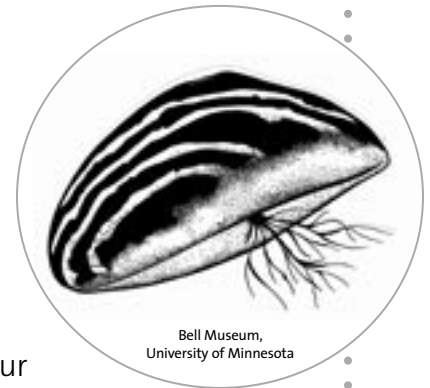
**Last Seen (habitat):** Ontario lakes

**Description:** This small, crafty, aquatic animal is about the size of your fingernail! It is brown with yellow or white stripes and attaches to hard objects.

**Notable Features (adaptations):**

- Females can lay 1 million eggs per year!
- Baby zebra mussels are too small to be seen and once hatched can float or be carried in or on boats to new places!
- It has few predators (only a few ducks and some fish)!

**Prevention Reward: Healthy aquatic habitats.**



Bell Museum,  
University of Minnesota

### THE PUSHY PURPLE PLANT!

Alias: Purple Loosestrife

**WANTED FOR:** Wetland takeover! It crowds out native plants that provide food and shelter for birds, fish, frogs and mammals.

**Last Seen (habitat):** Ontario wetlands (and ditches!)

**Description:** A tall, leafy plant with lots of tiny, purple flowers.

**Notable Features (adaptations):**

- It can spread its seeds easily with the help of the wind, water, people and animals!
- It has many small flowers that produce millions of seeds each year!
- Its seeds grow in many habitats (dry and wet)!
- It is pushy! Once it gets into a habitat, it spreads and spreads!

**Prevention Reward: Healthy aquatic habitats.**



Michigan Sea Grant

## THE BARBED BARBARIAN!

Alias: Spiny Water Flea

**WANTED FOR:** Choking and stealing food from young and small fishes!

**Last Seen (habitat):** Ontario lakes.

**Description:** A small crustacean with one dark eye and a long, hooked tail. It is so small you can barely see it!

### Notable Features (adaptations):

- It has a sharp, long tail, with many sharp spines that get caught in the throats of fish predators. This causes them to be coughed-up unharmed!
- It has lots of babies, producing young water fleas every 2 weeks!
- It has large front legs that help it catch and hold on to other crustacean as it eats them!

**Prevention Reward: Healthy aquatic habitats.**



## THE CRAZY CLAW! Alias: Rusty Crayfish

**WANTED FOR:** Gluttony and stealing food! Guilty of destroying aquatic plant beds that provide food and shelter to native fish and insect species. The Crazy Claw, bullies native crayfish and is aggressive towards most things including humans.

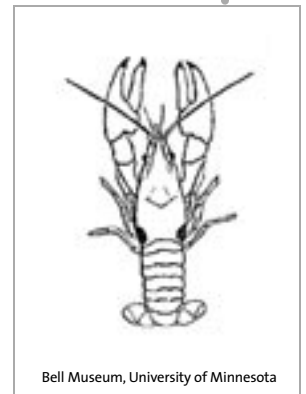
**Last Seen (habitat):** Ontario lakes and streams.

**Description:** A hand-sized crayfish with large, strong, black-tipped claws and dark rusty spots on each side of its body.

### Notable Features (adaptations):

- Eats almost anything! Is an omnivore that feeds on both plants and small animals!
- It has powerful claws that are larger and stronger than most other crayfish!
- It has a hard shell that some predators have a hard time getting through!
- It chases other crayfish out of their daytime hiding places making them easy for predators to catch!

**Prevention Reward: Healthy aquatic habitats.**

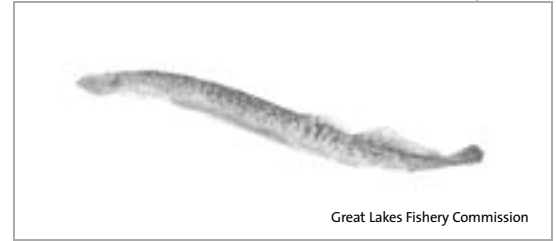




## THE FISH VAMPIRE!

**Alias:** Sea Lamprey

**WANTED FOR:** Illegally hitchhikes on Great Lakes fish with its cruel mouth! It sucks their flesh and robs them of their bodily fluids!



**Last Seen (*habitat*):** Great Lakes and connecting waterways.

**Description:** The sea lamprey is shaped like a cylinder. It has a flexible, eel-like body and a disk-shaped, sucker mouth.

**Notable Features (*adaptations*):**

- It has a large sucker mouth with teeth that grind through fish flesh!
- Its tongue helps them feed on the bodily fluid of fish!
- It produces a liquid that stops blood from clotting! This keeps fish from healing their wounds while the lamprey is attached!

**Prevention Reward: Healthy aquatic habitats.**

## SPIKE THE RUFFIAN!

**Alias:** Eurasian Ruffe (pronounced “rough”)

**WANTED FOR:** Snatching eggs, bullying local fish and using their spines as weapons!



**Last Seen (*habitat*):** The Great Lakes (Superior and Huron).

**Description:** A slimy, brown fish with spiky spines on most of its fins.

**Notable Features (*adaptations*):**

- It has special features that allow it to find food in the dark. By feeding in dark waters they can escape predators!
- It has a row of hard spines on its top and bottom fins, protecting it from some predators!
- It eats many different types of food, including the eggs of other fish!

**Prevention Reward: Healthy aquatic habitats.**

## THE BAIT BANDIT!

**Alias: Round Goby**

**WANTED FOR:** Stealing food and hogging habitat!

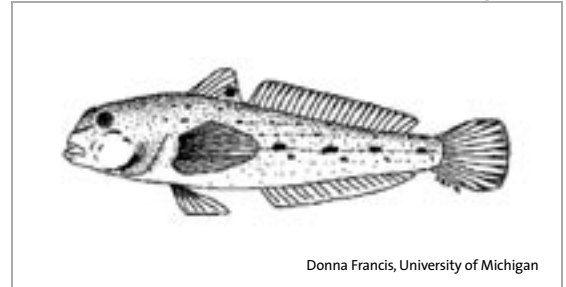
**Last Seen (*habitat*):** Hides out on rocky or sandy lake and river bottoms.

**Description:** A small, spotty brown fish that grows 7-15 cm long. It has a special fin on the bottom of its belly.

**Notable Features (*adaptations*):**

- It can have babies up to 5 times each year!
- It is a bully. It scares other fish away and eats their eggs and young!
- Its fin on the bottom of its body is in the shape of a suction cup. This odd fin helps the round goby stay still in fast moving waters!

**Prevention Reward: Healthy aquatic habitats.**



## THE GREEN STRANGLER!

**Alias: Fanwort**

**WANTED FOR:** Clogging bays, suffocating native aquatic plants and spoiling swimming holes!

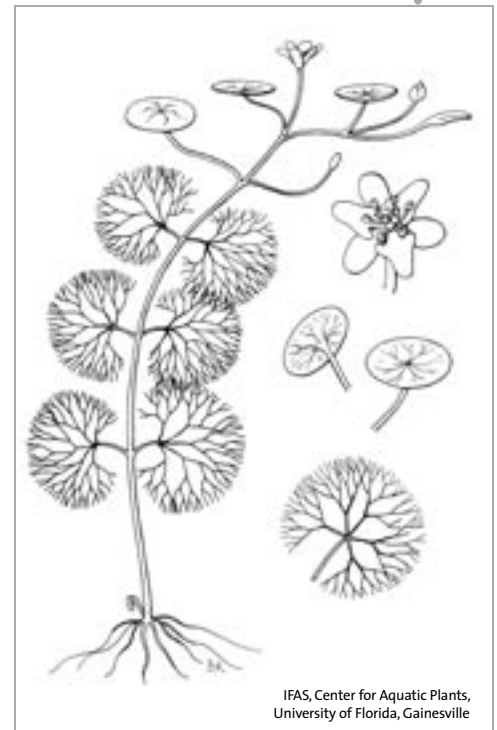
**Last Seen (*habitat*):** Ontario streams, ponds and lakes.

**Description:** An aquatic plant with fan-shaped leaves.

**Notable Features (*adaptations*):**

- It spreads quickly when pieces break off the mother plant and root in the lake bottom!
- Groups of fanwort grow to the surface to form thick mats on the water! Yuck!

**Prevention Reward: Healthy aquatic habitats.**



## THE FLOATING FELON

**Alias:** European Frogbit

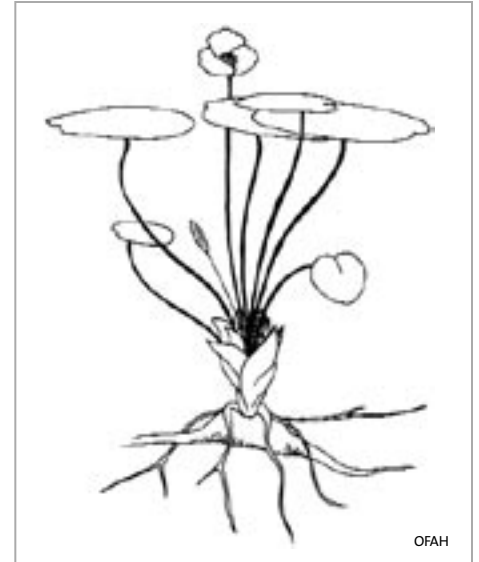
**WANTED FOR:** Choking shallow ponds, wetlands and lake edges.

**Last Seen (*habitat*):** Wetlands or shallow lake bays of Ontario.

**Description:** An aquatic plant that looks like a miniature water lily. It has toonie-sized leaves and a white flower with a yellow centre.

**Notable Features (*adaptations*):**

- It grows thickly on the top of the water hogging all the sun and nutrients from native plants growing under the water.
- It grows so thick on the surface of the water that it is difficult to boat and swim! This also makes it hard for ducks to land and fish to swim through its crowded roots.
- It does not root in the earth. Instead it uses its roots to hold onto other frogbit plants. This keeps it from drifting away!



OFAH

**Prevention Reward: Healthy aquatic habitats.**

## Full Expectations Listing

The following Ontario Curriculum Expectations are met by *Making Waves! Protecting Ontario's Aquatic Habitats*

### Science and Technology – Life Systems

Overall Expectations	<b>451</b>	Demonstrate an understanding of the concepts of habitat and community, and identify the factors that could affect habitats and communities of plants and animals.
	<b>452</b>	Investigate the dependency of plants and animals on their habitat and the interrelationships of the plants and animals living in a specific habitat.
	<b>453</b>	Describe ways in which humans can change habitats and the effects of these changes on the plants and animals within the habitats.
Understanding Basic Concepts	<b>454</b>	Identify, through observation, various factors that affect plants and animals in a specific habitat (e.g., availability of water, food sources, light; ground features; weather conditions).
	<b>455</b>	Classify organisms according to their role in a food chain (e.g., producer, consumer).
	<b>456</b>	Demonstrate an understanding of a food chain as a system in which energy from the sun is transferred eventually to animals, construct food chains of different plant and animal species (e.g., carrot -> rabbit -> fox), and classify animals as omnivore, carnivore, and herbivore.
	<b>457</b>	Describe structural adaptations of plants and animals that demonstrate a response of the living things to their environment (e.g., the height of a plant depends on the amount of sunlight the plant gets; many animals that live in the Arctic have white fur).
	<b>458</b>	Recognize that animals and plants live in specific habitats because they are dependent on those habitats and have adapted to them (e.g., ducks live in marshes because they need marsh plants for food and shelter and water for movement).
Developing Skills of Inquiry, Design and Communication	<b>4510</b>	Formulate questions about and identify the needs of animals and plants in a particular habitat, and explore possible answers to these questions and ways of meeting these needs (e.g., predict the structural adaptations, such as webbed feet, that help aquatic animals live in water).
	<b>4512</b>	Use appropriate vocabulary, including correct science and technology terminology, in describing their investigations, explorations, and observations (e.g., habitat, population, ecological niche, community, food chain).
	<b>4513</b>	Compile data gathered through investigation in order to record and present results, using tally charts, tables, and labelled graphs produced by hand or with a computer (e.g., display data gathered in a population-simulation exercise, using a labelled graph; classify species of insects in the neighbourhood according to habitat, using a chart or table).
Relating Science and Technology to the World Outside the School	<b>4515</b>	Describe ways in which humans are dependent on plants and animals (e.g., for food products, medicine, clothing, lumber).
	<b>4516</b>	Describe ways in which humans can affect the natural world (e.g., urban development forces some species to go elsewhere and enables other species to multiply too rapidly; conservation areas can be established to protect specific habitats).
	<b>4517</b>	Construct food chains that include different plant and animal species and humans (e.g., grass -> cattle -> humans).
	<b>4518</b>	Show the effects on plants and animals of the loss of their natural habitat (e.g., nesting sites of ducks may be destroyed when a dam is built).
	<b>4519</b>	Investigate ways in which the extinction of a plant or animal species affects the rest of the natural community and humans (e.g., chart the distribution of wolves on a world map and predict the effects if wolves were to become extinct; use a software program that simulates a specific environment to track the effects of the loss of a plant species).

<b>Social Studies</b>		
<b>Canada and World Connections – The Provinces and Territories of Canada</b>		
Understanding Concepts	<b>4z27</b>	Demonstrate an understanding of the significance of the St. Lawrence River and the Great Lakes systems (e.g., for transportation, industry, recreation).
Developing Inquiry/Research and Communication Skills	<b>4z40</b>	Use appropriate vocabulary (e.g., regions, Canadian Shield, Great Lakes lowlands, St. Lawrence lowlands, Hudson Bay lowlands, interior plains, Arctic lowlands, Cordilleras, physical features, boundaries, province, capital, territories, natural resources, grid, latitude, longitude) to describe their inquiries and observations.
	<b>4z42</b>	Sort and classify information to identify issues, solve problems, and make decisions.
Developing Map and Globe Skills	<b>4z47</b>	Locate and label the Great Lakes and other major bodies of water and waterways (e.g., Hudson Bay, James Bay, Ottawa River) on a map of Ontario.
	<b>4z50</b>	Use cardinal and intermediate directions, non-pictorial symbols, and colour on a map to locate and describe physical regions.

<b>English Language</b>		
<b>Writing</b>		
Overall Expectations	<b>4e1</b>	Communicate ideas and information for a variety of purposes and to specific audiences (e.g., write a brief research report on a class investigation for classmates).
	<b>4e2</b>	Begin to write for more complex purposes (e.g., to present and discuss their opinions and viewpoints, to pose questions, to record information).
	<b>4e5</b>	Produce pieces of writing using a variety of specific forms (e.g., humorous story) and materials from other media (e.g., photo sequence) to enhance their writing.

<b>Health and Physical Education</b>		
<b>Fundamental Movement Skills</b>		
Overall Expectations	<b>4p15</b>	Perform the movement skills required to participate in lead-up games, gymnastics, dance, and outdoor pursuits: locomotion/traveling (e.g., sliding, gliding), manipulation (e.g., kicking, trapping), and stability (e.g., putting their weight on different body parts).

<b>Health and Physical Education</b>		
<b>Active Participation</b>		
Overall Expectations	<b>4p26</b>	Demonstrate a variety of interpersonal skills (e.g., playing fairly, co-operating, behaving respectfully).
Living Skills	<b>4p35</b>	Follow the rules of fair play in games and activities (e.g., displaying good sports etiquette by maintaining self-control whether winning or losing).
	<b>4p36</b>	Demonstrate respectful behaviour towards others in the group (e.g., speaking kindly, refraining from hurtful comments, acknowledging others' ideas and opinions).

## The Arts Music

Creative Work	<b>4a18</b>	Write new words to familiar melodies, using their knowledge of rhythm to ensure that the new text fits with the melody.
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## The Arts Visual Arts

Overall Expectations	<b>4a31</b>	Produce two- and three-dimensional works of art that communicate ideas (thoughts, feelings, experiences) for specific purposes and to specific audiences.
Knowledge of Elements	<b>4a35</b>	Identify monochromatic colour schemes (i.e., tints and shades of one colour);
	<b>4a39</b>	Describe ways in which artists use a variety of tools, materials, and techniques to create texture (e.g., painting with a palette knife, embedding fabric in gesso, gouging Plasticine).
	<b>4a41</b>	Demonstrate understanding of the proper and controlled use of art tools, materials, and techniques singly and in combination (e.g., outline shapes, create shading, or colour a surface using both the point and the side of pencil crayons; create texture using cross-hatching).
Creative Work	<b>4a42</b>	Solve artistic problems in their art work, using the elements of design specified for this grade (e.g., create a self-portrait and defend their colour choices).
	<b>4a43</b>	Produce two- and three-dimensional works of art (i.e., works involving media and techniques used in drawing, painting, sculpting, printmaking) that communicate thoughts, feelings, and ideas for specific purposes and to specific audiences (e.g., create a poster for display in the school library to commemorate a personal literary hero, using an additive form of printmaking).

# Background Materials

## All About Invasives:

Ontario's aquatic habitats are world renowned for their beauty and abundance. Significant to our way of life, the plant and animal communities within these habitats are being harmed by invasive species.

### What makes a species invasive?

Think about the last 5 birds you've seen. Was a house sparrow or starling among them? Both of these species were brought across the Atlantic Ocean and released in Central Park in New York City so North Americans could experience birds that were featured in Shakespeare's plays!

There are numerous species, not native to North America, living in the habitats around us. Many of these species have been introduced by humans. Problems arise when these new species take away habitat and food from native species, the original inhabitants. These species are referred to as *invasive*. Their introduction or spread threatens aspects of the environment, the economy, and society, including human health. Invasive species can originate from other continents, neighbouring countries, or from other ecosystems within Canada.

Aquatic invasive species are seriously impacting the lakes and rivers of Ontario, harming native fish, invertebrate and plant populations. Some of these creatures are voracious predators, capable of destroying aquatic habitats and outcompeting native fish or invertebrate species for food and shelter. Others are aggressive plants that can form dense mats of growth, displacing native species. When they die they remove dissolved oxygen from aquatic habitats impacting fish and other species and may foster the growth of bacteria.

### **Invasive species impact our native species and habitats because they:**

- Have few natural enemies or predators!
- Outcompete native species for food and habitat!
  - Reproduce quickly and often!
  - Can adapt to many conditions!
- Are able to migrate (and therefore spread) easily!
- Are *generalists*; they can eat a variety of foods and live in a variety of habitats!
- Often have a "special feature", for example they can defend themselves well or tolerate extreme conditions!
- Are aggressive predators or experience little competition from other species!

# A Sampling of Invasive Species

## **EURASIAN RUFFE** (*Gymnocephalus cernuus*)

Eurasian ruffe (rhymes with “tough”) are small fish, native to Europe. They were first brought to the Great Lakes in the ballast water of ships. Ruffe eat a variety of foods, including fish eggs. Their small size, hard spikes and the fact they spend their nights in shallow water feeding, and their days swimming safely in deep water, ensures that they can avoid predation better than native fish.

## **EUROPEAN FROG-BIT** (*Hydrocharis morsus-ranae*)

European frog-bit looks like a miniature water lily with a small white flower. It is originally from Europe and Asia. This plant lives in calm waters. Frog-bit reproduces both sexually and asexually at rates faster than native species and grows quickly. It floats on the water’s surface, blocking sunlight and creating poor conditions for native plants growing beneath it.

## **FANWORT** (*Cabomba caroliniana*)

Fanwort is a subtropical, submersed South American plant commonly sold for use in aquariums. Released into the wild, fanwort can establish itself in lakes, ponds and slow flowing water. It spreads when its broken stem fragments continue to grow, becoming a new plant. Fanwort can form dense mats, crowding out native plants, clogging drainage canals and areas where there is still water. It can make swimming and boating difficult and may impact fisheries.

## **GOLDFISH, KOI AND CARP SPECIES**

(*Carassius spp.*, *Cyprinus spp.*)

Goldfish and koi are popular and beautiful aquarium fish. These and other carp species have the potential to become quite destructive to Ontario’s lakes and rivers. This is due to the fact that they can grow and reproduce quickly and in the process consume large quantities of aquatic vegetation that native species may depend on for food, shelter, laying eggs and protecting their young.

## **PURPLE LOOSTRIFE** (*Lythrum salicaria*)

Purple loosestrife is a plant with a bright purple flower

spike that contains many small purple flowers. It can grow to be over 1 m tall. Purple loosestrife reproduces prolifically. Its flowers produce millions of seeds each year that are blown in the wind and carried on water to new locations. The plant can also reproduce when its roots are split apart and from plant fragments. Loosestrife takes over wetland habitats limiting biodiversity and sources of food and habitat for native species. This is a huge problem, as wetlands are the most biologically diverse productive components of our ecosystem.

## **ROUND GOBY** (*Neogobius melanostomus*)

Originally from Europe, round gobies were brought to Ontario in the ballast water of ships. These 25 cm long fish are grey/brown and have a bottom fin in the shape of a suction cup – this allows them to sit on the bottom of streams and rivers. Round gobies are able to reproduce up to six times each year whereas native fish spawn only once. Round goby feed heavily on the eggs and fry of native fish including bass, lake trout and yellow perch.

## **RUSTY CRAYFISH** (*Orconectes rusticus*)

Rusty crayfish are native to the Ohio-Tennessee River basin in the United States. These crayfish have larger, stronger claws and are more aggressive than other crayfish. This aggressive behaviour forces native crayfish from their hiding places thus making them more vulnerable to predation. The rusty crayfish also eats 2-3 times as much as our native crayfish. By eating large amounts of bottom-dwelling organisms, fish eggs and fry, they compete directly with young fish. They also eat aquatic plants in significant quantities, limiting nursery habitat and shelter for young and small fish. The main way rusty crayfish have spread is by accidental release into the wild – from anglers’ bait buckets and hobbyists’ aquariums.

## **SEA LAMPREY** (*Petromyzon marinus*)

The sea lamprey is a long, jawless, fish without scales that resembles an eel. They have horn-shaped teeth set in a disk-shaped mouth which they use to attach themselves to the sides of fish. They then eat away the



fishes' skin and scales to feed on its blood and body fluids. This either kills the fish or leaves them with serious wounds that are susceptible to parasites and disease. Originating in the Atlantic ocean, sea lamprey were prevented from entering the Great Lakes by physical barriers such as waterfalls. Shipping canals built at the turn of the century allowed sea lamprey to expand their range into all of the Great Lakes.

**SPINY WATER FLEA** (*Bythotrephes longimanus*)

Spiny water fleas are tiny crustaceans (the size of your baby fingernail) with a large black eye. They are voracious predators feeding on other crustaceans, often eating two to three times more food than native species. By eating this much, they limit food for native zooplankton and fish. The spiny water flea, as its name suggests, has a long tail spine with barbs on it. The barbs make it difficult for young fish and fry to swallow – they literally cough them up – further limiting feeding opportunities for local fish. The spiny water flea can hitchhike to other waters on boats, boat trailers and other equipment such as fishing gear and snorkeling/scuba gear. They were originally brought to the Great Lakes in the ballast water of foreign ships. The **FISHHOOK WATER FLEA** (*Cercopagis pengoi*), is similar to the spiny water flea but is smaller with a loop or hook at the end of its tail. Their impact is similar.

**ZEBRA MUSSEL** (*Dreissena polymorpha*)

Zebra mussels and the related **QUAGGA MUSSEL** (*Dreissena bugensis*) are small crustaceans with a yellow, brown and cream-striped shell. Female zebra mussels produce over one million eggs each season which spread throughout water systems by floating on currents and being inadvertently transferred by people and their boats. Zebra mussels prefer warmer, shallower waters while quagga mussels can also live in colder, deeper waters, therefore inhabiting all areas of a waterbody. Both mussels eat by filtering phytoplankton (tiny plants) out of the water. Zooplankton (the primary food of young fish) also eat these plants. This competition with the mussels for food can have impacts throughout the food chain. Removal of large volumes of phytoplankton causes lake water to become clearer. This changes the lake habitat by enabling sunlight to penetrate further down and encourage weed growth and force fish like walleye to deeper and darker water. They also attach themselves to hard surfaces such as clam shells, crayfish, boat hulls, docks, buoys, etc. and can clog water pipes. They can hurt swimmers feet and infect predators with the contaminants they can carry. They were introduced to the Great Lakes by foreign ships dumping their ballast water.

**Big Stats  
and Interesting  
Facts!**

**There are over 180 different exotic species in the Great Lakes Basin!**

**Sea lamprey have long been considered a delicacy in Europe.** It is said that King Henry I of England, in a fit of royal gluttony, died from a “surfeit of lamprey”!

**The round goby has a well-developed sensory system** that helps them detect water movement. This allows them to feed in complete darkness, giving them an advantage over other fish!

**The Eurasian ruffe’s ability to “see” its prey is not through its eyesight** but rather through a sophisticated system of bone canals that contain sensory organs called “neuromasts”. These neuromasts can detect vibrations from both prey and predators. This ability allows the ruffe to seek darker waters, thus avoiding predators.

**There are some lakes where the rusty crayfish is so prolific that they cover the bottom of the beach.** Being very aggressive, they will hold their claws up in such a menacing way that swimmers are afraid to swim for fear of stepping on them and getting pinched!

**It’s costing millions of dollars a year to try to control invasive species** and repair the damage they have caused to Ontario habitats!

# How Do They Get Here?

Aquatic invasive species can spread readily... we're the one's who inadvertently help them! Below are the main ways these wily critters currently make their way into the aquatic habitats of Ontario:

## 1. AQUARIUMS AND WATER GARDENS

We love the tranquil beauty of our aquariums and water gardens. Unfortunately, many of the aquatic plants and animals that are promoted and for sale in many pet stores, garden centres and nurseries are not native to our area and some have the potential to become seriously invasive aquatic weeds, invertebrates and fish. Aquarium owners may feel they are doing the right thing for their pets by releasing them back to nature and water gardeners may not realize that their contained gardens are not so contained. If invasive species get into the wild, they can do severe damage to habitats, our economy and maybe even our health.

## 2. GONE FISHING.

Fishing is a popular pastime that allows many kids and families to enjoy Ontario's sparkling lakes and rivers. It is a common and accepted practice for anglers to use *livebait* like minnows and crayfish when they are fishing. Unfortunately, many people don't realize that releasing this bait when they are finished fishing to a new waterbody is illegal and a way of introducing new and potentially harmful species to those habitats. Invasive species in the bait bucket can wreak havoc on our lakes and rivers. These new species may: compete with native species for food and space; feed on the eggs and young of native fish; and, occasionally, carry and spread disease. Not only does this affect habitats but it can also harm local livelihoods and recreation.

Examples of invasives potentially in bait that are harmful if released alive are: rusty crayfish, European ruffe, rudd and round goby. Invertebrate species such as zebra mussel veligers and the spiny and fishhook water flea or their eggs may be in bait bucket water and could also spread if released from one water body to another.

## 3. BOATING FOR FUN

Invasive species are cunning hitchhikers, finding their way into Ontario waters by clinging to commercial and recreational boats or by hiding out in the water contained in watercraft. Boaters then, must be very wary, cleaning and inspecting their boats before moving them from water body to water body. Boats have been a major mode of transportation for: zebra mussels, the spiny and fishhook water flea, and plants such as European frog bit and Eurasian water milfoil. As well as boats, invasive species can attach themselves to propellers, trailers and other boating gear and equipment or be contained in the water in live wells, the bilge or the motor.

## 4. THE MARKETPLACE

We love our food and as a result, there is a growing culinary interest in buying live fish from the market. This is great but we need to exercise caution! Some exotic food species are aggressively invasive and if released into Ontario's aquatic habitats, they can take over food and space from other species and generally have few natural enemies.

Invasive species were brought to Ontario through human activity. We now need human activity to help solve this harmful problem. It's a big task that requires us all to pitch in!

## Make waves!

### Everyone can help keep our aquatic habitats healthy!

# Actions to Stop Species Invasion!

Invasive species pose enormous threats to our aquatic ecosystems. Fortunately, the actions we can take to prevent these invaders are simple:

## AQUARIUM CARE-IUM

**Responsible aquarium owners and habitat stewards will:**

- Never release or flush aquatic plants or fish into a lake, river, pond, stream, drainage ditch or sewer.
- Return or donate unwanted aquarium animals and plants to local pet stores, school groups, or community centres.
- Find out about the Fish Rescue Programs that can help you find a home for your unwanted pet by contacting the Invading Species Hotline toll-free at 1-800-563-7711 or visit [www.invadingspecies.com](http://www.invadingspecies.com)

**Aquarium owner's motto: Aquarium in! Nothing out!**

## GARDENERS OF THE DEEP

**Responsible owners of water gardens and habitat stewards will:**

- Dispose of unwanted and invasive plants by drying them completely and discarding them in household garbage. Don't compost them because some seeds can withstand drying and freezing.
- Consider using native aquatic plants and animals in your garden found at your local nursery. Ask to be sure that their native range includes your region. Never collect native plants from the wild.
- Select a site for your water garden as far away as possible from natural waterways and any areas subject to flooding.
- Remove potential "hitchhikers" from your purchases by rinsing in a light coloured bucket until free of soil.

**Water gardener's motto: Grow Native! Not Invasive!**

## FISHING CREDO

Responsible anglers and habitat stewards will:

- Never empty bait buckets into the water. It is illegal to release live fish from one body of water into another.
- Always put unwanted bait in the garbage or on dry land.
- Keep unused bait for future use by freezing or salting it.
- Never use round goby (See *Cottage County's Most Wanted Blackline Master – The Bait Bandit*) as bait! It's illegal!

**Angler's motto: Live bait doesn't get a break to escape!**

## AHOY THERE, BOATER!

Responsible boaters and habitat stewards will:

- Inspect their boats, trailer and equipment before leaving any body of water, removing any plants, mud and animals that they see.
- Drain water from their boat including the live well, bilge, and motor while still at the lake or river they have just enjoyed.
- Wash their boat and gear with hot water or high-pressure water (like a garden hose spray) or dry it out in the sun for at least 5 days before moving it to another body of water.

**Boating enthusiasts motto: A loved boat is a scrubbed boat.**

## AT THE MARKET

Responsible chefs and habitat stewards will:

- Refuse to buy or sell specific species of live carp (grass, big head, silver or black) or snakeheads (a vicious type of fish!) since this is illegal!
- Never release fish or other animals bought at the market into the wild.

**Food lover's motto: Just say no to live carp and snakeheads!**

It's as  
simple as  
1,2,3!

1. Learn how to stop invasive species and help habitats stay healthy!
2. Help out more by teaching others!
3. Enjoy and protect our beautiful Ontario waters!

# Invasive Species Teaching Resources

## CURRICULA

### Community Stewardship Projects on Exotic Aquatic Species

Booklet of activities and community stewardship projects developed by students as part of Sea Grant's "Exotic Aquatics on the Move" education project. To download the booklet, please visit...

<http://www.iisgcp.org/edu/cr/index.html>.

*Produced by the Illinois-Indiana Sea Grant Program. 2001.*

**Contact:** Valerie Eichman, IL-IN Sea Grant [eichman@uiuc.edu] [217/333-8055] or Doug Jensen, MN Sea Grant [djensen1@d.umn.edu] [218/726-8712]

**Cost:** Single hard copies available free of charge

### EATM: Exotic Aquatics on the Move

CD: "Building a Web of Awareness for Geography Educators and Students." Twenty-seven lessons on aquatic invasive species available as printable PDF files and in alignment with the National Geography Education Standards. Visit... <http://www.iisgcp.org/EXOTICSP/>.

*Produced by six Sea Grant Programs (IL-IN, LA, MN, NY, OH, and WA) and six Geographic Education Alliances (IL, IN, LA, MI, NY, and WA). 2001.*

**Contact:** Robin Goettel, IL-IN Sea Grant [goettel@uiuc.edu] [217/333-4780] or Doug Jensen, MN Sea Grant [djensen1@d.umn.edu] [218/726-8712]

**Cost:** \$2.50

### ESCAPE: Exotic Species Compendium of Activities to Protect the Ecosystem

An extensive collection on AIS for K-12 students! The compendium includes 36 hands-on, multidisciplinary activities, as well as game boards, zebra mussel shells, posters, music, an educational video, and more. To view lesson plans, please visit... <http://www.iisgcp.org/edu/escape/index.html>.

*Produced by the Illinois-Indiana Sea Grant Program in partnership with the Michigan, Minnesota, New York, and Ohio Sea Grant Programs. 2001.*

**Contact:** Valerie Eichman, IL-IN Sea Grant [eichman@uiuc.edu] [217/244-8809] or Doug Jensen, MN Sea Grant [djensen1@d.umn.edu] [218/726-8712]

**Cost:** \$58 (plus shipping)

### Exploring Science Writing: An Environmental Focus

Eighteen exercises engage high school students in writing clearly about ecosystem issues and in understanding science-based stories. Enhances science, language arts, and interdisciplinary curricula. For further explanation, please visit... <http://www.seagrants.umn.edu/seiche/apr.99/art11.html>.

*Produced by the Michigan Sea Grant Program in collaboration with the University of Rhode Island Journalism Department. 1998.*

**Contact:** Mike Klepinger, MI Sea Grant [klep@msu.edu] [517/353-5508] or Doug Jensen, MN Sea Grant [djensen1@d.umn.edu] [218/726-8712]

**Cost:** \$6

### Native Species, Nature's Choice

A 24-page curriculum unit informs young Canadians about the nature of invasive species, how they are introduced and spread, their impacts on native species and spaces, and how to protect our natural riches in the face of this threat. This unit uses inquiry-based lesson plans focusing on alien species for Grades 4-12 available in both French and English. To download this free unit, please visit... [www.wildeducation.org/programs/nww2003/nww2003booklet\\_e.pdf](http://www.wildeducation.org/programs/nww2003/nww2003booklet_e.pdf). Also available is *Battle with the Alien Space Invaders*, an on-line game that introduces the threats of invasive species and how to solve the problem

through the restoration cycle. Please visit...  
[www.wildeducation.org/maze\\_invasives/battle\\_mazec.htm](http://www.wildeducation.org/maze_invasives/battle_mazec.htm)

*Produced by the Canadian Wildlife Federation (CWF)*

**Contact:** Canadian Wildlife Federation  
[info@cwf-fcf.org]

**Cost:** Free

### **Nonindigenous Species Activities for Youth**

Activities and lesson plans focusing on aquatic and terrestrial nonindigenous species may be downloaded at no cost. Please visit...

<http://msucare.com/pubs/publications/p2286.pdf>

*Produced by the Mississippi Sea Grant Advisory Service, Mississippi State University, and the Mississippi Cooperative Extension Service. 1997.*

**Contact:** MS-AL Sea Grant [228/818-8836]

**Cost:** Free

### **Purple Loosestrife Project**

Learning activities focus on wetland stewardship, habitat protection, and biological control. Curricula are divided into ten sections and may be downloaded at no cost. Please visit... <http://www.miseagrant.umich.edu/pp/activities.html>.

To find out more about the project and ways to get involved, visit the "purple pages" at...

<http://www.miseagrant.umich.edu/pp/index.html>.

*Produced by Michigan State University in collaboration with the Michigan Sea Grant Program. 1997.*

**Contact:** Mike Klepinger, MI Sea Grant  
[klep@msu.edu] [517/353-5508]

**Cost:** Free

### **SEE CELLA CHOW! A Purple Loosestrife Biological Control Manual for Teachers**

Fifteen activities focus on wetland ecology and invasive species. Lessons emphasize biocontrol efforts, including the development, rearing, and release of beetles to combat purple loosestrife. The activity set provides teachers with background information, links to state standards, and activity instructions. For updates on cost and to view

related Web pages, please visit... <http://www.wiscwetlands.org/cella.htm> or to download please visit... [http://www.dnr.state.wi.us/org/es/science/publications/ss981\\_2003.htm#document](http://www.dnr.state.wi.us/org/es/science/publications/ss981_2003.htm#document)

*Produced by the Wisconsin Department of Natural Resources, the Wisconsin Wetland Association and Wisconsin Teachers. 2003.*

**Contact:** Derek Strohl, WI Wetland Assoc.  
[derek@wiscwetlands.org] [608/250-9771] or Brock Woods, WI DNR [Brock.Woods@dnr.state.wi.us] [608/221-6349]

**Cost:** Determined at publication time

### **Traveling Trunk Adventure: Exotic Aquatics**

Get up close and personal with exotic plants and animals! Trunk includes interdisciplinary lesson plans, preserved specimens, stories, identification guides, lesson plans, and a video that uses the 'Bill Nye the Science Guy' approach to learning. Designed for audiences ages 9-adult. Trunk assists educators in providing intensified studies of exotic species. To learn more, visit... <http://www.seagrant.umn.edu/education/ttindex.html>.

*Developed by the Minnesota Sea Grant Program in collaboration with the Illinois-Indiana Sea Grant Program. 1996.*

**Contact:** Doug Jensen, MN Sea Grant  
[djensen1@d.umn.edu] [218/726-8712]

**Cost:** \$35 / 10-day rental (costs vary depending on shipping)

### **Traveling Trunk Adventure: Zebra Mussel Mania**

Tune into zebra mussels and other exotic species with this award-winning science kit and curriculum. The trunk, geared towards learners ages 9-14, includes ten lesson plans which incorporate experiments, games, stories, and other hands-on activities. Lessons meet the science education standards. To learn more, visit... <http://www.invadingspecies.com/Library.cfm> in Canada and visit... <http://www.seagrant.umn.edu/education/ttindex.html> in the U.S.

*Developed by the Illinois-Indiana Sea Grant Program in collaboration with the Minnesota Sea*

*Grant Program. 1994.*

**Contact:** Invading Species Awareness Program [[invading\\_species@ofag.org](mailto:invading_species@ofag.org)] [1-800-563-7711] in Canada and Robin Goettel, IL-IN Sea Grant [[goettel@uiuc.edu](mailto:goettel@uiuc.edu)] [217/333-4780] in the U.S.  
**Cost:** \$30 for a three week rental plus shipping in Canada and \$25 rental in the U.S. (costs vary depending on shipping)

## POSTERS and PRINT MATERIALS

### A Sampling of Invasive Species

The Invading Species Awareness Program, a partnership program between the Ontario Federation of Anglers and Hunters and the Ontario Ministry of Natural Resources provides free outreach materials that include posters, stickers, magnets, watch cards, factsheets and brochures explaining the aquatic invasive species of concern in Ontario and the Great Lakes, pathways of introduction and impacts. Please visit... <http://www.invadingspecies.com/Library.cfm> to view and order on-line.

*Produced by the Invading Species Awareness Program, a partnership of the Ontario Federation of Anglers and Hunters and the Ontario Ministry of Natural Resources.*

**Contact:** The Invading Species Hotline [1-800-563-7711] [[invading\\_species@ofah.org](mailto:invading_species@ofah.org)]

**Cost:** Free

### Aliens Among Us

Ohio Department of Natural Resource's colorful poster visually explores aquatic and wetland invasive plants and animals. Graphics include fish, mollusks, and plants, as well as ways to prevent their spread.

*Produced by Ohio DNR's Division of Wildlife in collaboration with the Division of Natural Areas & Preserves and the U.S. Fish & Wildlife Service. 2002.*

**Contact:** Jennifer Windus, ODNR [[Jennifer.Windus@dnr.state.oh.us](mailto:Jennifer.Windus@dnr.state.oh.us)] [614/265-6468]

**Cost:** Single copies available free of charge

### America's Least Wanted: Alien Species Invasions of U.S. Ecosystems

Booklet includes a "Dirty Dozen" gallery of twelve of our nation's most damaging invasive species. Publication focuses on the harm they bring to "Hard-Hit Ecosystems."

*Produced by The Nature Conservancy. 1996.*

**Contact:** The Nature Conservancy [[invasivespecies@tnc.org](mailto:invasivespecies@tnc.org)] [703/841-5300]

**Cost:** Available at <http://www.conserveonline.org/2001/06/s/amleast>

### America's Most Unwanted

Poster features educational graphics regarding the U.S.'s "most unwanted" invasive species. Information on the bottom of the poster can be copied for classroom use. For information and to access additional materials, visit NOAA at...

<http://www.education.noaa.gov/>.

*Produced by the National Oceanic and Atmospheric Administration National Sea Grant Program Office in collaboration with Minnesota Sea Grant. 2001.*

**Contact:** Doug Jensen, MN Sea Grant [[djensen1@d.umn.edu](mailto:djensen1@d.umn.edu)] [218/726-8712]

**Cost:** \$5

### AIS Watch Cards

Wallet-sized cards popular amongst boaters. Eurasian watermilfoil, ruffe, round goby, rusty crayfish, spiny waterflea, fishhook waterflea, European frogbit, zebra mussel, and purple loosestrife cards identify species' characteristics, problems posed, means of spread, and "what you can do" to prevent and slow their spread. To view and order watch cards, please visit... <http://www.invadingspecies.com/Library.cfm> in Canada or <http://www.seagrant.umn.edu/exotics/zmid.html> in the U.S.  
*Produced by the Great Lakes Sea Grant Network and U.S. Fish and Wildlife Service. 1998.*

**Contact:** Ontario Federation of Anglers and Hunters at 1-800-563-7711 or MN Sea Grant [218/726-6191] or another Great Lakes Sea Grant Network Office.

**Cost:** Copies available free of charge

## Biological Invasions

This fold-out booklet examines how aquatic invasive species enter North American waters, resulting harm, and what can be done to help solve the problems. Booklet includes pictures, graphs, distribution maps, and informative text. Provides an excellent overview of problems associated with aquatic invasive species nationwide.

*Produced by the Great Lakes Panel on Aquatic Invasive Species. 1998.*

**Contact:** Great Lakes Commission [734/971-9135] or Minnesota Sea Grant [218/726-6191].

**Cost:** Single copies available free of charge

## Bio-Invasions: Breaching Natural Barriers

Booklet (20 pp.) explains in simple, clear terms the threat of non-native aquatic species and potential impacts on the economy and on the environment. Booklet is specific to west coast invasions. Booklet is available at... <http://www.wsg.washington.edu/pubs/bioinvasions/bioinvasionsindex.html>.

*Produced by the University of Washington Sea Grant Program. 1998.*

**Contact:** Andrea Copping, WA Sea Grant [acoppin@u.washington.edu] [206/685-8209]

**Cost:** Free

## A Field Guide to Aquatic Exotic Plants and Animals

Learn how to identify species in the Great Lakes region by way of this popular, informative brochure filled with colorful pictures and illustrations. Brochure shares the history behind species' invasions, species' biology, and species' likely means of spread. Guide dedicates panel pages to round goby, sea lamprey, rusty crayfish, white perch, flowering rush, and curly-leaf pondweed. Visit... <http://www.seagrants.mn.edu/exotics/fieldguide.html>.

*Produced by the Minnesota Department of Natural Resources. 1995.*

**Contact:** MN Sea Grant [218/726-6191]

**Cost:** Single copies available free of charge

## Hitchhikers: Guide to Exotic Species

Waterproof guide to 14 introduced marine species, as well as information on a few native species found along the New England coast. For further explanation and other resources, visit... <http://massbay.mit.edu/exoticspecies/hitchhikers/index.html>.

*Produced by the MIT Sea Grant Program. 2002.*

**Contact:** MIT Sea Grant [617/253-7041]

**Cost:** Single copies available free of charge

## Marine Education: A Bibliography of Educational Materials

Resource materials include educational materials on a variety of aquatic topics. The bibliography includes books, reports, videos, and brochures available from the Nation's Sea Grant College Programs. Please visit... <http://nsgd.gso.uri.edu/edu.html> to view the full list.

*Produced by the Texas A&M Sea Grant Program. 1997.*

**Contact:** State Sea Grant Program

**Cost:** \$2

## Photo-Mural: Invasive Non-Native Plants

Large, laminated photo-mural of 37 invasive non-native plants found in the U.S. Plants are depicted in attractive color photographs. To view, visit... <http://aquat1.ifas.ufl.edu/>.

*Produced by the Center for Aquatic and Invasive Plants, University of Florida, Bureau of Invasive Plant Management, the Florida Department of Environmental Protection, Sea Grant, and Cerexagri. 2001.*

**Contact:** APIRS Photo-Mural, Center for Aquatic and Invasive Plants, 7922 NW 71 St, Gainesville, FL 32653

**Cost:** Free (requests in writing – limited copies available)



### Stop Aquatic Hitchhikers!

Sticker lists four easy steps boaters and anglers can take before and after using their watercraft. To view, visit... <http://www.protectyourwaters.net>.

*Produced by the ANS Task Forces' Communication, Outreach and Prevention Committee's National ANS Outreach Campaign. 2002.*

**Contact:** MN Sea Grant [218/726-6191]

**Cost:** Single copies available free of charge

### Wild Cards

Wisconsin Department of Natural Resources has developed a series of identification cards for a variety of native and non-native plants and animals found in Wisconsin, including nine aquatic invaders. Designed for children, the cards include photos and descriptions, as well as how invaders pose problems and why native species are beneficial.

*Produced by the Wisconsin Department of Natural Resources. 2002.*

**Contact:** Ron Martin, WI DNR

[martir@dnr.state.wi.us] [608/266-9270]

**Cost:** Single cards available free of charge

## VIDEOS and DVDs

### Invaders in Our Waters

A comprehensive DVD package that includes: a 7 minute overview of the impacts of aquatic invasive species with a focus on the pathways of how they can be introduced; six-two minute and four-30 second PSA messages focusing on each pathway of concern; and a list of resource materials available free from the Invading Species Awareness Program.

*Produced by the Invading Species Awareness Program, a joint partnership of the Ontario Federation of Anglers and Hunters and the Ontario Ministry of Natural Resources in conjunction with the Ontario Ministry of Agriculture, Food and Rural Affairs.*

**Contact:** Invading Species Hotline [1-800-563-7711] [invading\_species@ofah.org]

**Cost:** Free

### Alien Ocean

Zebra mussels from the Black Sea. Green crabs from the Baltic Sea. How did they get here and what impacts do they have on our waters? Alien Ocean tells the dramatic story of scallop fishermen, cargo ship captains, pilots and the scientists who are pioneering a new field called "invasion ecology." *Produced by the Maryland Sea Grant Program. 1998.*

**Contact:** MD Sea Grant [mdsg@mdsg.umd.edu] [301/403-4220]

**Cost:** \$24.95

### Aquatic Invaders

"Cutting Edge Technology Report" shares the threats and challenges aquatic invaders have on our nation's ecosystems. Provides an overview of the problem, including highlighted segments on Chinese mitten crabs, European green crabs, zebra mussels, and sea lampreys.

*Produced by the Information Television Network. 2000.*

**Contact:** Doug Jensen, MN Sea Grant

[djensen1@d.umn.edu] [218/726-8712]

**Cost:** \$5

### Aquatic Exotics

Video takes a 'Bill Nye the Science Guy' approach to aquatic invasive species. This 22-minute video, designed for elementary and middle school students, is in the Exotic Aquatics Traveling Trunk. To view video clip, visit... <http://www.sgnis.org/av/video/aquatic.htm>.

*Produced by the Minnesota Department of Natural Resources. 1995.*

**Contact:** MN DNR: Publications Dept.

[ecoservices@dnr.state.mn.us] [651/296-2835]

**Cost:** Free to school libraries; \$10 for additional copies.

### STOP EXOTICS: Clean Your Boat

Eleven-minute video featuring John Ratzenberger ("Cliff" from TV show, *Cheers*). The video explores steps boaters, sailors and personal watercraft users

can take in order to prevent the spread of exotic plants and animals. For more information, please visit... <http://www.seagrants.mn.edu/exotics/stop.html>.

*Produced by the Minnesota Sea Grant Program. 2000.*

**Contact:** Doug Jensen, MN Sea Grant  
[djensen1@d.umn.edu] [218/726-8712]

**Cost:** \$10

### **You Ought To Tell Somebody! Dealing with Aquatic Invasive Species**

Twenty-three minute video provides an overview on aquatic invasive species, as well as the identification and natural history behind one significant new threat, the Chinese mitten crab. Visit... <http://seagrants.oregonstate.edu/sgpubs/multimedia.html>.

*Produced by the Oregon Sea Grant Program. 2001.*

**Contact:** Paul Heimowitz, OR Sea Grant  
[paul.heimowitz@orst.edu] [503/722-6718]

**Cost:** \$18.95 + 3.95 (postage)

### **Zebra Mussels: Lessons Learned in the Great Lakes Region**

Control, Biology, Spread and Impact, and Outreach Tools Set of four videos may be purchased together or individually. Control takes a look at the comprehensive monitoring and control techniques for industrial and municipal facilities. Biology provides an overview of the basic biology, including physical characteristics, life cycle, and reproductive behavior. Spread and Impact explores the zebra mussel's spread and distribution, as well as the resulting ecological and social impacts in the Great Lakes. Outreach Tools explores educational resource materials developed by Sea Grant, suitable for the classroom. To view video clips, visit... <http://www.iisgcp.org/EXOTICSP/NMEA/zmlesson.htm>.

*Produced by the Illinois-Indiana Sea Grant Program in collaboration with the Purdue University Ag Comm Service. 1998.*

**Contact:** IL-IN Sea Grant, Administration [217/333-6444] or Outreach [765/494-3573]

**Cost:** \$20 for video set or \$7.50 each

## **BOOKS and CDs**

### **Alien Invaders: The Continuing Threat of Exotic Species**

Book for youth, grades 6-12. Specific cases, plentiful photos, and boxed insets highlight particularly interesting stories involving non-indigenous species' introductions. The book was selected a "Best Book for the Teen Age" by the New York Public Library. Visit...

<http://www.author-illustr-source.com/sneedbcollard.htm#Published%20Books>.

*Published by Franklin Watts. 1996.*

**Contact:** Sneed B. Collard, III, Author  
[collard@bigsky.net]

**Cost:** \$15

### **Exotics To Go! Presentations and Publications to Prevent the Spread of Aquatic Invasive Species**

Compact disc includes seven "conveniently wrapped" PowerPoint presentations on aquatic invasive species, loaded with images of problem species, fact sheets, brochures, and pamphlets. Presentations and documents designed to give general audience a greater understanding of the impacts of AIS. To order, visit... <http://www.seagrants.mn.edu/exotics/exoticstogo.html>.

*Produced by the Minnesota and Illinois-Indiana Sea Grant Programs. 2001.*

**Contact:** MN Sea Grant [218/726-6191]

**Cost:** \$2.50

### **Oh No! Hannah's Swamp is Changing**

An illustrated children's book for grades K-4 identifying what nonindigenous species are, the effects they have on ecosystems, and what can be done to stem the tide. Written by LA Sea Grant's Marilyn Barrett-O'Leary and illustrated by Catherine Kiffe, a local artist and teacher, the book also includes a poster and several activities for young students. *Produced by the Louisiana Sea Grant Program. 2002.*

**Contact:** Marilyn Barrett-O'Leary, LA Sea Grant  
[moleary@lsu.edu] [225/578-6349]

### **SGNIS (Sea Grant Nonindigenous Species)**

Compact disc contains a collection of educational materials and peer-reviewed research publications produced by the National Sea Grant College Programs. To view contents, visit SGNIS's home-page at... <http://www.sgnis.org>.

*Produced by Minnesota Sea Grant on behalf of the Great Lakes Sea Grant Network. 2001.*

**Contact:** MN Sea Grant [218/726-6191]

**Cost:** \$8

### **Think About the Planet**

A musical CD by *Remy Rodden* that includes a song about invasive species titled "The Invadin' Alien Blues". Please visit... [www.thinkabout.ca/](http://www.thinkabout.ca/)

*Produced by Think About...Productions.*

**Contact:** Remy Rodden [1-867-668-7953] or Canadian Wildlife Federation [1-800-563-9453]

**Cost:** \$20 CD and \$17 cassette, S&H and taxes included

### **Visualizing the Great Lakes**

Compact disc contains 500 high-quality images gathered from 30 Great Lakes' agencies. A great tool to assist in the development of publications and PowerPoint presentations. Visit... <http://www.seagrant.umn.edu/pubs.vgl/index.html>

*Produced by the Minnesota Sea Grant Program and the U.S. Environmental Protection Agency's Great Lakes National Program Office. 1998.*

**Contact:** MN Sea Grant [218/726-6191]

**Cost:** \$12

## **WEB SITES**

The following Web sites include general information on aquatic invasive species, AIS. Sites offer photos, descriptions, and maps; as well as information on the impacts invasive species have on food webs and ecosystems.

### **[www.invadingspecies.com](http://www.invadingspecies.com)**

Invading Species Awareness Program: This site, representing a partnership program of the *Ontario*

*Federation of Anglers and Hunters* and the *Ontario Ministry of Natural Resources*, has detailed information of aquatic invasive species found in Ontario. In addition, it provides many activities that enable citizens to participate in the prevention of invasive species spread and to assist in control efforts.

### **[www.mnr.gov.on.ca/MNR/fishing/threat.html](http://www.mnr.gov.on.ca/MNR/fishing/threat.html)**

Ontario Ministry of Natural Resources: This site contains brief summaries of the invasive species found in Ontario, including their characteristics, where they have been spotted and what to do to prevent their spread.

### **<http://www.cwf-fcf.org/>**

Canadian Wildlife Federation: A bilingual site that includes a section on invasive species and houses "The Invasive Species in Canada database" which describes the species that are considered invasive in Canada, where they're from, where they're found, how they're introduced and their ecological impacts. Includes several educational programs and resources for educators and students.

### **<http://www.protectyourwaters.net>**

Protect Your Waters is designed for anyone who enjoys spending time on the water. The Web site, based on a national media campaign, includes procedures and tips for boaters and personal watercraft users to assist in preventing the spread of aquatic exotic species. The frequently updated site includes ways to "Become Informed and Take Action."

### **<http://www.sgnis.org/>**

Sea Grant Nonindigenous Species: An educator's information/resource guide. Information center contains collection of resources produced by Sea Grant and other institutions. Includes informative Kid's Page displaying 3-D images of prominent aquatic invasive species.

**<http://nas.er.usgs.gov>**

US Geological Survey: Nonindigenous aquatic species. Information resource pages include updated distribution maps identifying locations and spread of aquatic invasive species by region, as well as species' facts, images, biology and updated status reports.

**<http://www.seagrant.umn.edu>**

University of Minnesota Sea Grant College Program. Invasive species pages include updated information on zebra mussels, round goby, ruffe and other aquatic invasive species affecting the Great Lakes region. Contains links to many prominent AIS Web sites.

**<http://www.greatlakesseagrant.org/>**

Great Lakes Sea Grant Network. A network of Sea Grant programs working in partnership with government and private sectors. Site includes general information on aquatic invasive species, as well as links to additional, helpful sites.

**<http://www.glifwc.org/epicenter/>**

Great Lakes Indian Fish and Wildlife Commission. Emphases on invasive plants and ecological impacts on the Great Lakes... interactive maps, slide library, educational materials and more.

**<http://nature.org/initiatives/invasivespecies/>**

The Nature Conservancy identifies invasive species as one of the most critical conservation issues today. Web site includes photos, graphs, and downloadable documents relating to invasive species, ecosystems, and habitat loss.

The following Web sites offer in-depth, detailed information on aquatic invasive species. Sites include technical reports, newspaper and journal articles, and access to photo, video, and slide libraries.

**[http://www.cce.cornell.edu/aquaticinvaders/nan\\_ld.cfm](http://www.cce.cornell.edu/aquaticinvaders/nan_ld.cfm)**

National Aquatic Nuisance Species Clearinghouse. Searchable Web site houses a library of research, public policy, and outreach education publications pertaining to invasive marine and freshwater aquatic invasive species. Technical publications deal with the impacts, biology, spread and control of AIS.

**<http://www.anstaskforce.gov/>**

Aquatic Nuisance Species Task Force. An inter-governmental organization dedicated to the prevention and control of AIS. Established through U.S. Congress's Nonindigenous Aquatic Nuisance Control and Prevention Act of 1990.

**<http://www.nsgd.gso.uri.edu/>**

A Marine, Coastal, and Great Lakes information resource site and lending library for Sea Grant funded, developed, and published documents.

**<http://www.great-lakes.net>**

Great Lakes Information Network (GLIN). Current information from newspaper and journal articles, scientific papers, conferences, press releases and education curricula. Includes an education and curriculum page for students and teachers.

The following Web sites include lessons and games on invasive species, as well as access to educational water-related Web sites. Sites may prove useful for educators integrating aquatic invasive species education into broader curricular units.

**[www.wildeducation.org/programs/wld\\_prog.asp](http://www.wildeducation.org/programs/wld_prog.asp)**

Fishways / Project Wild / Focus on Forests / Below Zero: Interactive games, activities and lesson plans

educating children on the importance of healthy habitats and ecosystems from the Canadian Wildlife Federation. *Fishways* contains lesson plans that teach about fish and Ontario's aquatic habitats. This website also provides access to the curricular programs: Project Wild, Focus on Forests and Below Zero.

**[http://www.nps.gov/piro/wl\\_lesns.htm](http://www.nps.gov/piro/wl_lesns.htm)**

The National Park Service. A compilation of games and activities set up to assist educators teaching about plant and wildlife management. Includes "The Deadly Plant Invaders Game" – an active lesson engaging students in learning about the effects of invasive species.

**<http://www.vims.edu/bridge/>**

The Bridge: Ocean sciences education teacher resource site. Includes links to interactive activities for all ages as well as updated information on water studies. A unique clearinghouse to some of the best K-12 science education sites available online.

**<http://www.iisgcp.org/EXOTICSP/index.html>**

Exotic Aquatics on the Move: developed by National Sea Grant and Geographic Education Alliance. Site offers general invasive species information, as well as case studies on a wide array of species. Also features links and access to instructional materials.

**[www.ducks.ca](http://www.ducks.ca)**

Ducks Unlimited: Project Webfoot teaches the value of wetland ecosystems and helping them take positive actions to conserve wetlands in their own communities. Download curriculum-linked resources for grades 4-12.

**[www.campsite24.ca](http://www.campsite24.ca)**

Ontario Parks—Campsite 24. This website is for both students and teachers, and brings Ontario's parks and protected areas to your home, classroom or library. Download curriculum-linked resources for grades 2-6.

# GLOSSARY

<b>Adaptations</b>	The traits and characteristics that help plant and animal species live in a particular habitat and community.
<b>Carnivores</b>	Animals that get their food energy from feeding on other animals only.
<b>Community</b>	A group of plants and animals living and interacting together in a habitat.
<b>Competition</b>	When two or more species need the same, limited resource (ex. light energy, food energy, living space, etc).
<b>Consumer</b>	A species that must consume or eat other living things to get its energy.
<b>Ecosystem</b>	The community of living things and non-living things around it (air, water, soil and rock, for example).
<b>Exotic Species</b>	A species that is not originally from a particular habitat.
<b>Food Chain</b>	The plant and animal species that make up a continuous transfer of energy. Each consumers a lower member of the food chain and in turn is preyed upon by a higher member of the food chain.
<b>Habitat</b>	A place that is home to a plant, animal or community of plants and animals.
<b>Herbivores</b>	Animals that get their food energy from feeding on plants only.
<b>Invasive Species</b>	Species that did not originate in the particular habitat it is now residing in. These species have special adaptations that make them very successful in their new habitat and community at the expense of other, native, plants and animals or our economy or society.
<b>Native Species</b>	An animal or plant species that is originally from a particular habitat.
<b>Omnivores</b>	Animals that get their food energy from feeding on both plants and other animals.
<b>Parasite</b>	A species that grows, feeds, and is sheltered on or in a different species while not helping it to survive.
<b>Photosynthesis</b>	The process in which green plants create food energy (sugar) from air (carbon dioxide) and water using the energy from light.
<b>Predator</b>	Animals that hunt other animals for food.
<b>Prey</b>	Animals that are hunted by predators for food.
<b>Producers</b>	Species that produce their own food through photosynthesis; plants are producers.
<b>Species</b>	Types of plants and animals.
<b>Stewardship</b>	Taking care of our habitats; making responsible choices and taking action to ensure they remain healthy for the species that live within them.
<b>Wetlands</b>	A wet, lowland habitat, such as a marsh or swamp.