Terrariums

Students have the opportunity to see the water cycle happen right before their eyes. The students construct their own terrarium, plant seeds, and learn about the water cycle in the process.

Grade Level: 5th grade

Phenomena:
How does the water cycle affect the growth of plants?

Objectives:
- Students will describe different parts of the water cycle.
- Students will compare and contrast their terrarium and the water cycle.
- Students will record predictions and observations of their experiment.

Materials:
- 20 oz. or 2 L. soda bottles (1/ student)
- 1 Bag soil
- Activated carbon/charcoal (found in aquarium sections of stores- enough for 3 tbs. per student)
- Pebbles
- Seeds
- Tap water (2 L. total for class)
- Clear packing tape (1 roll)
- Permanent marker
- 3 oz. Plastic cups (approx. 10)
- Whiteboard/chalkboard
- Dry erase markers/chalk
- Scissors
- 2 - 1 tablespoon measurers

Time Considerations:
- Preparations: 15 minutes
- Activity 1: 5-10 minutes
- Activity 2: 10 minutes
- Activity 3: 5-10 minutes
- Activity 4: 10 minutes
- Activity 5: 10 –15 minutes
- Conclusion: 5 minutes

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Next Generation Science Standards

5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.

Science and Engineering Practices (SEP):
Engaging in arguments from evidence.
Developing and using models.

Disciplinary Core Ideas:
LS1.C: Organization for Matter and Energy Flow in Organisms

Crosscutting Concepts:
Energy and matter.

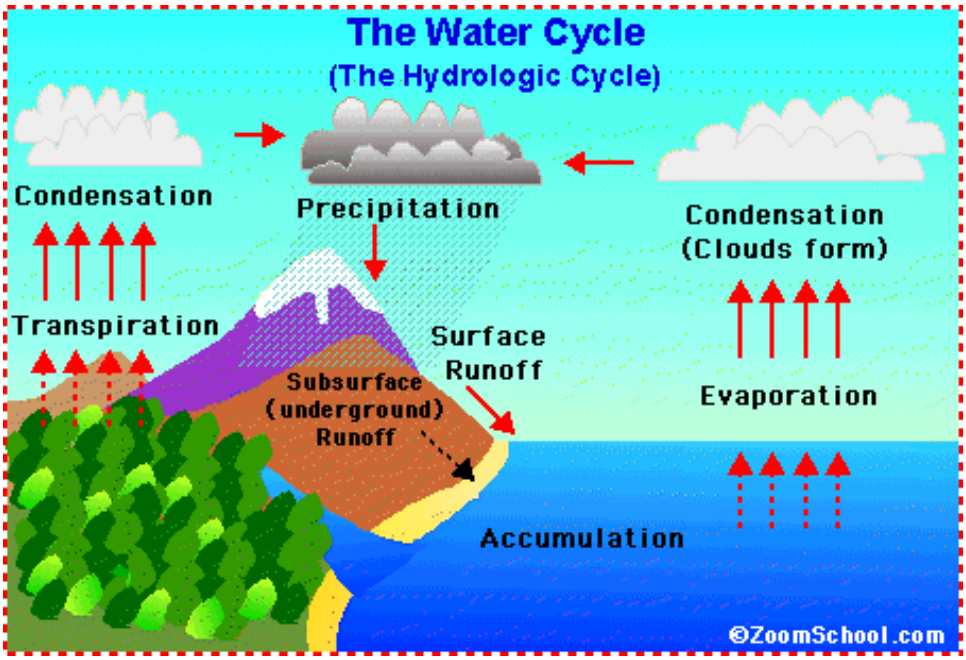
Excellence in Environmental Education Guidelines

Strand 1-*Questioning, Analysis and Interpretation Skills (A, B,C,G):* Learners are able to develop questions that help them learn about the environment, design simple investigations, locate and collect information about the environment and environmental topics and develop simple explanations that address their questions about the environment.

Strand 2.1-*The Earth as a Physical System (A, B):* Learners are able to identify changes and differences in the physical environment and in matter.

Background

Terrariums are clear glass or plastic containers that are closed systems used for growing plants. Terrariums are good representations of the water cycle on a smaller scale. Terrariums are a good way for students to visualize the equally important parts of the water cycle. The water cycle is the continuous movement of water on, above, and below the earth's surface. The diagram on page 2 is a helpful visual for understanding the process. For the entire process to take place, the sun is needed to warm the earth. Without the sun, the water cycle would not happen. The sun warms the earth and causes water to evaporate from areas of accumulation (lakes, oceans, puddles, etc.). Water also evaporates off of plants through a process known as transpiration. The evaporated water in the air rises and cools until it condenses. The point at which the water condenses is called the dew point. It is possible for clouds to form at the dew point. When the clouds are so saturated they can no longer hold any more water, the water falls in various forms of precipitation. The different forms of precipitation are: rain, snow, sleet, hail, etc. The precipitation hits the earth's surface and begins to flow down because of gravity (runoff). The water then travels



on land (streams, rivers) or underground (flows into water table). At some point, all of the water that hits the ground ends up back in an accumulation zone. From this point the process starts over again. The water cycle is constantly in motion, with no set beginning or end.

The water that is in the accumulation zone is also called a reservoir. Water will stay in these reservoirs for an average amount of time. This period of time is called “residence time”. See the chart below for average residence times for different places on earth.

Water on earth has been around as long as the earth itself. That means that the water that was in the apple you ate today could have been around millions of years ago when a dinosaur was giving her baby a bath.

Reservoir	Average residence time
Oceans	3,200 years
Glaciers	20 to 100 years
Seasonal snow cover	2 to 6 months
Soil moisture	1 to 2 months
Groundwater: shallow	100 to 200 years
Groundwater: deep	10,000 years
Lakes	50 to 100 years
Rivers	2 to 6 months
Atmosphere	9 days

Average Residence times in different types of reservoirs

Preparation

Collect bottles for the terrariums. Have the students bring in their own or check out the local recycling center for free bottles. (Some businesses may save bottles if they are given advance notice, such as Round Table Pizza) For 20 oz. bottles, choose bottles with little design on the plastic (ex. Pepsi bottles as compared to Coke bottles). The straighter the sides of the bottle the easier it is to put their terrarium back together.

Gather other needed supplies.

Doing the Activity

Activity 1:
Water Cycle Introduction

Explain to the class that today they are going to explore the water cycle by building a unique tool called a terrarium. Before building, begin to explain that the class needs to identify what the water cycle is and its important parts.

Students will record all their work and notes in their science journals throughout the lesson.

Activity 2:
The Water Cycle - Mad Dash

Begin by asking students to name all the parts of the water cycle that they know.

Parts may include precipitation, evaporation, condensation, accumulation, and transpiration, and runoff. Do not explain each part, rather just list them on the board.

Explain that, in groups, the students are going to do a *mad-dash.* This is a timed 2-minute brainstorm on a given part of the water cycle. Groups are to create a definition and list examples pertaining to their part.

Divide the class into groups of four and give each group one part of the water cycle (the same part of the water cycle

may be given to more than one group). Remind students to record their notes in their science journals and begin!

When time expires, have each group present their information.

As each part is presented to the class, draw a simple diagram on the board, which illustrates the parts of the water cycle.

After each presentation, clarify to the entire class what each part means and it's role.

Have students draw and label the process in their journals.

Activity 3:
Amazing Water Cycle

As students label their diagrams, share with them the following thoughts to add to their curiosity about the water cycle.

Water has been on earth for a long time. Water molecules come and go easily from one state to another (gas, liquid, solid), but they don't disappear all together.

Share with the class about average residence time of water and give them a few examples. Oceans, for example, have an average residence time of 3,200 years. This means that the water cycle does not always occur as fast as we might think.

Leave the drawing on the board and erase the answers (will be used to review).

Activity 4:
Terrariums - Introduction

Explain to students it's time to build our model that will demonstrate the water cycle!

Show students a pre-made terrarium.

Ask students for thoughts as to how this represents the water cycle.

Explain a terrarium is a closed system, just like earth. The terrarium is a model of the water cycle. Earth has the atmosphere that traps the water in and the sun heats the water on the earth, making it cycle. The bottle has a set amount of water in it that constantly cycles through (similar to earth). They will be able to see evidence of condensation on the top and sides of the bottle.

Explain to the class that as they build their terrariums, students will record all the materials they use, write a hypothesis, and throughout the next week record results and observations.

Write the following on the board and explain to students, that at any point during the activity, they find themselves waiting for supplies, students are to be work on writing the following in their journals.

- Material List
- Hypothesis
- First Observations –*Date*
- Sketch of their Terrarium with labels.

Activity 5:
Terrarium Construction!

Demonstrate to students your expectations for each step.

Before constructing, put up a poster or draw a picture on the board of the approximate ratios of each material in the bottle. Remind students each layer is to remain in the right position and the bottle should not be shaken or tipped upside down.

- *Bottles:* Find the middle of the bottle and cut it in half. Remove the cap to make cutting easier - but remind students to not lose it!
- *Pebbles:* Each student should take one cupful of pebbles, and put them in the bottom half of their terrarium.
- *Carbon:* Then take three tablespoons of carbon and sprinkle it over the pebbles. If using smaller bottles, the students will not need as much carbon (just enough to cover the pebbles). Carbon acts as a filter for the water in the bottle, which keeps the water from becoming stagnant.
- *Soil:* On top of the carbon, students should put 3 to 4 scoops of soil. This will depend on where the bottle was cut and how much of the carbon and pebbles are already in it. The proportions put in their bottles should be similar to those on the diagram on page 6.
- *Seeds:* Next, put in a sprinkle of seeds. Any plant seed can be used, although hearty vegetables seem to work well with very little care. The seeds should then be covered with a small amount of soil (depth depends on the type of seed).

After their seed is planted, the students will tape their bottle back together. One half of the bottle, will need to be bent a little to fit inside the other end.

After they are fit together, use packing tape to seal up the bottle (around where it was cut).

The students will need to use a permanent marker to write their names on the terrariums (won't smear if wet).

Once all the terrariums are complete, students should put 3 to 4 capfuls (less if smaller bottles) of water in their bottle.

Water may leak out of the area where it was taped together, which is normal. It is possible to add more water if too much leaked out.

Conclusion

Before adding more water again, wait a day or two and check the soil for moistness. If the students add too much water, have them leave the cap off for one day, then check it again.
Ask the students how often they should have to water their plants after the initial watering (never!). Since it is a closed system, the water will just cycle through the bottle, always with the same amount of water in the bottle that the students initially put in.

Remind the students that their plants may get too large for their terrariums and might need to be replanted into a larger pot or garden.

Encourage students to make detailed observations in their science journals each time they check on their terrarium.

Assessment

Use the drawing that was created in Activity 1 and have the students label different parts of the water cycle on the board. Assess the students on how well they are able to do this.

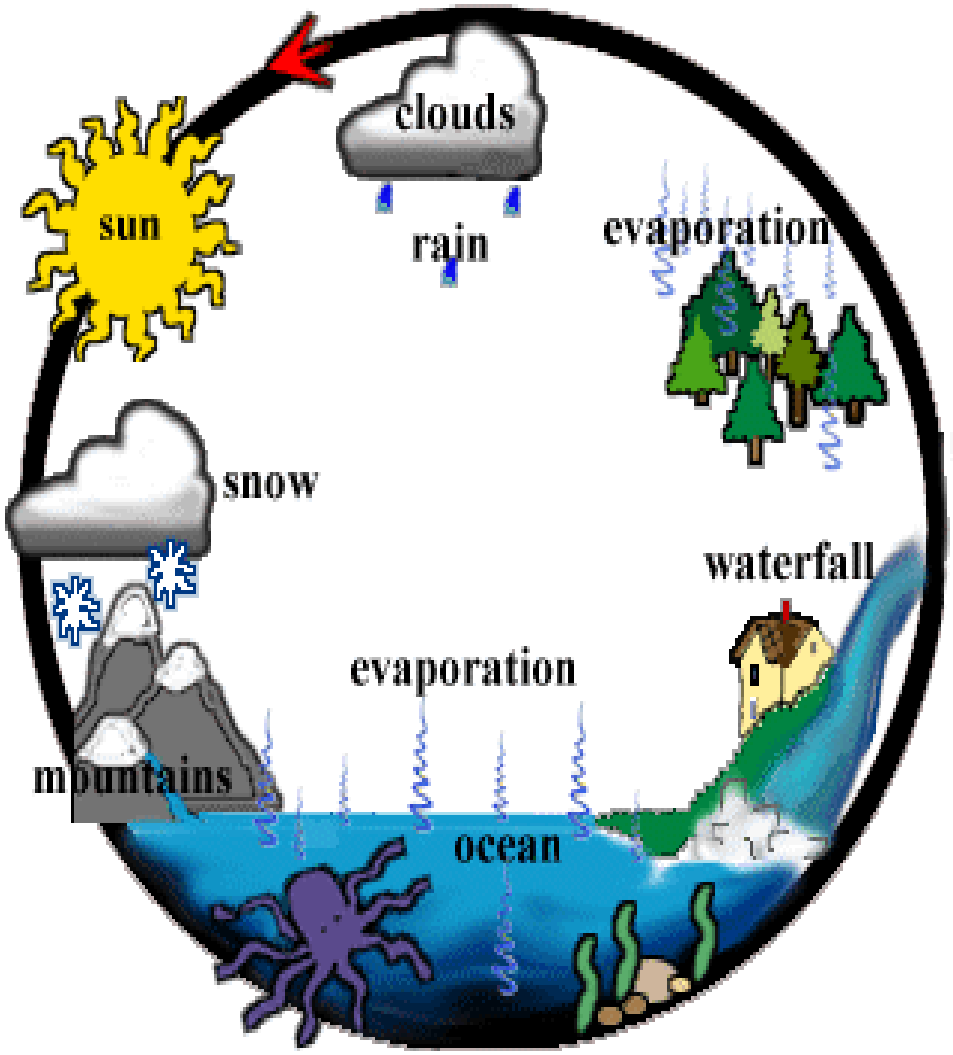
Also have them repeat to you the definitions of each of the words.

Students may also draw the water cycle, using a permanent marker, on their terrariums and label each part.

Extensions

The terrarium was first discovered by Nathanial Ward, on accident! Have your students read up on the history of the terrarium after they build their own.

Have the students experiment with their terrariums and light. Have a group of students put their terrariums in dark place (closet/cupboard), another group in the window, and another group in the open away from windows. Watch how the plants grow differently in each area. Have the students record their observations on a daily basis. The students will notice that the amount of light plants need is just as important as the water that they have in their terrariums.



The Water Cycle
http://www.bristolvaschools.org/mwarren/TheWaterCycleWebQuest.htm

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Vocabulary

Accumulation: The act of collecting, growth by continuous additions.

Atmosphere: The mixture of gases that surrounds a planet, the air.

Condensation: (Meteorology) Water changing from vapor to liquid to form clouds, or a solid to form precipitation.

Dew point: Temperature where water vapor condenses.

Evaporation: When a liquid changes into a vapor or gas.

Liquid: A wet substance that you can pour.

Model: Small or miniature version.

Precipitation: The falling of water from the sky in the form of rain, sleet, hail, or snow.

Reservoir: A natural or artificial place where water is stored (ex. lakes and oceans).

Residence time: The length of time water stays in a given reservoir.

Runoff: Way in which water moves across and under the ground.

Solid: Hard or firm; not a liquid or gas.

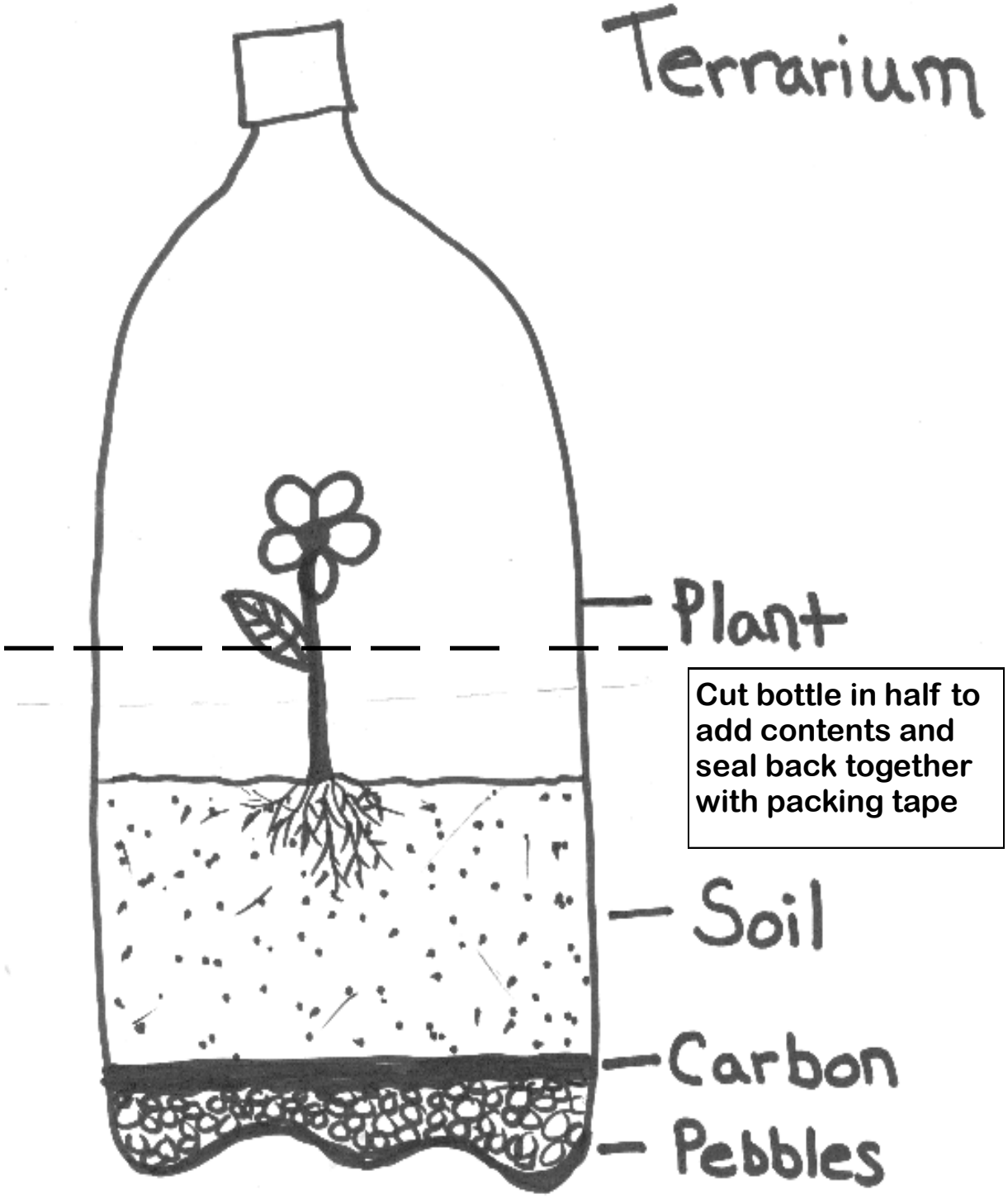
Terrarium: A glass or plastic container for growing small plants or raising small land animals.

Transpiration: The movement of water through a plant and into the atmosphere.

Water Cycle: constant movement of earth's water. Plants give off moisture, and water from rivers and oceans evaporates, making water vapor. This vapor rises, forms clouds, and then falls as rain, hail, or snow.

Water Vapor: gas produced when water evaporates.

Bottle Terrarium



Cut bottle in half to add contents and seal back together with packing tape