OHIO 4-H | PROJECT IDEA STARTER

Viruses, Bacteria and Fungi, Oh My! Become a Plant Health Investigator

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Can you remember the last time you were sick? You likely picked up a germ by breathing it in or getting it on your hands and transferring it to your mouth. To recover, you needed rest and plenty of fluids, and maybe even medication prescribed by your doctor. Plants get sick in much the same way. Germs spread from plant to plant, in the air or in water. Fortunately, plants also have doctors, called plant pathologists, who diagnose disease and recommend cures.

So, who calls plant doctors? Farmers, for one, but also foresters, horticulturists, teachers, biologists, greenhouse growers, and anyone else interested in keeping plants healthy. Plant pathologists protect plants from insects, diseases and weeds.

How Plants Get Sick

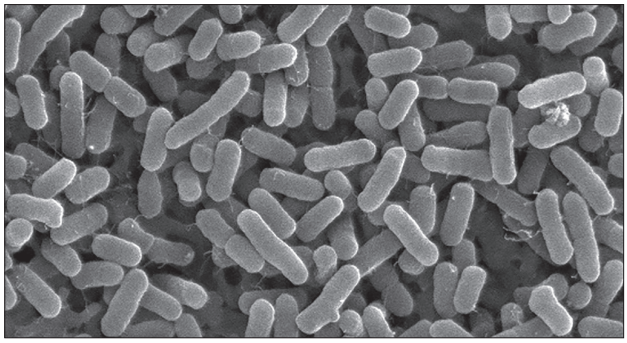
Plants become unhealthy in two ways: by disease or by injury. A disease is a change in plant growth due to a sickness-causing organism or by less-than-ideal growing conditions. Injury is a weakness in a plant caused by an immediate event such as a lightning strike, hail damage, or mechanical damage. For example, getting too close to a tree while mowing the grass might cut the bark. This cut is an injury that opens the plant to disease, similar to skin cuts on humans. We keep cuts clean by washing with soap and water and using a bandage. We can do a lot to keep injuries on plants clean, but it is pretty hard to cover up injuries to plants with bandages!

PLAN YOUR PROJECT

Use this idea starter AND publication 4-H 365 *Self-Determined Project Guide* as the starting place for your 4-H self-determined project. The *Self-Determined Project Guide* is available from your county OSU Extension office or on the Web at **ohio4h.org/selfdetermined**. You may choose to do a little or a lot depending on your level of interest. Be sure to register your project with your county OSU Extension office.

Once disease settles in, it is classified as either noninfectious or infectious. Noninfectious, or abiotic, diseases do not spread from plant to plant. They are typically caused by some aspect of the plant's environment: a nutrient shortage, too much or too little light, or air pollutants such as car exhaust. Most of the time noninfectious diseases cannot be seen. When a plant is not doing well, always consider its environment first.

Infectious, or biotic, diseases, on the other hand, are caused by germs that are similar to the organisms that cause disease in humans and animals. These germs, which can be viruses, bacteria or fungi, are called pathogens. They can infect any part of a plant: the leaves, stems, roots, fruit, and seeds.



Pathogen:

A virus, bacteria, or fungi that causes diseases in humans, animals and plants.

Three conditions must be present for an infectious disease to develop. There must be a plant capable of getting sick, a germ or pathogen to cause the sickness, and a favorable environment for the germ or pathogen to grow. If any of these elements is missing (plant, pathogen, or environment) the disease cannot grow.

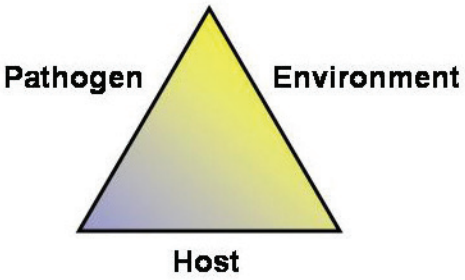
Farmers grow healthy crops by removing one or more of these factors. For example, using a disease-resistant variety lessens the chance of having a plant capable of getting sick. Quick removal of diseased or rotting plant materials lessens the chance of there being a pathogen. Finally, planting at the right time and in the right place lessens the chance of creating an environment for disease.

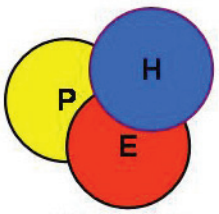
Humans can relate. If we are not in good shape, do not eat right, are exposed to cold weather, and sit by someone who has the flu bug, then we are more likely to get sick. In contrast, if we exercise, eat right, stay warm in cold weather, and wash our hands regularly, we lessen our chances of getting sick.

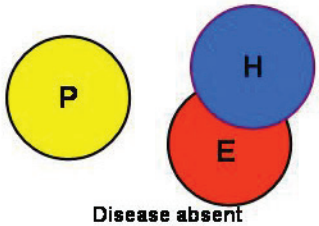
How a Disease Takes Hold

Diseases begin long before there are any visible signs on the plant. First, the germ or pathogen must gain entrance to the interior of the plant, either through a wound such as a cut; through a natural opening on a leaf, stem, or root; or by direct penetration. Next, the pathogen must establish itself in or on the plant. As the pathogen grows and multiplies in or on the plant surface, it is able to spread to other plants.

Successful pathogens also must be able to survive long periods of environmental conditions that they do not like. Sometimes, for example, a pathogen survives the winter by staying dormant in the soil until warmer weather arrives.







Courtesy of The Ohio State University

Sign or Symptom?

Two words that are used when discussing plant disease and injury are sign and symptom. Sign is used when the pathogen is directly observable in or on an infected plant. For example, spores may appear as a fluffy brown or gray mass on a leaf. When this is seen, you are seeing the actual pathogen. Orange ooze coming from the trunk of an apple tree is the actual bacteria, so it too is a sign. Pathogens are not always easy to see, so a magnifying glass can help. Symptoms, on the other hand, are visual or noticeable changes in a plant as the result of disease or injury. Symptoms take some time to develop. Examples include yellow or wilted leaves, dropped leaves or fruit, and stunted growth.

Plant pathology, the study of plant diseases, is an exciting career field that offers the opportunity to make significant contributions to the welfare of humans. Plant pathologists can help solve challenges in providing food for the world's growing population.

AREAS OF INTEREST AND THINGS TO DO

Every self-determined 4-H project can be broken down into areas of interest. These are the specific things members want to address during their project adventures. Using 4-H 365 *Self-Determined Project Guide*, identify at least three areas of interest with at least three activities per area to explore. Take your ideas from the list below or make up your own.

Plant Pathology Basics

- ☐ You can learn a lot about plant pathology simply by learning its special vocabulary. Make a notebook that defines its most common terms.
- ☐ Find out about two or more of the world's first plant doctors. Who were they? What did they discover? When did they discover it? Share what you learned with your project helper.
- ☐ Make a diagram of the three conditions that must be present for an infectious disease to develop. Explain how the absence of any one of the conditions prevents disease.
- ☐ Visit your local grocery store and examine different fruits and vegetables for symptoms and signs of disease. Record your observations in a journal.
- ☐ Give a demonstration to your club or group about plant pathology or about diagnosing a plant disease.

The Plant's Environment

- ☐ One abiotic cause of stress in plants is too much or too little light. Explore the impact of light versus shade on plants that you grow.**
- ☐ Plants consist of 70 percent water. Find out what happens when plants are watered too much and not enough.**
- ☐ Design an experiment that illustrates the differences in some aspect of a plant's environment. What happens when plants receive different kinds of water or different colors of light? What about plants grown in different soils or in different temperatures?

Social and Environmental Issues

- ☐ Humans are often affected by plant disease. Explore one or more of these history-making epidemics: Irish potato famine, Dutch elm disease, chestnut blight, citrus canker, and ergot and the Salem witch trials. Write a brief summary about what you learned.
- ☐ Explain one or more of these current plant pathology issues: genetically modified foods, organic vs. nonorganic crops, agricultural bioterrorism, pollution, acid rain, or pesticide use.
- ☐ Describe the challenges in providing food for all people of the world. What is the role of plant pathology?
- ☐ Use the Internet to find out about common plant diseases in your area. What is in your own backyard? In public areas near you? In your state?
- ☐ Go on a plant disease walk with a 10X hand lens or magnifying glass. Take a close look at a variety of plants, healthy and stressed. Take photos and record your observations in a journal.
- ☐ Expand your plant disease journal (from activity above) by making new observations a week later, two weeks later, etc.
- ☐ Find an article that relates to a current issue in plant pathology in your state or region. Write a one-page reaction that summarizes the major points and that includes your opinion.

- ☐ Develop a poster on one or more of these specific, worldwide plant diseases: powdery mildew, corn smut, dollar spot, apple scab, coffee rust, tobacco mosaic virus, verticillium wilt, leaf spot, crown gall, citrus canker, ergot, fireblight, and leaf rust.

Best Practices

- ☐ Visit a golf course, stadium, or other place with lots of grass. Ask the groundskeeper how the turf is protected from disease.
- ☐ Teach your 4-H club or group members the basics of good plant care.
- ☐ Visit a nursery or public garden and talk with the grower about how plant disease is controlled on the property.
- ☐ Soft rot occurs when fruits and vegetables are damaged, creating an entry point for bacteria. Find out the best way to store vegetables likely to get soft rot.**

***This optional experiment is described in detail on the following pages.*

EXPERIMENTS

When conducting an experiment, note your observations and data in a journal and take pictures before and after.

Light Stress

In cases with no evidence of a pathogen, most plant pathologists assume the cause to be abiotic (the result of something in the plant's environment). This experiment focuses on one possible abiotic factor, the impact of light vs. shade.

Materials

- 4 Styrofoam pots or cups
- 10 corn seeds
- 10 soybean seeds
- 4 labels
- Potting soil
- A large plastic container (dark in color) or a cardboard box

If you do not have soybean seeds, cucumber or pea seeds work great, too.

Procedure

First, poke holes in the bottom of the Styrofoam pots/cups for drainage purposes. Fill each pot with potting soil, leaving about one-half inch of space at the top of the pot. Plant five seeds per pot (two pots with five corn seeds each and two pots with five soybean seeds each). Label the pots as follows: 1–corn light, 2–corn dark, 3–soybeans light, 4–soybeans dark. Include the date on each label. Place the two pots for light on a windowsill or in a place where there is direct sunlight. Place the two pots labeled dark in the same area but with the plastic container/box covering them to block the sunlight. Water the plants until the soil is damp. (Be sure to have something under the pots to collect the extra water.) Write in your journal your prediction of how the plants in the light will differ from the plants in the dark.

Observe your plants twice a week for two weeks. Measure and record the plant height and color and any other data you believe would be useful in determining the role of light on plant growth. At the end of the initial two-week period, move the dark plants to the same location as your light plants (remove the plastic container/box) and continue making observations for an additional week. Record your observations and conclusions regarding the influence of light on plant health.

Water Availability

Plants consist of 70 percent water. Plant roots pick up or absorb water and transport it to the stems and leaves. When plants are watered too much, they become weak and bend over. If plants are not watered enough, they wilt and dry up. It is essential that plants receive the proper amount of water.

Materials

- One 4-inch diameter small clay flower pot with holes in the bottom
- 1 planter box or one 9” x 12” baking pan
- Potting soil
- Lima beans
- String
- 1 paper towel
- Water

Procedure

Fold the paper towel and place it in the bottom of the clay flowerpot. This helps reduce the flow of water out of the pot. Place the clay flowerpot in the corner of the planter box or baking pan. The clay flowerpot stays empty, but the box/pan around it should be filled with 2 inches of tightly packed potting soil. Use three pieces of string to create four rows with the first being very close to the clay pot. Each additional string should be 3 inches away from the one before. Plant the first row of seeds very close to the clay pot by pushing the seed into the soil with your finger. Plant each additional row between the string lines.

Now fill the clay pot with water. Do NOT water the potting soil. Keep the clay pot filled with water so that the soil next to the pot is moist. Predict what will happen by writing notes in your journal. Ask yourself a few questions. Which row of seeds will grow and which will not? Why? Take pictures and keep a record in your journal of what happens each day for the next few weeks.

Soft Rot

Vegetables and fruits are often wounded when they are harvested, transported and stored. These wounds are entry points for bacteria that cause soft rot. Soft rot bacteria causes plant cells to slide apart, resulting is a soft, mushy texture and a strong, unpleasant odor. The goal of this exercise is to determine the role of the environment in the development of bacterial soft rot.

Materials

- Adult supervision
- 1 carrot, 1 potato, 1 cucumber
- Water and paper towels
- 1 paring knife
- 6 one-gallon resealable plastic bags, such as Ziploc bags
- 1 electric fan

Procedure

Cut each vegetable into six pieces. Place one piece of each (cut side up, if possible) into each bag so that each bag has one carrot, one potato, and one cucumber section. Dampen a paper towel and place

one in each bag. Seal three of the bags and leave the other three open. Place one open bag and one closed bag on the kitchen counter at room temperature and one open bag and one closed bag in the refrigerator. Place the last open bag and the last closed bag in another location at room temperature with the fan blowing air across them. Remember to take pictures when your project is set up.

Write in your journal your thoughts about which vegetables will rot the least. What impact does sealing the bags have on soft rot?

Every day of the next week, observe your vegetables, make notes and take pictures. Use the following rating scale to show the amount of soft rot observed: 1=no rot, 2=a little rot, 3=some rot, 4=almost completely rotted and 5=completely rotted. Ask yourself these questions: What happened to each bag of vegetables? How do the vegetables look and smell? Based on your results, what can be done to prevent soft rot? Can you recommend a good storage method?

RELATED RESOURCES

The American Phytopathological Society, **apsnet.org**

United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS), **aphis.usda.gov**

Ohioline, **ohioline.osu.edu**

Ohio Agricultural Research and Development Center, **oardc.ohio-state.edu**

Ohio Integrated Pest Management, **ipm.osu.edu**

Ohio Department of Agriculture, **agri.ohio.gov**

Ohio State University Extension, **extension.osu.edu**