Playing in the Dirt

Discovering Soil

Skills: Math and Science

Objective: Students will use their science process skills to discover the percent of sand, silt, loam or clay in soil samples.

Background

Soil is one of our state's most valuable natural resources. There are over 550 different kinds of soil in Oklahoma. Port silt loam, our state soil, is the most common soil in Oklahoma and is present in at least 33 counties. It is very productive and is used to grow a wide range of crops—cotton, wheat, sorghums, oats, and others. Port silt loam is dark brown to dark reddish brown and is derived from upland soil materials weathered from reddish sandstones, siltstones and shales. The natural soil supports a native, undisturbed vegetation of tall prairie grasses and native trees, including pecan, walnut, bur oak and cottonwood.

Soils are a combination of minerals, organic matter, air and water that is constantly changing because of the organisms that live there. There are three basic categories of particles that exist in soils. Clay is the smallest of the particles, feels sticky, and often stains the fingers. Silt feels smooth and soft and is somewhat slick. Clay and silt particles cannot be seen with the naked eye. Sand particles are the largest and feel gritty. Soils are distinguished by observing the percentage of each of the three types of particles contained in the soil. These mixtures are called loams. If soil has more sand it is a 'sandy loam,' more silt, a 'silty loam,' or more clay, a 'clay loam.'

Soils are also home to two or more tons of living things per acre. Microflora, insects, worms, and animals, as well as other organisms, produce acids that in turn help break down soil minerals. Organic matter is beneficial to soils, as it increases water-holding capacity, serves as a reservoir for plant nutrients such as nitrogen, and provides food for the living things in the soil.

Soils vary in their ability to be cultivated. The combination of particle types dictates how the soil will handle, drain, and hold water. Soils that contain a large percentage of clay hold water tightly but they drain poorly. Clayish soils are sticky. Plants growing in clay suffer from a lack of air around the roots because the tiny clay particles adsorb so much water. Clay soils drain poorly and prevent plants from getting the needed water around their roots.

Sandy soils provide an ample air supply to roots because the particles are large; however, sand does not hold water well, and it drains quickly. The water becomes unavailable to thirsty plants. Plants in sandy soils need to be

P.A.S.S.

GRADE 6

Math Process—1.3; 2.1; 4.1; 5.1,4
Math Content—2.3; 4.3; 5.1,2
Science Process—1.1,2,3; 3.1,2,3,4,5; 4.1,2,3,4,5; 5.1,3,4
Physical Science—1.1
Life Science—4.1,2
Earth Science—5.1

GRADE 7

Math Process—1.3; 2.1; 4.1; 5.1,4
Math Content—2.1b,2c; 4.2a; 5.1
Science Process—1.1,2,3; 3.1,2,3,4,5; 4.1,2,3,4,5; 5.1,3,4
Physical Science—1.1,2
Life Science—3.1; 4.2

GRADE 8

Math Process—1.3; 2.1; 4.1; 5.1,4
Math Content—2.1ab; 5.1
Science Process—1.1,2,3; 3.1,2,3,4,5; 4.1,2,3,4,5; 5.1,3,4
Physical Science—1.2
Life Science—3.2

watered frequently. Silt can be found around water sources. It is generally the soil that is carried in by flooding and then left in the drying process. This soil can collect organic materials and nutrients and store them in the existing soil.

The best growing soils combine the airiness and drainage of sand with the water-holding capacity of clay. Loam soils that contain approximately 40 percent sand, 40 percent silt and 20 percent clay are considered the best cultivating soils.

Background Sources: "Port Silt Loam: Oklahoma's State Soil," Oklahoma Conservation Commission pamphlet; "Discovering Dirt," AIMS Education Foundation, 1987; *Dirt: Secrets in the Soil*, Utah Foundation for Agriculture in the Classroom,

Resources Needed

soil samples from three different areas:

A. Topsoil from a flower bed.
B Soil from a building excavation site.
C. Subsoil from an eroded road bank.

3 straight-sided jars and lids, equal in size and shape (Large glass pickle jars work well.)

rulers

clear plastic cups (9 to 12 oz)

seeds (wheat, corn, soybeans, alfalfa)

spray bottles for watering

calculators

computer access

Activity 1

This activity will take two class periods to complete. You may start Activity 2 while you are waiting for the soil to settle in the jars.

1. Read and discuss background and vocabulary.
   —Discuss the three basic soil components and the qualities that each add to the soil.
2. Provide each student with a small handful of soil. Distribute samples of different soil types to students at random so that not everyone has the same soil type.
   —Students will determine soil type by feel. THIS ACTIVITY IS MESSY.
   —Student will gradually add water to their soil samples until they can make balls of moist soil.
   —Students will gently stretch the soil between their thumbs and forefingers and try and make a ribbon. (Some samples will not form into a ribbon, depending on the soil texture).
   —Students will note the feel of the soil as they are working it.
   —Students will use the table below to assign soils to different textural classes.

SAND—Loose and single-grained with a gritty feeling when moistened. Not sticky and will not form a ribbon when pressed between thumb and index finger.
SANDY LOAM—Contains sufficient silt and clay to give coherence to the moistened soil. Feels gritty and also slightly sticky. Will not form a ribbon.
CLAY LOAM—Forms short ribbons of less than 3 cm long.
CLAY—Extremely sticky and plastic when moist, feels a bit like plasticine. Easily forms a ribbon longer than 3 cm.

3. Provide jars and soil samples.
   —Students will follow the procedure on Worksheet A to complete the experiment.
   —Students will classify the soil samples by comparing the information recorded on the "Soil Layers Chart" for each sample with the information

found on the "Soil Texture Chart."
—Students will compare and contrast the percentages for each soil samples with the percentages shown for "loam" on the "Soil Texture Chart."
—Does the soil from each sample have better, worse, or the same drainage as loam?
—How would the samples compare to loam for water capacity, airiness and ease of handling?
—Students will design and develop their own charts to compare the above attributes for each soil sample.

ACTIVITY 2

Start this activity while waiting for the soil components from Activity 2 to settle in the jars.

1. Divide class into groups. There should be an equal number of groups planting the same kind of seed.
—Each group needs three cups.
—Students will fill each cup with soil from one of the three samples.
—Students will record group name, soil sample used (A,B, or C), and kind of seed on the outside of each cup.
—Students will use the spray bottles to water as needed.
—Students will set cups near a window or in a plant center for germination.
—Students will design charts and use a separate chart for each sample to record observations.
—Students will continue their observations for 3 – 4 weeks.
—At the end of the study, set all cups together by seed and soil sample.
—Students will make final observations and discuss possible conclusions to the study.
—Students will use the "Scientific Method Format" to make a formal lab report on the study.

Extra Reading for Students

Nardi, James B., *The World Beneath our Feet*, Oxford University Press, 2003.

Silverstein, Alvin, *Life in a Bucket of Soil*, Dover Publications, 2000.

Bial, Raymond, *A Handful of Dirt*, Walker Books for Young Readers, 2000.

Walker, Sally M., *Soil*, Lerner Publications, 2006.

Extra Reading for Teachers

Kohnke, Helmut, *Soil Science Simplified*, Waveland Press, 1994.

Lowenfels, Jeff and Wayne Lewis, *Teaming with Microbes: A Gardener's Guide to the Soil Food Web*, Timber Press, 2006.

Vocabulary

clay—soil that is sticky when wet, can be rolled into a ball and is used in making bricks

cultivated—to prepare land for planting crops; to till the land

loam—a rich soil composed of sand, silt, clay and some organic matter

microflora—tiny plants of a specific region or time

organic—of, like, or derived from living organisms

particle—a tiny fragment or trace

reservoir—a place where water is collected and stored for use

sand—loose, gritty grains of disintegrated rock found in soils, on beaches and in deserts

sandstone—a sedimentary rock composed of sand grains cemented together, as by silica

shale—a rock formed of hardened clay and easily splits into thin layers

silt—a fine-grained, sandy sediment carried or deposited by water

Name _____

Worksheet A

Read and follow directions carefully. You will need a metric ruler and a calculator to complete the chart.

1. Fill 3 jars 2/3 full of water.
2. Pour one soil sample into each jar until the water is almost to the top.
3. Label the jar with the soil sample used. (A, B, or C)
4. Place lids on the jars and shake vigorously, about 2 minutes, until all soil is suspended.
5. Place jars in a safe place where they won't be disturbed.
6. Wait 24-48 hours.

After jars have settled and you can see distinct layers:

1. Observe the layers of sediment. (Floating material is organic.)
2. Measure the total depth of sediment and record.
3. Measure the depth of each layer and record on the chart.
4. Compute the percentages.
5. Record the percentages in the "Soil Layers Chart."

SOIL LAYERS
Top layer (B) is clay
Middle layer (C) is silt.
Bottom layer (D) is sand.

Soil Layers Chart

		Sample A	Sample B	Sample C
B	depth of sand layer			
B ÷ A	% sand			
C	depth of silt layer			
C ÷ A	% silt			
D	depth of clay layer			
D ÷ A	% clay			
A	total depth of sediment			
	type of soil			

5. After recording the percentages on the "Soil Layers Chart," classify the soil sample by comparing the percentages to those on the "Soil Texture Chart" on the next page. Record your findings on the last line of the "Soil Layers Chart."

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2008.

Soil Texture Chart

	% clay	% silt	% sand
loam	20	40	40
silt loam	15	60	25
silt	5	85	10
sandy loam	10	20	70
loamy sand	5	10	85
sand	2	3	95
clay loam	35	35	30
clay	60	20	20

6. Draw a picture of each jar in the spaces below. Include percentages of the soil levels and the soil texture you have identified for each sample. A more detailed description of soil textures can be found on the internet by using a search engine and typing in "Soil Texture Triangle."

Sample A Sample B Sample C

soil texture soil texture soil texture

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Name _____

Scientific Method Format

Title of Experiment or Study:

I. Stating the Problem:
What do you want to learn or find out?

II. Forming the Hypothesis:
What is known about the subject or problem, and what is a prediction for what will happen?

III. Experimenting: (Set up procedures)
This should include: materials used; dates of the experimental study; variables, both dependent and independent (constant and experimental); how and what was done to set up the experiment; fair testing procedures.

IV. Observations:
Includes the records, graphs, data collected during the study.

V. Interpreting the Data:
Does the data support/defend the hypothesis?

VI. Drawing Conclusions:
Justify the data collected with concluding statements about what has been learned. Discuss any problems or concerns. Use other studies to support the conclusion. Give alternative ideas for testing the hypothesis.

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