Lesson Title: What Makes a Healthy Soil?

Grade Level: 9-12

Subject Area: Horticulture

Duration: *120 minutes, over two class periods*

Standards Addressed: CTE Agriculture and Natural Resource Standards C2.1, C10.1; Next Generation Science Standards HS-ETS1-3

Activity/Lesson Objective:

- Students will observe and describe differences between natural soil and growing media used in horticulture, and discuss when each is appropriate.
- Students will conduct basic hands-on tests (e.g., jar test, pH test, infiltration test) to assess soil.
- Students will describe how practices like proper mulching, compost incorporation, and minimal compaction improve soil function in landscapes.

Engagement Activity: Comparing Soil and Growing Media (15 minutes)

Materials:

- Sandwich-size sealable bags (one per student)
- Several types of growing media (approximately 1 cup of each)
- Paper plates (one per student, plus a few extras)
- Magnifying glasses (optional)
- Gloves (optional)

Preparation:

- Prior to the lesson, distribute sealable bags to each student with the following written instructions:
  Return this bag with approximately one cup of soil found near your home. The soil must be collected from 3–4 inches below the soil surface. This will require you to dig down deep to collect a soil sample. Return the soil to (TEACHER'S NAME) classroom by (DATE).

Procedure:

1. Begin by introducing the topic: *"The material we grow plants in can affect everything—from how roots grow to how much water or fertilizer is needed. Today, you'll examine different samples to figure out what they're made of and where they might be best used. As you explore, try to decide: What looks like soil? What might not be? And why would we use one over the other?"*
2. Instruct students to open their sealable bag and pour their soil sample onto a paper plate. Provide several types of growing media. Place all plates on a central table or

around the room as observation stations. Allow time for students to walk around, observe, and compare. Encourage them to touch the samples (with gloves) and look closely with magnifying glasses (optional).

3. Lead a group discussion about the observations. Possible guiding questions:
    - What do you notice about the texture, color, or particle size?
    - Which samples look more natural? Which seem man-made or mixed?
    - Which samples feel heavier or lighter? Why might that matter for growing plants?
    - Where do you think each sample would work best—potted plants, gardens, greenhouses, farms?
4. After students share their thinking, share these definitions:
    a. Soil: The natural medium on the surface of the earth composed of minerals, organic matter, water, air, and various organisms, in which plants typically grow.
    b. Soilless growing media: A manufactured mix used in horticulture, especially in containers. Often made from materials like peat moss, perlite, coconut coir, or bark.
5. Revisit the samples and identify together which were soil and which were soilless.

Explore: Soil Tests

Instructors may select from the soil tests below to examine different aspects of soil health. For the most accurate and meaningful results, students should use soil from the same plot of land for all tests. Before beginning, students should collect enough soil to complete each planned lab activity.

Texture Test (15 minutes for test, check results 24 hours later)

Materials:

- Hand trowel
- Soil samples (one per group)
- Clear pint-sized jar with lid, twist-top gelato containers are a great option (one per group)
- Water
- Soil Exploration Lab Worksheet

Guiding Questions:

- How do we assess soil texture?
- Why is soil texture important?

Procedure:

1. Begin by introducing the activity: *“Today we’re going to test the soil samples you collected earlier to find out what type of soil we’re working with. By using a simple jar test, we’ll observe how much sand, silt, and clay is in each sample—and learn how that affects plant growth.”*
2. Using their previously collected soil samples, instruct students to fill a jar halfway with their soil sample, then add water until the jar is nearly full. Seal the jar and shake it well to break apart clumps.

3. Leave the jar undisturbed for 24 hours to allow the layers to fully settle. After 24 hours, have students observe and measure each layer in centimeters: Sand will be at the bottom, silt in the middle, and clay at the top.
4. Ask students to identify which soil type is most dominant and discuss what that tells them about their sample.
5. Conclude with a class discussion where students share their findings and reflect on methods that could be used to amend or change soil texture. Ask guiding questions such as: How might knowing the soil texture affect plant selection, frequency of irrigation, or other gardening decisions?

pH Test (20 minutes)
Materials:

- Soil samples (one per group)
- pH test strips (one per group)
- Clear plastic cups (one per group)
- Stir stick or spoon (one per group)
- Distilled water
- Soil Exploration Lab Worksheet

Guiding Questions:

- How do we measure pH?
- How does pH affect plant growth?

Procedure:

1. Begin by introducing the activity: *"Today we're going to test the pH level of different soil samples to learn how soil chemistry affects plant health. Each group will use their sample from the previous activity to determine if their soil is more acidic, neutral, or basic—and what that means for growing different types of plants."*
2. Place about 1/2 cup of soil into a clear plastic cup. Add enough distilled water to cover the soil—about equal parts soil and water. Stir the mixture thoroughly and let it sit for 5–10 minutes to allow solid particles to settle.
3. Insert a pH test strip into the water, then remove and compare it to the color chart. Record the pH result on your lab worksheet.
4. Compare and analyze as a class: Which sample was most acidic? Which was most basic?
5. Conclude with a class discussion about how soil pH affects plant health. Discuss how pH levels can be altered using soil amendments (like lime to raise pH or sulfur to lower pH). Explore how different plants prefer different pH levels—for example, blueberries thrive in acidic soils, while most vegetables prefer a neutral range. Ask students how knowing the soil pH might influence plant selection, fertilizer choices, or other gardening decisions.

Infiltration Test (20 minutes)
Materials:

- Large metal can with both ends removed, check with your foodservice team (one per group)
- Ruler or measuring tape (one per group)
- Stopwatch or timer (one per group)
- Water, enough to fill the can about halfway
- Soil Exploration Lab Worksheet

Guiding Questions:

- How do we measure soil infiltration?
- What does soil infiltration tell us about soil health?

Procedure:

1. Begin by introducing the activity: *"Today we're going to investigate how quickly water soaks into different soils, a property called infiltration. This helps us understand how soil texture and health affect how water moves through the ground."*
2. Have students take their infiltration cylinder to the location where their soil sample was collected. Guide them to gently press the can straight down into the soil. If needed, carefully use a mallet or block of wood to tap the can until it's inserted about 1-2 inches deep.
3. Add enough water to fill the can up to half its depth (For example, if the can is 6 inches tall, add 3 inches of water). Start the stopwatch as soon as the water is added.
4. Observe how quickly the water soaks into the soil. Record the time it takes for the water to completely soak in.
5. After the experiment, compare the results as a class. Which sites had faster or slower infiltration? What does this tell us about the soil at those locations? Encourage a class discussion about the possible reasons behind the infiltration rates. For example, soils near trees or under plants might have more organic matter, which can improve infiltration. Similarly, compacted soil in high-traffic areas may have slower infiltration.

Explain: What Makes a Healthy Soil? (30 Minutes)

Materials:

- What Makes A Healthy Soil? Google Slides Presentation
- What Makes A Healthy Soil? Guided Notes

Procedure:

1. Begin by reviewing the slideshow and ensuring familiarity with the content. Hand out the guided notes to each student.
2. As you present each slide, pause periodically to allow students to fill in their guided notes. Highlight key points, provide additional context, and encourage student interaction by asking questions or prompting discussion.

3. At the end of the slideshow, review the key concepts covered in the presentation. Go over the notes with the class, ensuring that students have accurately filled in their guided notes.

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5. Evaluate: If…Then… Soil Health (20 minutes)

Materials:

- If…Then…Soil Health Graphic Organizer

Procedure:

1. Introduce the assessment activity: *"You've now tested your soil's texture, pH, and infiltration rate. Use your charts to reflect on what the results tell you about soil health, and think about what could be done to improve it. For each 'If' statement, write a 'Then' statement suggesting a specific way to improve soil health. Imagine you are advising a homeowner on how to make their soil better for plants."*
2. Have students complete the If…Then…Soil Health Graphic Organizer, connecting each soil property to potential effects on plant growth and identifying practical improvements.
3. After finishing the chart, students should write a 3–5 sentence recommendation summarizing how to improve the health or performance of their soil sample. Remind them to reference evidence from their soil tests and to include at least one practical soil management technique, such as adding organic matter, adjusting pH, mulching, or improving drainage. Circulate to ensure responses are logical, evidence-based, and clearly explained.

Criteria for Success:

- *If…Then…* statements accurately connect possible test results with specific strategies for improving soil health.
- Recommendation paragraph features correct terminology, such as infiltration, organic matter, compaction, pH, plant nutrients, etc.
- Work shows thoughtful application of concepts from the lesson and soil tests.