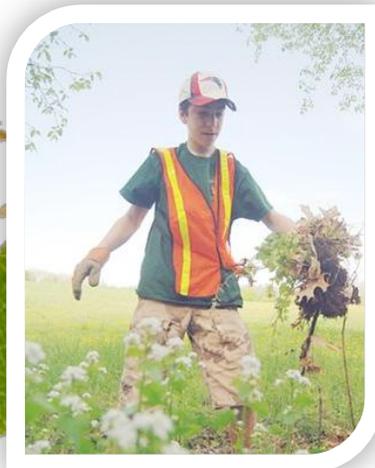


Invasive Species



A Resource for Grade 7

Acknowledgements

Writers:

Becky Parker, OCT — Project Development Coordinator, Ontario Agri-Food Education Inc.
Katelyn McEachren, OCT — Outreach Coordinator, Ontario Agri-Food Education Inc.

Contributors:

Ontario Invasive Plant Council Communications Committee
BEAN 2012 Board Members

Editor:

Jan Robertson — Marketing & Communications Manager, Ontario Agri-Food Education Inc.

This resource was made possible thanks to the Biodiversity Education and Awareness Network in partnership with Ontario Invasive Plant Council and Ontario Agri-Food Education Inc.

Copyright © 2012

Teachers are granted permission to photocopy activities and information from the document for classroom use only. Reproduction for other than classroom use, in any format, requires written permission from Ontario Agri-Food Education Inc. and Biodiversity Education and Awareness Network.

Ontario Agri-Food Education Inc.
www.oafe.org
Registered Charitable # 13237 2285 RR0001

Biodiversity Education and Awareness Network
www.biodiversityeducation.ca

Cover photo credits

www.gertens.com, www.wickedlocal.com, www.bonniesplants.com, www.naturepedic.com, www.life123.com



About Us

Ontario Agri-Food Education Inc. (OAFE) is a registered charity incorporated under the Agricultural and Horticultural Organizations Act of the Ontario Ministry of Agriculture, Food and Rural Affairs. OAFE was created in 1991 with the mission of building awareness and understanding of the importance of an agriculture and food system. The Ontario Ministry of Agriculture, Food and Rural Affairs provides baseline funding in support of OAFE's programs and services. www.oafe.org

The Biodiversity Education and Awareness Network (BEAN) is a collaboration of education, industry, government and nongovernmental organizations and agencies dedicated to increasing awareness, understanding and action related to biodiversity in Ontario. www.biodiversityeducation.ca

The Ontario Invasive Plant Council (OIPC) is a non-profit, multi-agency organization founded in April 2007 by a group of individuals and organizational representatives who saw the need for a coordinated provincial response to the growing threat of invasive plants. The OIPC contracts its business office support from one of the OIPC Board member organizations, the Ontario Federation of Anglers and Hunters. OIPC provides leadership, expertise and a forum to engage and empower Ontarians to take action on invasive plant issues. www.ontarioinvasiveplants.ca

Background

Agriculture encompasses more than food and fibre production. It is an umbrella topic, under which teachers can discuss healthy eating, the environment and biodiversity with their students. OAFE developed this resource to encourage students to explore Ontario's invasive plant and insect species, the negative impacts associated with many of them and ways they can create awareness and take action against their introduction and spread in Ontario.

According to the Canadian Food Inspection Agency (2010), invasive species can negatively impact Canada's domestic crop production, foreign market access, human health, land use and value, biodiversity and recreational opportunities. The estimated costs associated with their control are in the billions. Organizations like the Ontario Invasive Plant Council and Ministry of Natural Resources work hard every day to develop awareness programs, fact sheets, tracking tools and more to battle invading species.

The focus of this resource is on those species that become harmful when introduced into new areas but it is worth talking with your students about some of the positive benefits of some invasive species. There are grass and tree species that have the ability to grow along roadways in order to prevent soil erosion and plants like *Miscanthus* that are being researched as an alternative to corn-based fuels. There isn't a person in Ontario that wouldn't characterize a pound of dark soil teeming with Earthworms as the picture of environmental health, yet it is highly unlikely that a native Ontario species would be found enriching and aerating Ontario's agricultural fields. In the urban setting, many a homeowner rues the presence of the Dandelion, though that invader was introduced as a food source by our ancestors aware of its high vitamin C content and role in combating scurvy; and in recent years Dandelion has been returning to the dinner table in salads. (Killburn, 2012)

It is important for students to gain a big picture understanding of invasive species because of the large-scale impact they have on the environment and economy. Students need to learn where to look for accurate information on this topic and to acquire a sense that they can help stop the spread of those species that have a negative impact and make a difference.

For more information on other types of invasive species including lesson plans and activities, visit any of the links provided on page 24 of this resource.



Lesson Overview

Lesson 1 – Introduction to Invasive Species: What is the impact?	P4
<ul style="list-style-type: none">- Students will examine the environmental and economic impacts that invasive plants have on their local ecosystem and agricultural crop production- Students will create a public service announcement to stress to the public the negative impacts of their chosen invasive species and ways to prevent its introduction and spread	
Lesson 2 – Ontario’s Most Unwanted Invasive Species	p6
<ul style="list-style-type: none">- Students will research a specific invasive plant species- From this research they will create a Most Unwanted Fact Sheet	
Lesson 3 – On the Hunt for Invasive Species	p8
<ul style="list-style-type: none">- Students will spend time outdoors looking for and mapping invasive species in their local area	
Lesson 4 – Agricultural Efforts against Invasive Species	p10
<ul style="list-style-type: none">- Students will examine the characteristics of invasive plants which make them a threat to native species and agricultural crops- Students will identify ways that agricultural producers work to minimize the effects of invasive species- Students will create a plan for a farm which highlights the efforts they would take to control invasive species and create an environment which assists the establishment of native species	
Lesson 5 – Case Study: Insect Invasion - Japanese Beetle	p12
<ul style="list-style-type: none">- Students will reflect on challenges facing produce farmers as a result of invasive insect species.- Students will learn about invasive species and how they affect the agricultural industry by reading and discussing the sheet: http://www.omafra.gov.on.ca/IPM/english/apples/insects/japanese-beetle.html#beginner- Students will simulate and analyze different ecological scenarios related to invasive species and protection of crops- Students will make decisions about which farming methods they would employ if they were farmers	
Appendix A – Impact Statements	p15
Appendix B – Invasive Species in Canada	p16
Appendix C – Common Ontario Invasive Species	p17
Appendix D – Public Service Announcement Rubric	p18
Appendix E – Fact Sheet Rubric	p19
Appendix F – Methods of Controlling Invasive Species	p20
Appendix G – Case Study: River Run Farm	p21
Appendix H – Action Plan Rubric	p22
Appendix I – Purple Loosestrife Fact Sheet	p23
Additional Activity Suggestions & Links	p24
Vocabulary	p25

Lesson 1 – Introduction to Invasive Species: What is the impact?

Curriculum Connections:

Science: Understanding Life Systems – Interactions in the Environment

Overall expectations:

1. assess the impacts of human activities and technologies on the environment, and evaluate ways of controlling these impacts;
2. investigate interactions within the environment, and identify factors that affect the balance between different components of an ecosystem;

Language Arts: Media Literacy

Overall expectations:

1. demonstrate an understanding of a variety of media texts;
2. identify some media forms and explain how the conventions and techniques associated with them are used to create meaning;
3. create a variety of media texts for different purposes and audiences, using appropriate forms, conventions, and techniques.

Resources/Materials:

- Appendix A: Impact Statements
- Appendix B: Invasive Species in Canada
- Appendix C: Common Ontario Invasive Species
- Appendix D: Public Service Announcement Rubric
- Chart paper and markers

Teaching/Learning Strategies:

- Share with students the list of impacts that invasive species can have on the environment, the economy and society (Appendix A). Don't share with students that these statements are about invasive species – have students speculate as to what they think the statements describe.
- Once the class has determined that these statements are referring to invasive species, ask students to share what they know about invasive species – are they familiar with any in particular? If so – create a list under the following headings – terrestrial and aquatic. Students may even be able to divide species further under headings such as insect, fungus, plant, tree, fish and mammal.
- **Assessment for learning** – *consider the answers offered by students. Adjust classroom instruction and scaffolding according to their knowledge of invasive species.*
- Cue students to be aware that each of the statements on the list are of course negative in nature. Read the first four paragraphs of *Invasive Species in Canada (Appendix B)*.
- Ask students, what are some of the ways invasive species are introduced into ecosystems? Record student ideas. Read the final paragraph of *Invasive Species in Canada (Appendix B)*.
- **Assessment for learning** – *consider the answers offered by students. Adjust classroom instruction and scaffolding according to their understanding of how invasive species negatively impact the environment, economy and society.*
- Introduce the assignment to students – create a public service announcement about an invasive species of their choice. *** (A suggested list can be found in Appendix C) ***

- Inform students that public service announcements (PSAs) are usually made for television or radio and need to be short and concise. They are created to raise awareness of an issue, change public attitude, elicit action and demonstrate what impact that action will have.
- Cue students to research the major impacts of their invasive species and ways in which they can prevent its spread.
- Encourage students to think of other forms of media that they could use to share their messages (facebook, twitter, website, etc.).
- **Assessment of learning** – use a rubric (Appendix D) to assess student knowledge and understanding.

Extension Activities:

- Students take turns reading their announcement on the morning school announcements.
- Students create a video clip using their announcement. Consider uploading to YouTube.
- Students create a radio commercial using their announcement.
- Students create a podcast to share their PSA

Lesson 2 – Ontario’s Most Unwanted Invasive Species

Curriculum Connections:

Science: Understanding Life Systems – Interactions in the Environment

Overall expectations:

1. assess the impacts of human activities and technologies on the environment, and evaluate ways of controlling these impacts;
2. investigate interactions within the environment, and identify factors that affect the balance between different components of an ecosystem;

The Arts: Visual Arts

Overall expectations:

D1. Creating and Presenting: apply the creative process (see pages 19–22) to produce art works in a variety of traditional two- and three-dimensional forms, as well as multimedia art works, that communicate feelings, ideas, and understandings, using elements, principles, and techniques of visual arts as well as current media technologies.

Resources/Materials:

- Ontario's Most Unwanted Factsheet Series (<http://www.ontarioinvasiveplants.ca/index.php/publications>)
 - [Kudzu](#)
 - [Buckthorn](#)
 - [Garlic Mustard](#)
 - [Dog Strangling Vine](#)
 - [Giant Hogweed](#)
 - [Wild Chervil](#)
- Chart paper and markers
- Appendix A: Impact Statements
- Appendix E: Fact Sheet Rubric (for each group)
- Computers
- Student Notebooks for research notes
- Chart paper and markers
- Pens/pencils

Teaching/Learning Strategies:

- Ask students what issues they think would arise from a foreign species establishing in an ecosystem – make a list on the board.
- **Assessment for learning** – *consider the answers offered by students. Adjust classroom instruction based on their prior knowledge.*
- Share with students the following statement: “According to a Canadian Food Inspection Agency report, there are over 500 invasive plant species in Canada and most of them (440) are in Ontario making Ontario home to a large number of environmental and economic issues.”
- Share with students Impact Statements (Appendix A).
- Define what impacts would be considered economical and what would be considered environmental. Are there some that would fall into both categories?

- Show students the Ontario Invasive Plant Council – Ontario’s Most Unwanted Invasive Species fact sheets. Read through one of the fact sheets and discuss with students what key information can be found on the fact sheets.
- Create a list of key components with the students as to what they think a fact sheet should include that would inform others about invasive plants and encourage action.
- **Assessment for learning** – *define success criteria with students in order to create a rubric; use Appendix E as a guideline.*
- In pairs, students choose and research an invasive plant found in Ontario. Encourage students to not only describe the physical characteristics of their plant, but also its impact on our local ecosystems and economy and how it’s spread can be prevented.
- Using a selected art medium, students prepare a visual representation of the invasive species they have selected.
- **Assessment of learning** – *use class made rubric to assess student application of knowledge and understanding.*
- Compile fact sheets into a booklet for students to refer to in Lesson 3.

Extension Activities:

- Students post their fact sheets around the school as a campaign or place them in the mailboxes of people in the school community.
- Students contact a local farming group or Regional Federation of Agriculture and ask if they can make a presentation at a meeting or hand out their fact sheets to the group.

Lesson 3 – On the Hunt for Invasive Species

Curriculum Connections:

Science: Understanding Life Systems – Interactions in the Environment

Overall expectations:

1. assess the impacts of human activities and technologies on the environment, and evaluate ways of controlling these impacts;
2. investigate interactions within the environment, and identify factors that affect the balance between different components of an ecosystem;
3. demonstrate an understanding of interactions between and among biotic and abiotic elements in the environment.

Geography: The Themes of Geographic Inquiry

Overall expectations:

- use a variety of geographic resources and tools to gather, process, and communicate geographic information;
- analyse current environmental issues or events from the perspective of one or more of the themes of geographic inquiry.

Health and Physical Education: Active Living

Overall expectations:

- A1.** participate actively and regularly in a wide variety of physical activities, and demonstrate an understanding of factors that encourage lifelong participation in physical activity;
- A3.** demonstrate responsibility for their own safety and the safety of others as they participate in physical activities.

Resources/Materials:

- [Quick Reference Guide to Invasive Plant Species](http://www.ontarioinvasiveplants.ca/files/Invasives_booklet_2.pdf)
(http://www.ontarioinvasiveplants.ca/files/Invasives_booklet_2.pdf)
 - Student made Unwanted Fact Sheets
 - Paper/student notebooks
 - Pencils
- Optional*
- Cameras (disposable or brought from home)

Teaching/Learning Strategies:

- Using the class made fact sheets and *A quick reference guide to Invasive Plants*, students take a class trip –around the school yard, local neighbourhood/wooded area or a conservation area. Review safety precautions with students. (e.g. If they find Giant Hogweed, do not touch it.)
- Provide students with a map of the area. As an extension, students could also be asked to create their own map.
- Ask students to explore the area to see if there are any invasive plants.
- Have students mark on their maps where they find any plants they believe to be invasive using their fact sheets and/or reference guide. Students can draw or take pictures of the species they find.
- Back in the classroom students should make final touches to their map to illustrate what invasive species they have found and where.

- Have students present their maps to the class.
- Encourage students to call the Invasive Species Hotline or use www.invasivetrackingsystem.ca to report any sightings.
- **Assessment of learning** – *mark student maps for understanding and application of knowledge.*

Extension Activities:

- Research, purchase and plant native species in school flower beds and on school grounds using the following reference.
Grow Me Instead Guide
http://www.ontarioinvasiveplants.ca/files/GMI_Booklet_spreads_2011_Final_web.pdf
- Students work with local organizations to identify and plant native species in community areas (e.g. in front of police stations, libraries, seniors' residences, in flower beds on streets). The class can perhaps lobby the municipal government for funds.
- Contact a local conservation authority and ask about citizen science initiatives the class can become involved in.

Lesson 4 – Agricultural Efforts against Invasive Species

Curriculum Connections:

Science: Understanding Life Systems – Interactions in the Environment

Overall expectations:

1. assess the impacts of human activities and technologies on the environment, and evaluate ways of controlling these impacts;
2. investigate interactions within the environment, and identify factors that affects the balance between different components of an ecosystem.

Resources/Materials:

- Chart paper and markers
- Pens/pencils
- A copy of <http://www.biodiversityeducation.ca/bean/files/GarlicMustardFactSheet.pdf> (for each group)
- Samples of invasive species and agricultural crops, including roots (or pictures of each)
- Appendix F: Methods of Controlling Invasive Species (one for each group)
- Appendix G: Case Study: River Run Farm (one for each group)
- Appendix H: Action Plan Rubric (for each group)
- Appendix I: Purple Loosestrife Fact Sheet (for each group)

Teaching/Learning Strategies (Two Periods):

Period 1:

- Obtain a plant specimen of an invasive species (e.g. garlic mustard, dog-strangling vine (**Note: make sure it is a plant which will not harm students, such as Giant Hogweed**)) and an example of a crop that farmers grow (e.g. alfalfa, soybean, wheat). Note that many of the crops which our farmers grow (such as wheat and soybeans) are not native to North America. Examples of native crops include sunflowers, strawberries, raspberries, brome grass (for hay). Ensure that the plant is intact and includes the root structure. If this is not possible, find a picture of each of these.
- Show students the plant specimens. Make a T-Chart and compare the two plants. Discuss what characteristics of the invasive species make it such a competitive grower (extensive root system, an abundant amount of seeds, etc.). Why would farmers want to keep these out of their fields? What are the benefits of controlling invasive species: For farmers? For other citizens? For the environment/other species?
- Introduce the three ways that farmers and landowners control invasive plant species (biological control, mechanical control, chemical control). ***Definitions are in Appendix F*** As a class, identify some of the actions which would fall under these categories (e.g. spraying herbicide (chemical), pulling the weeds (mechanical)).
- **Assessment for learning** – *consider the answers offered by students. Adjust classroom instruction and scaffolding according to their understanding of invasive species and control measures.*

Period 2:

- Hand out the *Case Study: River Run Farm* (Appendix G). Tell students that the Environmental Farm Plan is a program that farmers use to make changes to their farms to improve the health of the environment and its ecosystems. More information can be found at www.ontariosoilcrop.org. Read through the case study together and address any questions which arise.
- Break students into groups. Students are to use their prior knowledge, resources from OFAH, OIPC, government, Conservation Authorities, the Purple Loosestrife Fact Sheet (Appendix I) and the Garlic Mustard Fact Sheet (link) to design an action plan to control and prevent invasive species on River Run Farm.
- **Assessment of Learning** – use a rubric (Appendix H) to assess student knowledge.

Extension Activities:

- Have students take an inventory of their school grounds/local park/natural area for invasive species. Students should spend time outside to see which areas of the grounds require attention, and what actions would be necessary. Have them design action plans to address the invasive species in their area.
 - Students can propose their plans to school administration/community groups. Engage in fundraising and garner support from the community to carry out the plan and manage the invasive species in the area.
 - Students can report their findings to local conservation authorities and/or citizen science initiatives such as <http://www.garlicmustard.org/>.
- Make arrangements to have a farmer speak about their efforts to control invasive species; or have a conservation officer describe how they help farmers and landowners to control invasive species.

Lesson 5 – Case Study: Insect Invasion - Japanese Beetle

This lesson has been adapted by Ontario Agri-Food Education Inc. from *It's (Not) Just a Bug! on The New York Times Learning Network* Original authors were *Catherine Hutchings, The New York Times Learning Network and*

Bridget Anderson, The Bank Street College of Education in New York City

Lesson was retrieved from: <http://learning.blogs.nytimes.com/2007/06/19/its-not-just-a-bug/>

Suggested Time Allowance: 1 hour + time for take home assignment

Curriculum Connections:

Science: Understanding Life Systems - Interactions in the Environment

1. assess the impacts of human activities and technologies on the environment, and evaluate ways of controlling these impacts;
2. investigate interactions within the environment, and identify factors that affect the balance between different components of an ecosystem;
3. demonstrate an understanding of interactions between and among biotic and abiotic elements in the environment.

Geography: The Themes of Geographic Inquiry

1. Analyze current environmental issues or events from the perspective of one or more of the themes of geographic inquiry.

Resources/Materials:

- pens/pencils
- classroom board/chart paper
- various fruits and vegetables
- paper for making “leaves”
- copies of the article <http://www.omafra.gov.on.ca/IPM/english/apples/insects/japanese-beetle.html#beginner>

Teaching/Learning Strategies:

Opening Activity:

1. Bring in a variety of fruit and vegetables grown in Ontario (e.g. apples, pears, cherries, peaches, carrots, potatoes) and display them at the front of the room. As a class, discuss: “Where did this produce come from, and what did it ‘go through’ to get to the local supermarket? How did the farmer ensure the healthiest possible crop? What challenges and threats might have faced these crops? How might the farmer have tried to protect the crops from these threats?”

2. As a class, read and discuss the article

<http://www.omafra.gov.on.ca/IPM/english/apples/insects/japanese-beetle.html#beginner>

Focus on the following questions:

- a. Why are these invasive insects a bad thing for farmers?
- b. What happens to plants if they have no leaves? What does this do to the fruit?
- c. How might this damage negatively impact farmers? Consumers?
- d. What ways are farmers minimizing the impact of the Japanese beetle?



Interactive Activity/Simulation:

Ideal Setting: Outside or in the gymnasium

3. Explain to students that they will now simulate the effects of Japanese Beetle invasion on a plant population. (This simulation requires ample space for students to spread out and move around.) In the simulation, students will represent plants and insects in several different rounds. Each “plant” will need “leaves” to hold. In each round, Japanese Beetles will be given one minute to “eat” as many leaves as they can while avoiding the “predators.”

At the end of the time limit, most plants should still have some leaves left. If tagged by a predator, insects are dead and must sit down or leave the game. Each round will change slightly from the previous one and students will be asked to compare and contrast the differences. (Each round is explained in more detail below.) Leaves need to be redistributed to plants at the beginning of each round.

At the end of each round, students must tally the condition of the plants using the following scale: 7-10 leaves remaining signifies healthy plants; 4-6 leaves, moderate condition; 1-3, severe damage; 0 leaves, dead plants. Complete a chart on the board with each round number and conditions at the top of each column and the four levels of plant health written in each of four rows.

RULES:

1. Insects can only take one leaf from a plant at a time and then must move to a different plant. They may not stay at one plant and eat all of its leaves.
 2. When tagged by a predator, insects are out of the game.
 3. Plants must remain stationary and give up their leaves, one at a time.
- (Add or change rules as necessary.)

ROUND ONE: Normal Populations of Native Species

- Two-thirds of the class will act as plants.
- Three-fourths of the remaining students will act as native insects which do not eat leaves.
- The remaining students are predators that eat the insects.

ROUND TWO: Invasive Insects

- Two-thirds of the class are plants.
- Remaining students are invasive insects. Predators from Round One may participate as insects in this round. Explain that invasive insects often do not have a natural predator, so they are able to reproduce in greater numbers.
- There are no predators in this round.

ROUND THREE: Use of Pesticides

- Two-thirds of the class are plants. Each plant should mark the underside of half of their leaves (chosen at random) with an X to denote the presence of pesticides. Since the underside of the leaves is not visible, the “insects” will not know if they are choosing a leaf marked with a pesticide or not.
- Remaining students are invasive insects. Insects play as normal, but when they “eat” a leaf marked with a pesticide; they are out of the game.

After these rounds, encourage students to think of additional variations on the game. For example, they may choose to play a round that includes predators and pesticides, combining rounds one and three. Another idea is to introduce a natural method of controlling the invasive species, such as bacteria that infects the larvae of the insects. Be sure to have students write down the conditions and the results of each round on their chart.

After all rounds are completed, use the following questions to lead a discussion with students:

1. Which scenario yielded the greatest number of healthy plants? The least healthy plants? Why?
2. Why are invasive species most dangerous to farmers? How might diversification of plants help farmers? Why might large-scale farms be resistant to trying this?
3. How did pesticides affect the pest populations? How did they help the plants? What is the downside to using pesticides exclusively?
4. In your opinion, what other solutions should be used to control invasive species and protect crops?

Assessment for learning: *Students rate their understanding of the interactions of invasive species in ecosystems. They write learning goals for their take home assignment and identify how they will access additional information.*

4. WRAP-UP/HOMEWORK: Individually, students imagine they are farmers in Ontario and, using what they learned in the article and the simulation as well as additional information on Japanese Beetles, they write an agricultural plan for their farms that answers the following questions:

What crop or crops do you grow?

What pests affect these crops?

How do you plan to protect your plants against pests? Would you choose to use pesticides, organic pesticides or another method? Why?

Assessment of learning: *Evaluate the students work for completion and completion of learning goals.*

Provide time for students to discuss and debate their plans in a later class period.

Further Questions for Discussion:

Why can invasive species cause greater destruction than native species of insects?

How has agriculture changed in the past 100 years? How do these changes make problems like those in Ontario into global problems?

Extension Activities:

- Research an invasive species in your region. What is it? How was it introduced? How does it affect agriculture in your province? What other businesses or industries does it affect? What are the monetary costs expected to be caused by the invasive species? What is being done to combat it? Make a community awareness poster or an educational pamphlet telling the public about the species and what they can do to help prevent it.
- Research more on the life cycle of the Japanese Beetle and make a diagram showing the different stages and host plants.
- Interview a local farmer about what he or she grows and the methods he or she uses to produce and sell crops. Talk about his or her experiences with pests, both native and invasive.
- Make an insect trap on the grounds near the school and use an entomology book to identify the insects you find. More about making these traps can be found online at

<http://www.ento.csiro.au/education/collecting.html>



Appendices

Appendix A

Impact Statements

- crowd out native plants, including rare and endangered species
- disrupt food webs
- introduce parasites and disease
- destroy wildlife habitat
- reduce crop yields (on average 10 to 15%)
- reduce crop quality (taint food products with off flavours, toxic berries, spines, etc.)
- can be a danger to humans, livestock, and wildlife
- create a fire hazard; a traffic hazard along roadsides; pose a danger to swimmers and boaters
- provide refuge for insects and diseases that attack adjacent crops and beneficial plants
- lower property value
- reduce aesthetics of an enjoyable landscape
- reduce soil stability and water quality
- cause physical discomfort to recreationists due to spines, burrs, prickles.

Appendix B

Invasive Species in Canada

Invasive species are alien species whose introduction or spread negatively impact native biodiversity, the economy and/or society, including human health. Invasive species are usually divided into two categories; terrestrial and aquatic. These species can include insects, fungus, plants, trees, fish and mammals. These organisms have been accidentally or deliberately introduced into areas beyond their native range. (www.ontarioinvasiveplants.ca)

Invasive species negatively impact Canada's food production, human health, biodiversity, land use and value, and recreational opportunities. They can spread disease, introduce parasites and compete with native plants for resources such as soil nutrients, water and sunlight.

It is estimated that invasive plants cost the Canadian agricultural community approximately \$2.2 billion each year. Prevention is the most effective way to address the negative impacts associated with invasive species. Once an invasive enters an area the impacts and the associated costs of controlling and eradicating that species become substantial. (www.inspection.gc.ca)

According to the Ontario Ministry of Natural Resources, fishing, hunting, forestry, tourism and agriculture can all be affected by invasive species. Every year invasive plants cost the agriculture and forest industries in Canada about \$7.5 billion. Fighting and preventing the spread of invasive species is also extremely expensive. That's why the best plan is to prevent invasive species from entering Ontario in the first place. Invasive plants have the capacity to move into a habitat and reproduce so aggressively that they displace the original vegetation. Globally, only habitat loss is a bigger threat to biodiversity than invasive species. (www.mnr.gov.on.ca)

Invasive species are often unintentionally introduced to areas by the transportation and movement of livestock, soil, plant products, vehicles, and humans. We all play an important role in preventing the spread of invasive species. It is important that we are able to recognize invasive species, understand how to prevent human-assisted transport of invasive species, and how we can help control and eradicate those invasive species that are already established.



Appendix C

Common Ontario Invasive Species

Common Name

Canada Fleabane
Carolina Horse-nettle
Common & Glossy Buckthorn
Common Reed
Dog-strangling Vine
English Ivy
European Frog-bit
European or Black Alder
European Spindletree & Winged Euonymus
Fanwort
Fishhook Water Flea
Garlic Mustard
Giant Hogweed
Goutweed
Himalayan Balsam
Japanese Knotweed
Kudzu Vine
Manitoba Maple
Non-native Bush Honeysuckles
Norway Maple
Periwinkle
Reed or Giant Manna Grass
Round Goby
Rudd
Rusty Crayfish
Spiny Water Flea
Spreading Atriplex
Wild Carrot
Yellow Floating Heart
Zebra Mussels

Latin Name*

Conyza canadensis
Solanum carolinense
Rhamnus cathartica & *R. Frangula*
Phragmites australis
Cynanchum rossicum & *C. Nigrum*
Hedera helix
Hydrocharis morsus-ranae
Alnus glutinosa
Euonymus europaeus and *E. Alatus*
Cabomba caroliniana
Cercopagis pengoi
Alliaria petiolata
Heracleum mantegazzianum
Aegopodium podagraria
Impatiens glandulifera
Polygonum cuspidatum
Pueraria Montana
Acer negundo
Lonicera spp.
Acer platanoides
Vinca minor
Glyceria maxima
Neogobius melanostomus
Scardinius erythrophthalmus
Orconectes rusticus
Bythotrephes longimanus
Atriplex patula L.
Daucus carota
Nymphoids peltata
Dreissena polymorpha

*Latin names have been provided to help students when researching their species. Take a moment to explain to students that species have a common name and a scientific name. Latin is used for scientific naming in order to make species names recognizable to scientist all around the world. It serves as a common language.



Appendix D

Public Service Announcement Rubric

Category	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding – subject specific content acquired in each grade (knowledge), and the comprehension of its meaning and significance				
	The student:			
Knowledge of Content <i>(impact statement and invasive species in Canada)</i>	Demonstrates limited knowledge of content	Demonstrates some knowledge of content	Demonstrates considerable knowledge of content	Demonstrates thorough knowledge of content
Understanding of content <i>(identification of major impacts to environment, economy and society caused by invasive species)</i>	Demonstrates limited understanding of content	Demonstrates some understanding of content	Demonstrates considerable understanding of content	Demonstrates thorough understanding of content
Thinking and Investigation – The use of critical and creative thinking skills and inquiry and problem solving skills and/or processes				
	The student:			
Use of critical/creative thinking processes, skills and strategies <i>(accurate analysis of research to determine appropriate content for public service announcement)</i>	Uses critical/creative thinking processes, skills, and strategies with limited effectiveness	Uses critical/creative thinking processes, skills, and strategies with some effectiveness	Uses critical/creative thinking processes, skills, and strategies with considerable effectiveness	Uses critical/creative thinking processes, skills, and strategies with a high degree of effectiveness
Communication – The conveying of meaning through various forms				
	The student:			
Expression and organization of ideas and information in oral, visual and/or written forms <i>(design of public service announcement – appropriate for chosen audience)</i>	Expresses and organizes ideas and information with limited effectiveness	Expresses and organizes ideas and information with some effectiveness	Expresses and organizes ideas and information with considerable effectiveness	Expresses and organizes ideas and information with a high degree of effectiveness
Application – The use of knowledge and skills to make connections within and between various contexts				
	The student:			
Proposing courses of practical action to deal with problems relating to science, technology, society, and the environment <i>(creation and incorporation of an appropriate call to action within public service announcement)</i>	Proposes courses of practical action of limited effectiveness	Proposes courses of practical action of some effectiveness	Proposes courses of practical action of considerable effectiveness	Proposes highly effective courses of practical action

Appendix E

Fact Sheet Rubric

Category	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding – subject specific content acquired in each grade (knowledge), and the comprehension of its meaning and significance				
	The student group:			
Knowledge of Content <i>(physical characteristics of chosen invasive species)</i>	Demonstrates limited knowledge of content	Demonstrates some knowledge of content	Demonstrates considerable knowledge of content	Demonstrates thorough knowledge of content
Understanding of content <i>(identification of major impacts to environment, economy and society caused by chosen invasive species)</i>	Demonstrates limited understanding of content	Demonstrates some understanding of content	Demonstrates considerable understanding of content	Demonstrates thorough understanding of content
Thinking and Investigation – The use of critical and creative thinking skills and inquiry and problem solving skills and/or processes				
	The student group:			
Use of critical/creative thinking processes, skills and strategies <i>(accurate analysis of research to determine appropriate content for fact sheet)</i>	Uses critical/creative thinking processes, skills, and strategies with limited effectiveness	Uses critical/creative thinking processes, skills, and strategies with some effectiveness	Uses critical/creative thinking processes, skills, and strategies with considerable effectiveness	Uses critical/creative thinking processes, skills, and strategies with a high degree of effectiveness
Communication – The conveying of meaning through various forms				
	The student group:			
Expression and organization of ideas and information in oral, visual and/or written forms <i>(design and layout of fact sheet)</i>	Expresses and organizes ideas and information with limited effectiveness	Expresses and organizes ideas and information with some effectiveness	Expresses and organizes ideas and information with considerable effectiveness	Expresses and organizes ideas and information with a high degree of effectiveness
Application – The use of knowledge and skills to make connections within and between various contexts				
	The student group:			
Proposing courses of practical action to deal with problems relating to science, technology, society, and the environment <i>(creation and incorporation of methods of control and prevention of chose invasive species)</i>	Proposes courses of practical action of limited effectiveness	Proposes courses of practical action of some effectiveness	Proposes courses of practical action of considerable effectiveness	Proposes highly effective courses of practical action

Methods of Controlling Invasive Species

- **Biological control**
Use of a plant's natural enemies to control its growth and establishment. In other instances, newly released biological control organisms have themselves become invasive, sort of a "backfire" in attempting biological control.
 - **E.g. of actions:** insects which eat that type of plant, plants which grow faster or higher than the invasive species
- **Mechanical control**
This method of invasive plant control involves physical removal of weeds. This is a method most people have used in their own backyards.
 - **E.g. of actions:** chopping, pulling, burning, hoeing
- **Chemical control**
This method involves the use of herbicides, which are chemicals that interfere with the physiology of plants and slow or terminate their growth or function.
 - **E.g. of actions:** spraying acetic acid (vinegar), sprays such as round up or others that can be bought at a hardware/garden store.
(<http://alic.arid.arizona.edu/invasive/sub3/p7.shtml>)

Appendix G

Case Study: River Run Farm

Description of Farm:

River Run Farm is a farm located in a rural area of Southwestern Ontario. The farm is about 150 acres in size: 100 acres are used for crops, 30 acres is mixed forest, and 10 acres is a pond and wetland area. The remaining 10 acres are taken up by the house and other farm buildings.

This farm has an Environmental Farm Plan (EFP) to minimize impact on the environment from their farming activities. The EFP is helpful for farmers to protect the environment and manage invasive species because the government covers some of the cost of taking action. Some examples of their actions include containing manure in a barn to prevent spills into waterways and keeping animals out of marshy areas to maintain water quality and habitat for birds and other species. However, there are some issues being caused on the farm by invasive species.

Description of Problem (Invasive Species):



Photo from:
www.biodiversityeducation.ca/index.php/garlic_mustard

Garlic Mustard:

Garlic mustard has started to establish itself along the trails in the forested areas of the farm. This invasive species is capable of doubling its population every four years. If it continues to spread it will displace native wildflowers such as Trilliums.

The plants are also progressing into the fields where the farmers grow crops. This means that at the edges of the fields, the yield (or amount) of crop is reduced. As well, the seeds from the Garlic Mustard are spread around every time machinery drives over the infected area.

Purple Loosestrife:

Along the marshy areas of Loosestrife. This invasive and around the pond. This birds, mammals,

If the Purple Loosestrife drainage in the nearby River Run Farm to use the



Photo from:
www.invadingspecies.com

the farm, there is an establishment of Purple plant is replacing native grass species in the wetland decreases biodiversity and impacts the habitat for amphibians, insects, etc.

continues to spread, the roots may prevent proper fields. The excess water could make it impossible for fields as pasture land for their animals.

Plan of Action

1. Use the knowledge you have gained about invasive species and the attached fact sheets to design a plan of action for River Run Farm. You can use pictures to illustrate the actions.
2. Identify which methods you are suggesting (mechanical, chemical, and/or biological).
3. For each action, explain what time of year the farmer should be controlling the invasive species.
4. What native species could the farmer use to replace the invasive species?

Appendix H

Action Plan Rubric – Agricultural Efforts against Invasive Species

Category	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding – subject specific content acquired in each grade (knowledge), and the comprehension of its meaning and significance				
	The student group:			
Knowledge of Content <i>(terminology of methods of control)</i>	Demonstrates limited knowledge of content	Demonstrates some knowledge of content	Demonstrates considerable knowledge of content	Demonstrates thorough knowledge of content
Understanding of content <i>(identification of actions to control invasive species i.e. procedures, processes)</i>	Demonstrates limited understanding of content	Demonstrates some understanding of content	Demonstrates considerable understanding of content	Demonstrates thorough understanding of content
Thinking and Investigation – The use of critical and creative thinking skills and inquiry and problem solving skills and/or processes				
	The student group:			
Use of critical/creative thinking processes, skills and strategies <i>(analyzing provided resources to form and justify conclusions)</i>	Uses critical/creative thinking processes, skills, and strategies with limited effectiveness	Uses critical/creative thinking processes, skills, and strategies with some effectiveness	Uses critical/creative thinking processes, skills, and strategies with considerable effectiveness	Uses critical/creative thinking processes, skills, and strategies with a high degree of effectiveness
Communication – The conveying of meaning through various forms				
	The student group:			
Expression and organization of ideas and information in oral, visual and/or written forms <i>(design of written and/or visual plan for River Run Farm Case study)</i>	Expresses and organizes ideas and information with limited effectiveness	Expresses and organizes ideas and information with some effectiveness	Expresses and organizes ideas and information with considerable effectiveness	Expresses and organizes ideas and information with a high degree of effectiveness
Application – The use of knowledge and skills to make connections within and between various contexts				
	The student group:			
Proposing courses of practical action to deal with problems relating to science, technology, society, and the environment <i>(developing action plan to control and prevent invasive species)</i>	Proposes courses of practical action of limited effectiveness	Proposes courses of practical action of some effectiveness	Proposes courses of practical action of considerable effectiveness	Proposes highly effective courses of practical action

Appendix I

Purple Loosestrife Fact Sheet

(Adapted from www.invasivespecies.com)

Flower: Each flower spike is made up of many individual flowers. Individual flowers are small and have five or six pink-purple petals surrounding small, yellow centres. Purple Loosestrife generally flowers from late June to early September. It requires pollination by insects or birds.

Seed Capsule: As flowers begin to drop off, capsules containing many tiny seeds appear in their place. Depending on where you live, plants may go to seed as early as late July.

Seed: Each mature plant can have more than thirty flowering stems which can produce up to 2.7 million seeds annually. Seeds are as tiny as grains of sand. They are easily spread by water, wind, wildlife and humans. Seeds are hardy and can lay dormant in the seed bank for several years before sprouting.

Leaves: Leaves are downy, with smooth edges. They are usually arranged opposite each other in pairs. These alternate down the stalk at 90° angles. Leaves may also appear in groups of three.

Stalk: Stalks are square, five or six-sided. They are woody, as tall as 2 m (6.5 ft) with several stalks on mature plants.

Perennial Rootstock: Mature plants can reproduce vegetatively with underground stems that can spread at a rate of 25 cm (9.8 in) each year. On mature plants, rootstocks can send out up to 30 to 50 shoots. This creates a dense web which chokes out other plant life.

Prevention

One of the simplest prevention measures one can take is to be sure that Purple Loosestrife (or one of the many "sterile" cultivars) is not growing in your garden and that you don't intentionally or unintentionally plant it (some wildflower seed mixes may contain Purple Loosestrife so be sure to read the label).

The best time to control Purple Loosestrife is in June, July and early August when it is in flower and easy to recognize before it goes to seed. Hand-digging young plants can be done in an area with a small infestation. Cutting the flower stalks before they go to seed helps to prevent future plants.

Proper disposal is important. This can be done by putting plants in plastic bags that will remain intact at the landfill site. Plants can also be burned. Chemical control (herbicide) is another form of control but should only be used on individual plants, in dry, upland areas and on your own property.

For large infestations, the most effective method has been biological control through the release of insects that are the plant's natural enemy in its native habitat. Two beetle species: *Galerucella pusilla* and *Galerucella californiensis* eat the leaves and new shoot growth. This seriously affects growth and seed production of the plant. These beetles will not get rid of all Purple Loosestrife however; they will reduce plant numbers and reduce seed production.

Additional Activity Suggestions

- Start a campaign similar to the yellow fish campaign. Paint signs to post in community areas to encourage people to avoid planting invasive species or record sightings of invasive species.
- Survey parents and community members about their knowledge of invasive species and use the report to offer suggestions on how to spread information to those who need it.
- Record where they see sightings of Garlic Mustard and report on <http://www.garlicmustard.org/>.
- Trace the path of food from its source to where it is sold. What foods come from which parts of the world? Make a map showing what you learned.
- Trace the path of an invasive species as it spreads across the globe.
- Create a photojournalism exhibit on the devastation that can be caused by invasive plants and insects. Present solutions to the problem. Present your exhibit to the class.
- Read the Science section of the local paper, or obtain an agricultural publication every week for one month. At the end of the month, write a summary of the main agricultural issues that arise.
- Write a report on how to manage one plant in that natural area.
- Grow native plants to give as gifts for a holiday or to sell to the people at home and in the community as a fundraiser.
- Draw invasive plant animated characters and create a comic strip.
- Survey the people at home to find out what they know about invasive plants and develop a report summary.
- Research and create an information piece on an invasive species in Ontario that has positively contributed to the environment, economy and/or society.

Links

Biodiversity Education and Awareness Network www.biodiversityeducation.ca

Canadian Food Inspection Agency <http://www.inspection.gc.ca>

Canadian Museum of Nature http://www.nature.ca/explore/di-ef/hpwe_cs_e.cfm

Canadian Wildlife Federation <http://www.cwf-fcf.org/en/resources/encyclopedias/invasive-species/>

Field Guide to Aquatic Invasive Species

http://www.ontariostewardship.org/councils/duff-simcoe/files/invading_species_field_guide.pdf

Great Lakes Information Network <http://www.great-lakes.net/envt/flora-fauna/invasive/invasive.html>

Invading Species Awareness Program <http://www.invadingspecies.com/>

Invasive Tracking System <http://www.invasivetrackingsystem.ca/>

Ontario Ministry of Natural Resources

http://www.mnr.gov.on.ca/en/Business/Biodiversity/2ColumnSubPage/STDPROD_069027.html

Ontario Invasive Plant Council <http://www.ontarioinvasiveplants.ca/index.php/publications>



Vocabulary

Adjacent - not distant or borders (NEAR)

Aesthetics - a pleasing appearance or effect (BEAUTY)

Agriculture - the science, art, or practice of cultivating the soil, producing crops, and raising livestock and in varying degrees the preparation and marketing of the resulting products (FARMING)

Biodiversity - the variability among living organisms from all sources including terrestrial and aquatic ecosystems and the ecological complexities of which they are part of; including diversity within species, between species and of ecosystems

Cultivars - an organism and especially one of an agricultural or horticultural variety or strain originating and persistent under cultivation (*farmed land*)

Displace - to remove from the usual or proper place (DISTURB)

Eradicate - to do away with as completely as if by pulling up by the roots (WIPE OUT)

Exotic species – an organism that has been moved from their native habitat, intentionally or unintentionally, and found living in a new and/or different habitat outside its native distributional range (ALIEN SPECIES, INTRODUCED SPECIES)

Invasive species – an organism that is found outside their native habitat and threatens the surrounding environment, economy and/or society by disrupting the local ecosystem

Native species - an organism living in an area naturally, without any human intervention

Parasite – an organism that lives on and feeds off another without rendering any service in return (FREE RIDER)

Physiology – the science of the functioning and processes of living organisms

Recreationists - a person who seeks recreation especially in the outdoors

Terminate – to bring or come to an end

Vegetative growth - a form of asexual reproduction in plants, a process by which new individuals arise without production of seeds or spores