Create Your Own Soil Profile Activity

Task Overview: Soil profile refers to layers of soil. A typical soil profile takes nearly 1,000 to 100,000 years to form. The formation of the soil profile mainly depends on parent rock material, climate, topography, and vegetation. A soil profile comprises 5 major soil horizons (i.e., layers). They are the O, A, B, C and R horizons.

SMAP (Soil Moisture Active & Passive mission) will measure the moisture content of the top ~5 cm of the soil profile. These surface layer measurements will be used in computer models to produce estimates of the soil moisture in the root zone, as well as estimates of evapotranspiration, infiltration/exfiltration, and recharge to ground water. These quantities are greatly influenced by the characteristics of the soil profile.

In this activity, you will create a desktop soil profile based upon the biome region of the United States where your school is located.

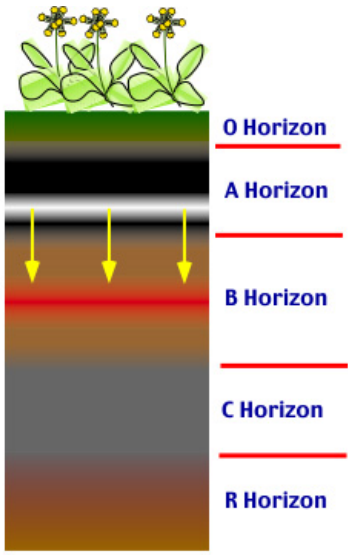

Figure 1: A typical soil profile

O Horizon: (1st layer) This is the top layer of soil. It is made of fresh to partially decomposed organic matter. The color varies from brown to black.

A Horizon: (2nd layer) The top part of this soil is made of highly decomposed, mixed up organic matter. The color ranges from brown to gray. This zone is also known as the root zone.

B Horizon: (3rd layer) Unlike the other horizons, this horizon has more clay and bedrock components. The higher clay content is due to leaching from the layers above. Some root activity also takes place in this layer.

C Horizon: (4th layer) This layer consists mostly of weathered bedrock. It is the cracked and broken surface of the bedrock.

R Horizon: (Last Layer) This is the last layer in the profile. It is made of unweathered rocks, the parent material.

Materials:

clear glass vase with four sides

rocks, dirt (based on biome type and soil horizons)

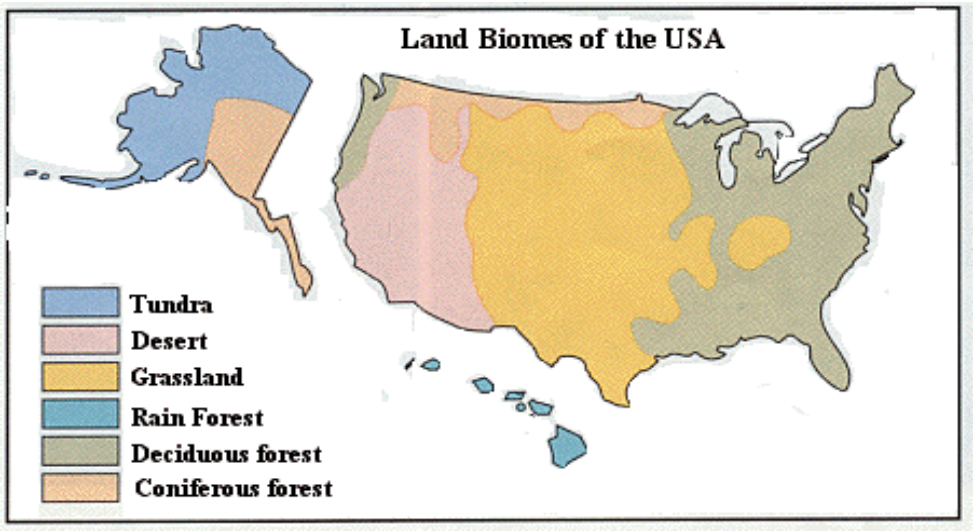

Figure 2: Land Biomes of the USA map

Procedure :

1. Read the GLOBE Program's Introductory soil background information.

2. Find which land biome best fits your school location by looking at the map in Figure 2. For this activity, you will either be Desert, Forest, or Grassland. If you fall within the Tundra biome, please choose the next biome closest to you.

3. Now, look at Figure 3 and match up your biome with the correct Soil Profile example.

4. Write down which Horizons are part of you biome's soil profile (this is very important, as the next step will be to collect soil samples from around your school and home that you can use to create your own soil profile.

Figure 3: Soil Profile examples; Desert (left), Forest (middle), and Grassland (right)

5. Collect samples from around your school and home those rocks and soils that best fit your biome's soil profile horizons.

6. For each sample, add them in layers to your vase and match them up to the examples in Figure 3.

7. Your Soil Profile will be complete after you add the final layer to your vase. Compare your soil profile to your classmates.

Questions for Discussion:

1.) What do soil profiles tell us?

2.) What is a biome and what is the difference between a desert, forest, and grassland biome?

3.) What effect does the soil type have on the amount of soil moisture it can hold? How might you demonstrate this with your newly-created soil profile?

4.) What role does soil moisture play in the world's climate?

5.) How will the SMAP mission help us better understand soil moisture? Please see http://smap.jpl.nasa.gov for more information.

Standards Addressed:

National Science Education Standards:

-Science as Inquiry: Content Standard A
-Earth and Space Science: Content Standard D
-Science and Technology: Content Standard E

Benchmarks for Science Literacy:

-The Nature of Technology (3c)
-The Physical Setting (4b, 4c, 4d,

Glossary of Terms

biome-a major regional group of distinctive plant and animal communities well adapted to the region's physical environment

climate-weather in a location averaged over a long period of time

evapotranspiration-the process of transferring moisture from the earth to the atmosphere by evaporation of water and transpiration from plants

exfiltration-loss of water from the soil

infiltration-the process by which water penetrates into soil from the ground surface

parent rock-the rock mass from which parent material is derived

recharge-the physical process where water naturally percolates or sinks into a groundwater basin

soil horizon-a layer in a soil profile

soil moisture-the total amount of water, including the water vapor, in an unsaturated soil

soil profile- a vertical section of soil from the ground surface to the parent rock

topography-the configuration of a surface including its relief and the position of its natural and man-made features

vegetation-plant life as a whole, especially the plant life of a particular region

Introduction to Soil (Information taken from the GLOBE Program's Soil Protocol)

Soils are one of Earth's essential natural resources, yet they are often taken for granted. Most people do not realize that soils are a living, breathing world supporting nearly all terrestrial life. Soils and the functions they play within an ecosystem vary greatly from one location to another as a result of many factors, including differences in climate, the animal and plant life living on them, the soil's parent material, the position of the soil on the landscape, and the age of the soil.
Scientists, engineers, farmers, developers and other professionals consider a soil's physical and chemical characteristics, moisture content and temperature to make decisions such as:

- Where is the best place to build a building?
- What types of crops will grow best in a particular field?
- Will the basement of a house flood when it rains?
- How can the quality of the groundwater in the area be improved?

Each area of soil on a landscape has unique characteristics. A vertical section at one location is called a soil profile. When we look closely at the properties of a soil profile , the story of the soil at that site and the formation of the area is revealed. The chapters of the soil story at any location are read in the layers of the soil profile. These layers are known as horizons. Soil horizons can be as thin as a few millimeters or thicker than a meter and the properties they contain that are different from the horizons above and below them. Some soil horizons are formed as a result of the weathering of minerals and decomposition of organic materials that move down the soil profile over time. Other horizons may be formed by the disturbance of the soil profile from erosion, deposition, or biological activity. Soils may also have been altered by human activity. For example, builders compact soil, change its composition, move soil from one location to another, or replace horizons in a different order from their original formation.

Soil Moisture

Moisture plays a major role in the chemical, biological and physical activities that take place in the soil. Chemically, moisture transports substances through the profile. This affects soil properties such as color, texture, pH, and fertility. Biologically, moisture determines the types of plants that grow in the soil and affects the way the roots are distributed. For example, in desert areas where soils are dry, plants such as cacti must store water or send roots deep into the soil to tap water buried tens of meters below the surface.

Plants in tropical regions have many of their roots near the surface where organic material stores much of the water and nutrients the plants need. Agricultural plants grow best in soils where water occupies approximately one-fourth of the soil volume as vapor or liquid. Physically, soil moisture is part of the hydrologic cycle. Water falls on the soil surface as precipitation. This water seeps down into the soil in a process called infiltration. After water infiltrates the soil, it is stored in the horizons, taken up by plants, moved upward by evaporation, or moved downward into the underlying bedrock to become ground water. The amount of moisture contained in a soil can change rapidly, sometimes increasing within minutes or hours. In contrast, it might take weeks or months for soils to dry out.

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References:
GLOBE. *Soil Protocol Introduction*, 2005. <http://www.globe.gov/tctg/soil_intro.pdf?sectionId=88&lang=EN>.