What in the World is Water?

LESSON

GRADE LEVEL 6-9

CATEGORY Water, Wetlands & Watersheds

TOPIC Water properties, phases and cycle

LENGTH
Two 60-minute periods

MATERIALS
Kettle, water, access to freezer; two plastic drinking glasses, jars with lids, plants, small amount water, soil, sand, gravel, access to computers, 11x17 paper for mind maps, sticky notes

SETTING
Classroom, computer lab

GROUP SIZE
Pairs, individual

SKILLS
Analysis, description, demonstration, synthesis, Powerpoint presentation, mind-mapping

SUBJECTS
Science

KEYWORDS
Solid, liquid, gas,water cycle, evaporation, condensation

HCTF Education

Overview

Students consider the molecular make-up of water and then discuss the three phases that water exists in on earth. Students then create their own mini water cycle model. To demonstrate their learning, students will develop either a mind map or Powerpoint presentation.

Objectives

Students will be able to:

- Understand that water has a molecular structure and exists in different phases on earth
- Understand aspects of the water cycle
- Demonstrate the ability to create a mind map or Powerpoint presentation.

Background

What is Water?

Water is a unique and ubiquitous substance. It's all around us, we use it every day and we depend on it for survival, but what is water? Water is a simple enough compound- just two hydrogens and an oxygen, but it has some interesting properties that are important to note. Relative to other compounds of similar molecular weight, the boiling and freezing temperatures of water are unusually high, which enables water to exist in all three phases - solid, liquid, and vapor - at the surface of the Earth.

To understand why water has some unique properties, we have to look at its molecular structure. The two hydrogen atoms are bonded to the oxygen by shared electrons, but the sharing is not equal. Oxygen draws these shared electrons closer to its nucleus, and since the hydrogens are not oppositely arrayed around the oxygen (giving the molecule its mouse head and ears appearance), the molecule has a weak negative charge on the oxygen side, and a weak positive charge on the hydrogen side, forming what is known as a polar molecule. It is this polarity that attracts water molecules to each other; polarity is the glue that holds water together.

Why is water so important?

Water is essential on our planet- it connects all earth systems through the water cycle. The water cycle, influenced by solar energy, gravity, and the movement of the earth, circulates water from oceans, lakes, streams, icecaps, the land and organisms to the atmosphere and back. The water cycle influences climate, landforms, and the distribution of life on Earth. Events that alter the water cycle, for example, spring flooding and intense storms such as hurricanes, can result in significant and dramatic negative impacts on landscapes and their inhabitants.

Evaporation occurs when the sun's rays heat water enough so that the water molecules lose their hold on one another and liquid turns into a gas: water vapour. Surfaces such as water bodies, glaciers and soils lose water through evaporation. Plants lose water through evapo-transpiration, a combination of water loss from the plant's surfaces and tissues. We lose water through our skin as perspiration. The "steam" you see when you breathe out on a cold winter day represents condensation of the water vapour that you exhale.

As part of a dynamic atmosphere, water vapour influences climate all over the world. Water vapour condenses back into a liquid when air cools, forming clouds. As the condensed water droplets merge, they fall back to the earth. Most of this precipitation falls into the oceans; the rest falls on land. It can vary from a light spring shower to a heavy winter blizzard. Precipitation on land can return to the ocean quickly from surface run-off that flows into streams and rivers, or remain frozen in glaciers and ice caps for a long time. Between these extremes, standing bodies of water (lakes, ponds) and living organisms hold water temporarily.

Water that falls onto land can also seep below the surface to become soil moisture, which plants can readily access. If it penetrates deeper it becomes stored as groundwater. The upper surface of this saturated ground is called the water table. Soil moisture and groundwater may flow downhill, draining into rivers or lakes, or collect deep underground in aquifers. Aquifers hold significant quantities of water over large areas for extended periods. A variety of wetlands form when water saturates the soil and collects on the surface.

Where does water come from?

Water is finite. Earth's oceans formed between 4.0 and 3.8 billion years ago as the cooling atmosphere's water vapour condensed, yielding the rain that solidified molten rock and filled depressions. Water covers over seventy percent of our planet. The water we use today is this same original, finite supply. Resource is a term based in economics referring to a useful or valuable possession; water is a natural resource of Canada, but it's seemingly inexhaustible abundance is actually limited. Our society uses water extensively, yet we have only recently become aware of the extent that our actions imperil this invaluable, finite resource.

Procedure

1. Ask students if they can think of the three phases that water exists in and examples of where those phases can each be found. Have them share their thinking with a partner and then have students share their thinking with the class.

   For older students, explain that water has a molecular structure. If we use a powerful enough microscope, we would be able to see that a water molecule consists of one oxygen and two hydrogen molecules. Draw the outline of a mouse's head (with big ears) to illustrate the configuration of the molecules for students to see. Emphasize that water may change phases but it is neither created nor destroyed.

2. Hold up a glass of water. Ask students which phase the water is in and draw a picture of a lake, river or ocean on the chalkboard. Draw a picture of the sun above the body of water and ask students what the sun adds to this scenario (heat energy). Explain that you are going to add heat energy to water and pour the glass of water into a kettle. Plugging the kettle in, ask the class what phase they think the phase the heat will turn the water into. As the steam rises, draw evaporation occurring on the diagram on the board. Ask the students to predict what will happen if you hold the water glass over the steam. Explain that the inverted glass is like a cloud that captures water as it rises from the earth. Ask the students what will happen if the steam keeps rising and condensing on the inside of the water glass. The water that will eventually begin falling back to earth as rain does. Ask for a volunteer to add to the diagram on the board to illustrate what happens as water vapour condenses. Finally, challenge students to think about what will happen to the water in the winter or if it falls to the top of a very high mountain.

   Next, take an identical plastic drinking glass that you have placed half full in the freezer beforehand and explain that this is water that may have been at the top of a mountain.

Ask students what will happen if you leave the water glass on its side at room temperature. Leave the glass on its side on a desk and return to it after 10-15 minutes to investigate what has happened and use the information to have a student complete the drawing on the board for the class to see. Write the title "The Water Cycle" at the top of the diagram.

3. Explain to students that they are going to create their own mini-models of the water cycle.

   Divide students into pairs and give each pair a jar and materials for their model. Have them place the soil, sand and small rocks in the bottom of the jar and then place the plant in a natural growing position. Add the water and put the lid tightly on the jar. Place the jar in a sunny place. Students should check back periodically to monitor events in their jar and record their observations in their notebooks. After students have completed their models, draw a picture of the earth on the chalkboard and explain that just as the jar limits the travel of the water in their mini water cycle, so does the earth's atmosphere limit water's movement on earth. Water is trapped inside the atmosphere and just as the amount of it cannot change in the jar (although it may change from one phase to another), the total amount of it does not change on earth.

   Have students draw the water cycle in their notebooks along with a diagram of their water models. Have them label and explain both diagrams in a few sentences.

Extensions

1. To extend the learning, check out "The Incredible Journey" in Project Wet. In this engaging, interactive activity, students roll the dice and move around the room to simulate the movement of water within the water cycle.
2. Investigate the stories that different cultures tell of how water came to be or the role it played in the creation of humans and the world.

Assessment

1. **Mind Map** - Have students Have students begin a mind map to show their learning about water so far. On an 11x17 piece of blank paper students write "WATER" in the middle of the page. As a class, generate some of the concepts that you have covered so far in the unit and ask students to begin showing their learning on their mind map. Students can add to their mind maps as they learn more about water, watersheds and water stewardship throughout the unit. Brainstorm with students the criteria for a powerful mind map.

   Criteria will include:

   - Givens: name, date, title, clearly organized, proper spelling, etc.
   - Includes central idea
   - Related key ideas radiating out from centre of map
   - Lines, arrows, colours, branches, pictures, symbols, etc. are used to describe relationships between ideas
   - Leave lots of space to add ideas as they occur

2. **PowerPoint presentation** - Have students Have students begin working on a powerpoint presentation to show their learning so far. Again, students can continue to work on their powerpoint presentations as they progress through the unit. Brainstorm with students the criteria for a powerful powerpoint presentation.

   Criteria will include:

   - Given: name, date, titles, proper spelling, etc.
   - Format: diagrams, pictures, not too many words per slide, well-organized, etc.
   - Content: demonstration of learning about water-related concepts, key vocabulary and concepts covered in unit, etc.

3. **Ticket out the Door -** Ask students Ask students to record on a sticky note one new thing they learned by the end of this lesson or one question they have about water. You could use these tickets as a way of beginning a KWL (what we Know, Wonder and have Learned) poster for the whole class to reflect on during the unit.