Lesson Plan
1 of 5

Introduction to Soil Health

Created: 07/2025 by the National FFA Organization

Description of Lesson: This lesson introduces students to the concept of soil health and its importance in agriculture and ecosystems. Students will explore the five essential functions of soil. Through hands-on activities and discussions, they will develop an understanding of what makes soil healthy and why maintaining soil quality is essential for food production and environmental sustainability.

Thank you to our current partners in sustainability:

Student Learning Objectives:

After completing these activities, students will …

1. Define soil health and its importance in agriculture and ecosystems.
2. Explain the five essential functions of soil.
3. Analyze soil samples to observe their ability to perform the five essential functions.

Suggested Grade Level:

Grades 9 and 10 (This lesson is written so instructors can scale up or down based on class needs.)

Suggested Time:

60-70 minutes (*Time requirements may vary based upon student understanding and class schedule.*) ***Preparation for this lesson should begin two or three days prior to teaching; see the lesson plan for details on what will need to be prepared.***

Resources/References:

1. Website: USDA NRCS, Soil Health, https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/soil-health

Related Resources:

1. AgExplorer Sustainability Systems Focus Area, AgExplorer.FFA.org/focus/sustainability-systems/
2. Introduction to Sustainability Lesson Series, https://FFA.box.com/v/introtosustainability
3. Darling Ingredients Educational Resources, https://FFA.box.com/s/3ko8e9w6zygohv1ewfsnc8byobjzeuxa
4. Valent — Sustainability in Agriculture Lesson Series, https://FFA.box.com/v/sustainabilityinagriculture

Equipment and Supplies Needed:

1. A copy of the "Five Essential Functions" student activity sheet for each student
2. Teacher computer/projection system to display slides
3. Plastic cups
4. Plastic bottles
5. Graduated cylinders
6. Water
7. Various soil samples
8. Stopwatch
9. Radish seeds
10. Stackable weights (or washers, coins, etc.)

Vocabulary:

1. Buffering
2. Filtering
3. Minerals
4. Organic Material
5. Qualitative
6. Quantitative
7. Soil Health
8. Sustainability

Cross-Curricular Connections:

Science	Mathematics
Perform several tests on a sample of soil to determine whether it has the capabilities of performing the five essential functions of soil.	Perform basic calculations such as percentages and multiplication within the context of lab activities.

SAE and FFA Connections:

1. Agronomy CDE, FFA.org/participate/cdes/agronomy/
2. Environmental and Natural Resources CDE, FFA.org/participate/cdes/environmental-and-natural-resources/
3. Proficiency Areas: Environmental Science and Natural Resources Management, FFA.org/participate/awards/proficiencies/
4. Foundational SAE Connections: Agricultural Literacy

Student Activity Sheets:

Direct access to student activity sheets without lesson plan or answer key for easy upload to a learning management system or printing for classwork.

https://ffa.box.com/s/m654po8e6l0dvqphoiyqcaxqrcuv1ktn (Word)
https://ffa.box.com/s/e3z9jsrhy5gyfdfiqa7hocyatr0uo3ku (PDF)
https://docs.google.com/document/d/1rKiBqqGN4dD-4pVvPxRbPYBoevn3Xb6ltaNQa8gQ6ok/copy (Google)

These Activities Are Aligned to the Following Standards:

AFNR Performance Element

- CS.03. Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
- CS.04. Demonstrate stewardship of natural resources in AFNR activities.
- CS.06. Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.
- NRS.02. Analyze the interrelationships between natural resources and humans.
- NRS.04. Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.

FFA Precept

- FFA.PL-A.Action: Assume responsibility and take the necessary steps to achieve the desired results, no matter what the goal or task at hand.
- FFA.PL-B.Relationship: Build relationships, work as a team player and appreciate the talents of others.
- FFA.CS-M.Communication: Effectively interact with others in personal and professional settings.
- FFA.CS-N.Decision Making: Analyze a situation and execute an appropriate course of action.

Common Career Technical Core

- AG3 Examine and summarize the importance of health, safety, and environmental management systems in AFNR businesses.
- AG4 Demonstrate stewardship of natural resources in AFNR activities.
- AG6 Analyze the interaction among AFNR systems in the production, processing, and management of food, fiber, and fuel and the sustainable use of natural resources.
- AG-NR2 Analyze the interrelationships between natural resources and humans.
- AG-NR4 Demonstrate responsible management procedures and techniques to protect or maintain natural resources.

Common Core – Speaking and Listening

- CCSS.ELA-Literacy.SL.9-10.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

Common Core – Science & Technical Subjects

- CCSS.ELA-Literacy.RST.9.10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Common Core – Math Practices

- CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others.
- CCSS.MATH.PRACTICE.MP6 Attend to precision.

Next Generation Science

- HS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Green/Sustainability Knowledge and Skill Statements

- AFNR Career Cluster, Statement 1 - Apply understanding of ecosystems and systems thinking to the management of natural resources to maximize the health and productivity of the environment, agriculture, communities, and society.
- AFNR Career Cluster, Statement 3 - Communicate the impact of green and sustainability principles on agriculture, food and natural resource systems.
- AFNR Career Cluster, Statement 7 - Demonstrate an understanding of green and sustainability trends that are impacting processes and markets in AFNR.

AFNR Career Ready Practices

- CRP.02. Apply appropriate academic and technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive.
- CRP.04. Communicate clearly, effectively, and with reason. Career-ready individuals communicate thoughts, ideas and action plans with clarity, whether using written, verbal and/or visual methods.
- CRP.05. Consider the environmental, social and economic impact of decisions. Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organizations and the environment.

Partnership for 21st Century Skills

- Communication
- Environmental Literacy
- Global Awareness
- Information, Communications, and Technology Literacy
- Think Creatively

Lesson Plan:

1. **Bell Ringer:** What do you think soil is made up of?
   Note: If you have not covered the components of soil, it may help to have a soil sample for students to look at as they answer this question.

2. **Introduction:** Review (or teach) the components of soil (45% minerals, 25% air, 25% water and 5% organic material). Ask students, "What do you think makes soil healthy?" Use the slides to review the USDA definition of soil health (the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans) as well as the five essential functions of soil:
   a. Regulating water
   b. Sustaining plant and animal life
   c. Filtering and buffering potential pollutants
   d. Cycling nutrients
   e. Providing physical stability and support

3. **Activity:** *(40-50 Minutes)* Each student needs a copy of the activity sheet "Five Essential Functions."
   a. **Teacher Preparation Notes:** Prior to teaching this lesson, you will need to obtain various soil samples. The more variety in samples, the better. You may consider asking local farmers for samples of their soil. Label each soil sample (i.e., Soil A, Soil B, Soil C, etc.). Additionally, you will need to complete the following preparation for the given student stations:
      i. Station 1: Gather the plastic cups, soil samples, graduated cylinders and stopwatches for this station.
      ii. Station 2: Pre-plant 20 radish seeds in a container of each soil sample a few days prior to completing this activity so they are sprouting by the day of the activity
      iii. Station 3: Prepare a "polluted water" source (mix muddy water, food coloring, glitter, etc. to mimic various pollutants in water).
      iv. Station 4: Bury leaves or other small organic matter in a container of each soil sample one or two weeks prior to completing the activity. Keep these soil samples moist to help facilitate the decomposition process. Take pictures of the organic matter before you bury it so you can provide them to students for reference on the day of the activity.
      v. Station 5: Mold moist samples of each soil into small balls and set aside for a day or two to allow them to dry. Be sure you have enough balls of each sample for the number of students you will assign to each soil sample.
   b. **Part 1:** Divide students into pairs and assign each pair a soil sample. Student pairs will rotate through five stations, spending six to eight minutes at each station. (Multiple groups may be at the same station at the same time, if they have different soil samples and you have enough materials at each station to allow this.) At each station, they will evaluate their soil sample's ability to perform one of the five essential functions of soil.
      i. **Station 1:** Regulating Water
      Materials: plastic cups, soil samples, graduated cylinders, water, stopwatch
      Directions: Students will fill a clear plastic cup with soil, packing it gently. They will poke a small hole at the bottom of the cup and hold it over another cup. Then, slowly pour 25 mL of water over the soil. They will time how long it takes for water to start dripping into the bottom cup and measure how much water is in the bottom cup after five minutes. Students will then calculate how much water has soaked into the soil sample. They will record these figures on their student activity sheets.
      ii. **Station 2:** Sustaining Plant and Animal Life
      Materials: radish seeds, soil samples, containers
      Directions: Students will obtain the container matching their assigned soil sample that the teacher planted radish seeds in a few days prior. Students will make both quantitative and qualitative observations on their student activity sheets. Students should count how many seeds have sprouted (out of 20) and record how the sprouts look (healthy, strong, small, weak, etc.).
      iii. **Station 3:** Filtering and Buffering Pollutants
      Materials: plastic bottles (cut in half), soil samples, pre-made "polluted water"
      Directions: Students will cut a plastic bottle in half, flip the top upside down so as to act like a funnel and place in the bottom part of the bottle. Students will then place their soil sample in the funnel portion of the bottle and lightly pack it. They will then pour "polluted water" over

their soil sample so that it saturates and drips through into the bottom portion of the bottle. Students should then compare the original "polluted water" to the water that has been filtered through their soil sample and observe changes in color, clarity and physical pollutants on their student activity sheets.

iv. **Station 4:** Cycling Nutrients
Materials: soil samples, containers, loose organic matter
Directions: Students will obtain the samples of soil in which their teacher buried leaves/organic matter in previously. They will dig around in the soil to find the organic matter that has been buried and compare it to the pre-burial pictures provided by the teacher. They should note any physical changes they see in the organic material on their student activity sheets.

v. **Station 5:** Providing Physical Stability
Materials: dried soil sample balls, stackable weights (washers, coins, etc.), scale
Directions: Students will obtain a small, dried ball of their assigned soil sample, the provided weights and a scale. They will weigh one of the weight materials and record that number for later. They will then stack the small weights on the ball one at a time until it begins to crumble and break apart. They should note how many weights they stacked on the sample before it broke apart on their student activity sheets and then calculate how much total weight their soil was able to withstand by multiplying the number of weights by the weight they took earlier.

c. **Part 2:** Students will form larger groups with other pairs of students so that each group has every soil sample represented. In these groups, each pair will share their soil sample and how it performed in each test. They will also discuss which soil sample they believe best performed the five essential functions of soil. As they discuss, they will answer the questions on Part 2 of their student worksheets.

4. **Follow-up:** *(5-10 minutes)* Begin a class discussion on what students think can be done to improve soil health. (This will be a good precursor to future lessons on soil health management practices.)

5. **Optional – Extended Learning opportunities (Not factored into time requirement):**
Have students design and conduct their own experiments to determine a soil's ability to perform the five essential functions.

6. **Exit Ticket:** Which essential function of soil do you think our local soil performs best? Why?

Name: _____

Five Essential Functions

Aligned to the following standards:
CS.03; CS.04; CS.06; NRS.02; NRS.04; FFA.PL-A; FFA.PL-B; FFA.CS-M; FFA.CS-N; AG3; AG4; AG6; AG-NR2; AG-NR4; CCSS.ELA.SL.9-10.1; CCSS.ELA.RST.9-10.3; HS-ESS3-1; CCSS..MP3; CCSS..MP6; CRP.02; CRP.04; CRP.05

Part 1

Directions:

Obtain a soil sample from your teacher to use for this activity. You will visit five stations, one for each of the five essential functions of soil. Follow the directions listed below for each station and record your observations for each essential function of soil.

My Soil Sample	

Station 1: Regulating Water

Directions:

1. Fill a clear plastic cup with soil, packing it gently
2. Poke a small hole at the bottom of the cup and hold it over another cup
3. Slowly pour 25 mL of water over the soil
4. Time how long it takes for water to start dripping into the bottom cup
5. After five minutes, use the graduated cylinder to measure how much water is in the bottom cup
6. Calculate how much water has soaked into the soil sample by subtracting the amount of water collected in the cup from the initial 25 mL.
7. Record these figures below and answer the analysis questions

Time until water started dripping	
Water collected in cup	
Water soaked into soil	

Analysis Questions:

1. How did your soil sample perform in this test? Did it hold a lot of water or a little? What do you think this means for its ability to support plant life? (Explain in one or two sentences.)

2. What impact do you believe your soil sample's ability to regulate water would have on plants growing in this soil?

Station 2: Sustaining Plant and Animal Life

Directions:

1. Obtain the container matching your assigned soil sample in which your teacher planted radish seeds.
2. Observe the sprouts in the container; count how many seeds have sprouted (out of 20) and record how the sprouts look. Make any observations you deem appropriate (color, size, strength, etc.).

Number of Sprouts	**Observations:**

Name: _____

Analysis Questions:

1. What percentage of the seeds that your teacher planted have sprouted?

2. What does this indicate about the ability of this soil to sustain plant life?

Station 3: Filtering and Buffering Pollutants

Directions:

1. Cut a plastic bottle in half, flip the top upside down to act as a funnel and place it in the bottom part of the bottle.
2. Place your soil sample in the funnel portion of the bottle and lightly pack it.
3. Pour "polluted water" (provided by your teacher) over your soil sample so that it saturates and drips through into the bottom portion of the bottle.
4. Compare the original "polluted water" to the water that has been filtered through your soil sample and observe changes in color, clarity and physical pollutants.

Original Polluted Water Sample	Soil-Filtered Water Sample

Analysis Questions:

1. What did you expect to happen to the water sample as it went through your soil? How did that differ from what actually happened?

2. Did any pollutants seem to get through the soil "filter"? Why do you think this happened?

3. Why is it important for soil to filter and buffer pollutants? What impact does that have on plants, animals and the environment?

Name: _____

Station 4: Cycling Nutrients

Directions:

1. Obtain the sample of your soil in which your teacher buried leaves/organic matter.
2. Dig around in the soil to find the organic matter that has been buried.
3. Compare it to the pre-burial pictures provided by your teacher.
4. Note any physical changes you see in the organic material.

Observations	
Pre-Burial Pictures	**Current State of Organic Matter**

Analysis Questions:

1. What condition was the buried material in when you found it?

2. What might affect how quickly organic material decomposes in soil?

3. What would happen if this process didn't occur in ecosystems?

Station 5: Providing Physical Stability

Directions:

1. Obtain a small, dried ball of your assigned soil sample.
2. Weigh one of the small weights provided by your teacher; record that figure here: _____.
3. Stack the small weights provided by your teacher on the ball one at a time until it begins to crumble and break apart
4. In the table below, note how many weights you stacked on the sample before it broke apart.
5. Calculate how much weight your soil sample was able to withstand by multiplying the number of weights by the weight of the material you recorded above. Record that total weight in the table below.

Number of Weights Stacked	**Total Weight Until Crumbling**

Analysis Questions:

1. How easily did your soil ball crumble? What does that tell you?

2. How does soil structure help plants stay upright and survive wind/rain?

Name: _____

Part 2

Directions:

Group up with other pairs of students so your group has every soil sample represented. Share about your soil sample and how it performed in each test, and discuss which soil sample(s) you believe best performed the five essential functions of soil. Answer the questions below as you have your group discussion.

1. As a group, discuss how each soil sample performed in all the tests. In the table below, state the soil sample you believe performed best in each test.

Essential Function Test	Best Performing Soil Sample
Regulating Water	
Sustaining Plant and Animal Life	
Filtering and Buffering Pollutants	
Cycling Nutrients	
Providing Physical Stability	

2. Which soil sample performed best overall? Looking at this soil sample, why do you think it outperformed the others?

3. Why is water infiltration important for agriculture?

4. How might soil life (like bacteria and earthworms) help plants grow?

5. How could this soil filtering ability affect nearby lakes, rivers or other water sources?

6. Why is decomposition and nutrient cycling an important part of soil health?

7. Why might compacted or weak soil be a problem for construction or agriculture?

8. Do you think it would be easy to perfectly balance all five essential functions of soil? Why or why not?

Name: _____

KEY: Five Essential Functions

Aligned to the following standards:
CS.03; CS.04; CS.06; NRS.02; NRS.04; FFA.PL-A; FFA.PL-B; FFA.CS-M; FFA.CS-N; AG3; AG4; AG6; AG-NR2; AG-NR4; CCSS.ELA.SL.9-10.1; CCSS.ELA.RST.9-10.3; HS-ESS3-1; CCSS..MP3; CCSS..MP6; CRP.02; CRP.04; CRP.05

Part 1

Directions:

Obtain a soil sample from your teacher to use for this activity. You will visit five stations, one for each of the five essential functions of soil. Follow the directions for each station listed below and record your observations for each essential function of soil.

My Soil Sample	Answers will vary.

Station 1: Regulating Water

Directions:

1. Fill a clear plastic cup with soil, packing it gently.
2. Poke a small hole at the bottom of the cup and hold it over another cup.
3. Slowly pour 25 mL of water over the soil.
4. Time how long it takes for water to start dripping into the bottom cup.
5. After five minutes, use the graduated cylinder to measure how much water is in the bottom cup.
6. Calculate how much water has soaked into the soil sample by subtracting the amount of water collected in the cup from the initial 25 mL.
7. Record these figures below and answer the analysis questions.

Time until water started dripping	Answers will vary.
Water collected in cup	Answers will vary.
Water soaked into soil	Answers will vary.

Analysis Questions:

1. How did your soil sample perform in this test? (Explain in one or two sentences.)

   Answers will vary.

2. What impact do you believe your soil sample's ability to regulate water would have on plants growing in this soil?

   Answers will vary.

Station 2: Sustaining Plant and Animal Life

Directions:

1. Obtain the container matching your assigned soil sample in which your teacher planted radish seeds.
2. Observe the sprouts in the container; count how many seeds have sprouted (out of 20) and record how the sprouts look. Make any observations you deem appropriate (color, size, strength, etc.).

Number of Sprouts	Observations:
Answers will vary.	Answers will vary.

Name: _____

Analysis Questions:

1. What percentage of the seeds that your teacher planted have sprouted?

   Answers will vary.

2. What does this indicate about the ability of this soil to sustain plant life?

   Answers will vary.

Station 3: Filtering and Buffering Pollutants

Directions:

1. Cut a plastic bottle in half, flip the top upside down to act as a funnel and place it in the bottom part of the bottle.
2. Place your soil sample in the funnel portion of the bottle and lightly pack it.
3. Pour "polluted water" (provided by your teacher) over your soil sample so that it saturates and drips through into the bottom portion of the bottle.
4. Compare the original "polluted water" to the water that has been filtered through your soil sample and observe changes in color, clarity and physical pollutants.

Original Polluted Water Sample	Soil-Filtered Water Sample
Answers will vary.	Answers will vary.

Analysis Questions:

1. What did you expect to happen to the water sample as it went through your soil? How did that differ from what actually happened?

   Answers will vary.

2. Did any pollutants seem to get through the soil "filter"? Why do you think this happened?

   Answers will vary.

3. Why is it important for soil to filter and buffer pollutants? What impact does that have on plants, animals and the environment?

   Answers will vary.

Name: _____

Station 4: Cycling Nutrients

Directions:

1. Obtain the sample of your soil in which your teacher buried leaves/organic matter.
2. Dig around in the soil to find the organic matter that has been buried.
3. Compare it to the pre-burial pictures provided by your teacher.
4. Note any physical changes you see in the organic material.

Observations	
Pre-Burial Pictures	**Current State of Organic Matter**
Answers will vary.	Answers will vary.

Analysis Questions:

1. What condition was the buried material in when you found it?

   Answers will vary.

2. What might affect how quickly organic material decomposes in soil?

   Answers will vary.

3. What would happen if this process didn't occur in ecosystems?

   Answers will vary.

Station 5: Providing Physical Stability

Directions:

1. Obtain a small, dried ball of your assigned soil sample.
2. Weigh one of the small weights provided by your teacher; record that figure here: _____.
3. Stack the small weights provided by your teacher on the ball one at a time until it begins to crumble and break apart
4. In the table below, note how many weights you stacked on the sample before it broke apart.
5. Calculate how much weight your soil sample was able to withstand by multiplying the number of weights by the weight of the material you recorded above. Record that total weight in the table below.

Number of Weights Stacked	**Total Weight Until Crumbling**
Answers will vary.	Answers will vary.

Analysis Questions:

1. How easily did your soil ball crumble? What does that tell you?

   Answers will vary.

2. How does soil structure help plants stay upright and survive wind/rain?

   Answers will vary.

Name: _____

Part 2

Directions:

Group up with other pairs of students so your group has every soil sample represented. Share about your soil sample and how it performed in each test, and discuss which soil sample(s) you believe best performed the five essential functions of soil. Answer the questions below as you have your group discussion.

1. As a group, discuss how each soil sample performed in all the tests. In the table below, state the soil sample you believe performed best in each test.

Essential Function Test	Best Performing Soil Sample
Regulating Water	Answers will vary.
Sustaining Plant and Animal Life	Answers will vary.
Filtering and Buffering Pollutants	Answers will vary.
Cycling Nutrients	Answers will vary.
Providing Physical Stability	Answers will vary.

2. Which soil sample performed best overall? Looking at this soil sample, why do you think it outperformed the others?

   Answers will vary.

3. Why is water infiltration important for agriculture?

   Answers will vary.

4. How might soil life (like bacteria and earthworms) help plants grow?

   Answers will vary.

5. How could this soil filtering ability affect nearby lakes, rivers or other water sources?

   Answers will vary.

6. Why is decomposition and nutrient cycling an important part of soil health?

   Answers will vary.

7. Why might compacted or weak soil be a problem for construction or agriculture?

   Answers will vary.

8. Do you think it would be easy to perfectly balance all five essential functions of soil? Why or why not?

   Answers will vary.