

Ecosystem Services - Soil

Secondary

Key Inquiry Questions

1. Why are healthy soils important?
2. How can the health of soils be improved?
3. What is the significance of pH and nutrient cycling in soils?
4. How does filtration work with different types of soils?

Learning Outcomes

1. Students will learn what soils are made of and why healthy soils are important to their everyday lives and the environment.
2. Students will learn how they can improve the health of soils.
3. Students will engage with an experiment about soil filtration and better understand the use of the scientific method.

Sustainability Curriculum Goals

Systems Thinking:

1. Our planet - the biosphere - is a complex system that supplies resources and creates conditions that sustain life on Earth.
2. All forms of life, including humans, are connected to each other through man-made and natural ecosystems on which their well-being depends on.

Sustainable Futures:

1. Actions associated with a sustainable future reflect values of care, respect, responsibility, empathy, and compassion for all living and nonliving things.
2. Sustainable futures involve actions that work to preserve, protect, and/or restore the natural environment.

Activities/Goals:

1. Students should be able to explain what sustainability is, the importance of ecosystem services and biodiversity.

Overview:

Students will begin by exploring the soil in their community near their school. This introduction to soil will serve as the spark for learning about soil as an ecosystem service during the lesson. Next, students will complete their portion of the worksheet titled “Characteristics and Importance of Healthy Soils,” in which they will engage their critical reading, comprehension,

and presentation skills. Lastly, students will complete the Filtration Experiment in which they will be able to recognize one of the many ecosystem services soil provides them with: filtration.

Materials

SolarSPELL Resource:

1. “Healthy Soil - English” (Local Topics > Pacific Islands > Agriculture for Islands > Healthy Soil - English)
2. “Filtration Fact Sheet” (Local Topics > Pacific Islands > Agriculture for Islands > Garden and Soil > Filtration Fact Sheet)

Other:

1. During Lesson - Section 1.4 Experiment
 - a. 3 jars or clear cups with lids
 - b. 3 soil samples from three different locations if possible (ex: farmland, the forest, and/or different gardens)
 - c. Water
2. After Lesson - Experiment Materials:
 - a. 5 empty plastic water bottles with lids per group
 - b. 1 coffee filter, cheesecloth, or a muslin cloth per group
 - c. 5 rubber bands
 - d. 1+1/2 cup of a type of soil from three different locations if possible (ex: farmland, the forest, and/or different gardens)
 - e. 1 pair of scissors per group
 - f. 1 ruler per group
3. General Materials
 - a. Notebooks
 - b. Pencils
 - c. “Characteristics and Importance of Healthy Soils” worksheet

Suggested Procedure

It is recommended that you complete the “Ecosystem Services - What does the Earth Provide” lesson before this one.

Before Lesson:

- Take students outside to an area with soil.
 - This could be a garden, the forest, or a farm for example
- Tell students to explore the soil and write down the following things in their journals:
 - How does the soil feel?
 - What does the soil smell like?
 - What types of animals or insects can you see, if any?
- Bring the students back inside and call on a few students to share their answers.

During Lesson:

- Explain to students that soil is another very important ecosystem service that, without, humans, animals, nor plant life could survive. Inform students that they will be learning about the importance of healthy soils and how to replenish soil nutrients.
- Divide the students into 8 groups or pairs (Note: there is an optional section that would require a 9th group/pair and materials for a mini-experiment associated with that section).
- Tell each group that they will be completing one portion of the assignment, then sharing their answers with the class.
- Give students the worksheet titled “Characteristics and Importance of Healthy Soils”.
 - If printing is not an option, begin the lesson (see next bullet point). Then go to each group, tell them the questions they will be answering, and have them write the questions down.
- Instruct students to read their portion of the document carefully and respond to the questions, including the very first one everyone will respond to that is located right under the instructions.
- Allow 10 minutes for students to complete their portion of the reading and answer the questions.
- Once the students are finished, have them select one person from their group to provide the answers to the questions their group found.
 - Instruct students to fill in the answers to the rest of the questions on the paper based on what the presenter says.
 - As the instructor, add anything to their answers you feel is important or necessary.

After Lesson:

- Students will be creating their own filter to showcase one of the many important things soil does for animal, plant, and human life: filtration.
- Divide students into groups based on the number of supplies you have available.
- Direct students to the “Filtration Fact Sheet”.
- Read the “Main Concept” of the assignment aloud:
 - “Main Concept: Soils can filter and clean water. The ability of a soil to filter water is largely dependent upon particle size and how fast water flows through soil.”
- Ask students to read the “Background” as a group.
- Allow students to complete the experiment and related questions, while being available to answer any questions they may have.
 - Walk around to each group and listen in on them collaborating to complete the experiment.
- At the conclusion of the experiment, discuss the answers to the questions as a class.
 - Look to the assignment document for the answers.

Assessment:

- Give students 5 minutes to respond to the following question in their journals.
 - Why is soil filtration important and how does healthy soil impact your life?

Characteristics and Importance of Healthy Soils

Instructions: Please respond to the questions below and write your answers in complete sentences. Start by filling in your own section with your group or partner, then fill in the rest as your classmates present.

Before answering your sections questions, respond to the following prompt:

- Name as many things you think soils do for plant, human, and animal life on Earth.

Section 1.1: About Soils

1. What three things should soil be protected from?
2. How does healthy soil directly impact human health?
3. What does having better health result in?

Section 1.2: What is Healthy Living Soil?

1. What is humus and why is it important?
2. Circle the correct answer: Soil is alive/dead.
3. Why are air pockets in soil important? Give 2 reasons.
 - a. How do you prevent popping air pockets?

Section 1.3: Benefits of Healthy Living Soil

1. What are four benefits of healthy, living soil?
2. What are three ways you can improve their soil?
3. What are two ways you can protect the soil?
4. What are 2 things burning does to the soil?

Section 1.4: Different Types of Soil (Optional to be done as a class, as an example, or as an 8th group)

1. Complete the soil layer experiment.
2. What type of soil exists in your community?
3. What is the difference between clay and sandy soils?

Section 1.5: Improving Soil Quality

1. For all types of soils, name two ways using compost, mulch, or liquid fertilizers can improve soil quality:
2. What are two things you can do to improve the soil quality of clay soils?
3. What are two things you can do to improve the soil quality of sandy soils?

Section 1.5: Soil pH

1. What does pH measure in soils?
2. Circle the correct answer: A healthy soils pH level is neutral/acidic/alkaline.
3. What does it mean if soil is acidic?
4. What does it mean if soil is alkaline?

Section 1.6: Nutrient Cycles

1. Where are nutrients stored in plants?
2. How can nutrients that are lost be replaced?
3. Why is burning land a serious problem?

Section 1.7: Organic Soil Improvement Strategies

1. Why do you think land that is under cultivation should have its nutrients replaced?
2. Is it enough to just replace the missing nutrients?

3. Name at least four sources of new nutrients that can be used to replenish nutrients and soil texture after cultivation.

Characteristics and Importance of Healthy Soils - Answer Key

Instructions: Please respond to the questions below and write your answers in complete sentences. Start by filling in your own section with your group or partner, then fill in the rest as your classmates present.

Before answering your sections questions, respond to the following prompt:

- Name as many things you think soils do for plant, human, and animal life on Earth.
 - Possible examples include: filter water, homes for bugs/worms, nutrients for plant and tree growth, allows us to grow crops

Section 1.1: About Soils

1. What three things should soil be protected from?

Answer: erosion, sunlight, and moisture

2. How does healthy soil directly impact human health?

Answer: better soil leads to better produce, which results in better health

3. What does having better health result in?

Answer: better health reduces the chance of getting sick, increases energy and strength, and can result in a longer life span.

Section 1.2: What is Healthy Living Soil?

1. What is humus and why is it important?

Answer: "Humus is partly broken down organic matter: compost, mulch, manure, plant roots, and plant material."

2. Circle the correct answer: Soil is **alive**/dead.

3. Why are air pockets in soil important? Give 2 reasons.

Answer: air pockets are important because they provide space for water to be held for the plants use, provides oxygen for plant growth, and allows rooms for roots to enable plants to grow bigger.

- b. How do you prevent popping air pockets?

Answer: Do not walk on your soil!

Section 1.3: Benefits of Healthy Living Soil

1. What are four benefits of healthy, living soil?

Answer: Healthy, living soil makes plants more drought resistant, disease and pest resistant, increases vitamins and nutrients in plants, and reduces evaporation from soil.

2. What are three ways you can improve their soil?

Answer: use organic mulch/compost regularly, recycle nutrients, use legumes, rotate crop production.

3. What are two ways you can protect the soil?

Answer: avoid compacting the soil, don't leave it exposed to the sun, avoid pesticide use, and try not to waste water

4. What are 2 things burning does to the soil?

Answer: burning soil destroys valuable nutrients, reduces soil bacteria, dries out the soil (reduces water), creates erosion, and produces pollution

Section 1.4: Different Types of Soil (Optional to be done as a class, as an example, or as an 8th group)

1. Complete the soil layer experiment.
2. What type of soil exists in your community?

Possible Answers: Sandy, Clay.

3. What is the difference between clay and sandy soils?

Answer: "Clay soil holds nutrients well but does not contain much air, so when heavy rains come, the water can become stuck in the soil. While sandy soil will soak up water quickly and contains a lot of air, it easily releases nutrients and can quickly become dry."

Section 1.5: Improving Soil Quality

1. For all types of soils, name two ways using compost, mulch, or liquid fertilizers can improve soil quality:
 - a. Answer: improve air pockets, increase soil biota, increase available nutrients, increase water storage capacity.
 - b.
2. What are two things you can do to improve the soil quality of clay soils?
 - a. Answer (Clay): reduce compaction, add sand, crop rotation, plant trees
3. What are two things you can do to improve the soil quality of sandy soils?
 - a. Answer (Sandy): add 3 shovels of clay to liquid fertilizer, add to soil, add 1/2 a shovel of clay to a large bucket of water, spray this mixture over the sandy soil, use green manure crops to add humus to the soil, and plant trees.

Section 1.5: Soil pH

1. What does pH measure in soils?
 - a. Answer: pH measures the acidity or alkalinity of the soil.
2. Circle the correct answer: A healthy soils pH level is **neutral**/acidic/alkaline.
3. What does it mean if soil is acidic?
 - a. Answer: “ Nutrients will easily leach out of the soil. Productivity will reduce and if the soil is very acidic, only a few types of plants can be grown.”
5. What does it mean if soil is alkaline?

Answer: “If the soil is alkaline, there are many nutrients in the soil, but they are bound and not easily available for plants to use. Productivity will reduce and only a few types of plant can be grown”

Section 1.6: Nutrient Cycles

1. Where are nutrients stored in plants?
 - a. Answer: Nutrients are stored in plant’s leaves, fruit, stems, trunk, and roots.
2. How can nutrients that are lost be replaced?

- a. Answer: Nutrients can be replaced by planting green manure or legume crops, implementing crop rotation, using compost and liquid fertilizer, recycling plant, and animal materials back into the soil, and applying mulch regularly
3. Why is burning land a serious problem?
 - a. Answer: Burning land reduces soil fertility and removes valuable nutrients from the soil.

Section 1.7: Organic Soil Improvement Strategies

1. Why do you think land that is under cultivation should have its nutrients replaced?

Answer: Because growing crops uses up nutrients.

2. Is it enough to just replace the missing nutrients?

Answer: “It is not enough to just replace the missing nutrients. Soil texture should be improved over time so that the soil can store more nutrients and water.”

3. Name at least four sources of new nutrients that can be used to replenish nutrients and soil texture after cultivation.

Possible Answers:

- Seaweed is very beneficial and contains many nutrients to help to replace missing nutrients
- Manure is good because it has lots of nutrients. Chicken and duck manure are concentrated manures (should be composted first). Cow and horse manure are good too and can be used without composting.
- Animal bones, carcasses and innards are a high concentrated source of nutrients and can provide a lot of micronutrients. These materials must be composted first, or buried under new fruit trees
- Leaves and grass clippings can be used as mulch to protect and enrich the soil
- Legumes to add nitrogen to the soil
- Wood ash from kitchen cooking fires can supply potassium
- The soil from the bottom of a well-managed fish pond contains lots of nutrients
- Tree leaves provide a variety of nutrients, because trees soak up minerals from deep in the soil