

Teacher Guide

Beech Leaf Disease at Huston-Brumbaugh Nature Center

Vocabulary – Blooms Taxonomy

Abstract:

Hannah Mitchell, a Brumbaugh Scholar at the University of Mount Union, investigated how the nematode *Litylenchus crenatae mccannii*—the cause of Beech Leaf Disease (BLD)—might be spreading through the air. Using spore traps placed near healthy American beech trees, she collected airborne particles and tested them for nematode DNA using PCR and gel electrophoresis. Her results consistently showed the presence of nematode DNA on the traps, suggesting that aerial transmission is possible. To further explore this, she also monitored uninfected saplings placed near the traps for signs of infection. While her findings support the idea that nematodes or their genetic material is airborne, more research is needed to determine whether they travel independently or with a vector. Hannah's work helps scientists better understand how BLD spreads and opens new questions about its transmission pathways.

Ohio High School Science Standards

Biology:

B.DI.1: Cells and cellular processes: Understanding how nematodes affect plant cells and tissues.

B.DI.2: Genetic mechanisms and biotechnology: Use of PCR and gel electrophoresis to detect DNA.

B.EC.1: Interdependent relationships in ecosystems: Investigating how parasitic nematode affects forest ecosystems.

B.EC.2: Cycles of matter and energy transfer in ecosystems: Impact of leaf damage on photosynthesis and energy flow in trees.

B.SI.1: Scientific inquiry and experimentation: Designing and conducting experiments using spore traps and molecular tools.

Nature of Science (Grades 9–12)

- Scientific knowledge is based on **empirical evidence** derived from observation and experimentation.
- Science is influenced by **historical and current events**, and it is conducted by people from diverse backgrounds.
- Scientific understanding can change based on **new evidence**.
- Scientists use **multiple methods** to investigate questions and communicate findings clearly.

Tier 1 – Basic Everyday Terms

These are common words students likely already know.

Tree: A large plant with a trunk, branches, and leaves.

Leaf: The part of a plant that collects sunlight for photosynthesis.

Worm: A small, soft-bodied animal, often found in soil.

Air: The invisible gas we breathe, made up of oxygen, nitrogen, and other gases.

Tier 2 – Academic Vocabulary

These words are used across subjects and help students understand concepts more deeply.

Hypothesis: A testable idea or explanation that leads to scientific investigation.

Observation: Using your senses or tools to gather information.

Evidence: Data or information that supports a conclusion.

Vector: Something that carries and spreads a disease or organism.

Transmission: The way something spreads from one place or organism to another.

Tier 3 – Domain-Specific Science Terms

These are specialized terms used in scientific contexts.

Nematode: A microscopic roundworm, some of which are plant parasites.

***Litylenchus crenatae mccannii*:** The specific nematode species that causes Beech Leaf Disease.

PCR (Polymerase Chain Reaction): A lab technique used to make many copies of a specific DNA segment.

Gel Electrophoresis: A method for separating DNA fragments by size using an electric current.

DNA Amplification: The process of making many copies of a DNA segment.

Spore Trap: A device used to collect airborne particles like spores or microscopic organisms.

Spore Trap: Using a microscope to view very small objects or organisms.

Answers to Guiding Questions

Guiding Questions for Students:

1. Compare the two maps showing Beech Leaf Disease symptoms. What differences do you notice in the number or location of affected areas? What might this tell us about how the disease is spreading over time?

The first map shows fewer areas with reported BLD symptoms, while the second map shows more widespread and intense outbreaks. This suggests that the disease is spreading over time and affecting more regions. The increase in affected areas could mean the nematode is moving through new pathways—possibly through the air, water, or with the help of animals or humans.

2. What was Hannah’s research question?

Can the nematode that causes Beech Leaf Disease be spread through the air?

3. Why did Hannah use both DNA testing and microscopy?

Hannah used DNA testing to detect the presence of nematode DNA on the spore traps and microscopy to visually confirm what was collected..

4. What does PCR help scientists do?

PCR (Polymerase Chain Reaction) helps scientists make many copies of a specific DNA sequence so they can detect even tiny amounts of DNA.

Data Interpretation:

5. Does finding nematode DNA in the air prove that the nematodes are floating on their own? Why or why not?

No, it doesn’t prove they are floating on their own. The DNA could be attached to dust, insects, or other particles. More research is needed to find out if the nematodes are airborne by themselves or using a vector.

6. What are some possible “vectors” that could carry nematodes through the air?

Possible vectors include insects, birds, wind-blown dust, or even rain splash. These could help move the nematodes from one tree to another.

7. How does Hannah’s research help scientists better understand Beech Leaf Disease?

Hannah’s research shows that the nematodes that cause Beech Leaf Disease may be present in the air, not just in soil or water. By using spore traps and DNA testing, she found nematode DNA floating in the environment. This suggests that the disease might spread through the air or by another carrier, like insects or dust. Her work helps scientists think about new ways the disease could be moving and how to stop it from spreading.

Your next steps as a scientist:

8. Science is an ongoing process. What new question(s) should be investigated to build on Hannah's research? How do your questions build on the research that has already been done?

One new question that could be investigated is: *Are insects or other organisms helping to carry the nematodes through the air?* Another question might be: *Can nematodes survive and stay infectious while airborne, or do they need a host?*

These questions build on Hannah's research because she already showed that nematode DNA is present in the air. The next step is figuring out *how* the nematodes are getting there and whether they're still alive and able to infect trees. This would help scientists better understand how Beech Leaf Disease spreads and how to stop it.

Citation:

1. **Mitchell, H. & Smith, J. (Summer 2024).** *Beech Leaf Disease*. PPT presentation. Brumbaugh Scholar Program. University of Mount Union, Alliance, H 44601