UTAH OFFICE OF
ENERGY DEVELOPMENT

Energy in the Aquifer

Grade/Subject: Grade 5 Science

Strand/Standard: 5.1.2 Use mathematics and computational thinking to compare the quantity of saltwater and freshwater in various reservoirs to provide evidence for the distribution of water on Earth. Emphasize reservoirs such as oceans, lakes, rivers, glaciers, groundwater, and polar ice caps. Examples of using mathematics and computational thinking could include measuring, estimating, graphing, or finding percentages of quantities. (ESS2.C)

Lesson Performance Expectations: Students will build a model of the relative amounts of saltwater and freshwater on Earth. They will build a model of an aquifer and test it for water flow and movement of heat.

Materials:

Part 1:

- 100 mL beaker
- 10 mL graduated cylinder
- Blue food coloring (optional, it makes the water easier to see)

Part 2:

- 200 mL sand or pea gravel (a coarse grain works best)
- 2 beakers (250 mL or larger), heat tolerant
- 1/2 in. diameter clear plastic tube 5 inches long
- Plastic pipet
- Digital thermometer or infrared temperature meter
- Hot plate
- Student sheet

Time: 50 minutes

Teacher Background Information:

Geothermal power plants draw water from underground reservoirs (aquifers) to the surface to produce heat or steam for turbines to generate electricity. This steam or hot liquid goes back into the aquifer after it cools.

Student Background Knowledge:

Students should know that water cycles through ecosystems and is stored in various reservoirs. Underground reservoirs or aquifers are hard for students to understand because they are invisible. Much of the drinking water supply in Utah cities is drawn from wells in the aquifer. Students may know where well sites are located in their neighborhoods, they are often housed in small, brick buildings surrounded by wire fences.

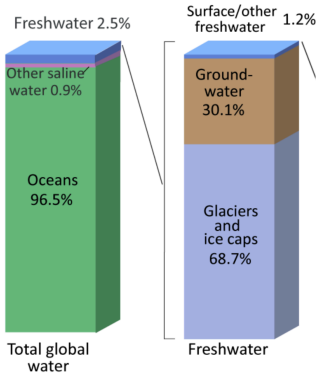
Students may also be aware of hot springs or geysers where underground water comes to the surface and is hot. Hot water can create electricity but students will have limited ability to understand electrical generation through a turbine. They can grasp how hot water can keep a home warm.

The mathematical relationship between percentage and mL may need explaining. If 100 mL are used, the percentage is the same number as the mL. If 1000 mL are used, a factor of 10 has to be applied to the percentage.

Teacher Directions: A standards-based lesson engages students' curiosity, interest and motivation to learn more. Time and space for the students to experience the phenomenon and ask questions is essential. The student sheet provided below provides guidance but is only one example of how students might respond.

1. Phenomenon: A picture is provided on the student page but a video is better:
   Old Faithful Geyser in Yellowstone National Park
2. Part 1 can be done as a demonstration or students can perform it as written.
3. The students should calculate that the amount of water poured into the graduated cylinder is 2.5 mL. (2.5 % X 1 mL). Where the students are asked "What questions do you have?" This would be a place to talk about how little freshwater there is or how much of Earths' water is salty.
4. Part 2 - Read the instructions with the students and make sure they have their materials.
5. Supervise the temperature the hot plates are set at. It should be no more than medium and may be less depending on the hot plate. As the students pull the water out of the plastic tube with the pipette, they will place it in the styrofoam cup to measure its temperature. The water is then poured back on the surface of the sand.
6. The students may find the temperature stops increasing as the input of cool water balances the ability of the hot plate to heat the water.
7. If student hot plates are not available, the model can be done as a single demonstration.
8. Possible answers to analysis questions:
   1. What can hot water from the Earth (geothermal) be used for? Generating electricity, heating homes.
   2. What are the advantages of using geothermal energy? It is a clean source of energy and "free" (despite the infrastructure to take advantage of it.
   3. What are disadvantages of geothermal energy? It is not found everywhere and requires equipment to take advantage of.

Assessment of Student Learning.



1. If 100 mL of water was used to model the total global water supply, how many mL would model the amount of freshwater?
   A. 1.2 mL
   B. 2.5 mL*
   C. 30.1 mL
   D. 68.7 mL

2. Which of the following lists go from greatest percent of water to least?
   A. Ocean, glaciers and ice caps, surface water*
   B. Freshwater, groundwater, oceans
   C. Glaciers and ice caps, surface water, freshwater

3. How is water stored in an aquifer?
   A. In containers created by volcanic action.
   B. In the spaces between the sand or rock particles.*
   C. As gas that turns to water as it rises to the surface.

4. Which of the following are uses for this geothermal energy? Choose two.
   A. Heat homes.*
   B. Produce electricity.*
   C. Bathing and handwashing.

Extension of lesson and Career Connections:
Utah has sources of geothermal energy. The FORGE website: https://www.energy.gov/eere/geothermal/forge has information on the use of this energy in Utah.

Title: Energy in the Aquifer Name_____

Phenomenon:

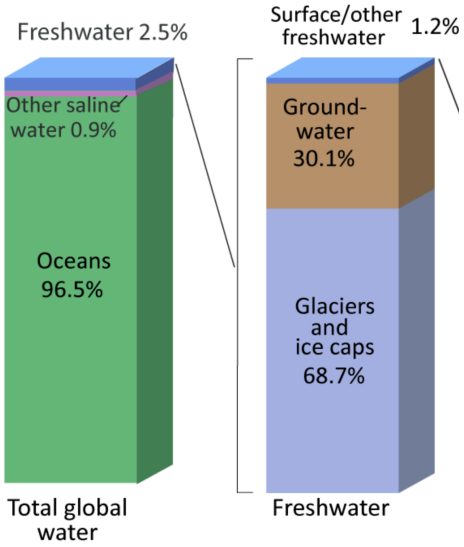
A column of hot water erupts in Yellowstone National Park:

USGS.gov https://www.youtube.com/watch?v=Qxf3xzirBrs

What questions do you have?

1.
2.

Part 1.
Introduction: When Earth is seen from space, it appears blue because of the oceans. How much of Earth's water is in the oceans? Lakes? Glaciers? These charts show where water is found on Earth. In this activity you will see how much water is fresh compared to salty (saline)



https://www.usgs.gov/media/images/distribution-water-and-above-earth-0

Materials

1. 100 mL beaker (represents all water on Earth)
2. 10 mL graduated cylinder
3. 100 mL graduated cylinder
4. Water
5. Blue food coloring (optional, it makes the water easier to see)

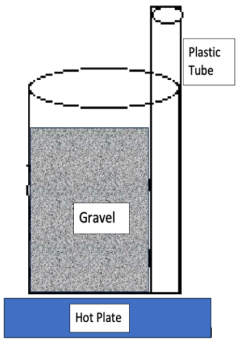
Procedure:

1. Measure 96.5 mL. The scale is 1 mL = 1 percentage of water. This represents the Ocean water. Pour it into the beaker.
2. Measure 1 mL of water. This represents the Other Saline water. Add it to the beaker.
3. Decide how much water you need to measure to represent the Freshwater on earth.
4. Measure this amount to pour from the graduated cylinder into the beaker.
5. On the graduated cylinder below draw and label the correct 3 kinds of water on earth.
6. What questions do you have?
    a. _____
    b. _____

Part 2

Introduction: In this part, you will learn about freshwater found underground in aquifers. An aquifer forms when water seeps down through the ground and fills spaces in the rock or sand below. Earth is hot deep in the ground from pressure and radioactive substances and it can heat water in aquifers. Hot water from Earth (geothermal) can be used for heating homes or running generators to create electricity.

Materials: Sand, glass beakers, styrofoam cup, clear plastic tube, plastic pipet, food coloring, temperature probe, marker, hot plate



Procedure:

1. Place the plastic tube upright in the beaker next to the edge. Fill the beaker nearly full of dry sand.
2. Add tap water to a cup and pour it down the side of the beaker. Watch as it fills the spaces in the sand. Fill until the water is near the top of the sand surface.
3. Place the beaker on the hot plate and turn it on to medium.
4. Use the pipet to take some water from the round tube. Squeeze the pipet into the styrofoam cup.
5. Take the temperature of the water in the styrofoam cup. Pour the water back into the sand.
6. Continue to take water out of the tube in the beaker and take the temperature in the styrofoam cup every two minutes.

Data:

	Temperature
1. Start (before hotplate)	_____
2. Minute 2	_____
3. Minute 4	_____
4. Minute 6	_____
5. Minute 8	_____
6. Minute 10	_____

What happens to the temperatures over time?

How do you explain that?

Analysis:

1. What can hot water from the Earth (geothermal) be used for?

2. What are the advantages of using geothermal energy?

3. What are disadvantages of geothermal energy?