

K-12 IYS Activity



Summary

Four basic processes occur in soils—additions, losses, transformations (changes), and translocation (movement). A PowerPoint presentation provides some examples. Experiments demonstrate these soil processes. Because soil minerals take hundreds to thousands of years to transform, M&Ms are used to represent minerals in the soil and will change rapidly.

Materials Needed

- Laptop, projector, and screen for showing PowerPoint presentation
- Topsoil—enough for the entire class to do experiments. It should be pulverized or sieved to remove the large aggregates, gravel, and other larger materials.
- Coarse sand
- M&Ms or similar colorful, easily dissolving candy
- Cheesecloth or gauze
- Large petri dishes or plastic plates
- Clear plastic cups with small holes in the bottom
- Water in cups
- Eyedroppers
- Digging device (spoons, popsicle sticks or tongue depressors work)
- Paper to protect desks as needed

Celebrating the



2015

International
Year of Soils

soils.org/IYS

Basic Soil Processes

Ages

Middle school and up. Could be done as a demo for elementary.

Where could you offer this?

local school

Recommended group size?

20-30

What type of room do you need?

Classroom seating with space or laboratory to look at soils

Type of Lesson

Lecture (basic info, invited speaker)

Demonstration

Hands-on

Time Needed

Scientist prep time: Time to read slides and fact sheet, practice the presentation, and run through each experiment before teaching the class.

30 to 60 minutes. Option to extend over 2 days.

Learning Objective

- Be able to list and explain each of the soil processes
- Be able to give examples of each process

If the activity costs money, how have you funded this in the past/suggestions for others?

- Materials can be purchased for under \$20. Items like spoons, cups, popsicle sticks, and plastic plates may be readily available at school, thus reducing costs.

Method

1. Prepare soil columns. Put holes in the bottom of a clear plastic cup. This can be done with a push pin or sharp pencil. Place a little cheese cloth in the bottom to prevent the sand from flowing out if the holes are too big. Fill the cup about 2/3 full with sand. Place M&Ms or similar candy on the sand, making sure that a couple touch the outer edge of the cup. Place topsoil on top of the sand to within about 1 cm of the top of the cup. Place the soil column on a petri dish or plate.
2. With an eyedropper, add water to the soil and observe changes (addition). Where does the water go? Observe what happens as the water moves down through the soil (translocation).
3. Continue to add water slowly using the cup. The water will reach the M&Ms. Observe the changes. The color on the M&M should start to dissolve (transformation) and move away (translocation) from the M&M. Also, some of the topsoil may be observed to move down into the sand (translocation).

Basic Soil Processes

4. Continue to add water to the soil column and observe as it starts to come out of the holes at the bottom of the cup. What colors are present? Is there some soil material leaving? This could take some time, so be patient. The material in the water and the water itself are losses to the soil column.
5. Stop adding water and let the soil drain. Next class (or next day), dig into the soil carefully to expose the M&Ms. Observe the changes to them (transformation) as well as where the color has moved (translocation).

Discussion Questions

- Describe what materials are added, lost, moved or changed.
- What would happen if you poured water through the soil for a long time? M&Ms would completely dissolve and be leached (lost) from the soil.)

Background: Additions, Losses, Transformations and Translocations

Additions are easy to understand. These consist of materials being deposited on the soil from above as well as materials moving in from below with rising groundwater. Obvious examples are additions of leaf litter as trees shed their leaves, or additions of organic material as plants and plant roots die. Also obvious are additions of mineral material due to flooding, landslides, and other geologic events. Perhaps not so obvious is the nearly constant additions of atmospheric dust to the soil surface. Some of this dust can travel long distances and is important to the overall fertility of a region. Rainfall is also an addition.

Losses are also rather obvious. Erosion is a major form of soil loss. Erosion can be the slow process of dust being blown away, the rapid, large-scale process of a landslide moving materials off a slope, or anything in between. Loss can also occur as nutrients are taken up by plants that are then harvested and removed. Transpiration is the movement of water into a plant through its roots and subsequent removal by evaporation from its leaves. Water also evaporates from the soil directly. As minerals and nutrients move through the soil into the groundwater or out of the rooting zone of the plants, this too is considered a loss.

Translocations are similar to losses in that they involve the movement of materials. Translocation differs in that the material is not removed from the soil; instead it moves from one location to another. This internal movement can be divided into illuviation (movement into) and eluviation (movement out of). Eluviation is the process by which a material is removed from a zone. Illuviation is the process by which material moves into a zone. Salts and highly soluble minerals like gypsum and carbonates (lime) can dissolve in the soil water and then move to wherever the water moves. In some cases, they may be lost to the groundwater but in others they may move only short distances in the soil. As the soil water evaporates, the dissolved materials (salts etc.) will precipitate (form solids) out of the water. This is common in arid areas, where salts are moved to and concentrated at the soil surface as water evaporates. Burrowing animals from ants to tortoises dig holes and physically translocate soil throughout the soil profile. Likewise, when we dig holes or till the soil we are moving the soil from lower to higher points (and vice versa) in the profile. Clay and organic matter can also be translocated as water physically moves them deeper into the profile as it percolates downward.

Understanding transformations takes a little more thought. As an example, leaf litter that is added to the soil is eventually decomposed. This decomposition is a transformation process. Likewise, rocks weathering to soil is also a transformation process. The initial minerals in the rock are transformed to clays and other minerals in the soils over time. If the soil is compacted, the amount of pores or void space is reduced. This too transforms the soil by decreasing the ability of gases and water to move through the soil. Compaction also makes it harder for roots to penetrate the soil. When soil water freezes, it is transformed from a liquid to a solid (ice); this, too, is a transformation. As water freezes, it expands. This action can help the particles in the soil clump together or aggregate, thus forming soil structure.

Additional Resources

www.soils4teachers.org



Soil Science Society of America
www.soils.org