EDIBLE SOIL PROFILE

Overview

Soil is one of our most important natural resources. It is the Earth's living skin. Soil is a naturally occurring mixture of minerals, organic matter, water, and air, all of which combine to form the surface of the Earth. In this lesson, students will create an edible soil profile, study how soils are formed and use soil erosion pans to help them understand the soil structure, layers, and the importance of soil conservation.

Suggested Grade Level:
3rd-5th

Time:
70 minutes

Subjects:
Physical Science
Life Science
Geography
Earth Science

Objectives

1. The student will identify soil layers and characteristics of each layer.
2. Define five factors that affect soil formation.
3. Demonstrate soil erosion and identify soil and water conservation practices.

Background Information

Typically, soil is thought of as the material that supports and nourishes growing plants. This is true as soil anchors the roots of plants and stores water and nutrients long enough for the plants to make use of them. However, soil's importance goes far beyond just supporting plant life.

The rich, productive soil of Kansas is the state's most valuable natural resource! Some soils were formed by the breaking down and weathering of rock. Others were formed from materials transported and deposited by water, wind, or glaciers.

Five factors contribute to the formation of soil: bedrock, climate, topography, living organisms, and time. Bedrock is a solid rock layer beneath the layers of soil. Although air and water can penetrate bedrock, the roots of plants cannot. Bedrock may be exposed, like in mountains or other rocky areas. Once it is exposed, the bedrock can be broken into smaller pieces through the process called weathering. Weathering takes place when bedrock is exposed to water, air, and other natural forces over a long period of time. In this process, the rock and mineral particles eventually break down into smaller particles, which move and form new soils, where they are deposited. and doesn't pollute the water.

Edible Soil Profile

Background Information Continued

Soils form over time, which may be sped up or slowed down depending on the interaction between the five factors. Climate refers to average weather conditions such as rainfall, temperature, and wind speed. These affect how quickly- or slowly- rocks break into smaller pieces and how easily the particles are moved. Topography, the slope of the land, influences how quickly the particles break down and are moved down hill to more level surfaces where they form deeper soil layers. Living organisms like plants, animals, people, and microorganisms also help form new soils by mixing the soil layers when they dig in the soil and move it from one place to another.

A soil profile is made up of three layers called soil horizons. From the bottom going up, the three layers are: parent material, subsoil, and topsoil. The thickness and qualities of each layer vary depending on location. Soils can be carried from one location to another by wind, water, gravity or ice.

Parent material is the deepest layer of soil. It is a mixture of smaller pieces that were once bedrock. These pieces of rock, gravel, and large particles break down over time into individual mineral particles, which can eventually form subsoil and topsoil.

Subsoil covers the layer of parent material and contains finer particles than the parent material, along with fewer and smaller rocks. The subsoil layer also includes organic matter (plant and animal material in various stages of decomposition) but not nearly as much organic matter as found in the topsoil. Some plants, like alfalfa, sunflowers, and soybeans, send roots deep into the subsoil to retrieve water and nutrients.

Topsoil is the uppermost and most productive soil layer. Topsoil contains more organic matter than any other layer of soil. Plants with shallow root systems, such as wheat, grain sorghum, and corn, depend on the topsoil for water and nutrients. Topsoil is the soil layer that is most impacted by weather conditions like rainfall, temperature, and wind speed.

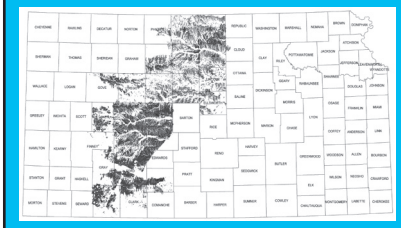
Important Facts:

Of nearly 18,000 soil types found in the United States, more than 300 different soil types have been identified and mapped in the state of Kansas.

Nearly 30 million acres of land are classified as cropland in Kansas. This includes both cultivated and uncultivated land. Around 23 million acres are planted to crops in any given year.

Kansas has more acres of prairie soils than any other state, and Kansas soils are internationally recognized.

Harney silt loam soil is the most widespread soil type in Kansas, covering almost 4 million acres in 26 counties.



Source: USDA NRCS
Harney Silt Loam in Kansas

Edible Soil Profile

Background Information Continued

Soil is a mixture of organic matter and inorganic components like minerals, air, and water that are not animal or plant based. The mineral particles that make up the soil are clay, silt, and sand. The largest and most abundant of the three sizes of particles are sand. Silt particles feel like a smooth powder, like wheat flour or baby powder. Clay particles are fine and require an electron microscope to be seen.

Soil textures are determined by the percentages of sand, silt, and clay in the soil mixture. Clay soils are fine and sticky, while silty soils are smooth, but crumble when wet. Sandy soils are gritty and abrasive, whether wet or dry. Loam soils contain equal amounts of sand, silt, and clay.

Color is an indicator of soil properties and is used to identify different soil layers. Minerals also affect the soil color. Generally, the color of a soil becomes darker as the amount of organic matter in the soil increases.

Farmers balance land uses with soil and water conservation activities to minimize soil erosion-the transportation of soil due to wind or water movement. Three general principles guide soil and water conservation practices: changing the surface of the soil to increase the ability of water to penetrate gradually into the soil layers, slowing down the movement of water along the top of the soil to give the water more time to soak into the soil, and managing the crops to take advantage of natural precipitation patterns. The goal is to keep the soil in place and the water on the land where it fell.

Other industries also work to limit soil erosion. For example, road-building and other construction activities cover exposed soils with mats of grass or straw to prevent soil from being washed away by rainfall or moved by the wind.

Soil erosion has been significantly reduced in the United States through national and state efforts that began in the 1930's. The most recent Natural Resources Inventory report shows that soil erosion on U.S. cropland decreased 44% between 1982 and 2012. In Kansas, soil erosion on cropland decreased 23% in that same 30 year time period.

Important Facts:

In 1990, Harney silt loam was adopted as the Kansas state soil.

Harney Silt Loam possesses the ideal qualities of prairie soil.

Scientists estimate that it takes 100 to 600 years to form one square inch of topsoil.

A single spade full of rich soil can contain more species of organisms than can be found above ground in the entire Amazon rain forest.

Source: Kansas Historical Society

Edible Soil Profile

Vocabulary

Acre: a unit of area used in land measurement equal to 43,560 square feet (approximately the size of a high school football field excluding the end zones).

Bedrock: solid rock layer at or near the Earth's surface.

Clay: the smallest mineral particles that make up soil, so small that they may only be seen through an electron microscope.

Climate: the average weather conditions of a specific site during a particular set of dates, including the average temperatures, humidity, and wind conditions.

Conservation: the wise and intelligent use of natural resources in a way that assures their continuing availability for future generations.

Cropland: any land available for the cultivation of plants or agricultural produce, such as grain, vegetables, or fruits.

Decomposer: an organism that recycles nutrients and makes them available for other organisms to use.

Erosion: the detachment and movement of soil or rock by water, wind, ice, or gravity.

Inorganic Matter: material that is mineral-based, rather than originating from animal or plant sources, and disintegrates through weathering.

Loam: soil types that contain equal amounts of sand, silt, and clay.

Microorganism: any living thing capable of growth and reproduction that is too small to be seen without a microscope.

Mineral: a natural compound with a definite chemical structure and formula that has formed through geological processes.

Nutrient: a substance needed for an organism to grow and function properly.

Organic Matter: plant and animal material in various stages of decomposition.

Parent Material: the deepest layer of soil, which is a layer of unconsolidated rock, gravel, and large particles covering the bedrock.

Edible Soil Profile

Vocabulary Continued

Runoff: any rain, ice, or snow that does not soak into the soil but flows across the land and eventually runs into streams and rivers.

Sand: the largest of the mineral particles that make up soil; can be seen without magnification.

Silt: small, powdery mineral particles that make up soil, but cannot be seen without magnification.

Soil: the naturally occurring mixture of minerals, organic matter, water, and air that forms the surface of the Earth.

Soil Horizon: a specific layer in the soil that has physical characteristics that differ from those of the layers above and below this layer.

Soil Type: a classification of soil which has distinct properties, including texture and color, but which never changes.

Subsoil: the layer of soil beneath the topsoil.

Topsoil: the uppermost and most productive layer of soil at the Earth's surface, moved in cultivation.

Topography: the features on the surface of the land, including natural features, like mountains or rivers and manmade features, like roads.

Weathering: the process of breaking rock and mineral particles into simpler particles.

Edible Soil Profile

Lesson 1

Materials

- 6 serving bowls
- Clear, plastic 4-6 oz. cups. 1 per student
- 2 1/4 measuring cups
- 2 tablespoons
- 2 serving tongs
- Vanilla wafer cookies
- Mini marshmallows
- Toasted oats cereal
- Chocolate puffs cereal
- M&Ms
- Gummy worms
- Labels for each serving container (i.e. bedrock, parent material, subsoil, topsoil, organic matter, decomposers)
- Soil Layers and Factors that Build Soil worksheets, 1 per student.

Preparation

1. Read recommended resource: Soil! Get the Inside Scoop, background information, lesson plan, and student worksheets in their entirety.

2. Make copies of Soil Layers and Factors that Build Soil worksheets.

3. Purchase ingredients and supplies for edible soil profile activity.

4. Pour vanilla wafer cookies, marshmallows, cereals, M&Ms and gummy worms into separate serving bowls.

5. Arrange and label bowls on a table in the following order: bedrock (vanilla wafer cookies), parent material (marshmallows), subsoil (toasted oats), topsoil (chocolate puffs), organic matter (M&Ms), and decomposers (gummy worms).

6. Place serving tongs into vanilla wafer cookie and gummy worm bowl, measuring cups in toasted oat and marshmallow bowls, and tablespoons into the M&M and chocolate puff bowls.

Edible Soil Profile

Procedures

1. Have students wash their hands .

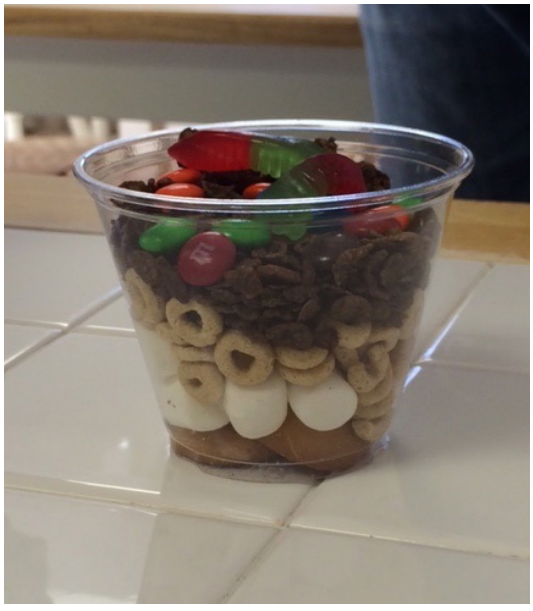
2. Give each student one cup.

3. Have each student layer the ingredients in the cup, allowing them to have different amounts of each ingredients to demonstrate how soil layers differ.
   - Vanilla wafers: 2
   - Marshmallows: 1/4 cup
   - Toasted Oats: 1/4 cup
   - Chocolate puffs: 2 tablespoons
   - M&Ms: 1-2 tablespoons
   - Gummy worms: 2

4. Hand out worksheets.

5. Discuss the layers of a soil profile, particle size and how soils are formed while students enjoy their Edible Soil Profile.

6. (Optional) Take photos of each student's soil profile to compare and measure the depth of the layers.



Edible Soil Profile

Name:_____ Date:_____

Instructions: Answer the questions below based on the Edible Soil Profile activity. Next, label the four layers of the soil profile using the words from the word bank.

1. What do the vanilla wafer cookies represent?

2. Which soil layer is represented by marshmallows?

3. Which soil layer is represented by the toasted oats cereal?

4. Which soil layer is represented by the chocolate puffs cereal?

Word Bank:

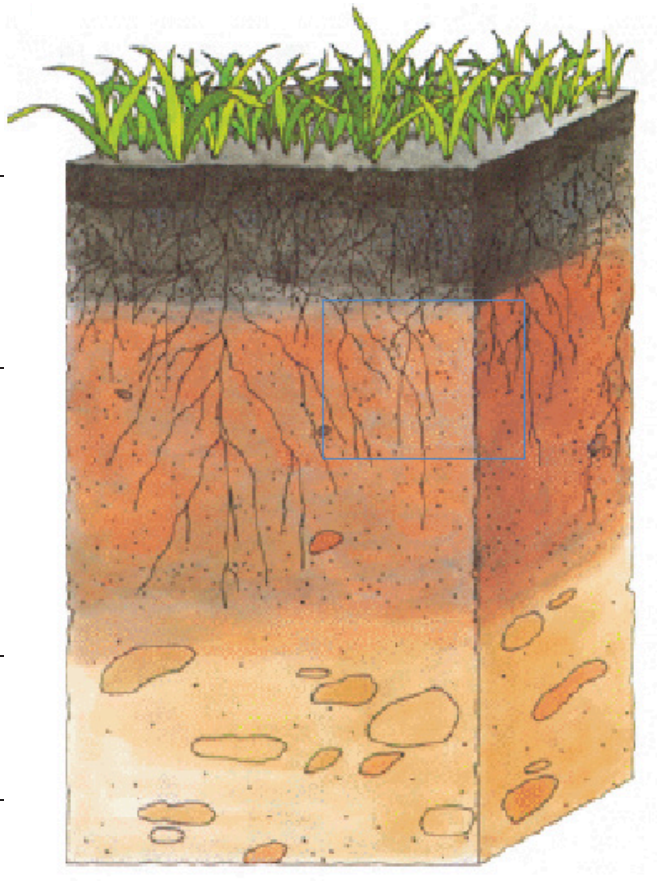
Subsoil
Topsoil
Bedrock
Parent Material

1. _____

2. _____

3. _____

4. _____



KFAC

Edible Soil Profile

Answer Key

Instructions: Answer the questions below based on the Edible Soil Profile activity. Next, label the four layers of the soil profile using the words from the word bank.

1. What do the vanilla wafer cookies represent?
   Bedrock

2. Which soil layer is represented by marshmallows?
   Parent Material

3. Which soil layer is represented by the toasted oats cereal?
   Subsoil

4. Which soil layer is represented by the chocolate puffs cereal?
   Topsoil

Word Bank:

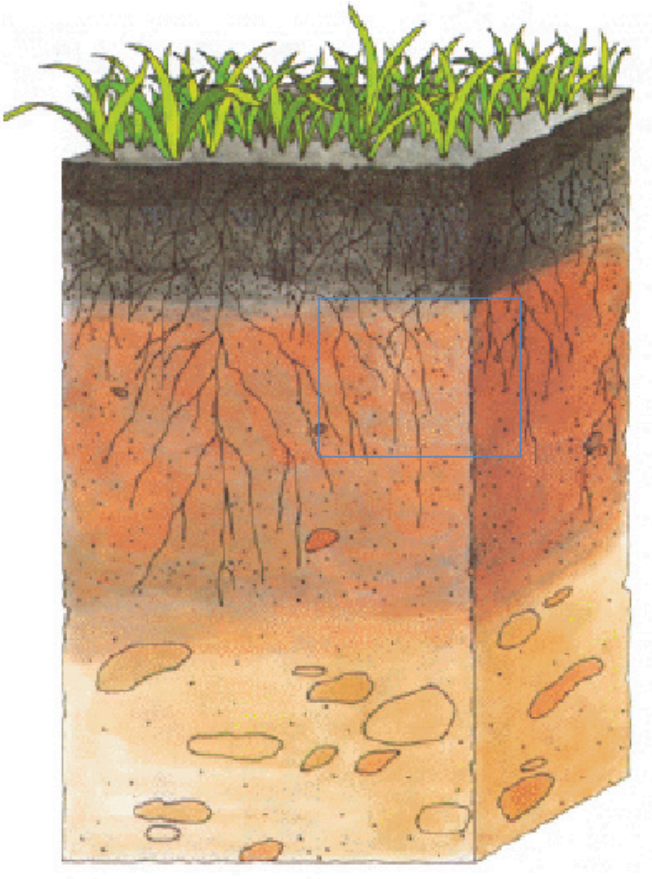
Subsoil
Topsoil
Bedrock
Parent Material

1. **Topsoil**

2. **Subsoil**

3. **Parent Material**

4. **Bedrock**



Edible Soil Profile

Name:_____ Date:_____

Instructions: Read the paragraph below. Fill in the blanks using words from the word bank to match the picture with the soil forming factor.

Five factors contribute to the formation of soil: bedrock, climate, topography, living organisms, and time. **Bedrock** is a solid rock layer that maybe exposed, like in mountains or other rocky areas. Once it is exposed, the bedrock can be broken into smaller pieces through the process called weathering. Climate refers to average weather conditions such as rainfall, temperature, and wind speed. These affect how quickly - or slowly - rocks break into smaller pieces and how easily the particles are moved. **Topography**, the slope of the land, influences how quickly the particles break down and are moved downhill to more level surfaces where they form deeper soil layers. **Living organisms** like plants, animals, people, and microorganisms also help form new soils by mixing the soil layers when they dig in the soil and move it from one place to another. Soils form over **time**. Soil changes may be slow or rapid depending on the interaction between the five factors.

1. _____

2. _____

3. _____

4. _____

5. _____

Word Bank:
- Topography
- Climate
- Bedrock
- Time
- Living Organisms

Edible Soil Profile

Answer Key

Instructions: Read the paragraph below. Fill in the blanks using words from the word bank to match the picture with the soil forming factor.

Five factors contribute to the formation of soil: bedrock, climate, topography, living organisms, and time. **Bedrock** is a solid rock layer that maybe exposed, like in mountains or other rocky areas. Once it is exposed, the bedrock can be broken into smaller pieces through the process called weathering. Climate refers to average weather conditions such as rainfall, temperature, and wind speed. These affect how quickly - or slowly - rocks break into smaller pieces and how easily the particles are moved. **Topography**, the slope of the land, influences how quickly the particles break down and are moved downhill to more level surfaces where they form deeper soil layers. **Living organisms** like plants, animals, people, and microorganisms also help form new soils by mixing the soil layers when they dig in the soil and move it from one place to another. Soils form over **time**. Soil changes may be slow or rapid depending on the interaction between the five factors.

1. Climate

2. Topography

3. Living Organisms

4. Bedrock

5. Time

Word Bank:
- Topography
- Climate
- Bedrock
- Time
- Living Organisms

Edible Soil Profile

Lesson 2 - Soil Erosion Pans

Materials

- 3, 5 gallon buckets of water
- A watering can
- 3 bricks or wooden blocks
- 3 large foil pans
- 3 clear storage tubs or medium foil pans
- Bare soil (enough to fill two pans)
- Sod/grass rooted in soil (enough for one pan)
- Dry plant matter such as straw (enough to cover one pan)
- Blow dryer (optional)
- White poster board (optional)
- Goggles, one per student (optional)

Preparation

1. Read background information, lesson plan, and worksheet in its entirety

2. Poke 12 equally spaced holes along one end of the 3 large foil pans near the bottom top of the pan.

3. Fill one large pan with bare soil.

4. Fill one large pan with sod/grass rooted in soil.

5. Fill one large pan with soil and cover soil with dry plant matter such as leaves or straw.

6. Set pans outside on the curb lengthwise.

7. For each pan, prop one end up on a brick or block so it slopes. Place end with holes in it just over the lip of the curb so it drains into clear plastic tub or medium foil pan.

Edible Soil Profile

Procedures

1. Simulate rainfall by using watering can over the foil pans. Use at a constant distance and a constant amount of water for each simulation.

2. Compare and contrast the amount of soil in the water runoff for each environment; bare soil, soil held with grass roots, and soil protected by dry plant matter. Compare the amount of time it took water to filter into the clear tubs or medium foil pans. Dig into the bare soil pan to determine how deep the water absorbed into the soil.

3. (Optional) While the soil is dry, use a blow dryer or fan to simulate wind erosion. Students should wear safety goggles to protect their eyes. Use a white poster board 'downwind' of the tubs to stop and collect soil particles moved by the wind.

4. Discuss how topography and soil types might affect the rates of soil erosion. Have students brainstorm and discuss how other factors such as construction, farming, landscape maintenance, and building roads might impact soil erosion.