



## AREA BEST LINKED TO

City of Kawartha Lakes, County of Haliburton and District Municipality of Muskoka.



## OBJECTIVES

- Understanding the basic needs of plants.
- Understanding the adaptive advantages that allow species to become invasive.
- Understanding the consequences of introducing an invasive species into an ecosystem.



## CURRICULUM LINKS

### Grade Four:

#### Science:

- 1.1 analyse the positive and negative impacts of human interactions with natural habitats and communities.

### Grade Five:

#### Science:

- 1.1 assess the effects of social and environmental factors on human health, and propose ways in which individuals can reduce the harmful effects of these factors and take advantage of those that are beneficial

### Grade Six:

#### Science:

- 1.1 analyse a local issue related to biodiversity.



## BACKGROUND INFORMATION

Invasive species are a serious threat to ecosystems, biodiversity, and agriculture.

Introduced invasive species is a species of plant, animal, or fungus that has become established in an area outside its native range.

How do they get here: Pathways describes the modes by which invasive species move from one place to another. These pathways can be natural caused, as when species are moved on ocean currents, or wind currents, or carried by an animal from one place to another. Alternatively, some pathways are human-induced, and can be intentional or non-intentional

Natural pathways that allow for the movement of species have been in existence since the dawn of life on Earth (ie/ migration of mammoths across the Bering land bridge that connected Alaska to Russia). The unintentional introduction of invasive species by natural pathways is rare.

Human-induced pathways are pathways created or enhanced by human activity. They are the source of most species invasions and continue to increase in frequency and severity.

Intentional introductions – Many species purposefully imported into North America have become invasive. Some of these introduced species were brought for agricultural purposes, horticultural purposes, and as pets. Some were used to combat other invasive species.

Invasive species can also have a negative effect on the economy. Damage and control costs can reach up to the billions annually.

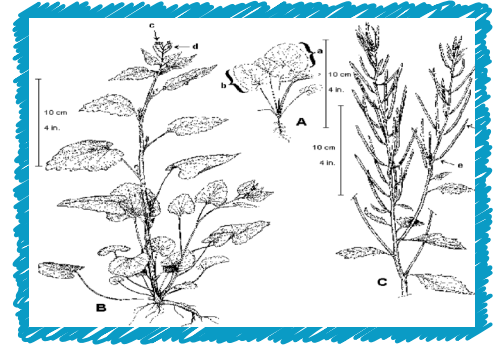


## MATERIALS

- 4 pylons to mark boundaries for the game
- 4 sets of (pinnies, bandanas etc.) or other means to identify players
- Sun, Water, and Nutrient cards (Print and cut out 15 of each card, may wish to stabilize cards by gluing to poster board.)

# BACKGROUND ON GARLIC MUSTARD: (ALLIARA PETIOLATA)

**General Description:** Garlic mustard is native to Europe and was introduced to North America in the late 1800's by early settlers. It is a cool-season biennial herb and produces rosettes of green leaves that grow close to the ground in their first year, remain green all winter and develop into mature flowering plants the following spring which gives it a head start on other perennials. New leaves emit the distinctive odour of garlic when crushed and fades as the plant matures. It was useful for medicinal purposes such as treating gangrene, ulcers, utilized for its high Vitamin A and C content. Garlic mustard spreads entirely by seed, producing hundreds per plant. (OFAH, 2011).



**Stems & Roots:** Stems up to 1m tall, simple or little branched, smooth or with a few simple hairs (OMAFRA, 2011).

**Leaves:** Rosettes leaves; kidney-shaped with a broad rounded tip. Their margins toothed with shallow, coarse teeth; lower stem leaves alternate (OMAFRA, 2011).

**Flowers:** Small and white, with 4 petals 3-6mm long and wide. The whole plant has a distinctive onion-like or garlic-like odour. Garlic Mustard flowers from May to June (OMAFRA, 2011).



**Distribution and Habitat:** Garlic Mustard is now found within the Trent Severn Watershed, it affects The City of Kawartha Lakes, County of Haliburton and the District Municipality of Muskoka. It grows in upland and floodplain forests, gardens, and along roadsides. Its primary habitat needs are shade, and relatively high fertility. It cannot tolerate acidic soils and is not commonly found in sunny habitats. The invasion of woodlands usually begins along trails or woodland edges where it can quickly invade any disturbed site when seeds have been transported on boots or within the treads of vehicle tires (OFAH, 2011).



**Ecological Impacts:** This invasive plant has become naturalized (non-native plant that has been introduced and have become established as part of the landscape, some become invasive and threaten native flora and fauna); it can enter and establish itself within a stable, healthy forest site. Its ability to form dense monocultures affects indigenous wildflower populations. Once garlic mustard moves into an area, it steals away available light, water and space from native flowers, as well as choking out forest understory growth. In southern Ontario, seed may remain viable in the soil for up to five years (OFAH, 2011). Allelopathy is a biological phenomenon by which an organism produces one or more biochemicals that influence the growth, survival, and reproduction of other organisms. Research has demonstrated that the allelopathic toxic chemicals produced by the roots of garlic mustard interfere with the microscopic fungi in the soil needed to stimulate the growth of native plants (CLOCA, 2011).

**Control Options:** The most effective method of controlling Garlic Mustard is to prevent its initial establishment. But once Garlic Mustard is established, prevention and detection strategies must be augmented with control treatments.

Garlic mustard control will produce good results if the plant is removed before it sets seed. Cutting the flowering plants at ground level is effective in killing the plant and removes the future seed source, whereas cutting 10cm above the ground allows some of the plants to survive and release seed (OFAH, 2011).

Garlic Mustard plants can produce viable seed even when they are pulled/cut before their fruit have substantially developed (Solis, 1998) Therefore, pulled/cut vegetation with maturing to mature seeds should be bagged and removed from site.

While several herbicides may effectively kill Garlic Mustard (e.g. Bentazon, 2,4-D and Aciflourfen), their non target effects, ability to spread offsite through water, and/ or residual life time make them unsuitable for use.

Currently biological control methods for Garlic Mustard are unavailable for use in most public Ontario properties as they are still in the research stage and have unknown levels of risk and effectiveness.

## WHY INVASIVE PLANTS ARE PROBLEMS

- Produce large numbers of new plants each season.
- Tolerate many soil types and weather conditions.
- Spread easily and efficiently, usually by wind, water, or animals.
- Grow rapidly, allowing them to displace slower growing native plants.
- Spread rampantly as they are free of the natural checks found in their native range

## BACKGROUND TO GAME

All plants need sun, water, nutrients and space and avoid being eaten to survive and reproduce.

Any plant that can do any of these things better than the other plants around it has a huge advantage and may come to dominate the landscape. This game simulates the introduction of one non-native invasive species, garlic mustard, into the landscape and the resulting changes in the plant community.

**Note:** This game is played in several rounds. Each round will simulate different conditions in the forest ecosystem.

The next step for students is to generate a list of native and non-native species they expect to find in their local forest community.

For a list of Native plants in Ontario visit The Native Plant Database- <http://nativeplants.evergreen.ca/search/guided.php?province=ON>  
From there you can choose, trees, shrubs, ground cover anything you can think of and it gives common and scientific names. From Same page you can access invasive species in the Province as well, look for: "(Search for invasive species in this province)"

Introduce the idea that some plants are native to an area and others are introduced. Generate a list of native and non-native plants. Discuss what might happen to plants that come to live in a new environment.

## DISCUSSION QUESTIONS:

- Define an invasive species.
- What makes a species invasive?
- How do invasive species come to be in an area?
- How can the addition of an unnatural species impact an ecosystem?
- What ways can you suggest to help control invasive species? Consider both preventative measures and methods of removal.
- What would happen to forest plants if garlic mustard completely covered the forest floor?
- If garlic mustard takes over, what will happen to the animals, birds, amphibians, reptiles, and invertebrates that live in that ecosystem?

## HELPFUL HINTS TO DISCUSSION QUESTIONS

**What is an invasive species?** A species which is not native to an area. These organisms can impact native ecosystems by being better competitors, eating native species, or by changing the environment.

**Mechanical control** involves removing the species either by hand or with a machine. Mechanical control is labour intensive, requiring detailed work over a long period of time. Oftentimes, multiple efforts are required to ensure proper control.

**Chemical control** uses chemical compounds to control invasive species. While this method is useful for both small and large areas, it is not target-specific and can contaminate nearby land and water resources, threatening the health of plants, animals and humans in the area. Another difficulty with chemical control is that target species may develop a resistance to the chemical compound, thereby rendering this method ineffective. Chemicals used to control invasive plant species are called herbicides and can be applied directly on the target plant species, around the soil on the plant's base, or in the soil before the seeds of the plant fertilize.

**Biological control** refers to a specific species being released into the environment to control an invasive species. It is a chemical-free method and can be environmentally friendly. Without proper research and planning, the introduced control species can become an invasive species itself, exacerbating the original problem.

**Prevention** is often the best method for controlling invasive species. This requires the work of government agencies and the public joining forces to address the problem. The public can participate by educating themselves on invasive species and by taking steps to control the spread of species in their communities through awareness.

# SET UP FOR THE GAME...LET'S BEGIN!

## Play Round 1 – The Undisturbed Forest

1. Distribute Sun, Water and Nutrient cards at one end of the playing area.
2. Five students will start as native plants at the opposite end of the play area.
3. One student will be a herbivore in the middle.
4. Remaining students start on the sidelines but will be brought into the game quickly.
5. In order to survive the first round, plants must collect one each of the Sun, Water and Nutrient cards. They may only pick up one card each trip down the field. They must avoid being eaten (tagged) by the herbivore.
6. The herbivore may tag the native plants when they are between the pylons. They must escort tagged plants to the sidelines before they may tag another plant.
7. The round ends when all the plants have been caught or collected three cards, whichever comes first.
8. Surviving plants reproduce. For each plant that survives, one student from the sidelines will join the game as a reproduced native plant.

## Play Rounds 2 & 3 – The Invader Arrives

1. Redistribute the cards to one play area at end of the field again. The surviving and new reproduced native plants are at the opposite end.
2. Add one student as the garlic mustard plant, newly arrived in the area.
3. One student will be a herbivore in the middle.
4. In order to survive the first round, plants must collect one each of the Sun, Water and Nutrient cards. They may only pick up one card each trip down the field. They must avoid being eaten by the herbivore.
5. The herbivore may only tag the native plants when they are between the pylons. They must escort tagged plants to the sidelines before they may tag another plant. The herbivore does not recognize garlic mustard as food or does not like its taste and therefore leaves it alone.
6. The round ends when all the native plants have been caught or collected three cards, which ever comes first.
7. Surviving plants reproduce. For each native plant that survives, one student from the sidelines will join the game as a native plant. Plants survive by collecting one of each of the Sun, Water, and Nutrient cards. Garlic mustard produces large numbers of seeds so two students from the sidelines will become garlic mustard plants in the next round for each garlic mustard that survives.

## Round 3

8. Redistribute the cards and repeat another round.
9. At the end of this round, some plants may not survive because there is not enough sunlight, water or nutrients to go around. Any plant not getting one of each card does not survive and moves to the sidelines.

## Play Round 4 – The Competition

1. Redistribute the cards in the playing area.
2. Garlic Mustard is a biennial which means that its life cycle takes two years to complete. It overwinters as a rosette of leaves under the snow. This gives it a head start in spring - most native woodland species are either annuals, starting from seed each year, or perennials that start from roots or bulbs underground. It grows quickly and spreads rapidly, crowding out native species. To simulate this, in this round, the surviving garlic mustard plants get a 15-second head start on the native plants.
3. If there are any native species left at the end of the round, go on to play round five. Other wise skip to the Discussion 1.

## Play Round 5 – The Domination

1. Redistribute the cards.
2. Garlic mustard plants release a chemical into the soil that kills soil fungi. This inhibits the formation of connections between the roots of native plants and fungi in the soil that help them absorb water and nutrients. This gives garlic mustard a huge advantage. To simulate this, the garlic mustard players may pick up both Water and Nutrient cards on the same trip.

# DISCUSSION 1

## WHAT HAPPENED DURING THE GAME:

- a. What advantages does garlic mustard have over native species?
- b. What would happen to the herbivores after all the native species are gone?
- c. What can be done to control garlic mustard?

## EXTENSIONS:

In additional rounds add in one or more of the following possible controls;

- a. Human cutting. Add one or more people to the middle to tag the garlic mustard players. This represents people manually cutting the plants before they flower to prevent them from reproducing. Eventually the seed supply will be exhausted and garlic mustard will be controlled, but this takes several years.
- b. Bio-Control. Add one or more people to the middle to tag the garlic mustard. This represents the possible outcome of research that is currently underway to find something that will eat garlic mustard but not everything else.
- c. Fire. Add many people to the middle during the first 15 seconds of the round. They may tag garlic mustard, even out of bounds. This represents the use of controlled burn fires in the early spring when garlic mustard has begun to grow, but native plants are still dormant.

## DISCUSS:

- a. Do the controls work?
- b. What are the limits/risks of the controls?
- c. Is it easier to prevent the introduction of an invasive species or to try to control it after it has escaped?



## FEEDBACK

### We appreciate your feedback! Please let us know...

- Did this activity continue the learning your students engaged in at the Water Festival?
- What curriculum requirements did this activity satisfy?
- Was the activity easy to facilitate to your class?
- Did students have fun and learn something new about water?
- Please send photos of your class using these activities!

Please send comments and photos to: [iheaven@outtolearn.ca](mailto:iheaven@outtolearn.ca)

 **Water**

 **Sunlight**

 **Nutrients**

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