Give and Take, Water and Soil

ALL ABOUT SOIL EROSION

Respect Rule: Look, Listen, Learn, and Leave Alone (until instructed).

Overview

Soils are affected by the flow of water through them and they in turn affect the water.

Background

pH is a measurement of acidity and alkalinity in a range from 1–14, with 7 being neutral.

0	Battery acid, strong hydrofluoric acid
1	Stomach acid
2	Lemon juice, vinegar
3	Orange juice, soda
4	Tomato juice, acid rain
5	Black coffee, "softened" drinking water (at 5.5 nitrogen becomes available to plants)
6	Saliva, urine (phosphorus becomes available to plants)
7	"Pure water"
8	Sea water
9	Baking soda
10	Milk of Magnesia, Great Salt Lake
11	Ammonia
12	Soapy water
13	Bleach, oven cleaner
14	Drain cleaner

As water moves through soils it changes in pH, and if it is slightly acidic (from air particles), it changes the pH of the soil.

All life on earth is carbon-based. The carbon cycle is a vital life process. Carbon dioxide from the atmosphere is used by plants during photosynthesis. It is then consumed by herbivores, which are in turn consumed by carnivores or omnivores. Carbon is a by-product of plant and animal respiration. Many students mistakenly believe that plants breathe out oxygen, but it is a by-product of photosynthesis. Photosynthesis is the process by which plants use sunlight to convert water and CO_2 to O_2 and carbohydrates. When plants or animals decompose, the carbon is released back into the atmosphere. Woody plants tie up massive amounts of carbon which is released when the wood burns. When steady amounts of small, shelled animals filter down to the bottom of the ocean, they eventually form carbonate. This can be vaporized by volcanic activity, releasing carbon back into the atmosphere. Organic matter buried under sediments over thousands of years can become fossil fuels (coal, oil, natural gas). Carbon is released as these fuels burn and combine with atmospheric oxygen to become carbon dioxide.

Large amounts of carbon dioxide in the atmosphere trap the sun's heat, similarly to the way glass panes trap heat in a greenhouse. Many scientists think that this greenhouse effect is causing global warming, which is causing climatic change, which in turn would have destructive effects on most life.

Before-&-After-the-Field-Trip Activity

Activity: Carbon Cycle Game
Time: 45 minutes
Materials: 3 poster boards: blue, brown, green

1. Label the blue poster board **Atmosphere**, the brown poster board **Land**, and the green poster board **Ocean**.
2. Make a spinner 1–6 or large dice out of cardboard for each poster. Each student will need a paper labeled 1–10. On the blue poster board under Atmosphere, write: 1, 3, 5: Terrestrial plants use you for photosynthesis. **Go To Land.** 2, 4, 6: Ocean plants (algae) use you for photosynthesis. **Go To Ocean**. On the green poster board under Ocean write: l: You are breathed out as CO_2 by an ocean animal. **Go To Atmosphere**.

Objectives
The student will 1. understand that water affects soils and soils affect water; 2. will measure pH; 3. study the carbon cycle.

Grade Levels
5–12

Adult/Student Ratio
1 to 30

Where
Outside at school

Key Words
Aerobic
Anaerobic
Carbon Cycle
Germinate
Mineral Soil
Organic
pH
Photosynthesis

This rock did not come here by itself. This tree does not stand here of itself. There is one who made all this, Who shows us everything.

—Yuki initiation chant, *The Way We Lived: California Indian Stories, Songs and Reminiscences*

2: You are an animal/plant that dies and sinks to the ocean floor. You become carbonate. **Stay In The Ocean**. 3: The plant/animal decomposes and releases carbon that is used by another plant. **Stay In The Ocean**. 4, 5: You are breathed out by algae. **Go To The Atmosphere**. 6: Magma vaporizes carbonate, releasing the bound carbon. **Go To The Atmosphere**.

On the brown poster board under Land write: 1: You are in a plant that burns. **Return To Atmosphere**. 2: You are in a plant eaten by an animal. **Stay On Land**. 3: A plant/animal breathes you out. **Return To Atmosphere**. 4: You are an animal/plant that dies and becomes trapped in sediment as a fossil fuel. You must stay locked up until you roll the same number twice in a row. Then **Return To Atmosphere**. 5: You are a plant/animal that dies and decomposes. **Return To Atmosphere**. 6: You are an animal eaten by another animal, then passed out during defecation; decomposition occurs. **Stay On Land**.

3. Spread the students out among the 3 stations. On their paper they will write where they are on #1. They will choose what animal/plant they are (a fish, whale, pine tree, wheat, rock). Students will take turns rolling the dice or spinning the spinner. If they are told to stay in a place they must go to the end of the line before they can re-roll. Each time they must record what they are and where they have gone.
   - (1) I am an anemone that died and now I'm a carbonate rock
   - (2) Still a carbonate rock
   - (3) A volcano sent me to the atmosphere
   - (4) I have been breathed in by a monkey in South America....
4. After all ten lines have been filled, have the student make a cycle of where he/she traveled as a carbon atom. It will have a lot of interconnections. Some of the students do beautiful illustrations at this point, others have an interesting tangle of arrows, but their cycles should reflect their list of ten positions. Ask them where they spent most of their time. What would happen if fossil fuels were released early?

Field Trip Activity

Activity: Soil Here, Soil There
Time: 1 hour
Materials: 1 Soil Here, Soil There Student Worksheet, graph paper, soil samples, outdoor thermometer, soil thermometers (if available), containers that will hold 500ml, large coffee filters, wide range pH paper, large rubber bands, rainwater collected in clean buckets, 64 box of Crayola crayons

1. Divide the class into groups of 3–4 students. Using the worksheet, students record observations of the soils.
2. Place a coffee filter over each container and wrap a rubber band around placing 250g of soil is placed on them.
3. Test the pH on 20 ml of rainwater. Pour the rainwater through the soil samples, remove the dirt, and test the pH of the water in the container. Use a new pH paper for each measurement.
4. Record data on Soil Here, Soil There Student Worksheet. Under color, use one of the names of a 64-count box of Crayola crayons that closely resembles the color of the soil.
5. Continue recording data on the worksheet.
6. Show the pH on the graph paper. Different plants have different pH requirements:

Corn	5.5–7.7
Pine	5.0–6.0
Rice	5.0–6.6
Milkweed	4.0–5.0
Carrot	5.5–7.0
Onion	5.8–7.0
White Cedar	4.5–5.0
Aspen	3.8–5.5
Apple	5.0–6.5

Most plants also have oxygen requirements for their roots. A good soil is usually equal part mineral, organics (decomposed plant/animal material), and pore space (the area that allows water to move through the soil, but that does not always stay saturated). Some plants have adapted to low oxygen and low pH.

7. Collect equal soil samples from each of the following areas and place on a labeled paper plate. Dig about six inches deep, getting the organic material and mineral soil.
   - Under an oak
   - Under a pine
   - From a wetland
   - From a garden
   - From an open area (perhaps a field or around the border of a soccer field)
   - An area of high erosion (a slope)
8. After the Soil Here, Soil There Student Worksheet is completed, discuss the following questions:

   If you were planning on planting an apple orchard, where would be the better location, a cut pine forest, oak woodland, or marshland? Why? (Look the pH chart-5.0-6.5.)

   What is organics?

   What is mineral soil?

   Why do you think that weeds are able to grow so well in different areas?

   What plants have adapted to acidic conditions?

   Some plants must have bare mineral soil to germinate (begin sprouting). Where would they be most likely to grow?

   When bacteria break down organic material, they give off gasses. Most of it goes into the atmosphere and one cannot smell it. In which soil do you smell the bacteria gas?

   Most plants cannot live with their roots always wet. They must have oxygen. When there is no oxygen, the soil turns slimy black, gray, or green. This is called gleyed soil. Which soil is gleyed?

   Aerobic means that oxygen is present. Anaerobic means there is no oxygen. Which soil is anaerobic?

   List three plants that you saw in the wetland that you did not see elsewhere.

   What do you think will happen to oak trees if their roots are always watered (e.g. if there was a lawn around them or a pond built next to them)? Why?

Name Date

Soil Here, Soil There

Student Worksheet

Where was the soil found?	What color is it?	What smell doees it have?	How does the soil feel when it is rubbed between fingers?	Is there an organic material present?	What is the tem-perature of the soil?	What is the pH of the soil?