The Garlic Mustard Plant

All Around and Down the Oxbow

Student Scientists

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Glossary

Invasive species (in **va** siv **spe** ses)- Any plant, animal, or organism that is not native to the ecosystem it is in, and is likely to cause harm to the environment, economy, or human health.

Understory (**un** dür **stôr e**)- Vegetation in a forest that is near the ground.

Native (**na** tiv)- Naturally occurring in an area.

pH (pe ach)- A measure of the amount of acidity or basicity of a solution. The scale ranges from 0 to 14. A pH of 7 is considered neutral. Acidic solutions will have a pH less than 7 and a basic solution will have a pH greater than 7.

Acidity (uh **sid** uh te)- The degree or amount of acid in a solution. An acid has a pH less than 7.

Germination (**jür** muh **na** shun)- The act of sprouting or beginning to grow.

Resistance (re **zis** tens)- The ability of an organism to resist harmful influences.

Distilled water (dis **tild wa** tür)- Water that has almost all impurities removed by distillation. Distillation involves boiling the water and then condensing the steam into a clean container.

Pipette (pi **pet**)- A narrow tube into which liquid is drawn by suction and then dispensed.

Average (**av** rij)- The number gotten by dividing the sum of two or more quantities by the number of quantities added.

Median (**me** de un)- A value in a series arranged from smallest to largest below and above which there are an equal number of values or which is the average of the two middle values if there is no one middle value. For example, in the number series 5, 6, 7, 8, 9 the median is 7.

Mode (mod)- The most frequent value in a set of values. For example, in the number set 3, 4, 4, 5, 7 the mode is 4.

Domesticated (do **mes** tuh ka ted)- Living near or with humans.

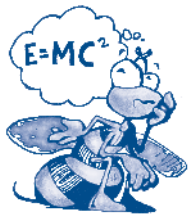
Herbivores (**ür** buh vôrz)- An animal that feeds on plants.

Pronunciation Guide

a	as in ape
ä	as in car
e	as in me
i	as in ice
o	as in go
ô	as in for
u	as in use
ü	as in fur
oo	as in tool
ng	as in sing

Accented syllables are in **bold**.

Thinking About Science



When scientists begin an experiment, they usually have an idea of how the experiment will work out. However, sometimes they have no idea what their results will show. In this experiment, the student scientists were uncertain about the possible results. Think of a time when you tried something new and had no idea how it would work out.

Thinking About the Environment

All plants need minerals to grow and survive. In this research, the student scientists were interested in discovering whether the amount of certain minerals in the soil affected the growth of an **invasive species**. Because these minerals promote plant growth, the students wondered if they would find a relationship between the presence of an invasive plant species and the amount of minerals in the soil.

Introduction

Looking at Oxbow Island, one would be surprised that the island has any invasive species **(figure 1)**. Invasive plant species that are growing uncontrollably are changing the scenery of the North American **understory**, including Oxbow Island. What was once a stunning forest full of wild plants is now changing into areas of overpopulated organisms that harm the **native** species by competing for resources such as water, space, and sunlight.

Invasive plant species are often brought to the United States as a product to sell. For example, invasive plants can be sold as garden plants. Seeds can also be brought over intentionally or accidentally as hitchhikers on other products. One reason invasive species do not spread as quickly in their native lands as the ones they invade is because animals living in the native lands consume some of the plants before they have time to seed. When introducing a plant or animal into a new environment, it generally does not have as many predators in its new area. Another potential reason for increased spread of invasive species is the

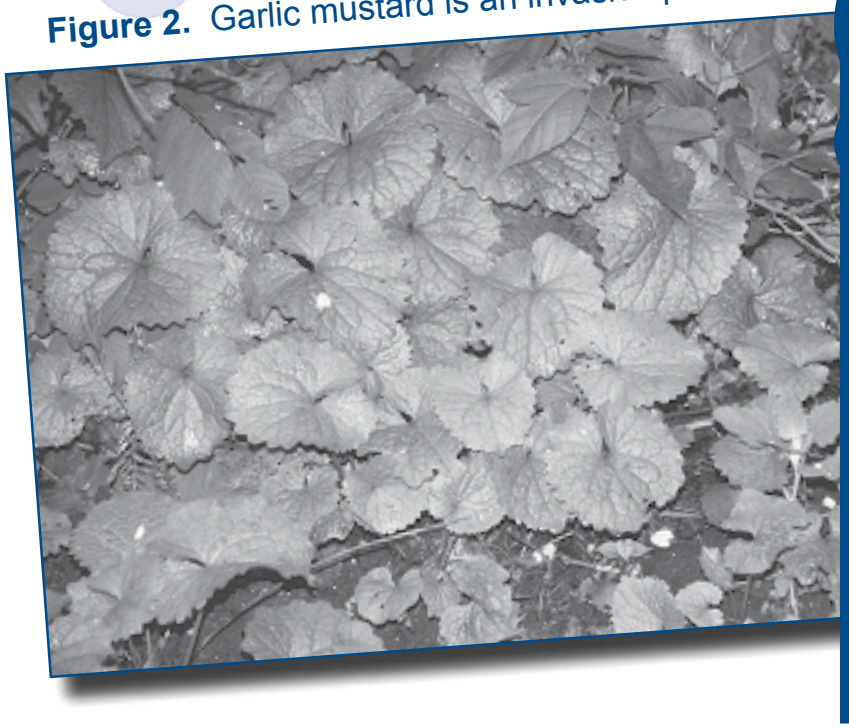
Figure 1. The Oxbow area of Greenfield Village, Dearborn, Michigan.

soil's fertility, which is determined by things like the soil's **pH**, potassium, nitrogen, and phosphorous levels. These nutrients are necessary for a plant's growth. We studied the effects of **acidity**, potassium, nitrogen, and phosphorous on the invasive species garlic mustard **(figure 2)**. We wanted to find out how nitrogen, phosphorous, potassium, and acidity levels in the soils affect the growth of garlic mustard.

Soil pH levels affect mineral levels which affect plant growth. More basic soils are usually more fertile than acidic soils. Acid rain physically touching plants also may affect plant growth, health, and **germination** rates. If time had permitted, the effects of acid rain would have been part of this research. We do believe that pH, potassium, nitrogen, and phosphorous levels might influence the spread and health of the garlic mustard plant.

Nitrogen is used in plant growth, while potassium enhances resistance to disease in plants by strengthening stalks and stems. Phosphorous helps with the transfer of energy. So, minerals help a plant **resist** any predators. We wanted to see just how much the minerals and pH were related to a concentration of garlic mustard in a particular area of the Oxbow Island that we were studying.

Figure 2. Garlic mustard is an invasive plant.



Reflection Section

State in your own words the question the student scientists wanted to answer.

Plants need nutrients like nitrogen, potassium, and phosphorus to grow. What things do you need to grow?

Method

The first step was collecting soil samples in the Oxbow. We gathered the materials we would need such as: a shovel, detailed map of the Oxbow, plastic bags, and paper for recording any additional notes. After entering the Oxbow, we used the map as our guide to locate some areas that included garlic mustard. There were three different locations—one with a large amount of garlic mustard (high concentration), one with lower amounts of garlic mustard (medium concentration), and one with very little garlic mustard (low concentration). While collecting each soil sample, we recorded facts about the area surrounding the garlic mustard plants. In addition, we labeled the areas we collected soil from on the Oxbow Island map. From each of the three sites we collected two samples.

After conducting the soil test to examine levels of nitrogen, phosphorous, and potassium, we tested each concentration of the soil using a pH level kit. We used a fluid called "wide range indicator." We used the **pipette** to remove the soil solution, and also to put it into another test tube **(figure 3)**. We put 10 drops of the wide range indicator into each concentration of soil solution. Then we shook the test tube for five minutes and let it sit for an additional two minutes. The solution changed into a certain color. The color helped us determine the pH level.

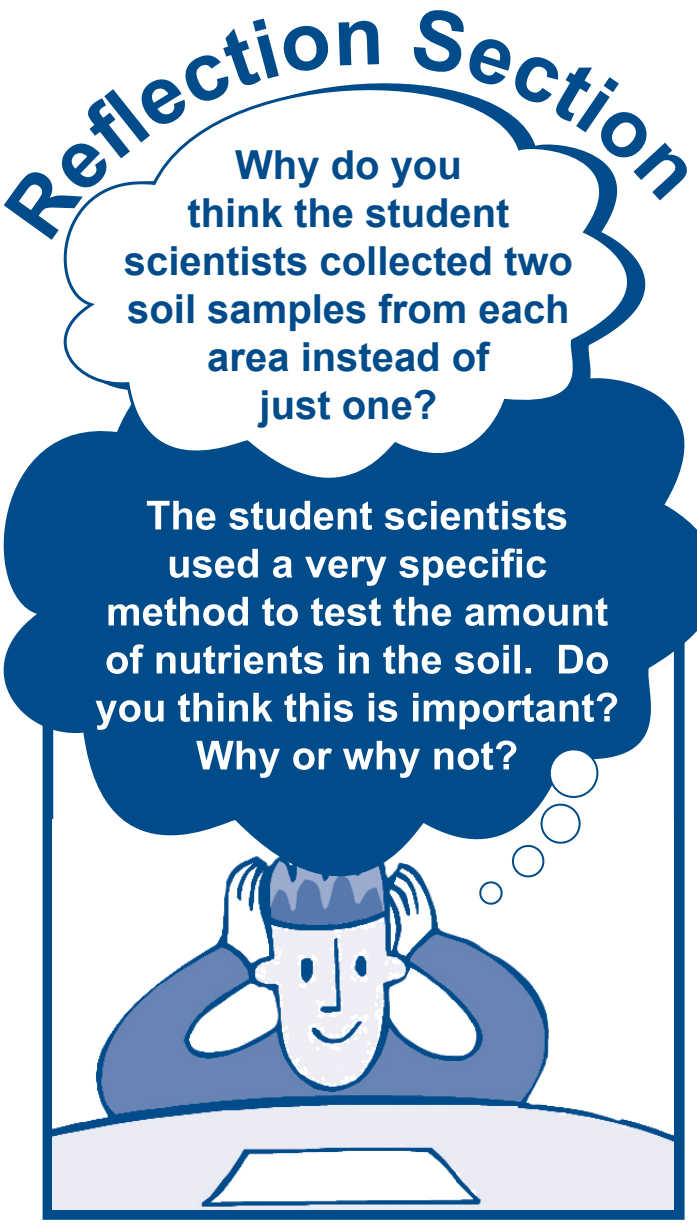


Figure 3. Pipettes are used in all different types of science experiments. Have you ever used a pipette?

Findings

While waiting for the results of the test for the nutrients in the soil, the soil solution with the nitrate began to change to a bluish color, the phosphorous to a pinkish color, and the potassium began to get cloudier. The degree of blue, pink, and clarity is what determined the level of the particular nutrient in the soil. The names of the trees indicate that the particular soil was close to that tree **(figure 4)**.

Garlic Mustard Present

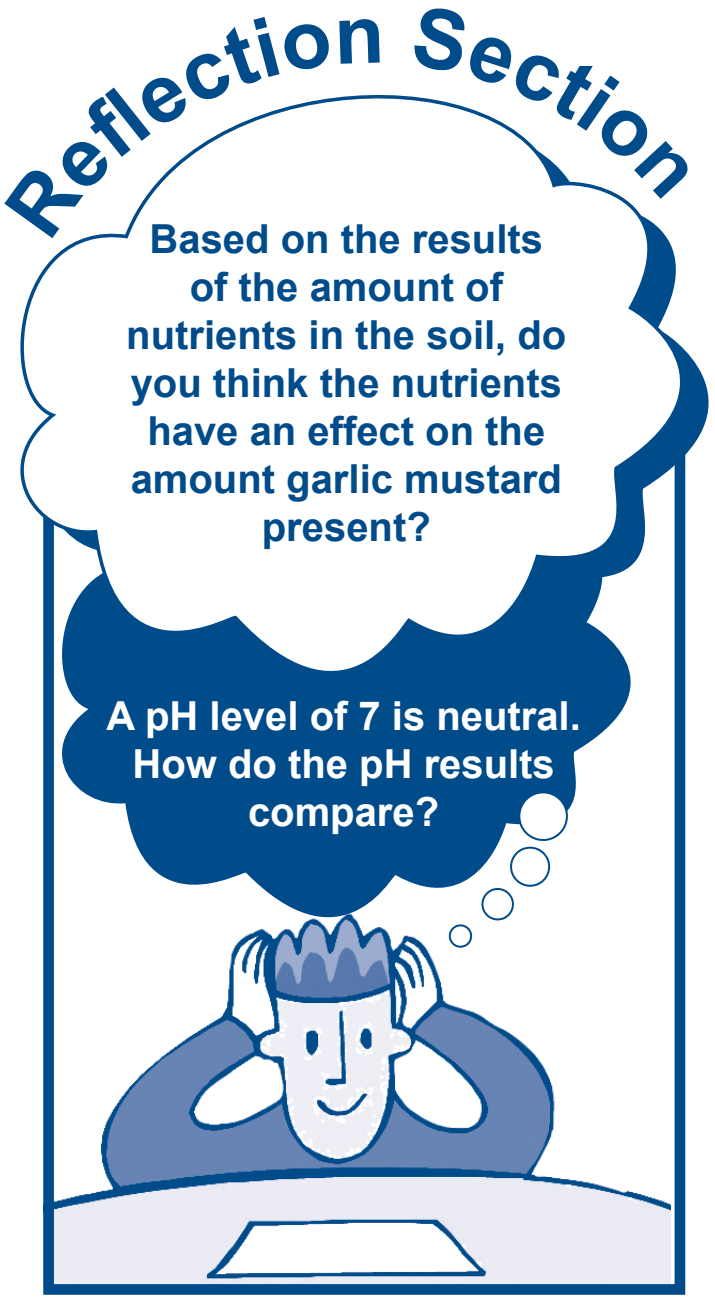
Concentration of garlic mustard	Level of nutrients
Phosphorous	
Low	Medium
Medium	Medium
High	Low
Nitrate	
Low	Low
Medium	Low
High	Low
Potassium	
Low	High
Medium	Medium
High	Low

No Garlic Mustard Present

	Potassium	Phosphorous	Nitrate
Hackberry 1	Low	Low	Low
Hackberry 2	High	Medium	Low
Ash 1	Medium	Low	Low
Ash 2	Medium	Medium	Low
Cottonwood 1	Medium	Low	Low
Cottonwood 2	Medium	Medium	Low

Figure 4. Results for the level of nutrients.

After studying the nutrients in the soil, we tested the pH levels. Using the pH level chart from the kit we compared our results to another soil testing example **(figure 5)**. The second table comes from an area where no garlic mustard was present **(figure 6)**. The names of the trees indicate that the particular soil was close to that tree.



Level of Garlic Mustard	pH Level
High	6.7
Medium	7.1
Low	6.9

Figure 5. pH level where garlic mustard was present.

Hackberry 1	7.3
Hackberry 2	7.3
Ash 1	7.3
Ash 2	7.3
Cottonwood 1	6.7
Cottonwood 2	6.1

Figure 6. pH level where garlic mustard is not present.

Discussion

The experiment was planned differently than what actually occurred. Initially the plan was to collect garlic mustard seeds and allow them to grow in various levels of pH and minerals. The time of year did not allow the research group to do that experiment. After searching for seeds, we found that a sufficient amount of seeds could not be found to complete the experiment. The objective was to find out how different pH levels and minerals affected the growth of garlic mustard, so we figured out a different way to test this question.

The experiment we did answered the same question, but used a different method. The experiment we did may have been undermined by outside variables: chemicals used in or around the area in which the plants were found; less or more resources in one place over another (for example, water, too much or too little sunlight, weeds or other organisms in the area competing for resources); type of soil (for example, sandy or clay-like, full of stones or fine grained); and room for growth.

In the second experiment, samples were taken from parts of the Oxbow that did not have garlic mustard in the area. Those samples were compared to areas that did have garlic mustard. The average pH for non garlic mustard areas happened to come out exactly to 7. The **median** and mode was 7.3. The **average** pH for areas with garlic mustard was 6.9. The median was 6.9.

The data set is very small, so the calculations are just a beginning. The numbers indicate that there is not much variation in the data. The numbers are all pretty close to average, and the range is low in each set. Because the numbers are all pretty close and do not vary, we can take the average of each set and see that they are nearly the same. Therefore, this

leads us to believe that the effect of pH on garlic mustard is inconclusive and needs more research.

As for the effect of minerals on garlic mustard, where there was a low amount of phosphorous, potassium, and nitrogen, there was a high concentration of garlic mustard. These findings lead us to believe that areas with a low amount of minerals allow garlic mustard to grow well. However, this finding needs additional research before we can say this with any certainty.

One thing we do know for sure is that garlic mustard is rapidly spreading through Oxbow Island, the state of Michigan, and North America. Currently, ways to effectively control or reverse the spread of garlic mustard without possible adverse effects to the environment are limited. For example, small areas of garlic mustard can be pulled out by hand with success. Additionally, according to a progress report done at Michigan State titled, Evaluating the Potential Biological Control of Garlic Mustard in Michigan, many animals, wild and domesticated, that are herbivores eat garlic mustard. However, the study showed that the herbivores did not eat enough to control its spread. We hope that scientists will make progress in findings ways to control garlic mustard.

Student Article Citations

PCA Alien Plant Working Group: http://www.nps.gov/plants/ALIEN/fact

USDA plants: http://www.plants.usda.gov/java/profile

Evans, J.A., Landis, D.A., Schemske, D. W., and Davis, A.S. (2005). Evaluating the potential for biological control of garlic mustard in Michigan: 2005 progress report. Michigan State University. Retrieved from http://www.ipm.msu.edu/pdf/2005garlic-mustard-reprot.pdf

FACTivity

In this FACTivity, you will learn about invasive species in your area. The questions you will answer are: What invasive species are in my area? And, what can be done to help stop the spread of them?

You will complete this FACTivity with a partner or in a small group. With your partner you will choose an invasive species to research. Your teacher may want to assign each group/pair with a certain invasive species. Once you have your invasive species, you will research this species using books and the Internet (if available). The following list is information you will want to find out about your species:

- What is the name of the species you are learning about?
- Where does this species live naturally?
- Where has this species invaded?
- How do scientists think the invasive species arrived in its new location?
- Why is this species harmful? Helpful?
- What can be done to help stop the spread of this species?
- What research is being done on this species?

Once you have gathered this information, you are going to create an information pamphlet about your species that you will share with your class and the school.

PLT

If you are a PLT-trained educator, you may use #70 "Soil Stories" as an additional resource.