

Global Precipitation Measurement Mission

Earth's Water Teacher Guide

Lesson Overview:

This activity was developed to give participants an understanding of Earth's water – how much exists, what it's like and where it is found. In this one hour long activity, students participate in a demonstration showing the distribution and composition of water on Earth. Students also create a map showing where freshwater is located on Earth (in streams, ice packs, wetlands, etc.).

Learning Objectives:

- Explain how much water is on Earth
- Describe the forms and locations of water on Earth
- Explain why it is important to know about our water resources

National Standards:

Core Idea ESS2.C: The Roles of Water in Earth's Surface Processes

- Water continuously cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation, and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS-4)

Core Idea ESS2.A: Earth Materials and Systems

- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produces chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-b) (MS-ESS2-c)

Background Information:

Water is fundamental to life on Earth. Knowing where and how much rain or snow falls globally is vital to understanding how weather and climate impact both our environment and Earth's water and energy cycles, including effects on agriculture, fresh water availability and responses to natural disasters. The Global Precipitation Measurement (GPM) mission, launching in 2014, will help scientist to better understand how much rain and snow falls around the world.

Global Precipitation Measurement Mission

Materials:

Copies of “Earth’s Water” student capture sheets

Crayons – red, blue, green, gray

5 gallon bucket

Measuring cup (1/2 cup and 2 cup sizes)

Ice cube tray

Water dropper

Globes or color maps of Earth

Engage:

Use the “Earth’s Water” PowerPoint and ask students to answer three riddles. (Slide 2) What do the answers all have in common? WATER!

Show the students a picture of Earth from space. (Slide 3) Ask the students how much of Earth’s surface is covered with water? (About 70%). Ask the students to list what they know about water and what they would like to learn on the KWL chart. Where is water? What kinds of water exist in, on, or around Earth? Why is water important?

Share answers with the class.

Explore:

Demonstration: Amounts of water on Earth

(adapted from <http://ecosystems.psu.edu/youth/sftrc/lesson-plans/water/6-8/everywhere>)

Show the students a 5-gallon bucket filled with water. This represents all the water on Earth. Ask students to make a prediction: of the 5 gallons of water, how much do you think is available to humans? (If desired, review with students what “available water” would be: fresh, liquid able to be accessed from surface water or aquifers.) (Slide 4)

Using the 5 gallon bucket of water, ask a student to come up and remove 2 cups of water. The bucket water represents salt water (97%) and the 2 cups represent fresh water (3%) Move the bucket to the side and focus on the cups of freshwater. Ask another student to remove ½ cup of water from one of the 2 cups. Pour the other 1 ½ cups into an ice cube tray. The 1½ cups of water represents freshwater that is stored as ice in glaciers and polar ice caps and is therefore not available for our use. The ½ cup of water is liquid water in the ground, surface water (rivers, lakes), and water vapor in the atmosphere. Although it is all freshwater, it is not all clean and usable by humans. Pull out an eye dropper and ask a third student to come up and hold her his/her hand. Drop one drop of water into the hand – this one drop represents the amount of freshwater that is clean, and accessible to humans.

Global Precipitation Measurement Mission

Explain:

Summarize this information on the student capture sheet. (Slide 5)

Explore:

World Water Distribution

Divide students in groups of four. Give each group a globe or map of the Earth. Give them about five minutes to observe the Earth and distinguish between water and land. Discuss the observations as a class. (Slide 6) Show Slide 7 and discuss where we find water on Earth.

Load the National Geographic fresh water interactive map (Slide 8 <http://ngm.nationalgeographic.com/2010/04/water/water-animation>) on a computer or projector for the class. Ask students to color and shade their world map outlines according to where the water is located. First, quickly shade or color oceans (salt water) red. We cannot use this water. Next, from the NG map, color the permafrost areas gray. (Permafrost is ground that remains below freezing for several years. There is water in the soil but it remains frozen.) Also color the glacial and ice areas gray. Along with permafrost, all of this water is frozen. Notice the glaciated area and ice sheets as outlines along mountain tops. Next, color the wetland areas green. Prominent wetland areas typically occur along large river systems or where land stays saturated with water for long periods of time. Finally, shade blue over the general river and lake areas.

What other water is on Earth that we haven't labeled? Answer: Water vapor in the atmosphere.

Remind students that although there is a lot of green and blue colored on our map (liquid fresh surface water), less than 1% of all the water on Earth is available for our use.

Evaluate:

Discuss with students: (Slide 9) Why is Earth's nickname "the water planet" both appropriate and misleading? Answer: 70% of Earth is water so it is appropriate. However only about 3% is freshwater and less than 1% is freshwater that is available for animals and humans to use. Also, we cannot create more water, so it is misleading because there is not an unlimited amount of water available to us.

List at least five things you learned to complete the KWL chart we started at the beginning of class.

Global Precipitation Measurement Mission

Elaborate/Extend:

- Give students the numbers to create their own pie chart or bar graph of global water distribution. (Slide 10) <http://ga.water.usgs.gov/edu/earthhowmuch.html>
Examples: <http://ga.water.usgs.gov>
<http://pacificwater.org/pages.cfm/water-services/water-demand-management/water-distribution/>

Teacher Notes:

There are many ways to represent the amount of water on Earth and divide it up into smaller amounts to show the amount of available fresh water. Here we have demonstrated using water from a 5-gallon bucket. Another method is to use 100 small objects and reduce them by percentages according to the estimate of water distribution on Earth. This lesson from EPA has several examples http://www.epa.gov/region1/students/pdfs/ww_intro.pdf

Additional Resources:

- Helpful information, background, and resources about the GPM mission and Precipitation Education <http://pmm.nasa.gov/education/>
- GPM freshwater availability classroom lesson <http://pmm.nasa.gov/education/lesson-plans/freshwater-availability-classroom-activity>
- An Apple as the Planet http://nasawavelength.org/resource/nwd_000d_000d_002d_889/
- EPA lesson “All the water in the world” with various levels for grades K-6 http://www.epa.gov/region1/students/pdfs/ww_intro.pdf
- USGS information about how much water is on Earth <http://ga.water.usgs.gov/edu/earthhowmuch.html>
- Penn State “Water, Water Everywhere” Lesson <http://ecosystems.psu.edu/youth/sftrc/lesson-plans/water/6-8/everywhere>