Water Cycle and Its Movement in the Soil

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Objective of the Lesson:

This lesson is designed to introduce students to:

- The water cycle.
- The entry of water into soil.
- Grain size and its role in water infiltration in soils.
- The rates of water movement in different soil types.
- Contaminant transport is different in different soil types.

Standards Addressed:

Science

K-3	4-5	6-8
Standard 1 *Nature and Application of Science and Technology* A-1, A-3,	**Standard 1** *Nature and Application of Science and Technology* A-1, A-2, A-3	**Standard 1** *Nature and Application of Science and Technology* A-1, A-2, A-3
Standard 2 *Materials and Their Properties* A-1	_____	_____
Standard 5 *Earth's Dynamic Systems* A-1, A-3	**Standard 8** *Earth's Dynamic Systems* A-2	**Standard 8** *Earth's Dynamic Systems* A-4

Agriscience

6-8
Standard 7 *Natural Resource and Environmental Careers* B-8

Materials Needed:

- Posters of water cycle and water movement in the soil
- Two columns (75 cm in length and 6 cm in diameter)
- Sands and silts

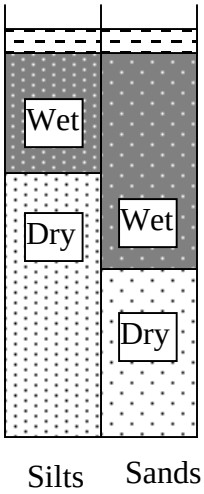
Teaching Tips:

- This lesson concludes with a demonstration of water infiltration into two soil types, each dominated by a different grain size (sand or silt). To enhance student participation and learning allow students to predict which soil will allow water to infiltrate faster. The students may hypothesize alone and then share with a partner (i.e. Think, Pair, Share).

Procedure:

1. Introduction of water cycle (approx. 5-8 minutes)
   - Water is essential to life. Without it, the biosphere that exists on the surface of the earth wouldn't be possible.
   - The Water Cycle (also called the Hydrologic Cycle) is the process that water moves around the earth. The Water Cycle can change the form of water from liquid to water vapor to ice, and even clean it along the way, but it can't make more water. Dinosaurs may have lapped up the water you drink today!
   - Water on this planet can be stored in any one of the following reservoirs:
     - Atmosphere
     - Lakes
     - Rivers
     - Oceans
     - Groundwater
     - Soil
     - Glaciers
     - Snowfields
   - All of these reservoirs are renewed on a continual basis. However, the rates at which renewal occurs differs with each reservoir. On average water is renewed in rivers once every 16 days. Water in the atmosphere is completely replaced once every 8 days. Slower rates of replacement occur in large lakes, glaciers, ocean bodies and groundwater. Replacement in these reservoirs can take from hundreds to thousands of years. Humans use these resources, particularly groundwater, at rates that far exceed their renewal times. This type of resource use is making this type of water effectively non-renewable.
2. Introduction of entry of water into soil (approx. 3-5 minutes)
   - The soil plays an important role in the hydrologic cycle, particularly the soil surface zone. It is here that the complex partitioning between rainfall (or irrigation), infiltration, runoff, evaporation, and deep seepage is initiated and sustained. This zone is also a primary site for the management and control by humans and all-important resource, water.
   - The movement of water in the field can be characterized as a continuous, cyclic, repetitive sequence of processes, without beginning or end. However, we can conceive of the cycle as if it begins with the entry of water into soil by the process of infiltration.
   - Water is supplied from above to the soil surface by:
     - Rainfall
     - Snowmelt
     - Irrigation

3. Different water infiltration rates in different soils (approx. 5-8 minutes)
   - ✧ Two simple experiments should be used to display the entry of water into the different soils composed of either silts or sands.
   - ✧ The kids should have learned about the textural designation of a soil on the Thursday class. The difference between the silt and sand is the particle size. Below is an image that shows the resulting water levels in each column of soil.



Check for understanding:

Possible Questions

1. Where can water be stored in our planet?
2. According to what you learned from the previous classes, what is the difference between the sand and silt?
3. What will happen when water is poured into the sand column and silt column at the same time?
4. In which column, sand or silt, will the contaminant (red color water) move faster?
5. What will happen if the field is polluted?

Suggested Answers

1. The ocean, the lake, the river, the soil, the groundwater, the atmosphere, the glacier, and the snowfield.
2. Their sizes are different; the size of sand is large, while the size of silt is small.
3. Water will move faster in sand column than it does in silt column. Because the size of sand is large, and the pores among the sands are large too. Water flows faster in large pores.
4. The water will flow faster in the sand column, because of the large pore spaces.
5. The contaminants will infiltrate into soils. In sandy soils, contaminants will move fast, while in silt soils, contaminants will move slowly. Some contaminants will be retarded by soils, some will move downwards to the groundwater. (we can introduce the following after this question: After years and years, the contaminant may be pumped out through wells and used

by humans, the contaminant may also move to the river and pollute other areas. It is necessary to protect the environment.)

Summary of learned material:

1. The basic concept about water cycle and water entry into the soils.
2. The soil particle size is one of the factors that affect the water movement in soils.
3. The movement of contaminants in different soils is different.

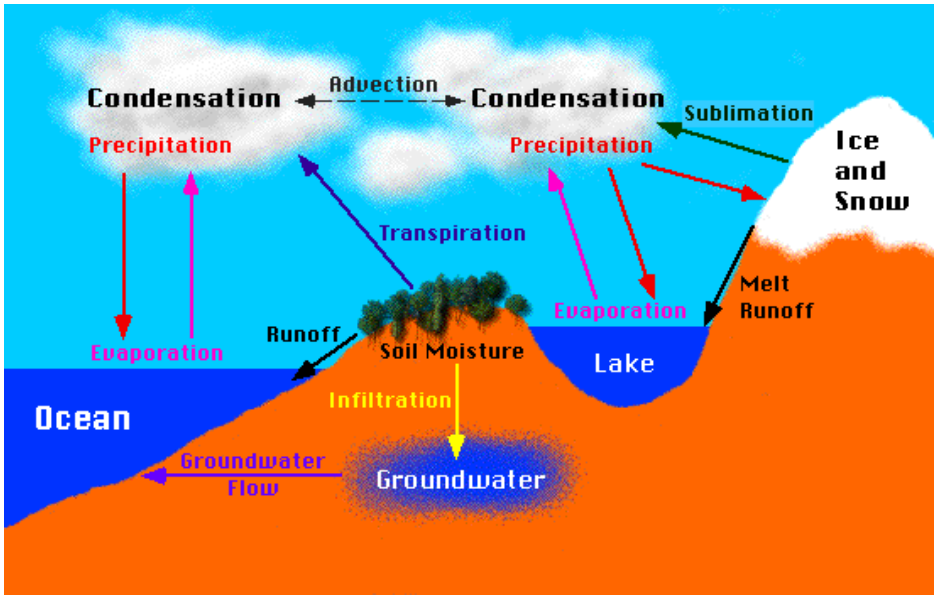
Additional Resources:

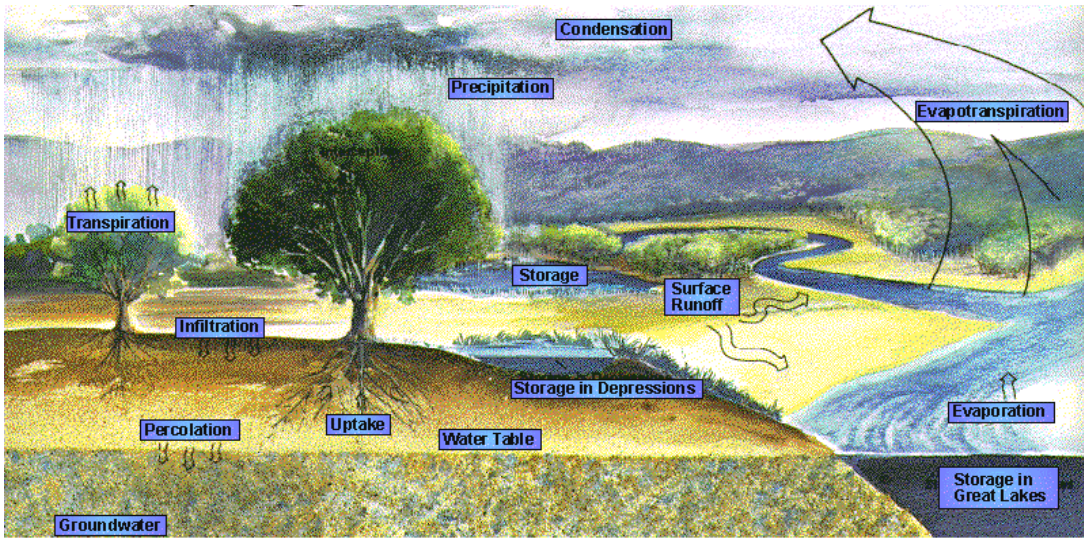
General Sites – Water Cycle:
http://www.kidzone.ws/water/ - Designed for younger students. Images and activity sheets as well.
http://ga.water.usgs.gov/edu/followdrip.html - Follow a drip through the water cycle.
http://earthobservatory.nasa.gov/Library/Water/ - Printable article, nice images and diagrams.
http://www.und.edu/instruct/eng/fkarner/pages/cycle.htm - Good supplementary questions.

General Sites – Sediment Size
http://earthsci.terc.edu/content/investigations/es1401/es1401page03.cfm - Images of rock types.
http://www.uwsp.edu/water/portage/undrstnd/soil.htm#Porosity - Porosity and packing.
http://www.uwsp.edu/water/portage/undrstnd/soil.htm#Permeability - Permeability information.

Additional activity:
http://www.ocrwm.doe.gov/pm/program_docs/curriculum/unit_4_toc/24.pdf

Images:


Condensation
Advection
Condensation
Sublimation
Precipitation
Precipitation
Ice and Snow
Transpiration
Melt Runoff
Evaporation
Runoff
Soil Moisture
Evaporation
Lake
Ocean
Infiltration
Groundwater Flow
Groundwater


Condensation
Precipitation
Evapotranspiration
Transpiration
Storage
Surface Runoff
Infiltration
Storage in Depressions
Evaporation
Percolation
Uptake
Water Table
Storage in Great Lakes
Groundwater