

Global Precipitation Measurement Mission

Water in the Geosphere Teacher Guide

Lesson Overview:

This is an activity that was developed to give participants an understanding of the geosphere. In this one-hour long activity, participants learn about the geosphere by making observations and taking measurements. They will go outside and use scientific equipment to investigate water in the soil by measuring soil moisture, temperature, color, and consistency. Students will use this qualitative and quantitative data to understand how water is found in many places in the natural environment and how these places are connected in the water cycle. The data collection is based on protocols from the GLOBE program, www.globe.gov.

Learning Objectives:

- Describe Earth's geosphere using qualitative (words) and quantitative (numbers) data
- Interpret data to assess the state of moisture in the geosphere
- Explain why the geosphere is an important part of the water cycle

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)

- **5-ESS2-2.** Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]
- **MS-ESS2-1.** Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

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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.



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Water is continuously cycling through all Earth systems (the water cycle). The geosphere includes Earth's materials, such as rocks, minerals, and soil extending from Earth's core to its surface. The geosphere is an important part of the water cycle because it filters and stores water so animals, plants and humans can use it.

This lesson adapts protocols from the GLOBE Program (www.globe.gov) to help students get hands-on experience collecting scientific data about our geosphere so they can better understand the water cycle and why it is important to know the distribution, quantity, and quality of water on Earth.

Many background facts can be found in the notes on the PowerPoint slides. These websites and resources may prove useful to get more detailed information. There are additional resources at the end of this lesson plan.

The Soils Guide from The GLOBE Program

http://www.globe.gov/documents/352961/353237/soil_intro.pdf

Materials:

Various samples of soil, sand, rocks (you can dig up some samples from around your home, school, or buy potting soil, rocks, or sand from the store)

Copies of "Geosphere" student capture sheets including data collection instructions

Soil moisture meter (Indoor/outdoor moisture sensor meter made by Niagara, available at www.amazon.com)

Pencils

Spoons

Soil thermometer (Taylor classic instant read pocket thermometer, or use the Taylor digital waterproof max/min thermometer – both available from www.amazon.com)

Engage:

Divide the class into workgroups of four students. Place soil samples in front of each group of students. (Slide 2) Ask them to brainstorm a list of observations about the soil as a group and record the ideas on their capture sheets. They can use all their senses (except taste). Then, ask them to brainstorm a list of things they would like to know about the soil if they had more equipment. Share ideas as a class.

Show students the introductory slide about the geosphere. (Slide 3) The geosphere includes Earth's materials, such as rocks, minerals, and soil from Earth's core to its surface. Today our focus is on the soil material on the Earth's surface. Our mission is to determine how much water is in the geosphere and how it contributes to the water cycle.

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Explore:

Present our scientific question: “How much water is present in the geosphere today?” (Slide 4) Ask the students if they can identify which components of the water cycle involve the geosphere. Let them discuss ideas or share as a class. Then show the animation of the water cycle and talk with the animation to describe the geosphere connection (Slide 5).

Prepare the students to go outside and explore the geosphere and test for water (Slide 6). Give them the testing equipment and review how to use and care for it. Also, review how and where to collect data (see capture sheet and data collection instructions). Finally, tell the students how to find their geosphere study site and give them a time to return and a time---keeping device. If they finish early, they could test another site with a different land use.

Explain:

Gather the groups together (Slide 7) to share and analyze their results. Based on the data collected, have them answer the scientific question, “How much water is present in the geosphere today?” using both qualitative and quantitative data. Students should discuss the answer with their group and record their thoughts on the capture sheet. High soil moisture readings indicate more water. Soils that are more loose and friable hold and filter more water, while more firm/compact soils do not let water infiltrate. Also, darker soils have more organic matter, which has more water. Remind the students that this data is just for today. We would need to collect this data over many days to get a complete idea of how much water is in the geosphere in this location.

Evaluate:

Discuss the following with the students: Which parts of the water cycle involve the geosphere? How is the geosphere an important part of the water cycle? (Slide 8)

Wrap up by sharing a little about NASA’s GPM Mission and satellite. (Slide 9). Also share the video “Too Much, Too Little” (4:44) (Slide 10).

Elaborate/Extend:

- Compare geosphere data in several different habitats and land use areas (near a stream, on top of a hill, in the forest, next to a building, etc.).

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- Study soil particle size in more detail by demonstrating how different soils (silt, clay, sand) settle in water. <https://www.soils.org/files/s4t/texture.pdf>
- Challenge the students to consider how soil and water availability differ from place to place and therefore measurements of soil moisture and soil type can be much different in a humid climate compared to a desert or urban setting.
- Make (and eat!) some edible dirt.
http://agpa.uakron.edu/p16/lessons/pdf/soil_recipe.pdf

Teacher Notes:

This lesson provides students with background information about the geosphere and allows students to go outside and take actual measurements about water in the geosphere. This data collection can happen with or without the background information.

Choose locations for groups to visit where they can easily access soil. Groups can all test in the same area, or you can send groups to different locations and compare water in the soil from these different land uses (near a water source, high on a hill, in a forest, in a yard, etc.). If you are not able to access soil, either because it's not easily available or because you cannot go outside, you can bring soil samples into the classroom. Dig soil in advance from around your school or home, ask students to bring in samples from their home, or use potting soil from a garden store.

The data collection is based on GLOBE Program protocols. The GLOBE Program has many training opportunities and offers a wide variety of different opportunities for students to collect authentic data and share it with other students around the world! Go to <http://www.globe.gov> and click "join" to learn more.

Additional Resources:

- Helpful information, background, and resources about the GPM mission and Precipitation Education <http://pmm.nasa.gov/education/>
http://www.nasa.gov/mission_pages/GPM/overview/index.html
- Background information about the geosphere and water cycle
<http://www.sciencelearn.org.nz/Contexts/H2O-On-the-Go/Science-Ideas-and-Concepts/The-water-cycle>
<http://www.miamisci.org/ecolinks/geosphere.html>