

# What is Soil?

## Purpose:

The purpose of these instructional activities is to demonstrate to students that soil consists of various inorganic and organic particles.

## NGSS Standards for Elementary grades -3<sup>rd</sup> Grade

- From Science and Engineering Practices –planning and conducting experiments.
- Observe sedimentary rocks. Identify these rocks were formed through compressing soil.
- Identify fossils and describe how they provide evidence about the plants and animals that lived long ago and the nature of their environment at that time.
- Describe natural materials and give examples of how they sustain the lives of plants and animals.
- Describe how the properties of earth materials make them useful to humans in different ways. Describe ways that humans have altered these resources to meet their needs for survival.
- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. Soils are made up of elements of all the geosphere, hydrosphere and Biosphere. (5-ESS2-1)

## Concepts:

Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things).

Soil consists of different sized minerals, organic matter, water and air.

Rocks erode and can become a part of soil as they break down.

## Goals:

The lesson will support students understanding of earth's major systems and they will demonstrate a knowledge of the composition of soil.

## Outcomes:

Students will write two hypotheses in their Science Journals.

Students will form hypotheses and test them

## Lesson Plan & Activities

In large group (hand out name tags and make sure they have science journals and pencils)

Do you remember what we talked about last time? How organisms are connected to each other and what else? Are they connected or dependent on anything else?

We talked last time about what we eat, do you remember the groups of organisms we eat? What do these organisms need to grow and be healthy?

All organisms are part of earth's biosphere and are dependent upon the other major earth systems. The hydrosphere (water), the atmosphere (air) and the geosphere (rocks and soil).

Why is soil important to us? Soil is really important for growing plants. We are going to spend time studying soil and a little time seeing the organisms that live in it.

We will divide into 4 groups like last time but all stations will perform the same activities at the same time. So each of you will stay at your table.

### **Activity 1: Breaking Rock**

4-6 students in each group max

Materials:

Safety goggles, newspaper, different sized rocks

Procedure:

Instructor (I): Ask students to pick up the rocks in front of them. Ask them how they think these rocks were formed. Describe how sedimentary rocks are formed.

Student (S): let students share their thoughts

I: We're going to try to break the rocks. Rocks breaking up (another word for this is weathering) usually happens over long periods of time. We are going to try to do it quickly. Demonstrate how you want them to do it. Ask students to put on safety glasses and hit the larger rocks with the smaller rocks for 30 seconds. Ask them to be careful of their fingers. Have them do this on newspaper, and note that you will collect the rock fragments from the newspaper in Activity 2. (Take safety goggles or they will be distracted)

After the rock is broken into pieces ask them to describe what they see

Get them to describe the rock. Look for size, shape, color, texture, etc. Ask: Is it possible to find rock in soil? Ask them to speculate on how rock might break apart or weather in nature.

Show them pictures of different ways rocks can be broken down (pictures will be at the station).

Ideas you could share: Rocks can weather by freeze and thaw cycles, by pushing against one another when moved by gravity. They can weather by water flowing over them or by the wind with small particles slowly nipping pieces of large. Rocks can be sent tumbling by moving animals, wind or water breaking rocks apart directly, or rocks can be split apart by the growing roots of plants.

### **Activity 2: Separating soil fragments by size**

Materials:

Two or three graduated sieves

Pan to hold fragments

Sand

Soil

Organic matter

Magnifying glasses

Small watch glasses for each student

Beaker of water  
Tiny pieces of clay

Show the students the sieves and mention that they are really expensive so we need to be careful with them!

Instructor: Ask student to gather the broken rock and put it in the sieves and ask what they think will happen.

Student: Verbal hypothesis (Smaller pieces will fall to the bottom)

I: (Learning Issue): As rock breaks down through weathering and erosion it becomes smaller. Pieces of rock and sand become even smaller than sand.

*Demonstrate by putting the rock particles into a stack of sieves:*

If there are enough rock particles that you created in Activity 1, put just them in to the top sieves. If there aren't many particles, also add small amounts of the sand. Then, have each student take a turn shaking the stack of sieves gently (if they seem like they can do this without getting sand everywhere, otherwise instructors can gently shake the sieves side to side). This will separate the rock particles by size. Gravel and large particles of sand will be in the top pan, mid-sized particles of sand in the middle, and small particles of sand, and even smaller particles of silt and clay will fall to the bottom.

I: What do you see?

S: (Verbal observation)

I: Show student that there are particles on the top of each sieve and in the bottom of the pan. Have them feel the different sized fragments and ask them to describe what they feel.

You can have students look at particles with a magnifying glasses if you want but they can be a distraction.

S: (Verbal observation)

I: Show students silt and let them feel it.

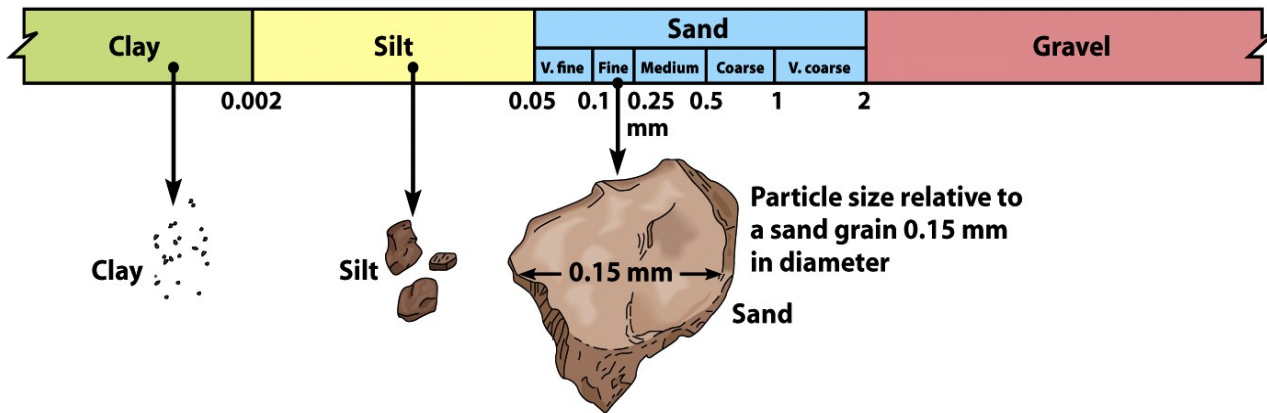
Put a small amount of clay in the weigh boats and give to each student, add water to each and let the students mix it in the water.

*Learning Issue:* What are left underneath the sieve are the finest particles. Clay particles are often so small and dense they cannot be sieved easily because they stick together when wet and when they dry they are really hard. However, we can observe that they break apart in a small amount of water (the water turns a different color).



#### *Information for Instructors*

*Most sediments, including sand, are made up of the fragments that result when rock is broken down by wind and rain (freeze/thaw or hot/cold cycles as well as chemical weathering. Generally, they start as larger fragments (rocks or gravel), which are broken down by particles colliding, by water percolating into them, roots growing into them or rivers carrying them down stream. In other words, large bits of gravel are plentiful on the banks close to the head of a river. As it travels downstream, gravel becomes finer into cobble, pebble, granule, and eventually turning into sand.*



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*In most cases, each grain of sand is made up of a single crystal of a mineral. Rocks are amalgamations of numerous minerals, but in the course of their being broken down and transported, they separate into minerals; by the time the fragments reach the size of sand, each particle consists of a single mineral. Composite particles, which have not broken down to single crystals, do also exist, especially in relatively coarse sand. These are known as lithic fragments.*

### Activity 3: Soil has many of these parts/components and we can separate them by density

Materials:

1 1000 ml graduated cylinder (name it and explain what it is usually used for—measuring liquids.)  
 Sand, clay, silt, soil, peat in labeled bags or in pans

I: Let's look at some materials that we find in soil.  
 Sand, clay, soil, and peat.

Clay and silt --some silt particles are such fine grains of rock that they cannot be sieved easily because their particles are so small.

**Peat or organic matter** is mostly dead plants in the process of decomposing. Organic matter is where lots of the nutrients plant need come from. Plants can also absorb nutrients from the minerals found in rocks in the soil, such as phosphate. As the rocks erode, plants can access these nutrients.

As we drop a small amount of each into the cylinder predict what will happen –will it sink or float?

I: What happened? (Sand sinks, organic material—from plants and animals floats, and clay is suspended in the water).

Where do you think the nutrients come from that are in soil that nourish plants? (Organic matter and from minerals that make up some kinds of rock). The nutrients are often bound to soil particles.

(Which soil particles do you think would be able to hold more nutrients, sand, silt or clay? Answer: clay because they are smaller and have more surface area and are negatively charged, so can retain many nutrients which are generally positively charged.) This is probably too much to discuss

Show students a large block made of smaller blocks and ask them to imagine it is sand. If the pieces of tape are nutrients bound to the block how many are on the surface of the large block (count together) how many if we break the block up? (Count together)

#### **ACTIVITY 4 Water movement through Soil—Water races**

Students will time how long it takes for water to travel through clay, peat, sand or soil. Clay and peat need to be done just once by the instructors to demonstrate how the experiment is done-water moves very slowly through clay-it will likely not move through over the time we are with the students, Peat moves really fast often too short for students to start to count.

##### Materials:

Several small tubes with either sand or soil held in the tubes by  
Cheesecloth and Rubber bands  
Small graduated cylinders  
Water bottle  
Pans to catch water  
Small chalk board  
One tube with clay in it as a demonstration  
Large beaker for waste water

Each cylinder is filled with either sand or soil. Have the students look at sand and soil as well as the tube with clay. The sand and soil columns should be the same height.

I: “If we pour water into each of these materials what do you think will happen?”

S: Verbal Hypotheses—

I: Start with the clay tube and demonstrate how to pour water on top of the soil.

I: Ask students to work together. One student will pour 15 ml of water from a small graduated cylinder it into the top of the soil/sand cylinders the other will hold it. Students need to hold the cylinder so everyone can see the water percolating through the sand or soil. Ask the students to start counting (1 Mississippi...) from the time the water is poured until there is no more water above the soil or sand. Write in a prepared table the time in seconds that it took for all the water to move into the sand and soil. Each pair of students will go through the procedure with sand or soil so there is replication. Ask students to write the results in their notebooks.

Ask students what they observed and what the data they collected means.

S: (The water should travel faster through the sand than soil.)

I: Learning issues: Is water present in the soil? When is a lot of water likely to be in soil? (After precipitation) Plants need water to live, just like us. What happens if water travels too fast through soil, will plants be able to absorb it? We see that water moves through soil at different rates depending on the how much sand, silt, clay and organic matter is in a particular soil. Which soil is likely to hold water longer so plants can absorb it (get good long drinks)?

#### **Activity 4B:**

##### Materials:

Small beakers with sand or soil with room for water  
Water in small beakers—the amount doesn't matter but about 25 mls  
Bubble maker

I: There is something else in soil that we can't see.

I: What do you think it is?

S: Verbal answers

I: Let's each pour water quickly on the cup of sand or soil in front of each of us (approx. 20 mls)

What do you see?

Learning Issue: The students should see air bubbles. The air bubbles are released really quickly in the sand so if they are distracted they won't see them. The soil continues to bubble for some time. Ask them what is in the bubbles they are seeing. They might need help with this. Use the bubble maker to demonstrate how bubbles can be made by blowing, ask them again what is in bubbles. They should be able to understand and say that there is air in soil. Instructors can explain that there is air between the particles of soil. Plants need air in their roots just like you and me to stay healthy and grow strong.

The final step is to write what they know what soil is—different sized particles of rock, organic matter, water and air. Some soils have more large particles of rock and are sandy soils, other soils have more fine particles of rock, and these are called clay soils. The best soils for growing plants have a balance of smaller and larger fragments of rock.

**Weathering** happens when rocks are broken into smaller pieces. These smaller pieces are called **sediment, sand, pebbles** or **silt**.



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Wind



## Water



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