

The Water Cycle

You have learned that almost three-fourths of Earth's surface is covered by water. Over 96% of this water is in the oceans. The polar ice caps and glaciers hold another 2% and less than 1% is available for processes on land. In this lesson, you will learn how water is exchanged between the ocean, atmosphere, and land. This cycle is known as the water cycle or hydrologic cycle.

Grade levels: Grades 3 – 6

Learning Goals:

Students will understand:

- that water moves through a continuous cycle through the oceans, other bodies of water, atmosphere, and land
- the processes that change water from one state to another.

Guiding Question(s):

How is water cycled through the oceans, other bodies of water and the atmosphere?

Correlation to Project 2061 Benchmarks for Science Literacy

Grades K - 2

- Water can be a liquid or a solid and can go back and forth from one form to the other. If water is turned into ice and then the ice is allowed to melt, the amount of water is the same as it was before freezing. 4B/P2 (K-2)
- Water left in an open container disappears, but water in a closed container does not disappear. 4B/P3 (K-2)

Grades 3 - 5

- When liquid water disappears, it turns into a gas (vapor) in the air and can reappear as a liquid when cooled, or as a solid if cooled below the freezing point of water. Clouds and fog are made of tiny droplets or frozen crystals of water. 4B/E3 (3-5)

Grades 6 - 8

- Water evaporates from the surface of the earth, rises, and cools, condenses into rain or snow and falls again to the surface. The water falling on land collects in rivers and lakes, soil, and porous layers of rock, and much of it flows back into the oceans. The cycling of water in and out of the atmosphere is a significant aspect of the weather patterns on Earth. 4B/M7 (6-8)

Concept Map (See Appendix)

Vocabulary

clouds

condensation

evaporation

gas

liquid

precipitation

runoff

solid

transpiration

water vapor

Materials

Clear plastic 8 oz cup

Small paper cup

Aluminum foil

Approximately 5 colored ice cubes

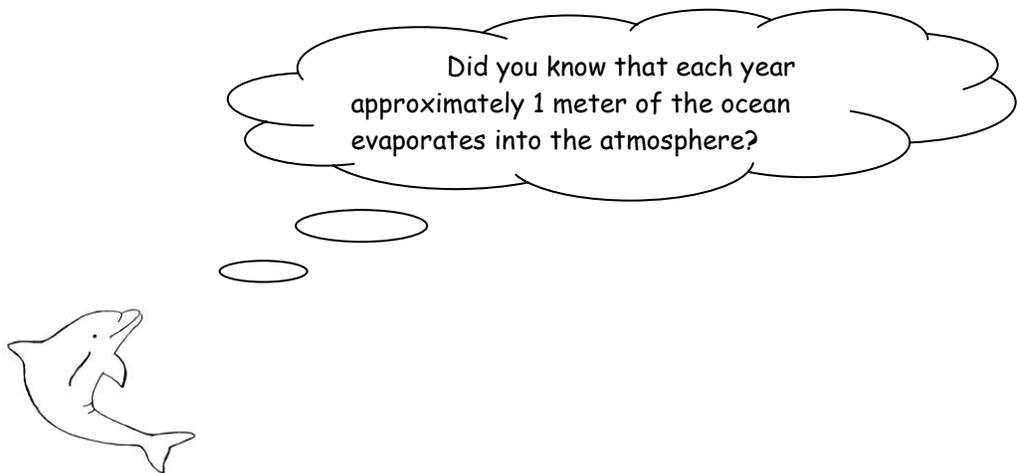
Food coloring

Heat source or sunlight

Salt

Warm water

Engage



So why does the ocean have about the same level of water? In this lesson, you will make a model of the water cycle and find out.

To engage students and assess their prior knowledge, you may ask students questions about the water cycle. You may show them pictures of images that show components (clouds, rain, ocean water, snow, etc.) or processes (condensation on eye glasses or a glass of ice water). You may have them try to put the water cycle processes in order or fill in a concept map. You may show them any type of model that demonstrates the water cycle, such as the Crystal Ball Fogger.

Common Preconceptions or Alternative Conceptions

- The water in a glass seeps through the wall of the glass, or evaporates from the inside and condenses on the outside.
- Students understand the concept of boiling and freezing before understanding evaporation and condensation.

- The water cycle involves the freezing and melting of water.
- Condensation occurs because the coldness changes the water or cold caused oxygen and hydrogen to change to water.
- Water disappears when it evaporates.
- Gases are not matter because most are invisible.
- Clouds are “sponges” that hold water or bags of water that rain when they are shaken by wind.
- When water evaporates, it immediately goes up to the clouds or into the sun.

Exploration: A Water Cycle Simulation

Procedure

1. Make approximately 100 ml of **warm** saltwater by adding 1 tablespoon of sodium chloride to the water.
2. Choose one color to add to the saltwater and pour this water into the clear plastic cup.
3. Float a small paper cup on the water in the larger plastic cup.
4. Place the aluminum foil over the top of the plastic cup. Carefully place the colored ice cubes on to the aluminum foil. You may push the foil in a concave (bowl-shape) position so that the aluminum will hold the ice cubes in place.

The food coloring is used to help students see that “rain or precipitation” does not come from the melting ice or from the saltwater in the plastic cup.

5. Place the model near a heat source, such as a light, or by the window. You will need to leave it for approximately 20 minutes.
6. Predict what you think will happen.

Questions

1. Describe your observations after 20 minutes. You may make a drawing.
Students should see water droplets forming on the foil and once they coalesce with other small droplets, they will begin to fall or precipitate.
2. If water was in your cup, what color was it? What does the color show?
The water in the cup is clear. This can help clear up misconceptions that the ice water actually leaked through the aluminum foil or that the precipitation was saltwater from the ocean.
3. If water was in your cup, how do you think it got there?
The water came from precipitation from the foil.

Explanation

The sun provides the energy to drive the **water or hydrological cycle** on Earth. As water is heated, the molecules begin to move faster and further apart. **Evaporation** occurs when liquid water changes into a **gas or water vapor**. Evaporation occurs at the surface of all bodies of water, soil, and living organisms. Water is evaporated from the leaves of plants through the process of transpiration. Approximately 80% of evaporation on Earth takes place over the oceans and 20% over the land. Once in the atmosphere, water vapor can be moved by winds. Most of this water vapor will eventually fall back into the ocean as precipitation, but approximately 10% will be transported over land and fall as precipitation over land. There is one process that must occur first though – that is condensation.

Water vapor is in the atmosphere for a short period of time. Because the water vapor is warm, it rises into the atmosphere, which is colder at higher altitudes. Colder air cannot hold as much water vapor as warmer air, so the water vapor condenses. **Condensation** is the process in which water vapor changes into liquid water. These droplets of water condense on tiny particles of dust, pollen or ice to form clouds. When water droplets combine and become heavy enough, they fall as solid (snow) or liquid (rain) precipitation. When precipitation falls onto land, some of the water evaporates and some drains downward through the soil. If the surface cannot absorb all the water, the excess will flow off the land as **runoff**, making its way into streams and rivers, and eventually back to the oceans.

The demonstration provides a model of heat warming the seawater. Water evaporates and the water vapor rises. As the water vapor rises to the top of the cup, the cooler air near the ice cannot hold as much water vapor, so condensation occurs on the bottom of the aluminum foil. As the water droplets combine and become heavy enough, they fall as precipitation.

QuickTime™ and a
decompressor
are needed to see this picture.

Questions

1. How does your water cycle model represent the water cycle on Earth?

The saltwater represents the ocean. The air inside the container represents the lower atmosphere and the air outside the container near the ice represents the upper, cooler atmosphere. The floating cup represents a rain gauge. The light represents the sun. The ice in the aluminum represents what happens as water vapor rises in the atmosphere and cools.

2. How is your water cycle model different from the water cycle on Earth?

This water cycle doesn't include land and runoff from the land, plants, etc. It is much smaller.

Elaboration

1. Make a list of examples at home or in the community of the processes of evaporation, condensation, and precipitation.

Students may list water dripping from an air conditioner, glasses fogging up, water on the outside of a glass of water, water on the inside of the windows on a cold day, dew on the grass, etc.

2. Based on your model, how could you obtain freshwater from saltwater?

Heating the saltwater causes evaporation. When the water vapor or gas rises, it cools as it comes in contact with the upper area of the plastic cup, and condenses on the bottom of the foil. The water droplets, once heavy enough, begin to fall into the cup as fresh water. The salt is left behind. This is also why bodies of water very more saline when there is more evaporation.

3. Using the Internet, describe some ways that the water cycle and people's lives may be affected if Earth's global climate were warmer. Think about what may happen in area where there a lot of evaporation.

With a warmer planet, evaporation will increase. However, all the water vapor has to fall again to keep the cycle in balance. Therefore, some regions will experience drought, while others will experience flooding.

Evaluation

Fill in the water cycle concept map based on what you have learned.

Write a story about a drop of water as it travels through the water cycle. Include a definition for each of the processes and an explanation of how the water drop moves through the cycle. Illustrate your story with a diagram of the water cycle.

Connection to Other Disciplines

Language Arts

Readers' Theater Script: Water Cycle Adventure

<http://www.enchantedlearning.com/rt/weather/watercycle.shtml>

Suggested Trade Books

- *Looking at Solids, Liquids, and Gases: How Does Matter Change?* Jackie Gaff. 2008. Nonfiction book. Recommended ages: Grades 2-4.
- *The Magic School Bus Wet All Over: A Book About The Water Cycle.* Pat Relf and Carolyn Bracken. 1996.
- *Water Series.* Helen Frost. 2000. Nonfiction books. Recommended ages: Grades K-1.
- *Water, Water Everywhere: A Book about the Water Cycle.* Melvin and Gilda Berger. 1995. Nonfiction book. Recommended ages: Grades 2-4.

Recommended Websites/Technology

Narrated Animation of the Water Cycle

http://www.harcourtschool.com/activity/science_up_close/209/deploy/interface.html

http://www.harcourtschool.com/activity/science_up_close/308/deploy/interface.html

EPA Water Cycle Animation

http://epa.gov/climatechange/kids/water_cycle_version2.html

<http://www.crickweb.co.uk/assets/resources/flash.php?&file=watercycle>

Water Cycle Matching Game

http://www.nwlg.org/pages/resources/geog/hydro_cycle/hydro/cycle.htm

Teacher Resources

USGS – The Water Cycle

<http://ga.water.usgs.gov/edu/watercycleevaporation.html>

NASA Aquarius Lessons

http://aquarius.nasa.gov/water_cycle.php

Beyond Penguins and Polar Bears: An Online Magazine for K-5 Teachers

<http://beyondpenguins.nsd.org/issue/column.php?date=August2008&departmentid=literacy&columnid=literacy!lessons>

Strategies for Diverse Learners

Vocabulary words are listed before reading passages and during in bold.

Visuals, demonstrations, hands-on activities are incorporated into each activity.

Lesson follows a consistent order.

Reading passages are divided into short sections followed by questions.

Careers

Hydrologists, meteorologists

The Water Cycle Evaluation of Student Learning

Formative Evaluation

Engage – Possible Questions

- Does Earth have more or less water now than 1000 years ago?
- How does water get into the oceans?
- What are clouds made of?
- Where does water go from puddles on the pavement?
- Where does the water go from the clothes you put in the dryer?

Water Cycle Processes - Have groups of students put the following in order to assess their prior knowledge. You will need to need to cut them out and mix them up.

- The sun heats the water in the ocean.
- Water molecules evaporate and form water vapor.
- Water vapor may also be evaporated from plants' leaves, known as transpiration.
- Water vapor cools and condenses on tiny dust particles in the air to form clouds.
- Water drops combine and become heavy.
- Precipitation comes from clouds in solid or liquid forms.
- Some precipitation infiltrates the soil.
- Excessive rain or melting snow causes runoff.
- Rivers and streams flow to the ocean.

Explore

- Describe your observations after 20 minutes. You may make a drawing.
- If water was in your cup, what color was it? What does the color show?
- If water was in your cup, how do you think it got there

Explanation

- How does your water cycle model represent the water cycle on Earth?
- How is your water cycle model different from the water cycle on Earth?

Elaboration

- Describe some examples of the water cycle in your daily life.
- Based on your model, how could you obtain freshwater from saltwater?
- Do you think water is a renewable resource? What do you think could happen to the water cycle if Earth becomes warmer?

Summative Evaluation

Fill in the concept map based on what you have learned.

Vocabulary for Concept Map

clouds	precipitation
condense	rain
evaporate	runoff
infiltrate soil	snow
ocean	sun
particles of dust, pollen, and ice	water droplets
plants	water vapor

Write a story about a drop of water as it travels through the water cycle. Include a definition for each of the processes and an explanation of how the water drop moves through the cycle. Illustrate your story with a diagram of the water cycle.