What's In My Soil?

NC Standards ESS.6.3.1 & ESS.6.3.2

Activity Description & Estimated Class Time

This series of activities consists of three different parts. Each part can take between 30-60 minutes. During the first part, students will play fun, interactive online games related to soil health. During the second part, students receive a brief introduction to soil contamination via PowerPoint. Finally, students will practice soil testing themselves.

Correlations to NC Science Standards

ESS.6.3.1 Engage in argument from evidence to explain that the good health of humans and the environment requires: monitoring of the lithosphere, maintaining soil quality, and stewardship.

ESS.6.3.2 Obtain, evaluate, and communicate information to compare the implications of sustainable and unsustainable land use practices (including agriculture and deforestation) and the importance of stewardship.

Learning Target

Students will develop an understanding of the following ideas and content:

- The good health of humans and the environment requires monitoring of the lithosphere, maintaining soil quality, and stewardship
- Human behavior can have both positive and negative effects on the environment
- Monitoring and maintaining soil quality ensures the safety and well-being of both humans and the environment
- Stewardship affects the good health of humans and the environment

Brief Science Background

Healthy soils are the foundation of every ecosystem. It's not just "dirt," it's a living system full of minerals, organic matter, microbes, and more. Healthy soils have the right balance of nutrients and the right amount of water to support plant growth. The primary nutrients needed are Nitrogen (N), Phosphorus (P), and Potassium (K). Other nutrients are needed too in lesser quantities. Beyond helping plant growth, good soils can prevent erosion, store carbon, and filter water. Contaminants can enter soil, harming plants, animals, and people. These contaminants can come from both human activities and natural processes. Common soil contaminants include heavy metals, pesticides and fertilizers, industrial chemicals, and pathogens. If these contaminants enter the soil, they can pollute water and make the food growing in it unsafe to eat.

Part 1 - Introduction to Soil Health

Materials

Materials for teacher

- Access to
  - What's In My Soil PowerPoint (Slides 1-5), located at www.ciblearning.org
  - A Forest Begins video (located on PowerPoint)

Materials for individual students

- Computer with access to the internet
- Introduction to Soil Health: Student Activity Sheet, SD1

Procedure

1. Give each student a What's In My Soil Student Activity Sheet, SD 1.
2. Open up What's In My Soil PowerPoint from www.ciblearning.org
3. Play the A Forest Begins video. At the end of the video, ask the students:
    a. What did you notice in the video?
    b. What does the video make you think about?
    c. What questions do you have?
4. Say "Soil health is very important because it supports almost everything we depend on. What are some things we depend on?" As the students brainstorm, write their ideas on the board.
   Some examples may include:
    a. Food Production - Healthy soil provides essential nutrients, water, and structure for plants to grow. Without good soil, crop yields drop and food becomes harder to produce.
    b. Water Filtration - Soil acts like a natural filter. It cleans and stores water as it moves through the ground, helping maintain clean rivers, lakes, and groundwater.
    c. Carbon Storage & Climate Protection - Healthy soil stores large amounts of carbon, helping reduce greenhouse gases and slow climate change.
    d. Biodiversity - Soil is full of life—bacteria, fungi, insects, and more. These organisms help break down organic matter, cycle nutrients, and keep ecosystems functioning.
    e. Preventing Erosion - Healthy soil with strong structure resists wind and water erosion. Degraded soil erodes easily, leading to loss of farmland and damage to waterways.
    f. Plant & Human Health - The nutrients that plants absorb come from soil. Poor soil = poor plant nutrition, which can ultimately affect human health too.
    g. Economic Stability - Farmers rely on healthy soil for sustainable production, and healthy soils reduce costs for fertilizers and irrigation over time.
5. For this part of the activity, inform students that they will explore soil health through three games.
6. Have students log in to https://www.soils4kids.org/games and follow the instructions on SD 1.

Content Connection

Say, "You have had the opportunity to explore different aspects that impact soil health. What do you think are some things that humans do that specifically impact soil health? Think positively and negatively." Conduct a class discussion and inform students that over the next couple of days, we will explore some of these ideas.

Part 2 - Soil Contamination

Materials

Materials for teacher

- Access to What's In My Soil PowerPoint (Slides 6-15), located at www.ciblearning.org

Materials for individual students

- Computer with access to the internet
- Soil Contamination: Student Activity Sheet, SD2

Procedure

1. Remind students that we are looking into soil health. Today, we will focus on specific contaminants in garden soil. Ask students, "Why do you think it is important to focus specifically on garden soil?"
2. Give each student a Soil Contamination Student Activity Sheet, SD 2.
3. Open up What's In My Soil PowerPoint from www.ciblearning.org.
4. Have students fill out SD 2 as the soil contamination video plays.
5. As you talk, give students time to fill in their chart for SD 2. Ask students, "What are we actually talking about when we say garden soil chemical contaminants? Contaminants and pollutants are the same thing. In our case, we are talking about three general categories of pollutants that are likely to end up in garden soil: heavy metals, petroleum compounds, and other organic pollutants. Let's look at these a little more closely.
    a. **Heavy metals** are chemicals that people are most familiar with when it comes to contaminants; some common examples include lead, arsenic, and chromium. Most heavy metals come from industry, livestock, etc
    b. **Petroleum** compounds are defined as the refined products of crude oil, including gasoline, kerosene, diesel fuels, and oils. These come largely from cars, industry, transportation, etc.
    c. The category of **"other organic pollutants"** (organic meaning carbon-based) includes PCBs and PFAS. These come mostly from animal waste, drinking water, industry etc. Now let's go into a little more detail about sources."
6. Ask, "Think back to the video and what you know. Where do these pollutants come from?"
7. Show Slide 8. Say "We know that industry and agriculture produce lots of chemical contaminants that end up cycling through our environment. Out of these, which one surprised you the most and why?" Accept all answers.
   It is important to note that chemical contaminants can also enter into your garden through the use of certain materials, such as railroad ties, treated wood, cars, and trucks. [Pressure-treated wood (from before 2004) = soaked in arsenic → copper sulfate. Railroad ties (from before 2004) = creosote] and lead paint.
8. Say "Scientists want to understand not only where these chemical contaminants might originate from, but also how they can enter our gardens, and how humans are exposed to them. How do you think you could be exposed to these contaminants?"
9. Show Slide 9. Say "The three categories of human exposure are: eating (read examples), absorption (read description), breathing in/inhalation (read description). Of these three, absorption is generally of the least concern. A few contaminants can be absorbed through the skin, but it is possible. Some level of contamination can still

Procedure cont.

be present in plant tissue from uptake. Even if you wash your produce, you could still be consuming contaminants. There is always that risk, if soil or water is particularly contaminated, but that is why it is essential to test your soil. The average home gardener does not consume enough of their own produce to warrant concern about exposure to contaminants in that way.

10. Say, "Why do you think we should care about exposure?" Show Slide 10 and go over.
11. Say, "Whether you test your soil or not, there are many ways of limiting your exposure to contaminants in the garden. Many of the actions fall into these three categories. We are going to do some brainstorming. If we think about some of the sources of contaminants and some of the exposure routes - how contaminants may enter the garden - what are some actions we can take to limit exposure?" Discuss as a class.
    Use slides 11-14 to hold the class discussion.

Content Connection

1. Project Slide 15 and say, "Now you're going to get an opportunity to test what you've learned! Here is a garden scenario. I want you to answer the questions on SD 2, based on this garden.
2. Discuss answers as a class
    a. Where might contaminants enter the garden?
    The roadway, runoff potentially, the fertilizer
    b. What features are protecting the garden from contaminants?
    Hedges/fences, raised garden beds, using compost.
    c. What could you do to make it safer?
    Raise all beds, No pesticides, Wear Gloves, Test soil, Use mulch, wash produce

Part 3 - Test Your Soil

Materials

Materials for teacher

- Instant Lead Testing Kits
- Access to What's In My Soil PowerPoint
- Trowel

Materials for individual students

- Rapid Nutrient Testing Kits
- Food Tray filled with Soil
- Paper towels
- 3 Plastic cups
- 2 spoons
- 2 Droppers
- 2 medicine cups
- Scissors
- Test Your Soil Student Instructions SD 3 (2 for each group)
- Test Your Soil Student Activity Sheet, SD 4 (1 for each student)
- Access to the Soil Scientist videos on www.ciblearning.org
- Something to keep track of time, *provided by teacher
- Distilled water, *provided by teacher

Preparation

Collect soil samples from school grounds and allow it to dry if necessary. Take the soil sample from 2-3" below the surface and take multiple samples and combine together.

Procedure

Day 1

1. Tell students they will have the opportunity to test the soil around the school.
2. Separate the class into eight groups.
3. Give each group the following:
   - Food tray filled with soil
   - spoons
4. Using the spoons, have students break up the soil sample. They should remove any small stones and organic material such as grass, weeds, or roots. Then, students will crumble the sample finely and mix it thoroughly.
5. Half of the class will test Nitrogen (N-purple) and pH (green). The other half will test Phosphorus (P-blue) and Potash (K-orange). Look at the chart below and give the groups the correct materials.

Nitrogen & pH	Phosphorus and Ptash
• 1 cup • Distilled Water • Medicine Cups	• 2 cups • Distilled Water • Medicine Cups

6. Fill each cup with 1 medicine cup worth of soil.
7. Add 5 medicine cups of distilled water, then stir the soil and water together for 1 minute.
8. Allow the mixture to set till the next day.
   The clarity of the solution will vary the clearer the better. However, cloudiness will not affect the test's accuracy.

Day 2

1. Inform students that while they test for their soil, you will run a lead test. Ask what they remember about lead. As the students are testing, follow the instructions for the Lead Soil Check.
   Lead in soil can be harmful to people if they inhale it or ingest it. It can damage the brain and nervous system, especially in young children who frequently come into contact with dust and dirt through mouthing behaviors.
2. Give each group:
   - Test Your Soil Student Instructions, SD 3
   - Test Your Soil Student Activity Sheet, SD 4
   - Paper towels
   - Droppers
   - Scissors
3. Have the students get their mixture from the previous day and allow them to carefully run their tests, ONE AT A TIME. They should record their results on the SD 4 chart.

4. While the students are waiting for their tests to run, have students watch the Soil Scientists videos on www.ciblearning.org and answer the questions on page 2 of SD 4.
5. Once everyone has finished testing, groups should share their results with one another to complete the SD 4 chart.
6. Share the results from the lead soil check with the class and have them record on their chart.

Content Connection

Based on the results, groups will develop a plan to remediate the soil or maintain its health (if it is healthy) and answer the question: What do they think will happen if people do not care about the soil around them?

SD 1
pg. 1 of 2

Introduction to Soil Health: Student Activity Sheet

Name:

As you watch "A Forest Begins" answer the following questions:

1. What did you notice in the video?

2. What does the video make you think about?

3. What questions do you have?

You will explore soil health through three games. Follow the directions for each game.

Soil Tris

1. Click Start and select wheat. What are the four main ingredients of soil?

2. What should the soil structure be for wheat?
    a. Air:
    b. Sand:
    c. Silt:
    d. Clay:
    e. Organic Material:
3. Why do you think air is important?

4. When you are ready to begin, click and drag the soil particles to move them left to right.
5. Play the game again and select potato. What should the soil structure be for potatoes?
    a. Air:
    b. Sand:
    c. Silt:
    d. Clay:
    e. Organic Material:
6. How are the potato soil structure and wheat soil structure different?

Remember: The perfect soil for a potato crop will not be the best soil for the wheat crop.

SD 1
pg. 2 of 2

Introduction to Soil Health: Student Activity Sheet

Amazing Underground

1. What is a soil scientist called?

2. What 5 things are needed in the soil?

3. Why would you not want to collect more nutrients than you need?

4. What were your results?

5. Why is understanding soil composition important?

Survivor Soak

1. What happens if you water the plant too much?

2. What happens if you do not give the plant enough water?

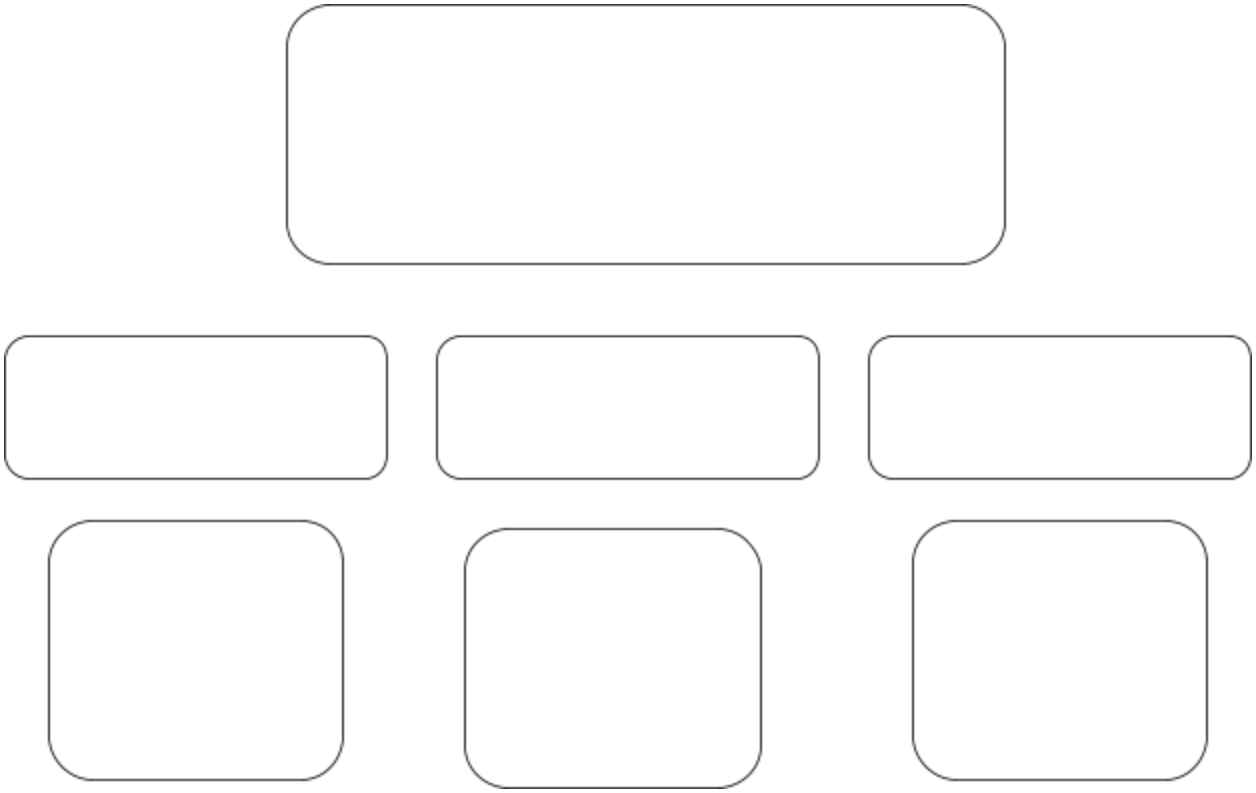
3. What was challenging about the game?

SD 2
pg. 1 of 2

Soil Contamination: Student Activity Sheet

In the chart below, list some of the common soil contaminants and where they come from.

Common Soil Contaminants	Where Do They Come From?



SD 2
pg. 2 of 2

Soil Contamination: Student Activity Sheet

Out of the soil contaminants, which one surprised you the most and why?

How can you be exposed to soil contaminants?

Why should we care about exposure?

In the chart below, list the three categories for limiting exposure and what we can do.

Category	What we can do

Content Connection

1. Where might contaminants enter the garden?

2. What features are protecting the garden from contaminants?

3. What could you do to make it safer?

SD 3
pg. 1 of 2

Test Your Soil Student Instructions

After you complete each step, place a check mark in the square.

Nitrogen

- ☐ Get the **purple** Nitrogen testing container and remove the cap. Make sure the color chart is in place. Place the container on the paper towels.
- ☐ Using a dropper, fill **both** chambers to the fill mark on the chart with the soil sample solution. **Transfer only liquid.**
- ☐ Hold the **purple** capsule horizontally over the smaller chamber. This is the test chamber.
- ☐ Use the scissors to snip off one end of the capsule, then pour the powder into the test chamber.
- ☐ **Carefully**, place the cap back on the container. Make sure it is sealed tightly. Shake gently.
- ☐ Allow the color to develop for 10 minutes. **Do not allow the color to develop for more than 10 minutes.**
- ☐ Compare the solution color in the test chamber to the color chart. Record your results on your student activity sheet.

pH

- ☐ Get the **green** pH testing container and remove the cap. Make sure the color chart is in place. Place the container on the paper towels.
- ☐ Fill the small chamber to the soil fill line with your dry soil sample.
- ☐ Hold the **green** capsule horizontally over the smaller chamber. This is the test chamber.
- ☐ Use the scissors to snip off one end of the capsule, then pour the powder into the test chamber.
- ☐ Using a dropper, fill the test chambers to the fill mark with distilled water.
- ☐ **Carefully**, place the cap back on the container. Make sure it is sealed tightly. Shake gently.
- ☐ Allow the soil to settle and color to develop for a minute.
- ☐ Compare the solution color in the test chamber to the color chart. Record your results on your student activity sheet.

SD 3
pg. 2 of 2

Test Your Soil Student Instructions

Phosphorus

- ☐ Get the **blue** Phosphorus testing container and remove the cap. Make sure the color chart is in place. Place the container on the paper towels.
- ☐ Using a dropper, fill **both** chambers to the fill mark on the chart with the soil sample solution. **Transfer only liquid.**
- ☐ Hold the **blue** capsule horizontally over the smaller chamber. This is the test chamber.
- ☐ Use the scissors to snip off one end of the capsule, then pour the powder into the test chamber.
- ☐ **Carefully**, place the cap back on the container. Make sure it is sealed tightly. Shake gently.
- ☐ Allow the color to develop for 10 minutes. **Do not allow the color to develop for more than 10 minutes.** If flakes of blue color appear to have settled to the bottom after 10 minutes, gently shake the container.
- ☐ Compare the solution color in the test chamber to the color chart. Record your results on your student activity sheet.

Potash

- ☐ Get the **orange** K testing container and remove the cap. Make sure the color chart is in place. Place the container on the paper towels.
- ☐ Using a dropper, fill **both** chambers to the fill mark on the chart with the soil sample solution. **Transfer only liquid.**
- ☐ Hold the **orange** capsule horizontally over the smaller chamber. This is the test chamber.
- ☐ Use the scissors to snip off one end of the capsule, then pour the powder into the test chamber.
- ☐ **Carefully**, place the cap back on the container. Make sure it is sealed tightly. Shake gently.
- ☐ Allow the color to develop for 10 minutes. **Do not allow the color to develop for more than 10 minutes.**
- ☐ Compare the solution color in the test chamber to the color chart. Record your results on your student activity sheet.

SD 4

Test Your Soil: Student Activity Sheet

Name:

In the chart below, record your results from your soil test.

Test	Results
Nitrogen	
pH	
Phosphorus	
Potash	
Lead	

Based on your results, develop a plan to remediate the soil or keep it healthy (if it is).

What do they think will happen if people do not care about the soil around them?