MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

DISCOVERY SCIENCE CENTER

Second Grade ~ Teacher Packet

Themes: Introduction to Groundwater, Aquifers, and Filtration; Transpiration

California State Science Standards addressed:

Earth Science

- Soils differ in their color, texture and capacity to retain water.
- Rock, water, plants, and soil provide many resources, including food, fuel, and building materials that humans use.

Key Vocabulary:

Soils	Resources	Conservation
Water Cycle	Accumulation	Evaporation
Condensation	Precipitation	Groundwater

Key Concepts:

Percolation	Filtration of Water	Transpiration
Storage of water underground		Retrieval of groundwater
Aquifer		

Prompting and Closing Questions:

1. Why is sandy soil or rocks better for storing underground water than clay soil? (the sandy soil and rocks have more air spaces between them for water to flow into.)
2. How do plants clean our water? (plants lose water from their leaves which comes out as pure water.)
3. Can dirt actually clean our water? (yes, the water filters through the dirt, leaving behind some of the impurities / pollutants.)
4. Water is a precious resource. What is one way to use it wisely? (answers will vary)

The prompting and closing questions focus on the standards listed previously, will be used by the program instructor during the visit to your school, and will be incorporated into the take-home Ricki the Raindrop activity booklets distributed to your students.

Background Information for the Teachers:

Water Cycle

Water is one of the only substances that can exist in three different forms (solid, liquid, gas) at the same point in time, under the same temperature and pressure conditions. For example, if you experience snow on a sunny day, you would see snow (solid water) slowly melting into liquid water because of the warming sunlight. This liquid water will then evaporate (forming gas water) due to the warming sunlight. As you breathe out, the water vapor (gas water) in your breath condenses into fog (liquid water).

We can see the same situation by carefully observing a glass of ice water. Ice (solid water) is floating in liquid water. Water vapor (gas water) from the surrounding air which is warmer than the glass of ice water, can condense onto the outside of the glass of ice water because the glass provides a cooler surface than the surrounding air ~ forcing the water vapor to change to a liquid water form (the droplets of water on the outside of the glass).

It is through this ease of water moving from one form into another that facilitates the water cycle. The water cycle is the course that water follows as it moves through its different forms:

- The Sun causes liquid water to evaporate, turning the liquid water into water vapor (gas water).
- Hot air containing gas water rises. As it reaches the upper atmosphere, the air containing the gas water cools. This process condenses the gas water into liquid water, forming clouds.
- When clouds become heavily saturated with liquid water, the liquid water falls out of the sky. This process is called precipitation. Depending on the temperature, the precipitation can be in the form of solid water (snow) or liquid water (rain).
- When the liquid water reaches the earth's surface, it accumulates into puddles or pools. Snow accumulates in piles and eventually melts due to the warm sunlight.

When discussing the water cycle, we usually refer to four processes: (1) Evaporation (2) Condensation (3) Precipitation and (4) Accumulation. Probably the least understood process is evaporation, as many people refer to that as the stage at which "water disappears." The term "disappears" can be misleading to the students who may think that the water no longer exists at that time, when in fact the water does exist, it is just in a form that is more difficult to see. Emphasize that during evaporation, the tiny bits of water moving into the air are so small that you cannot see them.

Soils ~ Filtration and Percolation

Other processes related to the water cycle involve when the water comes in contact with the earth: (1) Runoff (2) Filtration and Percolation and (3) Underground Storage of water. Liquid water from many sources, including rain and melted snow, provide surface water and can run off to different areas. Streams, creeks, rivers, and even storm drains can deliver runoff water to the ocean, lakes, or manufactured reservoirs. This runoff water can be captured for our use in water storage systems, such as in reservoirs, or move quickly into the ocean where we cannot easily use it.

Other liquid water can soak into the ground through a process called percolation, if the soil is permeable and provides enough air spaces between the individual soil particles for the water to slip through. Typically, the larger the soil particles, the larger the spaces *between* the individual soil particles will be, and the more efficient the percolation process will be. An aquifer is an underground layer of porous rock and sand where water can accumulate for retrieval at a later date through a pumping system.

Filtration is a process related to percolation. As the water percolates through the soil, some materials can be filtered out of the water, helping purify the water as it moves toward storage in the aquifer. The water that is stored underground in the aquifers is called groundwater.

Plants and Transpiration

Plants move water through their different parts, taking water out of the ground and releasing water into the air. As the plants' roots take up water, the water is transported to the plants' leaves for use during the photosynthetic process (the manufacture of sugar). Carbon dioxide is also used in the photosynthetic process. Carbon dioxide is obtained from the air through the plants' leaves. As the leaf gathers air, it loses water. This addition of water into the air cools the environment surrounding the plant. The bigger the leaf, the more water it is able to contribute to its surroundings…but the bigger the leaf, the more water is needed by the plant in order to survive.

Activity: Saltwater Evaporation

Materials:

- Salt
- Tablespoon
- Warm water
- Pie pan

Procedure:

Obtain warm water from the teachers' lounge or by bringing a thermos of heated water from home. Mix 1 –2 tablespoons of salt into the warm water and place it in a pie pan. Allow the saltwater to evaporate over time. Have the students predict whether the salt will also evaporate or be carried into the air by the evaporating gas water. Discuss the results.

Conclusion:
Some particles are small enough to be carried into the air with the gas water as it moves from the liquid form into the gas form. Salt is actually a large molecule (relatively speaking) much bigger and heavier than the water molecules, so the water vapor is unable to carry the salt with it. Through this experiment, we can see that the water which evaporates is pure, clean water (assuming that the mixture only contained salt and water with no other very small impurities which could have been hidden in the mixture). If we could recapture the gas water and lower the temperature to condense the water into liquid ~ it would be good to drink.

Activity: Soil Samples

Materials:

- Index cards (3" X 5")
- Rulers and pencils
- Scissors
- Glue
- Soil samples
- Brass brads (optional)

Procedure:
Collect a variety of soil samples, particularly small bits of gravel, sand, and clay. Have the students use their rulers to measure and their scissors to cut an index card horizontally into three 1" X 5" strips. Have the students label one end of their strips "A," "B," and "C" or "Gravel," Sand," and "Clay" (depending on the soil samples you are using). Then place glue on the other end of each index card strip. Have the students collect a different soil sample on each glued area. Have the students carefully observe their soil sample strips. Answer these questions:

1. Which sample has the largest particles?
2. Which sample has the smallest particles?
3. Which sample seems to have the largest spaces between particles (for a greater amount of water storage space)?
4. Through which sample could water travel the fastest?
5. Through which sample could the water filter through slowly (possibly taking out more impurities and cleaning the water more thoroughly)?
6. Which sample would make the best aquifer?
7. Which sample would make the best filter?

Conclusion:
Rocks, gravel and sand make the best aquifer (underground water storage) material, since they have large spaces between them to allow for water storage space. The soil above an aquifer has to be rocky or sandy in order for the water to percolate down into a deep storage spot. If the soil above an aquifer is also good for filtering out impurities,

that will help clean the water. If the particles of soil are too close together or are a solid rock layer, the water cannot filter through to get to an underground storage area.

Activity: Transpiration in Plants

Materials:

- Access to outdoor plants
- Ziploc bags

Procedure:
Find one or more living, outdoor plants. Zip a Ziploc bag over a few of the leaves of the plant in an area where it will be undisturbed. If possible, perform this experiment on a large leafed plant and on a small leafed plant during a sunny day. Ask the students to predict what will happen after 30 minutes have passed inside the bags. Revisit the bags after 30 minutes have passed. [If the day is not very sunny, this experiment may take more time.] Discuss the results.

Conclusion:
Water moving from the plants' leaves into the air will be trapped by the Ziploc bag and condense into a small collection of liquid water in the bag. If you performed this experiment on different sized leaves, notice that the larger leaves will release a greater amount of water in a shorter period of time than the smaller leaves. Compare the sizes of the leaves with the amount of water that is collected in the bags. Remind the students that the larger leaved plants also require a greater amount of water to survive since they lose a greater amount of water than smaller leaved plants.

Ricki the Raindrop and Underground Water

Materials:

- Ricki Raindrop booklets (you will receive these following the class presentation)
- Empty 2-liter bottle
- Small piece of screen
- Rubber band
- Rocks, sand, and dirt
- Cup of water

Procedure:
Use the Ricki Raindrop booklets to review with the students the water cycle, underground water, and how plants can use and lose water. Have the students go through their booklets at school and at home with their parents. The students should answer all of the questions asked in the booklet; remember, it is an important science-thinking and language-building skill to have the students articulate what they think or know.

Also, have them perform all of the activities, such as: (1) drawing arrows mapping the different pathways of water; (2) making an aquifer model and (3) collecting leaf samples and taping them into their booklets.

Ask your students the prompting and closing questions as a check for understanding.

Conservation of Resources Activities:

A copy of the "Water Cycle" and "Water, Who Needs It?" video and accompanying posters may be obtained from the Department of Water Resources for free at www.publicaffairs.water.ca.gov/education/orderform.cfm

When you conduct the transpiration experiment, encourage the students to look closely at the different types, sizes, textures, and colors of leaves that different plants have. Explain that if a leaf were a sponge, the larger the leaf (sponge), the more water you could squeeze out of it….so the more water the leaf loses into the air. Since a large leaf loses a lot of water, it requires a lot of water to survive. Take a short walk around the school grounds if possible to look for different types of leaves. Have the students look for different types of leaves around their home or neighborhood for use later in a leaf collection. Discuss how over-watering plants can lead to wasted water.

Check for leaky faucets or fountains during your walking tour, or areas where water may have pooled or the ground is muddy due to over-watering. If you discover these areas, discuss with the students a strategy for correcting this wastefulness. Perhaps the students can create a short picture story to encourage saving water; these stories can be passed along to the principal or maintenance crew or even taken home to the students' parents. Have the students conduct a similar walking tour at home with their parents in order to have the students encourage their parents to help conserve water.