

The Water Cycle:

Concepts and Goals

- By taking notes on a guide sheet and in their notebooks and by performing experiments and analyzing their results, students will explore the different components of the water cycle.
- Students will develop a better understanding of the need to conserve this valuable renewable resource.

State Standards Addressed: Effect of Consumer Desires on a Natural Resource (4.2); Dependency of Living Components in an Ecosystem on the Nonliving Components, Identification, and Explanation of a Cycle (4.6)

Procedure

- Students will use their notebooks and complete the attached guide sheet illustrating the water cycle as they are presented with the following information. This will be done prior to the lab activities.

Introduction

Like all matter, water is constantly cycled through ecosystems. This compound comprises nearly 70 percent of our bodies and is used in many of our chemical reactions. The oceans contain about 97 percent of the world's water. The remainder is fresh water that is in the form of gas (vapor), liquid, or ice. Seventy five percent of this water is frozen in glaciers and in ice in the polar regions. Only about 1 percent of the earth's water is available as fresh, liquid water.

Much of this fresh, liquid water is found in the ground in rock and soil layers. The zone in the earth that contains water saturated soil and/or rocks is known as an aquifer. The upper surface of an aquifer is known as the water table. The remainder of our fresh water is found in the surface water of lakes, rivers, and ponds, and in the bodies of organisms.

The Components of the Water Cycle

1. The movement of water into the atmosphere--molecules of water, like molecules of all liquids, are in constant motion.
2. Because of this, what happens to these molecules? They collide with each other, causing them to move to a less crowded area.
3. What is the movement of particles from a crowded to a less crowded area called? Diffusion. When water diffuses from the soil or from a body of water, it changes from a liquid to a gas form.
4. What is this diffusion of water called? Evaporation. Water is also released from the bodies of organisms and evaporates into the atmosphere.
5. In what ways do animals release water? Excretion, exhaling, and perspiration
6. Where is water released from plants? Mostly from microscopic pores in their leaves
7. What is transpiration? The evaporation of water from pores of plants

The Formation of Clouds

9. As water diffuses into the atmosphere, it will become cooler. Also, the air molecules and tiny dirt particles it mixes with will become increasingly farther apart. (The air pressure decreases.)
The presence of
- water molecules
 - dirt particles, also known as condensation particles
 - a decrease in air pressure
 - a decrease in air temperature result in condensation
10. What is condensation? Process whereby water changes from a gas to a liquid. As they condense, the water molecules attach themselves to nearby condensation (dirt) particles. The result is a cloud droplet. Many, many of these droplets form a cloud.

Precipitation

11. Eventually the clouds become heavy with water.
12. What is precipitation? Water in clouds falling to the earth as rain, snow, sleet, or hail.
13. Explain what becomes of the precipitation? It may seep into the soil and become part of the ground water (aquifer). Much of the water enters the roots of plants. Some enters into the cells of microscopic organisms, and some enters the bodies of animals when they drink water or when they eat other animals. Some of the water moves along the surface in rivers and streams.
14. What is this water flow along the surface called? Runoff
15. What becomes of this water? It enters various bodies of water.
16. If water is constantly cycled, why do we need to conserve water? The water we fail to conserve will, over time, pass through the cycle and return to the earth in some form of precipitation, but it may return many, many miles away. Also, water pollution is still a problem: therefore, it is wise to conserve water that is safe to drink. This completes the water cycle.

Exploring the Components of the Water Cycle

If there is enough equipment and class time, any of the activities below can be performed by the students working in pairs.

Transpiration

Materials

- small potted plant
 - clear plastic bag
 - twist tie
1. Put a plastic bag over a small potted plant or over one of its branches and secure the base of it with a twist tie around the stem. For quicker results, put the plant in a warm, preferably sunny location and observe throughout the period.

2. Explain what you observed on the inside of the plastic bag. Water from the plant diffused into the air and collected on the inside of the bag.
3. What is the process of water diffusion from plants called? Transpiration

Cloud Formation Part 1

Materials

- flask
 - stopper (one holed) for top of flask into which the syringe fits
 - water
 - matches
 - large plastic syringe
1. Place enough slightly lukewarm water in the bottom of a flask to cover the bottom. Fit the top with a one holed stopper into which a large plastic syringe has been inserted vertically. Remove the stopper/syringe assembly. Light a match. Hold it over the mouth of the flask and blow it out so that some of the smoke is forced down into the flask. Quickly replace the stopper/syringe assembly and while holding it down, pull up on the plunger in the syringe. Observe the inside of the flask.
 2. Explain the change that you observed inside the flask. Pulling up on the plunger decreased the air pressure inside the flask causing the water molecules to condense onto the smoke particles (condensation particles). A cloud formed. (Note: Pushing the plunger back down increases the air pressure. The water molecules move away from the smoke particles. The cloud "disappears.")
 3. What three conditions were present in this experiment that enabled a cloud to form?
Condensation particles, water, and a drop in air pressure
 4. What condition that is often involved in cloud formation is not involved in this experiment? A decrease in temperature

Cloud Formation Part 2

Materials

- 400-500 ml beaker or jar
 - plastic wrap
 - water
 - rubber band
 - matches
 - ice cubes
1. Fill a 400-500ml. beaker fill with lukewarm water. Light a match and hold it over the beaker. Then blow it out forcing some of the smoke down into the beaker. Quickly put a piece of plastic wrap over the beaker and secure it if necessary to keep in the smoke. Observe the beaker for any change in the air above the water. After 30 seconds, place 2-3 ice cubes on top of the plastic. Observe again.

2. Why was there very little, if any, change in the air before the ice cubes were placed over the top? Not enough conditions were present for cloud formation to occur.
3. What conditions for cloud formation were present before the ice was added? Water and smoke particles
4. Explain the change you observed after the ice was added. The temperature of the air dropped enabling the water to condense onto the smoke particles forming cloud droplets and therefore, a cloud.
5. What condition that is often involved in cloud formation was not present in this experiment? A drop in air pressure.
6. When you see fog, what are you actually seeing and what caused it to form? It is a cloud over the earth's surface due to a sufficient amount of water molecules and dirt particles in the air, along with a drop in air pressure and/or a drop in temperature.

Evaluation

During the discussion of the water cycle ask the students questions about the various components of the cycle: what they anticipate will happen at each phase and how and why it happens. Answers to the questions that pertain to each of the lab activities can also be discussed and graded.

References

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Kimball, John W. (1983). *Biology*. Reading, Mass.: Benjamin/Cummings Publishing Co.

"Winds and Weather." Biological Sciences Curriculum Study, 1970s.

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