The Emerald Ash Borer

An Ash Tree's Worst Enemy!

Student Scientists
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Photo: Eric R. Day, Virginia Polytechnic Institute and State University, Bugwood.org

Glossary

Infestation (in **fes** ta shun): To swarm or spread in and over in a troublesome manner.

Oxbow (**ox** bo): A U-shaped bend in a river.

Distilled water (dis **tild wa** tür): Water that has been through a process where almost all impurities in the water have been removed.

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

Alkalinity (**al** kuh lin uh te): The degree or amount of base in a solution. A substance with a pH more than 7.

Phosphorus (**fôs** fôr us): Phosphorus is an essential nutrient for plant growth. It helps plants with photosynthesis, plant structure, and energy.

Potassium (po **täs** e um): Potassium is an essential mineral that helps with photosynthesis, the quality of fruit, and disease reduction.

Nitrogen (**nit** ro jen): Nitrogen is a part of chlorophyll and helps plants with rapid growth and fruit and leaf production.

Economy (e **kän** o me): The production, consumption, and distribution of goods and services.

Parasitic (pair uh **sid** ik): An organism living in, with, or on another organism.

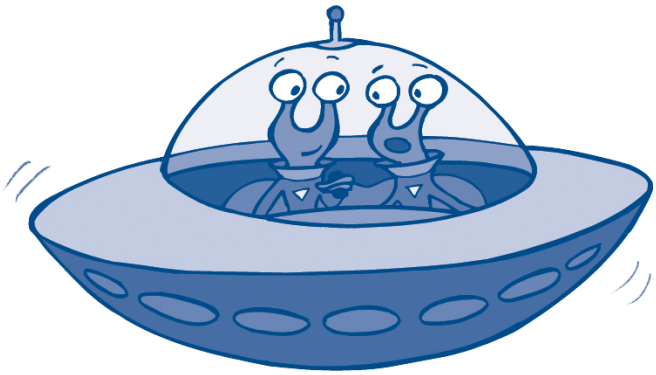
Larvae (**lär** ve): The immature, wingless, and often wormlike feeding form that hatches from the egg of many insects.

Entomologist (**en** to **mal** o jist): A scientist who studies insects.

Pronunciation Guide

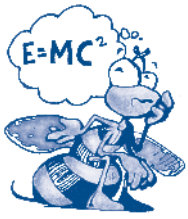
a	as in ape
ä	as in car
e	as in me
i	as in ice
o	as in go
ô	as in for
u	as in use
ü	as in fur
oo	as in tool
ng	as in sing

Accented syllables are in **bold**.



Although invasive species do not come from another planet, they can come across oceans from distant countries. Invasive species have the potential to cause a lot of damage. They cost the United States $100 billion each year! The Oxbow area in Greenfield Village, part of The Henry Ford, has been invaded by emerald ash borer (EAB). In this research, you will learn about student research and the EAB.

Thinking About the Environment



What is an invasive species? If you are thinking of invaders from a distant planet, you are almost right, except that these species invade from right here on Earth. Invasive species are any plant, animal, or organism that is not native to the ecosystem it is in. An invasive species is likely to cause harm to the environment, the economy, or human health.

Thinking About Science

Scientists need the proper equipment to do their work. This is true for student scientists as well. In this research, the student scientists were able to use a soil testing kit. Without the soil testing kit, the students would have been unable to do this research. If the proper equipment is not available, scientists must make their own equipment or change their methods. As you can see, science often depends on technology to make new kinds of investigations. Name one kind of investigation made possible today by technology that was not possible 50 years ago.

Introduction

Agrilus planipennis, (**ag** ruh lus **plan** uh **pen** us) or emerald ash borer is a colorful beetle, native to eastern Russia, northern China, Japan, and Korea **(figure 1)**. The average beetle's length is 20 millimeters long and 4 millimeters wide **(figure 2)**. An EAB is an invasive beetle known for killing ash trees. The damage to trees is caused after EAB bores or tunnels itself into the tree. The EAB adult lays eggs in the bark which hatch into larvae. The EAB larvae feed off of the trees by eating the inner bark and taking much of the tree's nutrients.

Figure 2. The EAB is an emerald colored beetle, 20 millimeters long and 4 millimeters wide.

Photo courtesy of http://www.bugwood.org. David Cappaert from Michigan State University.

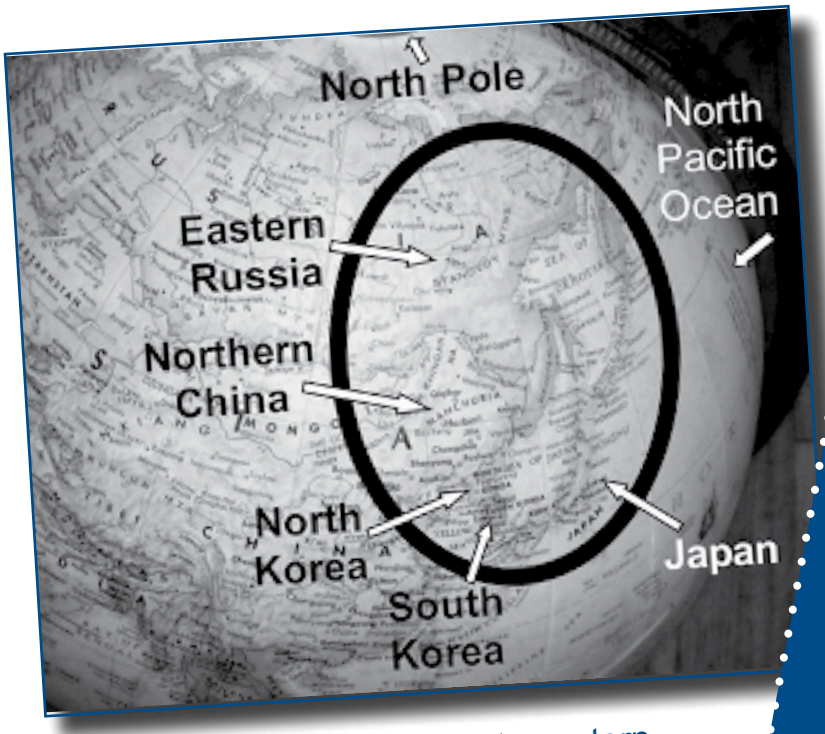


Figure 1. The EAB is native to eastern Russia, northern China, Japan, and Korea.

Number Crunches

How many inches long and wide is the average EAB beetle? Multiply 20 millimeters X 0.039, and 4 millimeters X 0.039 to find out.

Before 2002, EAB had never been found in North America. It is not known how it got into North America, but it most likely came in ash wood in ships or from packaging or crating. One of the major ways that EAB was transported and spread so fast within North America was by people moving firewood from one place to another. Since ash trees make very good firewood people sell it or bring it on vacation.

All species of North American ash trees are at risk now. In 2002, the EAB was found in southeastern Michigan and Ontario **(figure 3)**. Evidence suggests that EAB had been in the United States for at least 10 years before it was first detected.

Since the EAB was first detected, it has killed over 20 million ash trees in Michigan alone. EAB has also been found in Indiana, Ohio, Illinois, Maryland, Kentucky, New York, Pennsylvania, Missouri, Minnesota, West Virginia, Wisconsin and Virginia. Most of these **infestations** are not new. Scientists have just become better at finding them.

We studied an area near our school called the **Oxbow**. The Oxbow is an area of land surrounded by an Oxbow lake of the Rouge River in Dearborn, Michigan. The Oxbow was infested with EAB, which has infested all of the ash trees. We were interested in studying the soil in the Oxbow and how soil properties are related to ash trees infested by the EAB.

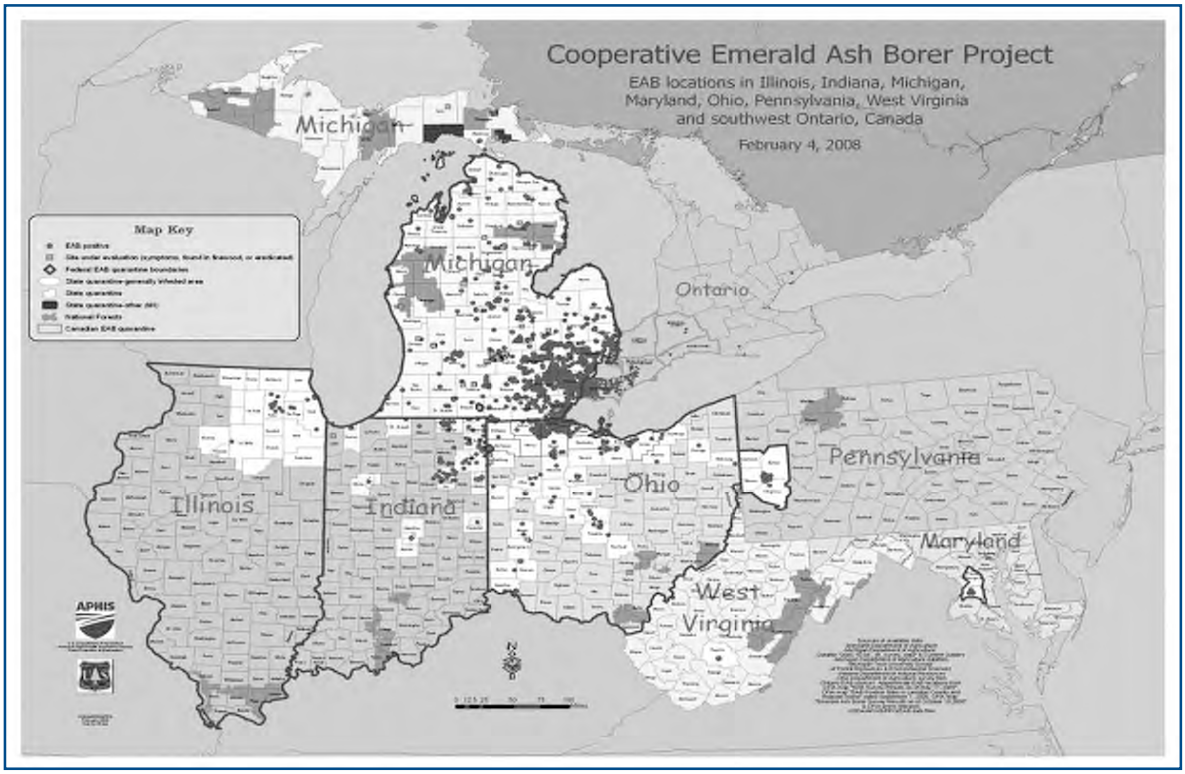


Figure 3. A map of EAB infestations. The areas in gray show where the EAB has been found.

Reflection Section

From what you read so far, do you think the EAB problem will improve worsen, or stay the same? Why?

What was the question the student scientists wanted to answer?

Method

We collected our data from the Oxbow area in Greenfield Village, which is part of The Henry Ford, located in Dearborn, Michigan **(figures 4, 5, and 6)**, during the week of November 28, 2007. Our data consisted of soil samples taken underneath various trees, including ash trees.

We tested the pH levels of the soil samples by using a pH kit and pH paper. The equipment we used included a shovel to dig up the dirt, bags to hold the dirt, a pH kit to test the pH levels, pH paper to also test the pH levels, test tubes, and **distilled water.** The variables we studied were the pH levels in the different soil samples.

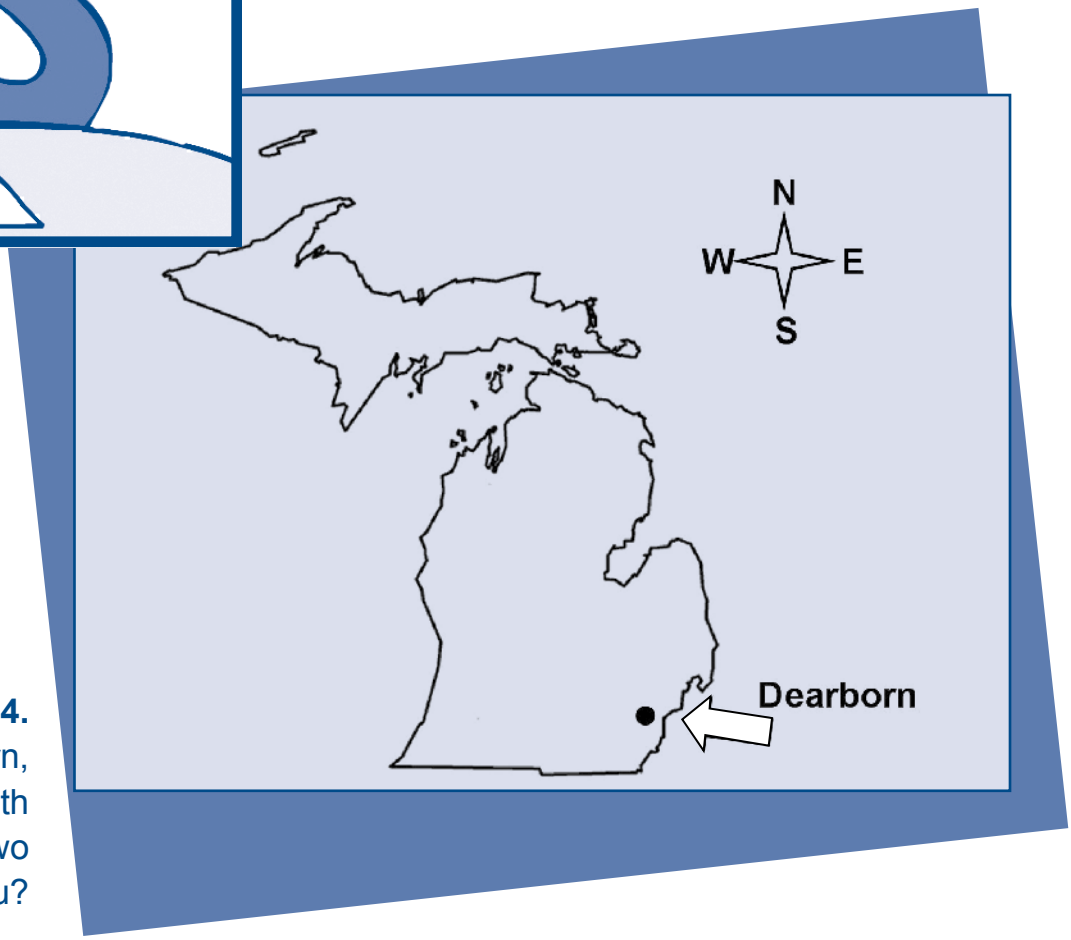


Figure 4.
Location of Dearborn, Michigan. Compare this with figure 3. What do these two maps together tell you?

Figure 5. Greenfield Village is a living history village.

Figure 6. The Oxbow is a natural area and a part of Greenfield Village.

Altogether, we took seven different soil samples from under each of seven different trees. The soil was taken from around the following trees: two different dying ash trees, a sugar maple, a hackberry, a cottonwood, a sycamore, and a box elder tree **(figures 7-12)**. The pH was the unit of measure. We analyzed our data by using the pH kit and the pH paper to determine the pH levels in the different soil samples.

The pH scale is a measure of the degree of **acidity** or **alkalinity** of the soil. The pH scale has 14 divisions ranging from 1 to 14. At the midpoint of this scale, 7, soil is neutral (neither acid nor alkaline). Those between 1 and 6.9 are acidic soils; soils that measure 7.1 to 14 are increasingly alkaline (also called basic). Increments between each number represent a tenfold increase. For example, at pH 5 it is 10 times more acidic than at pH 6. Soil pH of 5.5 to 6.5 is suitable for most plant growth. Gardeners should know the pH of their soil because it affects the availability of plant nutrients. Nutrients become less available at pH extremes.

Figure 7. Ash tree.

Figure 8. Sugar maple tree.

(Note: All photos courtesy of bugwood.org and forestpests.org)

Figure 9. Hackberry tree.

Figure 10. Cottonwood tree.

Figure 11. Sycamore tree.

Figure 12. Box elder tree.

We also determined the amount of **phosphorus**, **potassium**, and **nitrogen** in the soil. The soil testing kit enabled us to identify these amounts as low, medium, or high. We tested these amounts for all seven soil samples.

Reflection Section

What might be an advantage of taking 7 soil samples from under each tree, instead of taking just 1 or 2 samples?

Look at the photos in figures 7-12. What is one common feature of all of these trees?

Findings

As the chart shows below the only real difference in the data is the pH levels collected with the pH kit. From the data that was collected it is clear that soil samples 1 and 7 seem optimal for plant growth. The interesting aspect of this finding is that 1 and 7 were the samples collected near infected ash trees while all the other samples were from areas free of infected trees. However, the conclusion that the EAB is making the soil better for other plants to grow in cannot be drawn from these results as of yet. It is important to conduct more research to better understand the relationship between soil pH and ash trees affected by EAB.

Reflection Section

Are you surprised at the student scientists' findings? Why or why not?

What might you conclude about the EAB and soil properties from these findings?

If you had an opportunity to repeat this research, what might you do differently?

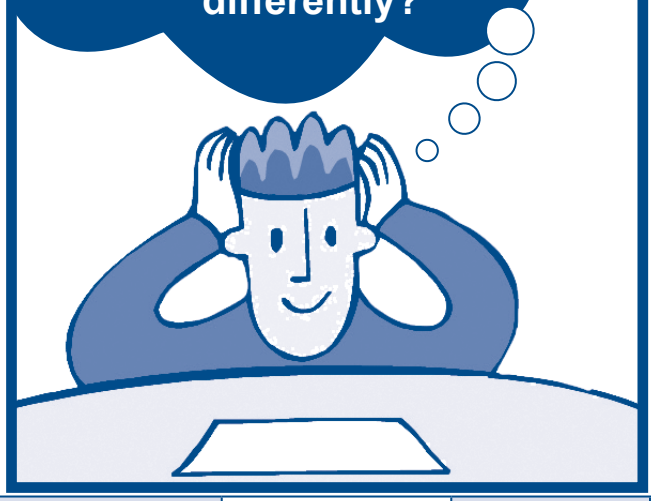


Figure 13. This table shows the results of our research. The level of phosphorus, potassium, nitrogen, and pH for the seven soil samples.
L=Low M=Medium H=High

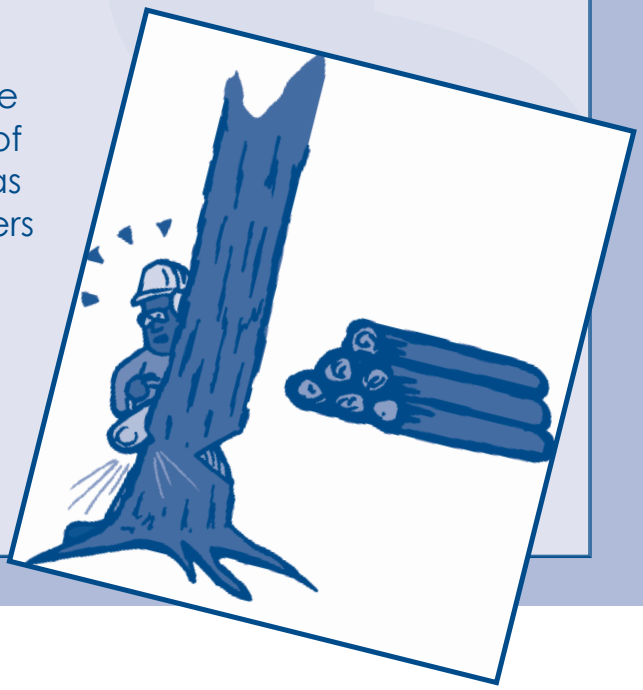
	Phosphorus	Potassium	Nitrogen	pH Kit	pH Paper
Soil Sample 1	L	H	L	6.5	6.0
Soil Sample 2	M	M	L	7.5	6.0
Soil Sample 3	M	H	L	7.0	6.0
Soil Sample 4	L	H	L	7.0	6.0
Soil Sample 5	M	H	L	7.5	7.0
Soil Sample 6	L	H	L	7.5	6.0
Soil Sample 7	L	H	L	6.5	6.0

EAB
Effects on the Economy

Almost 114 million board feet, worth $25.1 billion, are produced from ash trees grown in northeastern U.S. Therefore, it's easy to see the potential danger and problems the EAB can cause. Ash trees are used in making of all sorts of things from cabinets to baseball bats for Major League Baseball. The EAB can have quite a large impact on the economy. The local economy has already been impacted as over 300 million ash trees that have been planted for landscaping purposes must be removed because of EAB.

However, the EAB is actually supposed to have a larger negative impact on the economy in Ohio than in Michigan. This is because Ohio has more ash trees and a greater variety of them. Ash trees contribute more than $20 million of Ohio's annual revenue, and without most of these trees it's easy to see the hefty cost of losing them. Over the next ten years the EAB is projected to cost over $20 million in damages in Ohio alone.

Detroit newspapers have previously said that because of the EAB infesting so many of the urban trees, the cost of removing the trees has forced property owners to take out second mortgages.



Discussion

Among other places, the EAB has been detected in 52 different counties in Ohio. There are some possible solutions for the ash tree-eating beetles. Foresters have destroyed the infested trees and quarantined counties where the infested trees are found to slow down the spread. This is not the only way that the government has tried to stop the spread.

There are three parasitic wasps that could possibly help control the EAB population. One type of wasp is the stingless parasitic wasps that are native to China. A possible solution to the problem may be the release of stingless **parasitic** wasps that are native to China **(figure 14)**. The tiny female wasps insert their eggs through the bark into or on the EAB larvae. The larvae that hatch out of the eggs then eat the damaging EAB **larvae**. **Entomologists** in Michigan have been experimenting with the Chinese wasp and have bred thousands of them, ready and waiting to be released. They are planning to release the wasps in Michigan where EAB has hit the hardest in order to investigate the success of using these wasps.

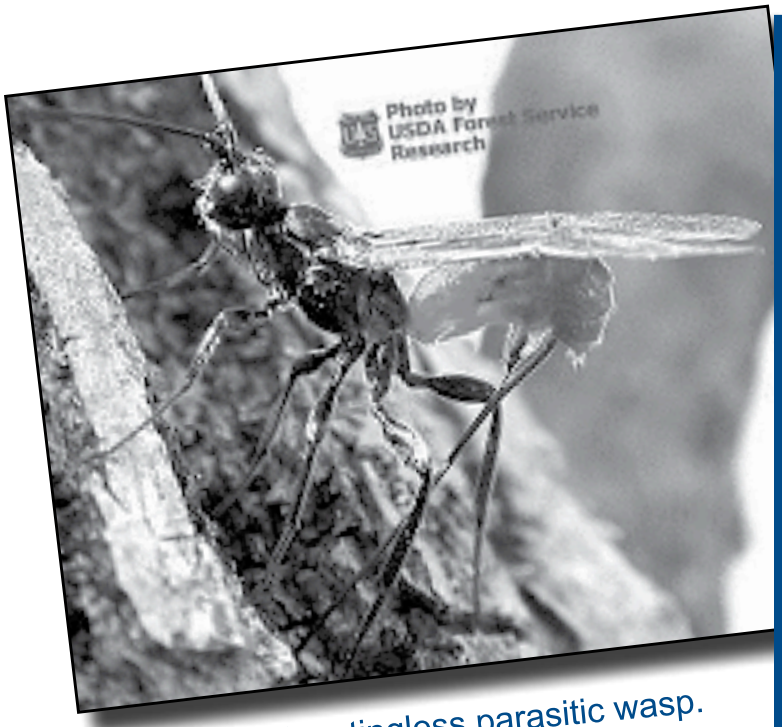
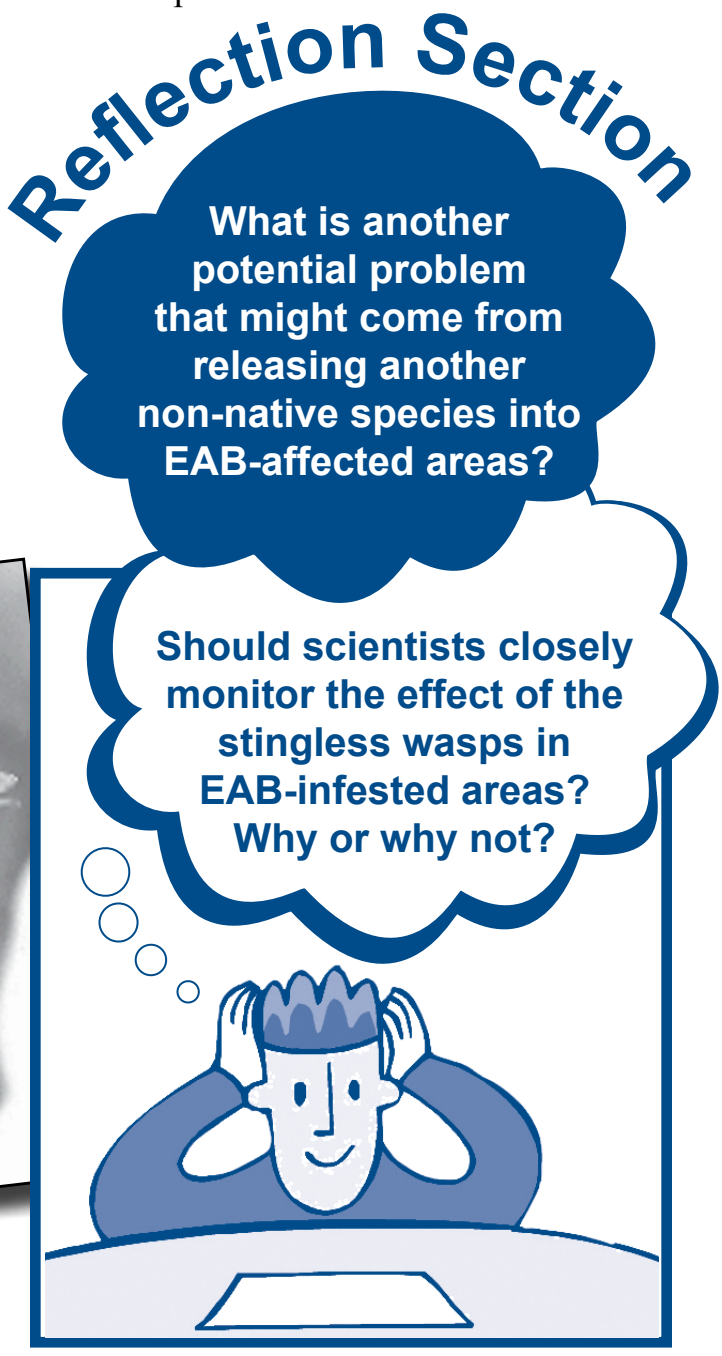


Figure 14. The stingless parasitic wasp.



FACTivity

In this FACTivity, you will explore soil just like the student scientists. The question you will answer is what is the soil profile like near my school or home?

Background: If you look in a soil pit or on a roadside cut, you will see various layers in the soil. These layers are called soil horizons. The arrangement of these horizons in a soil is known as a soil profile. Soil scientists, who are also called pedologists, observe and describe soil profiles and soil horizons to classify and interpret the soil for various uses.

Soil horizons differ in a number of easily seen soil properties such as color, texture, structure, and thickness. Other properties are less visible. Properties such as chemical and mineral content, consistence, and reaction require special laboratory tests. All these properties are used to define types of soil horizons.

Soil scientists use the capital letters O, A, B, C, and E to identify the master horizons, and lowercase letters for distinctions of these horizons. Most soils have three major horizons -- the surface horizon (A), the subsoil (B), and the substratum (C). Some soils have an organic horizon (O) on the surface, but this horizon can also be buried. The master horizon, E, is used for subsurface horizons that have a significant loss of minerals. Hard bedrock, which is not soil, uses the letter R.

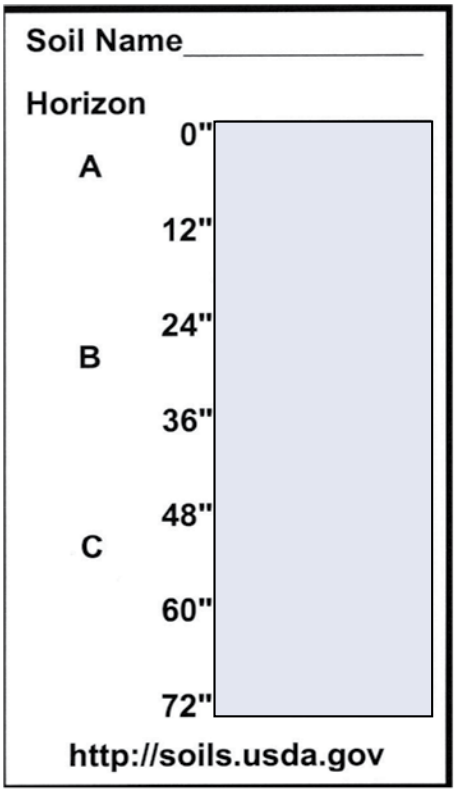
The method you will use is:

1. Get a copy of the soil profile card.
2. Attach some double-sided tape to the card. One inch, carpet tape is preferable.
3. Go out into the school yard and find a place where you can see the layers of the soil. If an area like this is not available, you may dig a small hole down into the ground to reveal the layers of soil.
4. Take a small sample of each layer of soil and pull back the sticky tape for the surface layer of soil. Place some soil on the tape to represent the depth of this first layer of soil.
5. Pull back the tape for each additional layer of soil and repeat the same procedure.
6. Properly dispose of any remaining tape.
7. The soil card can now be placed in an envelope or small plastic bag for protection.

8. You may want to repeat this activity at several different locations and compare the soil depths.

9. You may also want to create a drawing of a hill slope or the landscape to go along with this soil card.

10. After you have finished your soil cards, you can compare your cards with your classmates. Are they similar? Different? Why?



This FACTivity is from The United States Department of Agriculture Natural Resources Conservation Service.

A larger reproducible soil card is on the next page.

PLT

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

For more information about this activity, visit http://soils.usda.gov/education/resources/k_12/lessons/profile/

Student Article Citations

www.semired.org/ash

www.inspection.gc.ca/eng

www.saveqourash.info

www.emeraldashborer.info

www.michigan.gov/eab

www.ohioagriculture.gov/eab

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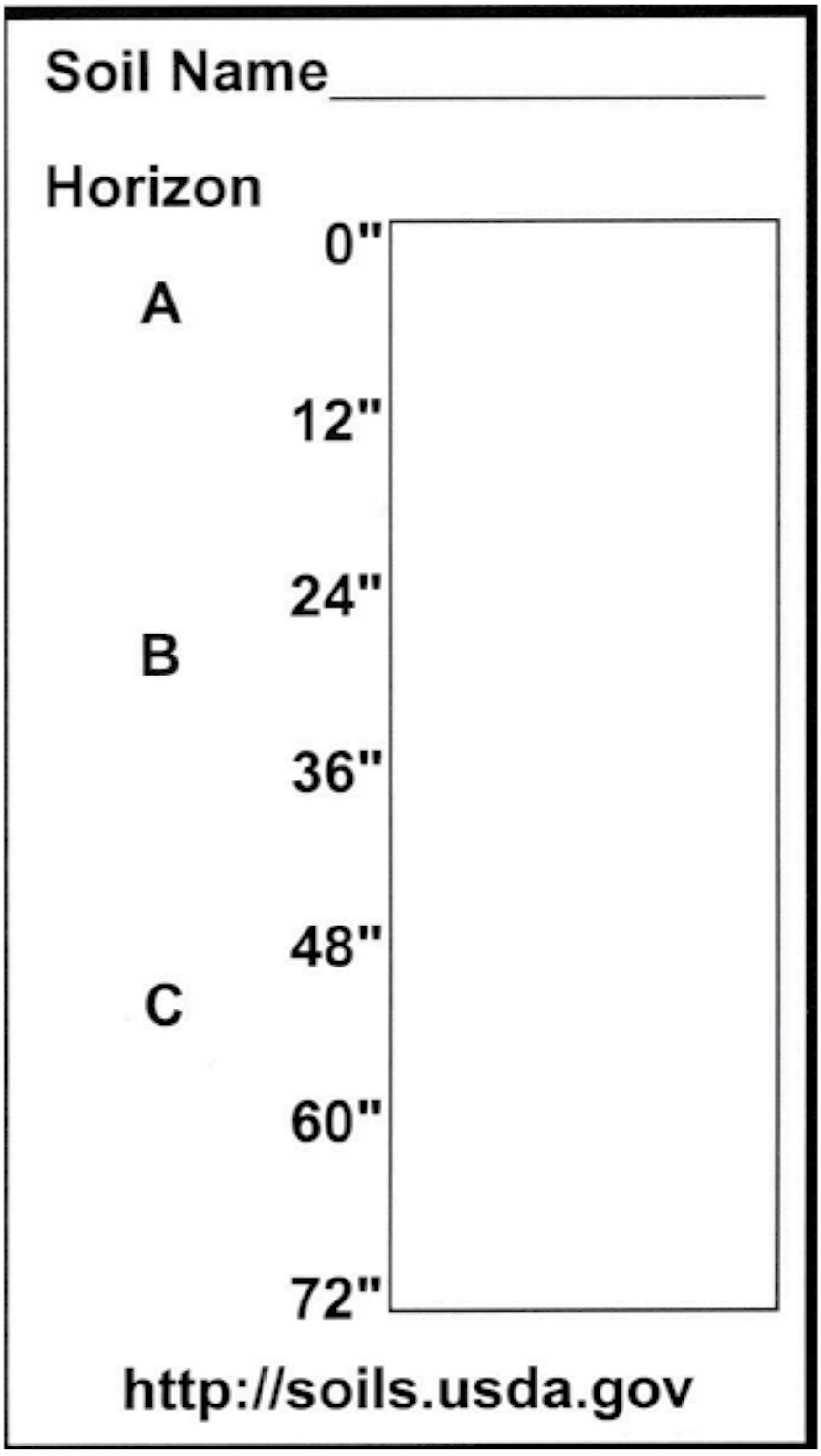
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Horizon
0"
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12"
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