WHAT IS THE WATER CYCLE?

Overview

In this lesson, students investigate the processes of evaporation, condensation, and precipitation by building their own model of the water cycle.

Objectives

On successful completion of this lesson, students will be able to:

- write a hypothesis for an experiment;
- draw a conclusion based on their observations; and
- define the terms evaporation, condensation, and precipitation.

Alaska Standards
Alaska Science Standards / Grade Level Expectations

[4, 5] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[4, 5] SA1.2 The student demonstrates an understanding of the processes of science by using quantitative and qualitative observations: observing, measuring, and collecting data from explorations and using this information to classify, predict, and communicate.

[4, 5] SA 2.1 The student will demonstrate an understanding of the attitudes and approaches to scientific inquiry by supporting their ideas with observations and peer review.

[4, 5] SB1.1 The student demonstrates an understanding of the structure and properties of matter by identifying and comparing the characteristics of gases, liquids, and solids.

[4, 5] SB3.1 The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by explaining that temperature changes cause changes in phases of substances (e.g., ice changing to liquid water and liquid water to water vapor)

[4, 5] SE2.2 The student demonstrates an understanding that solving problems involves different ways of thinking, perspectives, and curiosity by identifying multiple explanations (e.g., oral traditions, folklore, scientific theory) of everyday events (e.g., weather, seasonal changes).

Alaska Cultural Standards

[A] Culturally-knowledgeable students are well grounded in the cultural heritage and traditions of their community.

[D] Culturally-knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning.

[E] Culturally-knowledgeable students demonstrate an appreciation of the relationships and processes of interaction of all elements in the world around them.

Bering Strait School District Scope & Sequence

4th Grade Sequence #8: Water cycle
5th Grade Sequence #7: Water cycle

Materials

- Gallon-size zip-lock plastic bags (one per student)
- Permanent markers (5 per class)
- Clear plastic Dixie cups (one per student)
- Water
- Pitcher
- Red food coloring (1 bottle)
- Duct tape (1 roll)
- Student Lab Packet: "Water Cycle Bag"

Multimedia

REACH Mutlimedia 4-6: "Water Cycle"
Available at: www.k12reach.org

Additional Resources

Harcourt School Publishers Science IV: Ch. 9, Lessons 1-4
Harcourt School Publishers Science V: Ch. 11, Lessons 1-3

Activity Preparation

1. Fill a pitcher with water, add several drops of red food coloring, and stir. Water should be noticeably pink.

Whole Picture

In rural Alaska, the seasons and activities are driven by water, its many states, and the habitats it creates. In his book 'Make Prayers to the Raven', Richard Nelson writes, "Water shapes and modifies the land, presents avenues or barricades for travel, supports a wide assortment of plant and animal communities, and both threatens and sustains human life" (36).

Water is essential to life. Without it, the biosphere that exists on the surface of Earth wouldn't be possible. Nicknamed the "water planet," Earth is covered by one of our most precious resources. However, almost 93% is locked in the oceans as salt water and is undrinkable for humans and terresterial plants and animals. To understand where fresh water resources come from, it is necessary to explore the Water Cycle (also known as the Hydrologic Cycle). The water cycle begins with the ascendancy of moisture into the air from water, ice, and land, through

evaporation, sublimation, and transpiration. As moist air is lifted, it cools and water vapor condenses to form clouds. Moisture is transported around the globe until it returns to the surface as precipitation. Once the water reaches the ground, some of the water may evaporate or sublimate back into the atmosphere or the water may infiltrate the surface and become groundwater. Groundwater either seeps its way into the oceans, rivers, and streams, or is taken up by plants and released back into the atmosphere through transpiration. The balance of water that remains on Earth's surface is runoff, which empties into lakes, rivers, and streams and is carried back to the oceans, where the cycle begins again. The water cycle is the continuous movement of all this water through Earth's ecosystem. The water cycle is a dynamic system that interacts with other parts of Earth's ecosystem, tying together the land, ocean, and atmosphere as vapor, condensing as clouds, and falling as precipitation. Liquid water travels the surface of Earth as runoff, finding its way into lakes, and streams and eventually traveling to the oceans. Water also infiltrates the ground, percolating through soil and rock to become groundwater. Despite all of this change and transport, the overall amount of water in the system remains fairly constant.

Evaporation

When the sun warms the surface of a large body of water, such as an ocean or lake, water is added to the atmosphere through the process of evaporation. Evaporation causes water to change state from liquid to invisible water vapor.

Transpiration

Water trapped underground is added to the atmosphere by a process called transpiration. Transpiration occurs when plants drink water from the ground through their roots and release it through their leaves as vapor into the atmosphere.

Sublimation

Earth's glaciers and ice sheets can melt into liquid water and flow into rivers and oceans. Sublimation occurs when solid ice skips the liquid phase and changes directly into water vapor.

Condensation

When temperatures in the atmosphere cool, water vapor molecules stick to tiny particles floating in the air. This process is called condensation. A droplet of liquid water forms after many water vapor molecules condense on one tiny particle. A group of droplets form a cloud.

Precipitation

Cloud droplets become larger as temperatures fall. When a drop becomes too heavy to float in air, it falls as rain or snow through a process called precipitation. When this liquid reaches Earth, it can runoff as rivers or streams, soak into the ground, collect in oceans and lakes, or freeze into glaciers or ice sheets. Rain is liquid precipitation. Snow, hail, and sleet are solid forms of precipitation.

Vocabulary

condensation	the process by which a gas or vapor changes to a liquid, by cooling or by increased pressure; this is how clouds are formed
evaporation	the process by which a liquid changes to a gas or vapor, at a temperature below the boiling point; most of the water vapor in the atmosphere has evaporated from Earth's surface
freeze	to change from a liquid to a solid state by being cooled to the freezing point
liquid	a form of matter with no fixed shape characterized by the ability to flow; the volume and density of a liquid usually remain constant
melt	to change from a solid to a liquid state; the temperature at which this happens is called the melting point
precipitation	water that falls to Earth's surface in the form of rain, snow, hail, or sleet
solid	a form of matter characterized by a rigid structure and fixed shape and volume
sublimation	the process of changing from a solid to a gas without passing through an intermediate liquid phase (such as ice and snow to water vapor)
transpiration	the release of water vapor from plant leaves
vapor	the gaseous state of a substance at a temperature where that substanc can also be a liquid or solid; for example, water vapor exists as a gas at a temperature below water's boiling point

Activity Procedure:

Day 1

2. Share information from the "Whole Picture" section with students.
3. As a demonstration, build a water cycle bag (see steps outlined in the Student Lab Packet). Ask students to predict what will happen to the water in the cup if the bag is left in the sun or near a heater vent. Students may know that the water will evaporate. Point out that the cup is sealed inside the bag. Ask students where the water vapor will go. Facilitate discussion of student hypotheses.
4. Distribute the Student Lab Packet: "Water Cycle Bag." Ask students to complete the hypothesis portion of their lab packet.
5. Distribute supplies and ask students to build their own water cycle bags. Students must write their names on their bag with permanent marker before placing the cup of water into the bag.
6. Assist students in filling a clear plastic cup half full with colored water from the pitcher. Using a permanent marker, mark the level of the water in the cup. Explain that the cups of water represent oceans, rivers, lakes, and ponds.
7. Instruct students to place the cup in the bag, taking care not to spill the water into the bag. Demonstrate how to hold the bag by one corner so the cup nests into the bottom

corner of the bag. Explain that the bag represents the atmosphere and air.

8. Instruct students to seal the bag, leaving some air inside the bag.
9. Using a piece of duct tape about three inches long, instruct students to affix their bags to a south-facing window (or near a heat source) with the cup nested upright in the lowest corner. Leave the bag overnight.
10. Direct students to complete question #1 in the "Data" section of their lab packets.

Day 2

11. Some water from the cup should evaporate and condense on the bag, and will then roll down and pool in the bottom of the bag. Look to see if the level of water in the cups is lower. The water on the sides and in the bottom of the bag represents rain.
12. Explain that the water from the cups (representing lakes, rivers, oceans, and ponds) evaporates into the air in the bag and condenses on the bag (representing clouds). It then runs down inside the bag to the bottom of the bag (representing rain, snow, or other precipitation).
13. Direct students to complete their lab packets. Assist as necessary.

Extension Activity

- For homework, students talk to cultural knowledge bearers to learn about place names for different water bodies in the area. Instruct students to ask their parents, aunties, uncles, and grandparents about local water bodies, including ponds, rivers, streams, lakes, and the ocean. Students might find information about how these have changed in the recent past, folklore associated with them, or even what these are called in the local language. Students should share their findings with the class on a specified day.

Answers to Student Lab Packets

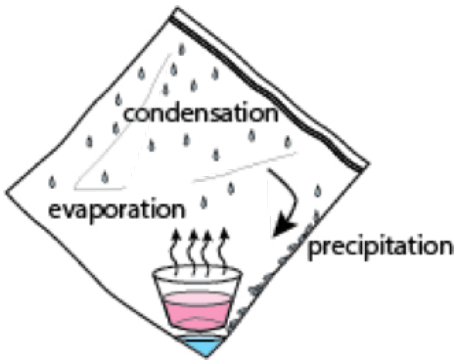
1. (Heat source will vary)

2. (Heat source will vary)

3. On day 1, all the water was pink and in the cup. On day 2, some pink water remains in the cup, but there also is clear water in the bottom of the bag and on the sides of the bag.
4. A.
5. D.
6. Conclusion If a cup of water is sealed inside a plastic bag and left overnight in a warm area, then the water in the cup will evaporate into the air in the bag, then condense on the sides of the bag and run down into the bottom of the bag.
7. Explanations will vary.

Answers to Further Questions

1.



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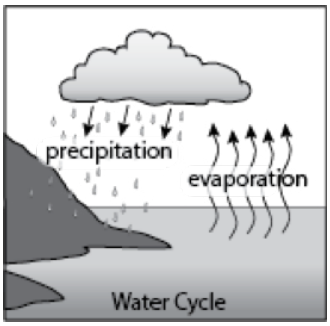


References

Nelson, Richard K. (1983). *Make Prayers to the Raven: A Koyukon View of the Northern Forest.* Chicago and London: University of Chicago Press.

Student Lab Packet: "Water Cycle Bag"

Name _____

Testable Question

If a cup of water is placed inside a sealed bag and left in a warm area overnight, what will happen to the water?

Hypothesis

A hypothesis is a testable possible answer to a scientific question. Write your own hypothesis by completing the statement below.

If a cup of water is sealed inside a plastic bag and left overnight in a warm area, the water in the cup will: _____

_____

_____

Experiment

Materials

- 1 gallon-size zip-lock plastic bag
- permanent marker
- 1 clear cup
- Pink water
- Duct tape

Procedure

Day 1

1. Write your name on the bag with permanent marker.
2. Fill a clear plastic cup half full with colored water from the pitcher, and mark the level of the water in the cup (with a marker on the side of the cup).
3. Place the cup in a bottom corner of the bag, being careful not to spill any water. Hold the bag by one corner so the cup nests into the bottom corner of the bag.
4. Next, seal the bag, making sure to leave some air inside.
5. Using a piece of duct tape about three inches long, affix the bag to a south-facing window (or in a warm place) with the cup nested upright in the lowest corner.
6. Complete the "Day 1" portion of the Data section.
7. Leave the bag in the sun (or in the warm place) until tomorrow.

Day 2

8. Complete the "Day 2" portion of the Data section.
9. Complete the "Analysis of Data" portion of your lab packet.

Data

1. **Day 1** When your bag is hanging, draw a picture of in it the space below. Label your drawing "Day 1." On your drawing, label the bag, the cup, the water and water level, and the heat source.

2. **Day 2** After leaving your bag overnight, re-examine it the next day. Leaving it hanging, draw a picture of it in the space below. Label your drawing "Day 2." On your drawing, label the bag, the cup, the water and water level, and the heat source.

Analysis of Data

3. What differences do you see between your drawing for Day 1 and your drawing for Day 2? Pay close attention to the location and color of the water.

_____

_____

_____

4. Where is the water located on Day 1?
    a. In the cup
    b. In the bottom of the bag
    c. On the sides of the bag
    d. All of the above

5. Where is the water located on Day 2?
    a. In the cup
    b. In the bottom of the bag
    c. On the sides of the bag
    d. All of the above

Conclusion

In your own words, answer the following question: If a cup of water is placed inside a sealed bag and left in a warm area overnight, what will happen to the water?

_____

_____

_____

Explain how you reached this conclusion:_____

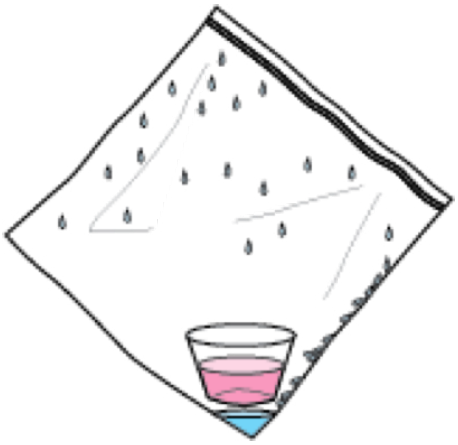
_____

_____

_____

Further Questions

1. Draw arrows to indicate the path of the water in the water cycle bag below. Label evaporation, condensation, and precipitation in this model of the water cycle.



2. Draw arrows to indicate the path of water in the picture below. Label evaporation, condensation, and precipitation on this drawing of Earth's water cycle.