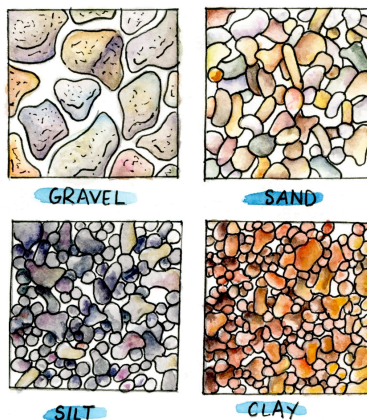


TTCD Lesson Plan (2): Sand, Silt, and Clay Game and Demonstration

Unit: Soil Science	Grade(s): All	Class Size: 1-30	Lesson Duration: 60 minutes	Location: Classroom and gym
Topic(s):	Soil science, erosion, watershed			
Student Prerequisites:	N/A			
Essential Questions:	Why is soil important?			
Student Objectives:	Students will learn that minerals in soil have three particle sizes: clay, silt, and sand. Students will understand that loam soil is good for most plants because it holds on to water for plant roots, but filters and drains when there is too much water.			
Standards:	Supports NGS Standards: 5-PS1-3. Make observations and measurements to identify materials based on their properties. MS.ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. 5-ES2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. <i>Note: to better support MS-ESS2-4 or 5-ES2-1, students should be asked to either draw a model of water moving through different soils/mineral types, or to make suggestions for refining the game to be more accurate. The game is a model!</i> Relevant NGSS Crosscutting Concepts: Structure and Function: The way an object is shaped or structured determines many of its properties and functions. Energy & Matter: Tracking energy and matter flows into, out of, and within systems helps one understand their system's behavior. Supports Cultural Standards: E-2: Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to: understand the ecology and geography of the bioregion they inhabit.			
Local Context:	Students will consider the composition of the soil in their greenhouse and gardens. Older students will consider types of soil around Tyonek.			
Vocabulary:	Soil particle size Component			

	Minerals organic material Sand Silt Clay loam
Dena'ina language words:	<i>Added by TTCD or community partners</i>
Materials:	• Classroom whiteboard • Basketballs or other ball • Four different soil medium samples for “soil filter” demonstration • Four 2L bottles, prepped ahead of time (see below) • Large pitcher OR bucket of water + smaller pouring cup • For older students: printed maps of Tyonek • Pencils to annotate maps
Instructor Prep:	Prep the “Soil filter” demonstration: 1. Collect soil samples of four different textures: clay-like soil, very fine sand or silt, coarse sand or gravel, and loam soil from the garden or outside. <i>It is rare to find soil samples that are consistently one soil particle size throughout. Use four samples that each contain different quantities of each of these soil types.</i> 2. Cut each 2L bottle a few inches from the top. Remove the cap and turn the top part of the bottle upside down and place it in the bottom part of the bottle, creating a funnel shape. Fill each of the funnels with a different soil medium, and label accordingly. 3. Practice pouring water through each “soil filter” type. 4. Fill a pitcher with water, OR fill a large bucket and have a cup handy for students to dip and pour. 
Introduction:	Review: What are the four main components of soil? (water, air, minerals, organic material). These all must be present in order for plants to grow! Today we are going to break it down even further, by just looking at the mineral layers that made up the bottom, densest part of our soil layer jars. Explain to the class that when you take out all of the water and organic material in the soil, you are left with just minerals, which come in three soil particle sizes: sand, silt, and clay. Sand is the largest, followed by silt, and the smallest is clay. There also might be pieces of rock or gravel in your soil. Ask the class: Which one do you think is easiest for water to flow through? You can draw a sketch like this one on the board, or show them your soil samples:



Explain that it is rare to find just one type of soil texture in a soil sample. Each soil sample you take will probably have a mix of these different textures. What soil texture do you think plants like the most? Why? (There is no right or wrong answer to this question.)

Today, we are going to play a game to find out what happens when water moves through each type of soil.

Directions:

Gym game: Sand, Silt, and Clay

1. Demonstrate the hand and body positions for each type of soil particle, and have students practice along with you:
 - a. Sand: standing with feet wide apart and hands stretched out to the sides like a sea star
 - b. Silt: standing with feet wide apart and elbows bent with hands clasped in front of the chest
 - c. Clay: standing with legs close together and arms tight to the sides
2. Divide the class evenly into two groups. One group will be soil particles (either sand, silt, or clay, depending on the round) and the other will be water particles.
3. Give each **water particle** student a ball.
4. **Round ONE:** Have **sand particle** students stand in a line in the center of the gym, with their arms and legs wide apart (like a sea star!). Each particle should be touching another, fingertip to fingertip.
5. Have the **water particle** students try to run from the starting line at one end of the gym to the other, through the sand group (under their arms). They should be able to run through with little difficulty.
6. If they make it through the sand, the water particles must try to make a shot with their ball. Once they make it, or if they try unsuccessfully more than 10 times, they run *around* the sand (along the edge of the gym) to return to the starting line and try to run through again.

	7. Round TWO: Switch out the sand particles for silt. Silt particles stand with legs wide apart but elbows bent and hands clasped in front of their chest. Students should be touching elbows. 8. Have the water particle students run from the starting line, through the silt particles (under the legs or elbows), and to the basketball hoop again. If students don't feel comfortable squeezing through the silt particles, allow them to go around. What happened to the water this time? (It either had to squeeze, or go around the particles.) 9. Round THREE: Switch out the silt particles for clay. Clay particles stand with their legs close together and arms tight to their sides. Clay students should be touching shoulders. 10. Ask the water group if they think they move through the clay. The answer should be no! Allow students to run around the clay in order to make their shots. 11. Round FOUR: Now, mix up the sand, silt and clay particles (students) to make a mix of textures. Explain that if you add some organic material to this soil, you would have a loam, which is what the plants in our garden prefer. Some students will be touching elbows to shoulders, fingertips to elbows, etc. Ask the water group to run through. 12. Switch water and soil groups so that every student gets a chance to run and shoot hoops.
Wrap Up:	Have students gather together. Sit in a circle in the gym or at desks back in the classroom, and have a helper set up your demo "soil filters" where students can see. Which type of soil particle do you think plants like the most: sand, silt, clay, or the mix called loam? Well, it can depend on the plant, but most plants like a mix of all of these, plus some organic material! Choose student volunteers to come up and <i>slowly</i> pour some water through each of your demo filters. • Notice how the sandy soil lets all the water flow away, probably taking nutrients away with it! • The clay and silt don't let the water drain, so plants could get flooded. Any toxins that get washed down to these plants would sit in the water and possibly get absorbed by the plants. • Plants usually need this mixed loam soil with organic material in order to hold on to enough water and nutrients to grow and thrive. Explain to students that this soil came from their garden or greenhouse. Is this a good soil for plants? <i>Evidence of learning for younger students:</i>

	Using their TTCD notebooks or binders, have students work in small groups to draw or write a “recipe for soil” that could support healthy plant growth. Those who demonstrate learning will include sand, silt/clay, and organic material in their soil. <i>Evidence of learning for older students:</i> Divide students into small groups and provide each group with a map of Tyonek. Instruct them to annotate the map showing one spot where they think sandy soil is common, one spot where they think silty/clay soil is common, and one spot where they think loam is common. Have them circle areas where they think plants have the soil they need to thrive. Those demonstrating learning will have overlap between the loam soil and thriving plants, or be able to explain an alternative reason that plants are thriving despite the silty/clay or sandy soil (i.e. certain wild plants have adapted to do well in these types of soils).
Lesson Adaptations:	• Younger students can use soft balls, and try to toss it into a bucket or over a net rather than the basketball hoop. • Instead of, or in addition to, the live demonstration, show the class the video “Water Movement in Soil”: https://www.youtube.com/watch?v=vmo0FRAVgkM
Extensions:	Building on the evidence of learning for older students, take a field trip to some of the locations they highlighted on their map and examine the soil types. Squeeze Test: Take a field trip to the greenhouse or garden. Have each student collect a handful of soil, and squeeze it firmly with one hand. What does it feel like? When you open your hand, what happens? From this test, we can make an estimate about what type of soil we have: • Loam: It will hold its shape, and when you give it a light poke, it crumbles. • Clay/Silt: It will hold its shape, and, when poked, sits stubbornly in your hand. • Sand: It will crumble apart as soon as you open your hand. Wrap-Up: What might we be able to add to our soil to achieve the texture we want for our vegetable plants? Consider sand, perlite, and organic material like compost or manure.
Reflections:	How did it go? What did students understand most/least? What could change about instruction or lesson plan?
Resources Used:	https://www.soils4kids.org/files/s4k/perkin.pdf https://cdn2.hubspot.net/hubfs/451937/Extension/Superior%20Soil_Experiment.pdf USDA Natural Resources Conservation Service: Soils

