PLANTS GET SICK, TOO!

A Plant Pathogen Investigation

Mentor's Guide: An Overview

Expect teachers to adapt the module for their students:

School facilities or resources may make some experimental designs challenging. The equipment available and class experience with inquiry learning will influence the direction investigations take. Student motivation also plays a role in these investigations.

Connect with your teams' teacher via the **Classroom Group** for details about the students and teacher's goals and schedule.

Please see the **Plants Get Sick, Too!** and the **Tree-mendous Benefits of Trees Teachers' Guides** for learning goals, suggested sequence of activities, and schedule planner.

The **purpose of this tip sheet** is to help you as a scientist mentor **anticipate and respond** to students as they post online about their plant pathology-related investigations. The initial guided inquiries for this module may include learning how to inoculate potatoes with soft rot bacteria and determining how lesions develop. For the guided inquiry, they will inoculate surface-disinfested potatoes and measure lesions over the course of a week. In the second,. After these guided inquiries, students will need to develop research questions to address their knowledge of the disease triangle with **potato soft rot** investigations. Your role as a mentor is to guide students through this process.

Because plant pathogens cannot be shipped from state-to-state, teachers will need to isolate the soft rot pathogen (*Pectobacterium carotovorum* subspecies *carotovorum* (Pcc)) prior to inoculation of potatoes in the classroom by the students. Roughly, this is done by buying potatoes at the store, cutting and soaking the pieces in water in resealable bags, then saving the bacterial suspension. Please see the Teacher's Guide for more detailed information. You may be asked to provide support with this process.

Students will be encouraged to review the disease triangle again and tasked with coming up with a research question (how to get bigger lesions faster, how to get smaller lesions, etc.), and they need to develop and test their hypotheses. Students can test different potato varieties, vegetables, different environments, etc. Depending on equipment available, students could make macro- or microscopic observations: view cells with microscope, measure lesions over time, etc. Your role as a mentor is to guide them on this journey, and keep in mind that these students may be inexperienced in recording and analyzing data and s may need help with such tasks.

Juicy Questions for student investigations:

- What are optimal conditions for bacterial growth?
- Does the type of potato affect lesion development? Why?
- Was there an optimal strategy for measuring lesions?
- What, exactly, is the "goo" leftover inside the lesions?
- What do farmers do to reduce infection by potato soft rot pathogens?
- Are there other diseases in crops that affect your refrigerator or growers' wallets?

Video Resources:

Soft Rot in the Field (Dr. Amy Charkowski): https://youtu.be/cD6Ls8gmCoA

Cornell University Plant Pathology Photo Lab: https://youtu.be/guRE1qMZyC0

Potato Soft Rot Bacteria at 400x (Dr. Lou Hirsch): https://youtu.be/SB31hT5ryFU

What are students thinking when it comes to plant pathology?

As students post about their investigations, they reveal their ideas. Many students are not aware that plants get sick, and while they may know animals can fight disease, students are unaware that plants do have defense mechanisms. You may find that you need to draw similarities between plant and human diseases. It is common for students to believe…

- that plant products are alive and have defense mechanisms,
- food magically shows up at the grocery store,
- crops never get sick,
- crops do not need disease management strategies (pesticides, cultivar selection, etc.),
- there is little diversity in plant pathogens – like botrytis on strawberries in the fridge – that can cause disease, or
- surfaces of food (and humans!) are sterile and free from microbes.

Attending to students' ideas and thinking

By attending to students' thinking, attention shifts from a right-answer orientation to uncovering student ideas and reasoning. As experts, we often make assumptions about what a student is meaning and connect concepts in ways novice learners cannot. Assumptions are often turned on their heads when probed. Also, responding as a naïve mind opens up possibilities in the discussion. Although students often learn by rote that food comes from farmers – in an abstract way, they have little experience with the concept of plant stress or disease/pest management. **What do farmers do when plants "get sick"? Can farmers protect plants from pests?** This process of armchair inquiry, or **digging into juicy questions**, is a highly valued process in science.

Resources and References

- Hirsch, R. Louis, Miller, Seth, and Halterman, Dennis. "An Inquiry-Based Investigation of Bacterial Soft Rot of Potato." *The American Biology Teacher*, Vol. 80, No. 8, pp. 594–599, ISSN 0002-7685, electronic ISSN 1938-4211. DOI: https://doi.org/10.1525/abt.2018.80.8.594.
- Dr. Hirsch's website: https://www.drlouhirsch.com/an-inquiry-based-investigation-of-b

- *Teachers say it is hard to find accessible, scientifically accurate background information for students. Are there resources you recommend?*