# Backyard STEM

## Ecosystem in a Bottle

### Exploring the Water Cycle with Terrariums

**The word terrarium comes from the late 19th century, modern Latin. "Terra" means earth. It's definition is a sealed transparent glob or similar container in which plants are grown.**

**Project Area:** Environmental Science

**Skill Level:** Intermediate

**Learner Outcomes:**

⇒ Be able identify components and processes of the water cycle.

⇒ Describe the water cycle as it occurs in the terrarium.

**Tennessee Science Curriculum Standard GLEs:**

**Science Skills:** Design a model, observe, reflect

**Life Skills:** Observing, Reasoning

**Tags:** water cycle, ecosystems

**Materials:**

⇒ Clear glass jar with lid
⇒ Moss
⇒ Rocks/gravel
⇒ Sand
⇒ Topsoil/potting soil
⇒ Small plants
⇒ Calculator
⇒ Stretchy cord
⇒ Colored beads
⇒ Scissors
⇒ Colored pencils

The purpose of this activity is to review the water cycle, create a model of an ecosystem (the terrarium) and discuss how the water cycle occurs in the bottle.

**GO OUTSIDE!**

Ask the students to bring in a rock, moss or some other item from their yards to contribute to the terrarium.

**Ask your students:**

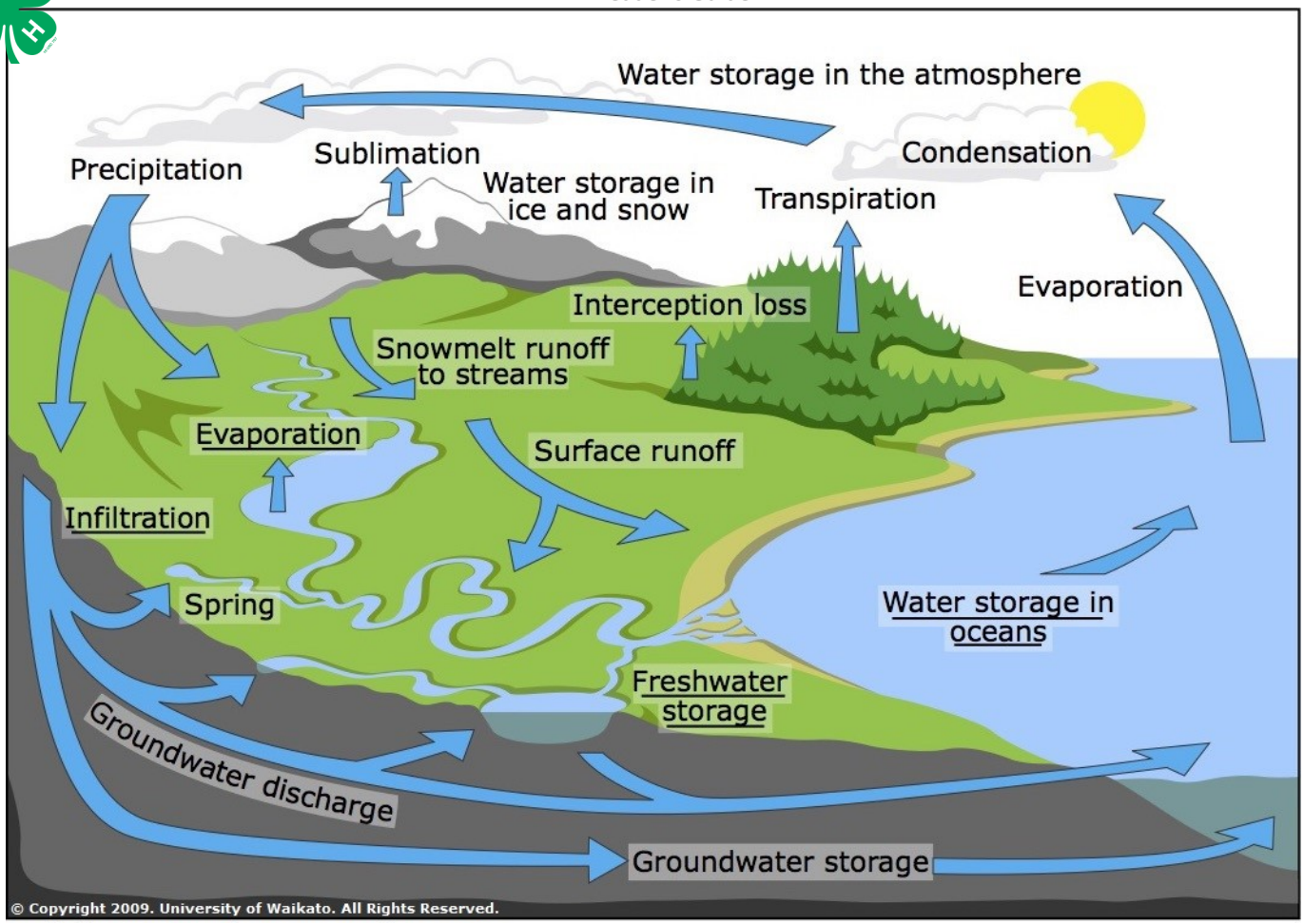
⇒ What is the most important compound on earth? [water] Water is considered the ultimate recyclable resource, why? Talk about how water cycles through various phases in the biosphere—from liquid, solid and gas—in different components, such as precipitation, runoff, condensation, surface water in rivers, groundwater, etc.

⇒ Ask them to talk about how these components interact. For example, when it rains a lot, what do they see? Swollen creeks and rivers, runoff from land draining to the creeks. Or when clouds collide due to wind currents and pressure patterns, what results? Rain, snow or flooding?

**Introduce Key Concepts:**

The water cycle describes the existence and movement of water on, in and above the earth. Water is always in movement, changing states from liquid to vapor to ice and back again. The water cycle has no starting point, but the sun drives the cycle as the external energy source. The sun heats up the water in oceans, which cover s over 70% of earth surface and make up over 97% of water volume on earth. Some of the water evaporates as vapor into the air; a smaller amount of vapor is created from snow and ice through sublimation—or the movement of water directly from a solid state into vapor. Rising air currents take vapor into the atmosphere to combine with water that has gone through transpiration, which means it was transpired from plants. Temperatures in the atmosphere vapor to condense into clouds. Air currents move clouds around, causing them to collide, grow and then fall as precipitation. Some precipitation falls as snow and can accumulate in ice caps or glaciers, which can store frozen water for thousands of years. Some precipitation in the form of rain is intercepted by plant leaves, a process called interception. Of the precipitation that makes it to the earth surface, some infiltrates into the ground and replenishes aquifers, which store large amounts of water for long periods of time. Some infiltrated water stays close to the land surface and can seep back into surface-water bodies as groundwater discharge. Groundwater is also absorbed by plant roots to end up as evapotranspiration from leaves. Over time, all of this water keeps moving, some to re-enter the ocean, where the water cycle begins again.

Credits: Andrea Ludwig and Jennifer DeBruyn




The goal of this activity is to review the water cycle, create a model of a water cycle (the terrarium) and help students think of water resources in terms of distributions of volumes in different phases and processes.

**Make a Terrarium:**

Materials:

- Glass container with lid and preferably smooth sides, gravel/rocks, sand, soil, moss, small plants

Methods:

- Make sure glass jar is clean and free of label glue/oils. Soak bottles in hot water with a dash of baking soda to help remove label glue or rub with oil and steel wool.
- Put a layer of rocks in the bottom, no more than an inch or less than 10% of the jar height.
- Add a layer of moss such that the green side is facing down and/or outward onto the glass. The moss can come up the walls of the jar making a bowl-like shape, but no more than 1/3 the jar height.
- Add a thin layer of sand in the bottom of the moss bowl; this will help with drainage and ensure roots won't rot.
- Add a layer of potting soil on top of the sand and moss. Use your preference as to weather the soil comes up above the moss lip or remains hidden inside the moss bowl. Add enough height to be able to burry the plant roots.
- Dig a small depression in the soil and add the plant(s). You may also add in decorative rocks, lichens, or other items that the students may have brought from their yards or the school yard.
- Add a small amount of water, close lid and set in a window sill.

**Terrarium Drawings**

Ask the students to sketch their terrarium in the space provided on their activity sheets. Make sure the students include infiltration, precipitation, condensation, groundwater storage, transpiration, evaporation, and interception.

**Water Cycle Bracelets**

Ask the students to make bracelet with beads that are a specific color to represent a water cycle component or process and in the order of the water cycle. Allow the students to use multiple beads for their favorite parts to ensure the strand is long enough to complete a bracelet, or ask the students to include two cycle pathways to make a longer bracelet.

| | |
|---|---|
| Sun/Evaporation | Yellow/Orange |
| Condensation | Clear |
| Clouds | White |
| Precipitation | Light blue |
| Plants/Transpiration | Green |
| Soil | Brown |
| Rivers | Dark Blue |
| Ocean | Teal |

**Answers to Calculations**

1. 2.75 $m^3$
2. 4500$m^3$
3. 8,750 $m^3$
4. Yes, runoff will occur because 0.333 cm/s rain intensity is greater than the soil infiltration rate of 0.1 cm/s.

**References:**

http://sciencelearn.org.nz/Contexts/H2O-On-the-Go/Science-Ideas-and-Concepts/Humans-and-the-water-cycle

http://water.usgs.gov/edu/watercyclesummary.html

Interactive web application: http://sciencelearn.org.nz/Contexts/H2O-On-the-Go/Sci-Media/Animations-and-Interactives/Dynamic-and-complex-the-global-water-cycle

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