Only a Drop to Drink

Adapted from: "A Drop in the Bucket" in Project WET: Curriculum and Activity Guide. Bozeman: The Watercourse and the Council for Environmental Education, 1995.

Grade Level: Basic

Duration: 20-30 minutes

Setting: Classroom

Summary: Students perform hands on demonstrations showing the relative volumes of ground water, surface water, water in ice caps, and water in the ocean.

Objectives: To understand the distribution of earth's water and realize the small amount available for human consumption / use.

Vocabulary: groundwater, surface water, water vapor, potable

Materials (Included in Module):

- 1- 1000mL container
- 1 graduated cylinder
- eyedroppers
- Salt
- Plastic Bucket
- Play Dough

Additional Materials (NOT Included in Module):

- Water
- Metal bucket
- Additional 1000mL containers or beakers
- Additional graduated cylinders

Academic Standards

Mathematics Pre K – High School

- 2.1 Numbers and Operations
  - A Counting and Cardinality
  - B Numbers and Operations in Base Ten
  - C Numbers and Operations – Fractions
  - D Ratios and Proportional Relationships
- 2.3 Geometry
  - Geometry
- 2.4 Measurement, Data, and Probability
  - A Measurement and Data

English Language Arts Pre K – 5

- 1.5 Speaking and Listening
  - Comprehension and Collaboration
  - Presentation of Knowledge and Ideas
  - Integration of Knowledge and Ideas
  - Conventions of Standard English

English Language Arts 6 – 12

- 1.5 Speaking and Listening
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Writing in Science and Technical Subjects 6 – 12

- 3.6 Writing
  - Production and Distribution of Writing

Reading in Science and Technical Subjects 6 – 12

- 3.5 Reading
  - Integration of Knowledge and Ideas

Background

Throughout the planet, water is stored in many different forms, in different stages of the hydrologic cycle, and with varying usefulness to humanity. Ocean water makes up 97.2% of all water on earth. This water is salt water and is can not be consumed without extensive desalinization. When this water evaporates into the atmosphere, it becomes water vapor, making up 0.001%. Eventually, this water becomes precipitation in the form rain or snow and falls to the ground. Some of that water absorbs into the ground and becomes groundwater and makes up 0.6%. What does not absorb runs off and becomes surface water and makes up 0.01%. Water captured in the form of sea ice and polar ice caps makes up 2.1%. After treatment, all unpolluted fresh water is potable (can be consumed). However, most of it is inaccessible. In actuality, only surface water and groundwater are used with any frequency. Arctic ice can be melted, rain can be collected, and ocean water can be desalinized. This is extremely expensive in comparison, sometimes costing more than 15 times.

Overview

A variety of activities offer students a way to learn about water distribution on earth, recognizing the small amount of water available for humans to use and drink.

Procedure 1

1. Divide students into 5 groups.
2. Each group receives a container of play dough. Instruct students to shape it into a sphere.
3. Tell students that the play dough represents all the water on the earth. Ask students to remove the amount of water (play dough) that they think is accessible and useable by humans for use and consumption. Have students share their estimated amounts with the rest of the class.
4. Tell students to place all of their clay back together, reform a sphere.
5. Lead students through the removal of clay based on the following statistics:
6. Students take out 97.2% of the clay (approximate visually). This volume represents the water in oceans.
7. Of the 2.8% remaining, which is freshwater - remove 2/3 of it to represent water in ice caps and glaciers (2.1% of total). We cannot easily or economically use this water.
8. Of the .7% remaining, remove 1/1000 or .001% of it (or the tiniest little speck). This volume represents water vapor in the atmosphere (.001% of total). We cannot easily or economically use this water.
9. Of the .699% remaining, remove 98% of it (.6% of the total). This volume represents groundwater. Though used by humans, we only tap into a very limited amount of the total groundwater. There are very deep reservoirs of groundwater that humans will never reach.
10. So the most accessible and useable water remaining is surface water (streams, rivers, and lakes) – approximately .01% of the total. This is considered easily available for human use.
11. HOWEVER, most scientists suggest that almost .5% of water on earth is accessible to humans (this includes surface water, groundwater, and some ice and ocean). But, approximately only **.003%** is potable (fit for human consumption) and/or inexpensive enough to obtain.

Procedure 2

1. Fill a graduated beaker with one liter (1000 mL) of water. Explain that this water represents all the water on earth.
2. Ask students if you were to spill out all the water on earth (represented in the beaker) that is easily accessible and useable onto a desk, what would they predict that they need to clean it up – a mop, a sponge, a few paper towels, tissue, or a cotton ball.
3. You can have students predict a volume (of the 1000 mL in the beaker) of the useable and accessible water for humans.
4. Now it is time to have students figure out how much is available. Pour 28ml out into a 100 mL graduated cylinder (2.8%). This represents earth's fresh water. For added effect you may put salt in the remaining 972 mL to represent the oceans, nonpotable water.
5. Now remove 7 mL of the fresh water into another container (perhaps a graduated cylinder). The remaining 21ml of freshwater represents the volume trapped in glaciers and ice caps (2.1% of the total water on earth).
6. Tell students to look at the 7 mL of freshwater that remains. As they are looking, a small amount of it has evaporated into the atmosphere – representing the .001% of the earth's water that is in the form of water vapor.
7. From the 7 mL, fill an eyedropper with only a few drops full of water (1 cm of the eyedropper perhaps). The water remaining in the graduated cylinder represents the groundwater on earth - .699% of the total.
8. The water in the eyedropper represents surface water – rivers, streams, lakes, ponds. This is .01% of the total water on earth.
9. HOWEVER, most scientists suggest that almost .5% of water on earth is accessible to humans (this includes surface water, groundwater, and some ice and ocean). But, approximately only .003% is potable (fit for human consumption) and/or inexpensive enough to obtain. Of the water in the eyedroppers, only 1 drop would represent the .003% of water on earth useable and accessible by humans. You may want to take the one drop and drop it onto a desk or into a metal bucket for a neat sound effect. A plastic bucket is supplied with the module.

Procedure 3

1. Have students get out a full sheet of paper / or reuse old pieces of 8.5 x 11 paper.
2. Tell student that the sheet of paper represents all the water on Earth.
3. On the paper, have students color in the amount that they think represents the water that is easily available and potable to humans. Maybe they draw and fill in a little lake.
4. Tell students that you will walk around the room and indicate the true representation on their paper. Place a dot with your pen on each paper.
5. Go through the percentages outlined in the first 2 procedures above to make understand why the little dot on the paper is a fair representation of available water

Discussion

How did the student's guesses compare with the end results. Discuss the implications of world water distribution and the hydrologic cycle. Ask students if they think it is important to protect the limited amount of surface and groundwater that we can use for drinking water purposes.

Evaluation

Students understand the relative volumes of water in the ocean, surface, groundwater, etc. Students understand the ratio between fresh and salt water and how that relates to potable and non-potable water.

Extensions and Modifications

Ask students to try to create additional ways to demonstrate the amounts of water on earth.

Notes (Please write any suggestions you have for teachers using this activity in the future