WHAT'S IN WETLAND SOIL?

Summary

Does soil from different places have different proportions of organic and inorganic materials? In this lesson, students will perform tests and take measurements to determine how the composition of wetland soil compares to that of sandy soil.

Objectives

Students will:

- know that soil is a mixture of organic and inorganic compounds, water, and air
- calculate the proportion of organic and inorganic compounds in different types of soul
- understand the wetland soil contains a high percentage
  of organic components

California Content Standards Addressed

Grade Six - *Math content standard 1.3:* "Use proportions to solve
problems."
Grade Six - *Math content standard 2.1:* "Solve problems involving addition, subtraction, multiplication, and division of positive fractions and explain why a particular operation was used for a given situation."
Grade Six - *Science content standard 5.e:* "Students know the
number and type of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures,
and soil composition."
Grade Six - *Science investigation and experimentation standard 7 c*: "Construct appropriate graphs from data and develop qualitative statements about the relationship between variables."

The Basics:

Grade Level:
6 - 8

Subject areas:
physical science, mathematics

Duration
65 minutes

Materials:
for organic/inorganic inquiry:
teacher prep, for each group of 3-4 students:
1. a set of organic and inorganic objects spread out evenly on a table: (such as rocks, sticks, plastic bags, leaves, seeds, feathers, sand, insects, Styrofoam cup, tree bark, newspaper, plastic container)

for each student:
1. their science notebook
2. pencil and clipboard
3. copy of organic/inorganic worksheet (Appendix A)

for the experiment:
teacher prep, for each table of 3-4 students:
1. 1 copy of Soil Test Steps (Appendix C)
2. 1 quart each of 2 different soil samples, one wetland, one sandy (samples should be dry and powdery)
3. 2 vials with lids
4. 1 ruler
5. erasable crayons
6. table salt
7. small beaker of water
8. colored pencils
9. magnets

for each student:
1. Lab worksheet (Appendix B)
2. pencil

for journal prompt:
for each student:
1. Journal Prompt 2 (Appendix D)
2. pencil

Outline

There are six parts to this lesson:

1) Organic/Inorganic Inquiry (10 minutes)
2) Instruction: discussion of soil (5 minutes)
3) Experiment: soil + water profile (30 minutes)
4) Groups share data/discuss findings (10 minutes)
5) Journal prompt (5 minutes)
6) Closing circle (5 minutes)

Vocabulary

organic, inorganic, weathered, Earth's crust, proportion, prediction

Background Material

Organic material + Minerals (inorganic material) + Air + Water = Soil

Why learn about soil? Soil is the "skin" that covers our earth, a natural ecosystem made up of minerals, organic matter, air, and water. It is created by of weathered minerals produced by parent material and transported by volcanoes, wind, water, ice, or waves, mixed with organic matter produced plant and animal decay. Layers of soil called horizons form and change slowly over time.

Knowing about soil and the different types of soil data are important. For example, knowing how much water from rain and runoff will enter the soil has an impact on farmers, in order to understand what types of crops will grow best; to structural engineers, to understand how best to construct buildings that will not sink or slide, and hydrologists, who need to understand how much water can percolate through the soil into the groundwater.

Factors influencing soil formation

There are five factors influencing the formation of soil: parent material, climate, topography, biological factors, and time.

The first factor, parent material, is the material in which soils form. This is the **inorganic** component of soil. Parent material is generally bedrock. Often soils form in materials that have moved in to an area because of factors such as wind, erosion, and glacial till. This parent materials gives soil its physical properties of color, texture, and structure. The **texture** of soil is created by the proportions of each of three different soil particles in the sample. These three types of particles are sand, silt, or clay. The size of the particle determines its type. Sand

particles are the largest, between 2 to 0.05mm in diameter. They can be seen with naked eye and feel rough or gritty. Silt particles are between 0.05 to 0.002 mm. They can hardly be seen without a microscope and feel smooth, like flour. Clay particles are smaller than 0.0002mm, are invisible to the naked eye, and feel slick and gummy when wet.

Climate affects soil formation in two ways. First, temperature, rain, and wind patterns cause different patterns of weathering in the parent material. Climate can also cause different rates of chemical and biological reactions that occur as soil is formed.

Topography is also a factor in soil formation. Steeper slopes, such as steep cliffs and mountainsides, are generally more eroded, leading to a thinner layer of soil. More level land has a tendency to build up deeper layers of soil.

Different biological factors affect the formation of soil. This is the **organic** component. Animals and microorganisms tunnel through soil, causing aeration and mixing. Decomposition, caused by microorganisms, constantly creates fresh upper layers of soil. Plants affects soil formation is different ways; the roots create avenues for aeration to occur, and leaf litter provides material for decomposition on the surface. The amount of organic matter present helps to determines the type of soil, for instance, hydric wetland soils can contain 95% organic materials arid while desert soils can contain less that 1% organic matter. The type and amount of organic matter in soil directly affects its chemical properties.

The last factor influencing soil formation is time. This process can be either fast or slow depending on climate, topography, biological factors, and human factors. For example, weathering can take millions of years, but a flood or landslide can move tons of topsoil in just minutes.

Procedure

1) Organic/Inorganic Inquiry (10 minutes)

- Divide class into groups of 3-4 students.
- Give each student his or her science notebook, clipboard, pencil, and one Organic/Inorganic Inquiry worksheet
- Show students the tables covered with objects, and assign one group to each table. Tell students they have 5 minutes to examine the objects on the tables and decide if they are organic (are alive **OR** were alive) or inorganic (are not alive **AND** were never alive).

- Tell students to discuss each item on the table within their group to come to a conclusion. Ask students to write the name of the item on their worksheets either under the "organic" column or under the "inorganic" column.
- Go!
- After 5 minutes, call time and gather the entire group in a circle. Go over each item on the table and compare the groups' answers. Challenge students: why did you choose to put that in the organic category? in the inorganic category? What do you know about (the object) that made you come to that conclusion?

2) Instruction: discussion of soil (5 minutes)

- Segue discussion of organic and inorganic materials into a discussion of soil. Tell students that they will be experimenting with soil today. Ask what they think the (name some organic and inorganic things they students found, for example grass and rocks) have to do with soil.
- Ask students what they know about soil.
- Tell students soil is the loose material found in the upper crust of the earth. It is the "skin" that covers the earth.
- Tell students that soil is made from organic matter, inorganic matter, air, and water.
- Ask students if they think all soil has the same mixture of those 4 ingredients.

3) Experiment: soil + water profile (30 minutes)

- Tell students that they are going to do an experiment that will help to answer that question. Does wetland soil have the same mixture of organic and inorganic ingredients as sandy soil? That is the science question they will experiment to answer today.
- Ask class for a prediction in the form of a statement and write it on the white board. Tell class that this is their prediction. Tell class that the result from the experiment will let them know if their prediction was true or false.
- Divide students into their original groups of 3-4. Direct each group to a table prepped with the experiment materials.
- Go over the steps of the experiment with the class: Tell students that there are 2 soil samples on each table. One is a wetland soil and one is a sandy soil from the other side

of the Monterey Bay. Tell students that they will add water and salt to each sample and shake until it is thoroughly mixed. Then the soil samples need to sit and settle. When it is settled, the inorganic components will settle to the bottom and the organic components will float on the top. Then they will figure out what part, or proportion of each soil is organic and inorganic.

- Read over the Soil Test Steps with the students.
- Ask one person in the group to be in charge of reading the directions to his/her group.
- Teachers and docents: make sure that each student in the group engages in the experiment either by marking the bottles in 1/8 inch marks, adding soil, adding salt, adding water, and/or shaking the bottle. Explain that adding the salt helps the water clear and the soil settle faster than it would with ordinary tap water.
- Teachers and docents: while students are waiting for the soil samples to settle, ask them to copy the "soil + water profile" drawing and pie chart onto a blank piece of paper for their science notebooks. Direct them to write the question and prediction on their lab worksheets.
- Once the bottle has cleared, ask students what they think settled to the bottom? (heavy things, rocks, sand, silt, clay).
- There may be a dark black layer of material at the top of the sandy soil sample. This is iron. Students may be interested in what it is: so you can ask them if they have any ideas what material they think it could be. Direct them to place a magnet gently on the side of the bottle to find out if it is magnetic.
- Measure the thickness of the inorganic layer at the bottom of the bottle. (the layer may vary in height from place to place, so ask students to estimate and all agree on the measurement.) Direct students to record this measurement on their lab worksheets.
- Ask students what they think is floating on the top (light things, organic ingredients).
- Ask students to tell you the thickness of the floating layer without actually measuring the material. Guide students by asking:

  1. How much of the bottle did you fill with soil? (1 inch or 8/8)

  2. How much inorganic material is left at the bottom (example, 5/8 inch)

  3. Knowing that information, how can you figure out how much is floating organic material? (8/8 - 5/8 = 3/8)

- Repeat for each soil sample.
- Ask students to color and label their pie charts to represent the fractional organic and inorganic parts of the soil. Be sure that students make the connection between the 1/8 inch measures on the sample and the 1/8 segments on the pie chart.

4) Group share data/discuss findings (10 minutes)

- Ask one representative from each group to stand and share their findings.
- Write their results on the board.
- Did every group come up with similar results? What factors may have caused any differences?
- Which soil had the most organic material? Which soil had the least?
- Did they prove their prediction to be true or false?
- What does organic material contribute to gardens? (keeps soil loose, provides air pockets and nutrients for soil fertility, retains moisture)
- What does inorganic material contribute to gardens? (provides soil structure and minerals.
- How could you improve your soil if you needed more organic material? If you needed more minerals and structure?

3) Journal prompt (5 minutes)

- Give each student a Wetland Notebook Journal Prompt 2 (Appendix B).
- Ask students to record their name and date at the top of the page.
- Tell students to take 5 minutes to write a journal entry about their experiment today.
- Then tell students that they can:
    1. Write a summary of the experiment.
    2. Write what they learned.
    3. Write down any questions they have after doing this experiment.
    4. Tell students they can take notes, write full sentences, or make drawings. Assure them it is their journal entry and they are free to record information the best way they know how.
- Collect science notebooks with all students' paperwork inside and put away.

6) Closing circle (5 minutes)

Pass a rock around the circle and ask each student to say one interesting thing they discovered today.

Bibliography/Resources used:

- Barrett, K., White, J., et al. (2006). *Math in the Garden*. Burlington, VT: National Gardening Association.

Extensions

Suggested extensions for this activity:

- ✓ Hands-on restoration gardening project outside at the WERC
- ✓ Wetland Plant and Clay Tile Art (Wetlands Stewards Extension)
- ✓ Wetland Soil Permeability Case Study Extension (Wetlands Stewards Extension)

Appendices

Appendix A: Organic vs Inorganic: an inquiry

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Appendix B: Wetland Lab Worksheet: Soil + Water Profile

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Appendix C: Soil test steps and sample drawings

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Appendix D: Wetland notebook journal prompt 2

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Appendix A
Organic vs Inorganic: An Inquiry

Examine each item on the table. Decide which is organic and which is inorganic. List each item in one of the two columns below.

Organic things: *are alive OR were alive*	Inorganic things: *are not alive AND were never alive*

APPENDIX B
WETLAND LAB WORKSHEET SOIL + WATER PROFILE

NAME_____DATE_____

Lab worksheet

Science question: _____

Prediction: _____

Copy the drawings from the Soil Test Steps directions onto your lab worksheet below. You will record your results on these drawings.

Appendix C
Soil Test Steps and Sample Drawings

1/ Mark a line 1-in from the bottom of the bottle

2/ Divide inch into 1/8-in units

3/ Add soil up to 1-inch mark

4/ Add pinch of salt

5/Add water almost to top of bottle

6/Replace lid and shake well

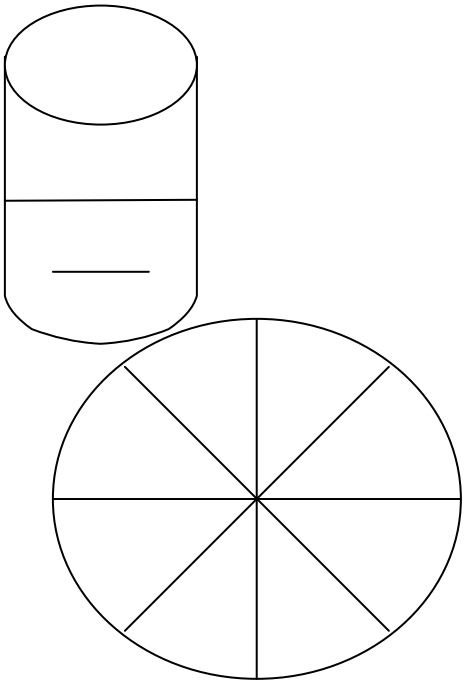
7/Put bottle on flat surface - let mixture settle

8/Measure to the nearest 1/8 inch the height of the settled soil

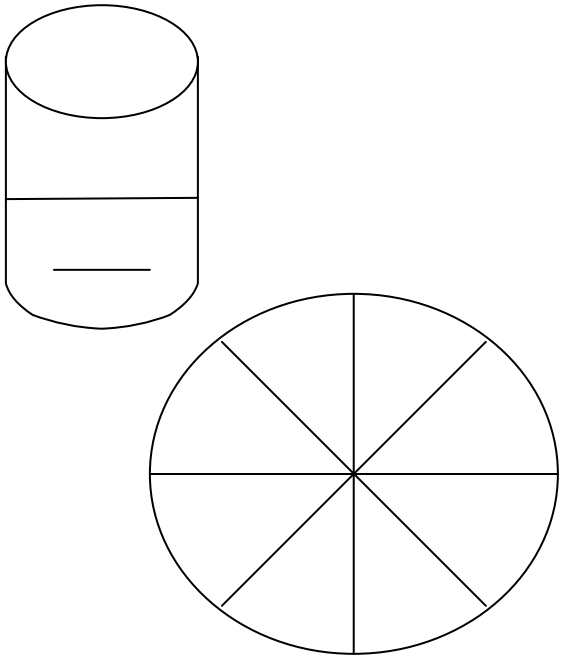
9/Color the pie chart to show the corresponding number of 1/8 segments

Copy these drawings into your lab worksheets, one set for each soil sample:

Sample # _____



Sample 2 _____



WETLAND NOTEBOOK JOURNAL ENTRY
SOIL + WATER PROFILE

NAME_____DATE_____

WEATHER_____TIME_____

This is the place for you to write, take notes, or make drawings about the activities you did today. You can record:

- *about the experiment and any observations you made.*
- *what you thought was interesting.*
- *any questions you have about organic things, inorganic things, or about soil.*