GLOBAL VERSION / MODULE 2

DROPS OF KNOWLEDGE FOR RIVERS OF CHANGE

GLOBAL TEACHING AND LEARNING MATERIAL

A hands-on guide to teaching
and learning about
water, sanitation, hygiene,
and the environment

SWAROVSKI
WATERSCHOOL

BACKGROUND INFORMATION

Water resources on our planet can only be understood within the context of the water cycle. The global water cycle is a closed system in which the same water moves through the different states of solid (ice), liquid (water) and gas (steam) in a continuous loop through all of time. The sun is the "motor" of the water cycle. On the surface, water flows across the land and underground, settling eventually in rivers, ponds, lakes, and oceans. As the water is heated by the sun, it evaporates and enters the atmosphere in the form of steam to make clouds.

Another term for the water cycle is "hydrologic cycle"; "hydrologic" comes from the Latin words hydro (water) and logic (knowledge).

RAINY SEASON IN BRAZIL

THEMATIC CONCEPTS

Water as a human right – As stated by the United Nations, "On 28 July 2010, through Resolution 64/292, the United Nations General Assembly explicitly recognized the human right to water and sanitation and acknowledged that clean drinking water and sanitation are essential to the realisation of all human rights."[3]

Solid, liquid, and gas – When steam in the atmosphere cools, it condenses and, depending on the climate and temperature, returns to the planet in the form of different types of precipitation such as rain, snow, sleet, and hail.

Groundwater – Liquid water found underground in the cracks and spaces in soil, sand, and rock, which is stored in and moves slowly through geologic formations of soil, sand, and rock called "aquifers."[4]

Surface water – Liquid water on the surface of the planet, such as a stream, river, lake, wetland, or ocean. Surface water can be either salty (saline), as in the ocean, or fresh (nonsaline), as in rivers and lakes. When freshwater is discharged by a river into the ocean, it becomes salty.

Precipitation – The amount of rain, snow, hail, etc., that has fallen at a given place within a given period of time, usually expressed in centimeters (or inches) of water.

Ice – Water in its frozen (solid) form. Glaciers are huge masses of ice that slowly flow over land and melt very slowly over time.

3 International Decade for Action: Water for Life, 2005–2015, "The Human Right to Water and Sanitation," United Nations Department of Economic and Social Affairs and UN Water, May 29, 2014, un.org/waterforlifedecade/human_right_to_water.shtml. **4** The Groundwater Foundation, "The Basics: What Is Groundwater?," Lincoln, Nebraska, groundwater.org/get-informed/basics/groundwater.html.

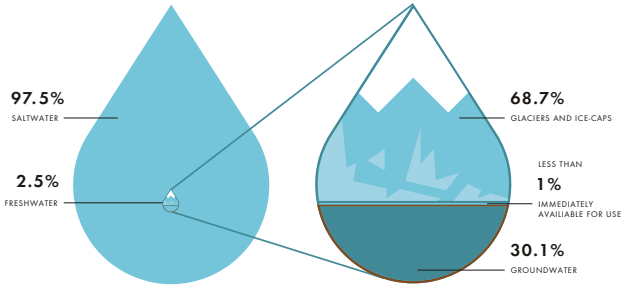
ACTIVITIES FOR WATER BASICS

ACTIVITY 2.1: LOOKING AT THE GLOBE AND UNDERSTANDING THE PERCENTAGES AND FORMS OF WATER

Although around 70% of the Earth's surface is covered with water,[5] approximately 97% of the blue water that we see on a globe is saline (salty) ocean water that is not suitable for drinking by humans or animals. About 2% of the Earth's water is freshwater that is frozen in glaciers, permanent snow, and ice caps—so less than 1% of water is available for the use of all the humans and animals on Earth.[6] This is water falling from the sky and moving into streams, rivers, lakes, and groundwater. This activity demonstrates the ratio of available freshwater to all the rest of the water on Earth.

Time: 50 minutes / **Thematic Areas:** Science, Mathematics, Social Studies / **Goal for Learning:** Gain understanding of how water is distributed around the world in different forms and different amounts.

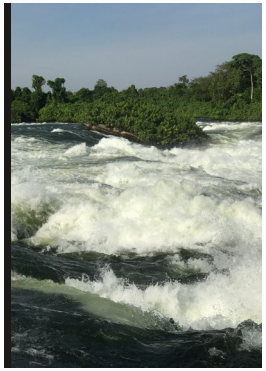
Materials: ☐ Globe or map of the Earth (as available) / ☐ 1 glass or plastic jug filled with water (3.8-liter/1-gallon size) / ☐ 1 teaspoon (holds 5 milliliters of liquid) / ☐ sheets of green and blue paper / ☐ black markers or crayons



Source: https://water.usgs.gov/edu/earthhowmuch.html

5 USGS Water Science School, "How Much Water Is There On, In, or Above the Earth?," U.S. Geological Survey, March 19, 2014, https://water.usgs.gov/edu/earthhowmuch.html. **6** Windows to the Universe, "The Water Cycle: A Climate Change Perspective," National Earth Science Teachers Association, www.windows2universe.org/earth/Water/water_cycle_climate_change.html.

ACTIVITY STEPS:

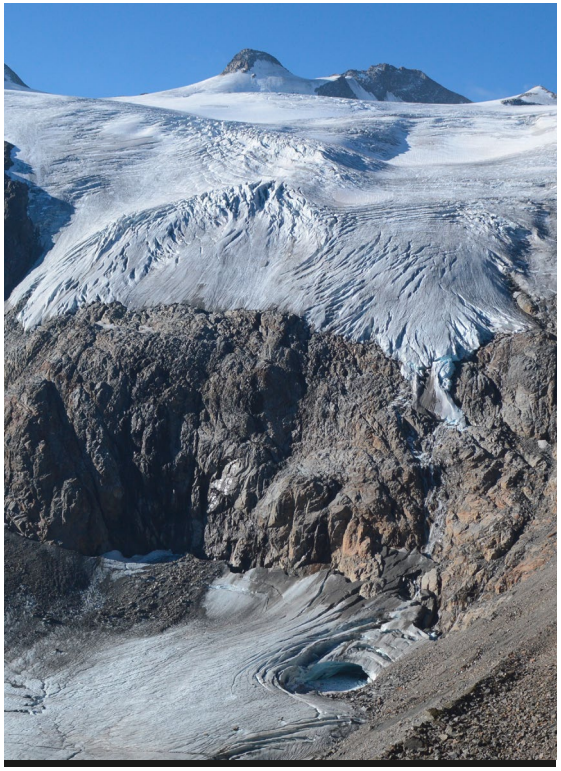


WATER

1. Begin by showing a globe or map of the Earth, explaining that 70% of the planet's surface is covered by oceans. Note that, of all the water on our planet, around 97% is salt water, 2% is frozen in icebergs and glaciers and is inaccessible to human beings, and less than 1% of drinkable freshwater is accessible from groundwater, rivers, lakes, and streams.

2. Next, hold up the jug of water and a teaspoon to show the difference, explaining that the jug represents all the water on Earth and the teaspoon represents how much is available to us as freshwater. Note that water is a limited resource with unlimited use, and encourage students to think about how important it is that we keep the water in this teaspoon clean and safe.

FOG



ICE, GLACIER

3 Organize students in groups of four and give each group one blue sheet of paper and one green sheet of paper.

4 Explain that the blue paper represents drinkable freshwater, while the green represents the rest of the water on Earth. Then ask them to tear both sheets of paper into 100 pieces.

5 Ask students to estimate the ratio of potable (drinkable) water and non-potable water in the world by setting aside a total of 100 blue and green pieces. Not all the ripped pieces will be used. Once their estimates are done, explain the real ratio: **1/** Three pieces of blue paper represent all the freshwater on Earth, including in glaciers and ice caps; in lakes, rivers, and underground aquifers; and in the atmosphere (3%). **2/** 97 pieces of the green paper represent all the rest of the water that we cannot use (97%).

6 Tell students that, of the three pieces of blue paper: **1/** Two pieces represent water that is frozen in glaciers and ice caps and is hard to reach. **2/** One piece represents water from surface water and groundwater sources that we can access.

OBSERVATION AND DISCUSSION:

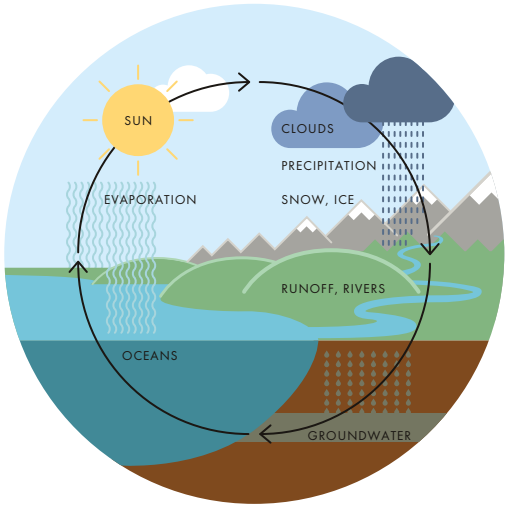
Discussion prompts include: Are there any freshwater sources in our community? Is there water in the soil? When you dig a hole in the ground, is the soil very wet, moist, or dry?

ADDITIONAL RESOURCES:

EPA New England, "All the Water in the World," Boston: U.S. Environmental Protection Agency, April 25, 2014. Available at: https://www.epa.gov/education

ACTIVITY 2.2: WATER CYCLE IN A BOWL AND ROLE-PLAY (Adapted from Swarovski Waterschool Austria)

All the Earth's water resources are interconnected in the global water cycle. The sun provides the energy that keeps water continuously circulating, as its radiation causes water on the surface of the oceans, and on the surface of the land underground throughout the world (in the form of rivers, lakes, and streams), to evaporate.



Source: http://www.srh.noaa.gov/jetstream/atmos/hydrocycle_max.html

When the rising water vapor/steam cools in the higher levels of the atmosphere and condenses, tiny water droplets come together to form clouds, which are blown around by the winds. Because cool air within the clouds can hold less water than warmer air, these drops fall to the Earth in the form of rain, snow, or hail. The precipitation is affected by gravity, and collects in streams and rivers. Then, it either evaporates back into steam or ultimately flows into the oceans. Some rain drains into the ground, where the soil absorbs it like a sponge. Trees and plants absorb water from the soil, and that water is then released into the environment in the form of water vapor. And the cycle continues forever. In some places, like big cities where concrete covers many ground areas in the form of roads and buildings, the soil is not able to absorb the water, and flooding occurs, threatening daily life on the surface.

MODULE 2

THIS ACTIVITY HAS TWO PARTS: an experiment with a bowl of hot water and ice cubes, plus an optional step for a warm day, and staging a play about the water cycle. Younger children may particularly enjoy watching older students perform the play.

PART 1 creates a miniature water cycle of "rain" in a bowl, demonstrating that it is a closed system in which water becomes part of our daily lives and that no part of the water is lost.

PART 2 encourages everyone to use their imagination. The play is designed to help students develop an understanding of the water cycle concept by acting out the parts of water drops and the sun. The topics it covers include evaporation, water vapor, condensation, clouds, raindrops, groundwater, plants, transpiration, and the atmosphere.

PART 1: EXPERIMENT TO DEMONSTRATE PRECIPITATION

Time: 50 minutes / **Thematic Areas:** Science, Art, Theater / **Goal for Learning:** Foster a deeper understanding of the cycle of water on our planet.

Materials: ☐ 1 large clear plastic or glass bowl / ☐ Hot water (not boiling) / ☐ Clear plastic wrap / ☐ Cellophane, or a piece of a clear plastic bag (large enough to cover the top of the bowl / ☐ 1 large rubber band / ☐ Several ice cubes

Optional Extension: ☐ 1 glass and cold water

ACTIVITY STEPS:

1. Put enough hot water in the bowl to fill it about ⅓ of the way.

2. Stretch a layer of clear plastic wrap over the top of the bowl, smooth it down on all sides so that the bowl is airtight, and secure the plastic with the rubber band.

3 Watch as the water begins to evaporate and rise. Soon it will begin to drip back down from the clear plastic wrap ... it is "raining."

4 Place several ice cubes on top of the clear plastic wrap, and watch the "raindrops" form and fall more rapidly.

5 Explain that water vapor in our atmosphere gets cold and changes back into liquid, forming clouds. This is called "condensation." If the air is really cold, raindrops turn to snowflakes or ice (hail or sleet).

Optional Extension:

6 On a hot day, pour cold water into a glass. Watch what happens: drops of water form on the outside of the glass.

7 Explain that the water did not leak through the glass, but came from the air. Water vapor in warm air turns back into liquid when it touches the cold glass.

WATER CYCLE IN BOWL

PART 2: "ALINA AND VIKTOR EXPLORE THE GLOBAL WATER CYCLE"

(Script for the play, provided in ANNEX A., page 151)

Materials: ☐ 1 large piece of blue cloth to represent a puddle of water / ☐ 1 yellow cloth to represent the sun (or use a sun made of paper or cardboard) / ☐ 1 gray cloth to represent a cloud / ☐ A gong or other loud noisemaker to simulate thunder / ☐ 1 brown cloth to represent the ground / ☐ A leafy branch from outdoors to represent a tree (or use a branch made of paper or cardboard)

ACTIVITY STEPS:

1 This short play can take place on any area that can be cleared and set up for a performance; the instructions in Annex A simply refer to "the stage."

2 Before the play starts, gather the materials listed above, and ask everyone in the group to read through the script

3 Three children will volunteer to be Alina, Viktor, and Tony. One child will act as the sun, and several other children, depending on the size of the group and the stage, will appear as more water drops. Other children will be needed to spread the cloths out on the stage, and to fold them up and take them away.

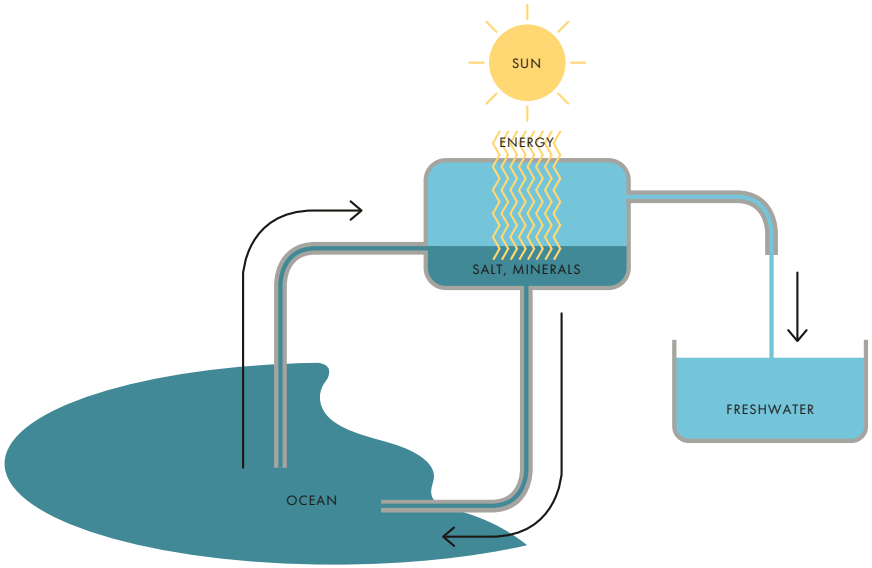
4 A teacher or group leader will read the script throughout the performance

OBSERVATION AND DISCUSSION:

Spark discussion about the water cycle on Earth and how it relates to the experiment. Ask students to share their observations from the experiment and the performance.

ACTIVITY 2.3: DOES THE SALT COME OUT OF SALT WATER? IF SO, HOW?

Desalination, or the distillation of salty water into safe, drinkable water, is one of the earliest forms of water treatment and is still a popular method used throughout the world today. In ancient times, many civilizations used this process on their ships to convert seawater into drinking water. Today, desalination plants are used to convert seawater to drinking water on ships and in many dry and drought-stricken regions of the world, as well as in other areas to treat water that is fouled by natural and unnatural contaminants. In this activity, students will use the sun to desalinate water and see for themselves how it works.



Source http://water.usgs.gov/edu/drinkseawater.html

Time: 90 minutes / **Thematic Areas:** Science, Mathematics, Geography / **Goal for Learning:** : Learn about freshwater compared to salty or brackish water in the context of both ecological balance and human consumption.

Materials: ☐ 720 milliliters (3 cups) of water / ☐ 1 large mixing bowl / ☐ 22.5 grams (1½ tablespoons) of regular table salt / ☐ 1 shallow cup or small, light bowl / ☐ Clear plastic wrap, cellophane, or a piece of a clear plastic bag (large enough to cover the top of the bowl) / ☐ 1 large rubber band / ☐ 3–4 small rocks (or substitute materials, i.e.: a small stack of magnets might create a heavier weight with a smaller surface area

Optional Extension: ☐ The students can experiment with options such as a stack of coins / ☐ 1 glass half filled with water / ☐ 1 egg (in the shell) / ☐ A container of salt (enough to use freely) / ☐ Kitchen scale (if available)

ACTIVITY STEPS:

1. Pour the water into the mixing bowl and ask students to mix the salt into the water, stirring thoroughly until it is fully dissolved.
2. Place the cup or smaller bowl so it floats in the mixing bowl, taking care to keep the salty water out of the cup
3. Stretch a layer of clear plastic wrap over the top of the mixing bowl, smooth it down on all sides so that the bowl is airtight, and secure the plastic with the rubber band.
4. Take a small rock (not too big or it will break the plastic-wrap seal) and place it in the middle of the plastic wrap, so that all of the plastic slants slightly toward the middle of the bowl, where the cup is.
5. Put the whole setup in full, hot sun, and wait. Within an hour, you should see water droplets begin to form on the underside of the plastic. They will flow and drip into the center of the bowl, and into the cup.

6 Wait several hours, and then take the plastic off. A good amount of water should now be in the small cup.

7 Invite students to taste the water in the cup; it is no longer salty. Explain that the water turned to steam in the heat of the sun, and then returned to its liquid state. Salt is heavier than water, so it stayed in the large bowl.

Optional Extension:

8 Fill a glass half full with water. Place an egg, in the shell, into the water–it will sink because it is denser than the water.

9 Start adding salt to the water one tablespoon at a time. Help the salt dissolve by stirring. What happens? How much salt do you have to add to get your egg to float?

10 Explain to students that adding salt to the water makes the water denser than the egg, so now it will float.

11 If a kitchen scale is available, weigh a cup of salt water and a cup of freshwater. Compare the weights. The salt water will weigh more than the freshwater even though it is taking up the same amount of space (a cup). This is because the salt water is denser than the freshwater.

OBSERVATION AND DISCUSSION:

Look at a map of your country and discuss the nearest ocean or salty lake. Ask if students have tasted the water and/or what they know about drinking salty water.

Talk about places nearest to your community that are facing drought situations.

MODULE 2

"Individuals should never underestimate their own influence and the role they can play in changing things for the better."

— KOFI ANNAN,
FORMER UNITED NATIONS
SECRETARY-GENERAL[7]

7 As quoted in: Swanson, Peter, Water: The Drop of Life, Minnesota, USA: NorthWord Press, 2001, p.13.

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