Ag for Life

AGRICULTURE & THE ENVIRONMENT

SOIL

Curriculum Connections

Science Grade 5: Outcomes

Conservation agriculture is a sustainable practice that responds to local climate and weather events.

Climate and weather events may influence agricultural practices by affecting components such as

- crop type
- crop production
- animal population
- soil quality
- water access

Conservation agriculture practices are adapted to the requirements of plants and animals farmed.

Agricultural practices involve monitoring and responding to climate or weather.

Conservation agriculture practices include :

- minimizing soil disturbance
- maintaining soil cover
- using water efficiently
- using sustainable harvesting practices

Sustainable harvesting practices support the maintenance of stable plant or animal populations over time and include:

- crop rotation
- companion planting
- limiting hunting and trapping
- considering future harvests

Curriculum Connections

Science Grade 7: Outcomes

Unit A: Interactions and Ecosystems (Social and Environmental Emphasis)

Overview: Ecosystems develop and are maintained by natural processes and are affected by human action. To foster an understanding of ecosystems, this unit develops student awareness of ecosystem components and interactions, as well as natural cycles and processes of change. Building on this knowledge, students investigate human impacts and engage in studies that involve environmental monitoring and research. By reflecting on their findings, students become aware of the intended and unintended consequences of human activity, and recognize the need for responsible decision making and action.

Unit B: Plants for Food and Fibre (Science and Technology Emphasis)

Overview: Humans have always depended on plants as a source of food and fibre, and to meet a variety of other needs. To better meet these needs, technologies have been developed for selecting and breeding productive plant varieties and for maximizing their growth by modifying growing environments. Long-term sustainability requires an awareness of the practices humans use and an examination of the impacts of these practices on the larger environment.

SOIL QUALITY AND AGRICULTURE

What is Soil?

As you have learned, soil is the foundation for all life and every farm needs good, fertile soil to produce healthy crops. While soil only covers 10% of our Earth's surface, most people don't realize how important to life it is. Soil is a living, breathing world that supports all life on earth. Healthy soil is made up from approximately 45% minerals (clay, silt and sand), 25% air, 25% water and 5% organic matter (decomposing animals and plants). All of these ingredients, together with climate, affect the soil composition and how well the soil produces.

"Soils hold nutrients and water for plants and animals. They filter and clean water that passes through them. They can change the chemistry of water and the amount that recharges the groundwater or returns to the atmosphere to form rain. The foods we eat and most of the materials we use for paper, buildings, and clothing are dependent on soils. Soils play an important role in the amount and types of gases in the atmosphere. They store and transfer heat, affect the temperature of the atmosphere, and control the activities of plants and other organisms living in the soil." (GLOBE, 2005b)

1 Soil essentially has four main jobs. Soil's first main function is being an anchor for plant roots; soil provides a place for plants to take root and grow. Soil properties like texture, particle size, porosity (the empty spaces), and the ability to hold water all affect how well a soil is able to grow plants. Soil has the important role of storing and supplying nutrients to plants.

2 Soil's second main job is the ability to absorb and store moisture for later use by plants and animals. As soil is able to hold moisture, it creates a pool of water that plants and soil organisms can live on between rainfalls. For example, when the soil is very wet and saturated, the water will move downward within the soil profile, unless it is drawn upwards to the surface through plant transpiration and evaporation. A soil's ability to hold water is affected by its texture and pore sizes. For example, coarse (sandy) soils allow for quick absorption but do not hold the water, whereas a fine textured soil has a slower absorption rate, but is able to hold the water for longer periods. Without soil, water would just be running on rocks, whereas soil filters the water as it moves from the surface into the groundwater.

3 Soil's third job is to be a recycler. Soil is the original recycler and was recycling before we even knew what recycling was. This is the greatest function of soil. As dead plants, animals and organisms decompose, soil transforms their remains into minerals that then can be utilized by other living plants, animals and organisms. This important process is also what allows soil to store carbon and essential plant nutrients. This is known as carbon sequestration, the temporary storage of carbon in the organic matter of soils.

4 The fourth job of soil is to provide a habitat for living organisms, ranging from plants and animals, to small insects and micro-organisms, like bacteria and fungi. These micro-organisms are the decomposers of the soil and are the workhorses that recycle the dead materials into the nutrients needed for new growth. Soil provides the environment for the decomposers to work and survive.

What is Agriculture's Role in Soil Conservation?

Agricultural practices today focus on soil conservation. Having healthy soil is imperative to an agricultural operation, as this helps increase yields and serves to benefit the environment. Using practices like crop rotation and rotational grazing are important for soil conservation and boosting the soil's biodiversity. Crop rotation refers to the practice of growing different types of crops on the same land each year, instead of growing the same type of crop year after year. Rotational grazing refers to moving animals through different pastures to improve soil, plant and animal health.

Zero-till planting (no-till planting) and reduced tillage are another way that farmers help preserve the soil. Planting cover crops prevents soil erosion and increases soil fertility. Cover crops are planted to cover the soil to prevent erosion, enhance water availability, and help to control pests and weeds. Overall, protecting soil quality ensures a farm that continues to produce abundant and healthy crops and livestock.

Soil Activity #1:

1. Review the importance of soil: Soil is essential to life on Earth. Soil cannot be replaced by human efforts. Soil is the foundation for our ecosystem.
2. Identify the four components of soil: mineral particles, organic matter, air and water.
3. Review the particles in soil: sand, silt and clay.
    a. Sand – the largest particle, drains water quickly, provides air space within the soil and contains few nutrients.
    b. Silt – the mid-size particle, drains water slowly, provides some air space within the soil and contains nutrients.
    c. Clay – the smallest particle, prevents water from draining, provides very little air space in the soil and contains many nutrients.
4. Knowing the soil's texture and fertility allows you to assess whether it is functioning productively.

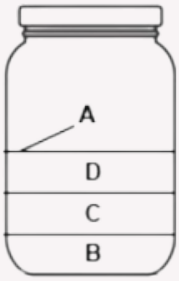
Soil Analysis Field Report Part 1 – Soil Texture

The mineral component of soil is made up of different sized particles called sand, silt and clay. In this test, you will mix soil and water in a jar and then let the soil sink to the bottom so that these different sized particles form different layers.

By measuring the layers, you will be able to calculate the percentage of sand, silt and clay in your soil.

Follow these steps and record your measurements below.

1. Using a trowel or large spoon, fill your jar about one-third full of soil taken from 2-3 inches below the surface.
2. Shake the jar gently to level the soil, then measure the soil's depth (A).
3. Fill the jar nearly full of water and then shake it hard to mix the soil and water.
4. Place the jar on a table and wait for the soil to settle.
5. The largest and heaviest particles, called sand, will settle at the bottom in less than a minute. Measure the depth of sand in the jar (B).
6. The medium-sized particles, called silt, can take hours to settle. Wait a day and then measure the depth of the silt layer (C).
7. The smallest particles, called clay, take even longer to settle, but you can assume that the depth of the clay layer (D) will be equal to the total depth of the soil minus the depth of the sand and silt layers – that is, A - (B + C) = D.



Sample location: _____
A. Soil Depth: _____
B. Sand Layer: _____
C. Silt Layer: _____
D. Clay Layer: _____

8. Now calculate the percentage of sand, silt and clay using these equations.

(B ÷ A) x 100 = _____ percent sand
(C ÷ A) x 100 = _____ percent silt
100 - (percent sand + percent silt) = _____ percent clay

The most productive soil, called loam, is approximately 40% sand, 40% silt and 20% clay.
How does your soil compare to loam?

_____
_____

Biodiversity Activity #2:

Soil Analysis Field Report Part 2 – Soil Fertility

For thousands of years, farmers had to rely on their senses to determine if a soil was fertile – that is, whether it would be good for growing healthy crops. Today, most farmers use a soil testing laboratory to determine if their soil is fertile, but you can still learn a lot about soil by using your senses.

Conduct this soil fertility analysis when the soil is moist, about two days after a soaking rainfall or after you've watered the garden. Mark an X in the appropriate box for each soil test, then total the X's at the bottom of the chart. Remember to describe other colours you see in the soil in the space provided.

Soil Tests AIR AND WATER	Fertile	Average	Infertile
Can you push a wire coat hanger into the soil?	Goes in easily	Can be pushed in	Coat hanger bends
How does a handful of moist soil feel?	Moist but not muddy	Somewhat dry or muddy	Very dry or very wet
How does the moist soil hold together?	Holds shape but crumbles easily	Breaks apart in clumps	Doesn't hold shape or hard to break up

Biodiversity Activity #2:

Soil Analysis Field Report Part 2 – Soil Fertility

Soil Tests NUTRIENTS	Fertile	Average	Infertile
What colour is the topsoil?	Black, dark brown	Light brown	Grey, yellow
What other colours do you see in the soil? Write down the colours that you see.			
How does the soil smell?	Fresh, earthy	No smell or dusty	Sharp, swampy, strange
Can you see organic matter (straw/leaf matter/woody material etc.) in the soil?	Lots	Some	Not much
Can you see worms and other organisms?	Lots	A few	Almost none
Total (count X's for each column)			

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Educator's Guide • Agriculture and the Environment

Biodiversity Conservation Guide for Farmers and Ranchers in Alberta
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Copyright 2020 Marsh, Jane. Why Soil Quality and Health are Key to Agriculture
Retrieved from: https://environment.co/why-soil-quality-and-health-are-key-to-agriculture/

Agricultural producers care deeply about the land they live on. For many producers, caring for their land is their most important job.

References

GLOBE. (2005b). Protocols. Retrieved October 29, 2013, from https://www.globe.gov/do-globe/globe-teachers-guide/soil-pedosphere
Copyright 2020 Marsh, Jane. Why Soil Quality and Health are Key to Agriculture
Retrieved from: https://environment.co/why-soil-quality-and-health-are-key-to-agriculture/

Science Buddies Staff. (2018, June 14). Get Down and Dirty: How Does Soil Change with Depth? Retrieved from https://www.sciencebuddies.org/science-fair-projects/project-ideas/EnvSci_p011/environmental-science/how-does-soil-change-with-depth

Tim Kettler, Department of Agronomy and Horticulture, University of Nebraska-Lincoln Soil Genesis and Development, Lesson 6 - Global Soil Resources and Distribution
https://passel2.unl.edu/view/lesson/69c7561e50b3

The Role of Soil, The Nature Conservancy
https://www.nature.org/content/dam/tnc/nature/en/documents/nature-lab-lesson-plans/NLGardens-Soil.pdf

Crop Rotation and Soil Health. Enes, Brooklyn. November 15, 2022.
https://decisivefarming.com/crop-rotation-and-soil-health/

This resource was made possible through the generous support of TD Friends of the Environment.

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