Teek and Tom Episode 2

The Ocean is Key to the Weather and Climate We See!

LESSON 4

Up, Up and Away!

All URLs were reviewed and accurate at the time of this lesson's publication. If you should come across a non-operational link, contact NOAA Ocean Service Education at oceanserviceseducation@noaa.gov. All images are credited to NOAA unless otherwise noted.

Introduction

Water is a limited resource. The total amount of water in the world does not change over time. It changes form and moves around the Earth in a process called the water cycle. A model globe shows about 70% of the Earth is covered in water. Of the total amount of water on our planet, 97% is in the ocean and is undrinkable — without removing the salt. Of the remaining 3% of water, less than one-half of 1% is available as fresh water in surface sources like lakes, rivers, and swamps.

The atmosphere has a major impact on weather and climate. Evaporation occurs when a liquid changes into a gas. Evaporation from the ocean is the primary mechanism supporting the surface-to-atmosphere portion of the water cycle. The large surface area of the ocean allows for large-scale evaporation to occur. On a global scale, the amount of water evaporating is about the same as the amount of water delivered to the Earth as precipitation (rain, snow, etc.). Most of the water that evaporates from the ocean returns there as precipitation. Only about 10% of the water evaporated from the ocean is transported over land and falls as precipitation. Although the atmosphere does not store a lot of water, it is the superhighway used to move water around the globe. In fact, if all the water in the atmosphere rained down at once, it would only cover the globe to a depth of about 1 inch.

Lesson Summary

Students will investigate the relative amount of salt and fresh water on Earth and then do a simple experiment about water evaporation with covered and uncovered containers. Finally, students will look at the evaporation of water from a salt solution as they paint their name on paper with a salt solution treated with food coloring. The students will find colored salt left behind as the water evaporates overnight. Some of these activities were adapted from the NASA Aquarius Sea Surface Salinity Project, Evaporation Investigation (https://aquarius.oceansciences.org/activities/evap_invest.pdf).

Objectives

- Students will be able to describe the relative amounts of salt and fresh water on Earth.
- Students will compare and contrast their observations before and after an evaporation event.
- Students will describe the process of evaporation through discussion and pictures.

Estimated Time

It is estimated that one to two 45-minute class periods are needed for each lesson. This does not include the time required to view Episode 2 of Teek and Tom, *"The Ocean is Key to the Weather and Climate We See!"*, 11:15 minutes (https://oceantoday.noaa.gov/teekandtom/episode-2.html).

The activity in part two of this lesson can be set up during the first class period, but daily recording of the water levels in the containers should happen over four to five days.

Education Standards

The lessons that accompany the Teek and Tom series were designed for upper elementary and middle school students. The standards addressed are abbreviated here. A full list of standards is available in Appendix A (https://oceantoday.noaa.gov/teekandtom/educators-guide/appendix-a.pdf).

Next Generation Science Standards

- 3-ESS2-1: Earth's Systems. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
- 5-ESS2-2: Earth's Systems. Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
- ESS2.C: The Roles of Water in Earth's Surface Processes. Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.

Common Core English and Language Arts: Writing Standards Grades 4-5

Common Core Mathematics: Measurement and Data - Represent and interpret data.

College, Career, and Civic Life (C3) Framework for Social Studies: Geographic Representations

Materials

For a class of 30

- One 5-gallon bucket with a sign that says "Ocean"
- Plastic container that will hold 2 cups of water with a sign that says "Fresh water"
- Plastic container that will hold ½ cup of water with a sign that says "Groundwater, Rivers, Lakes"
- Ice cube tray with a sign that says "Glaciers and Ice Caps"
- Sticky note or 4-by-6 card for each student
- Measuring cup that will measure 1 cup of liquid

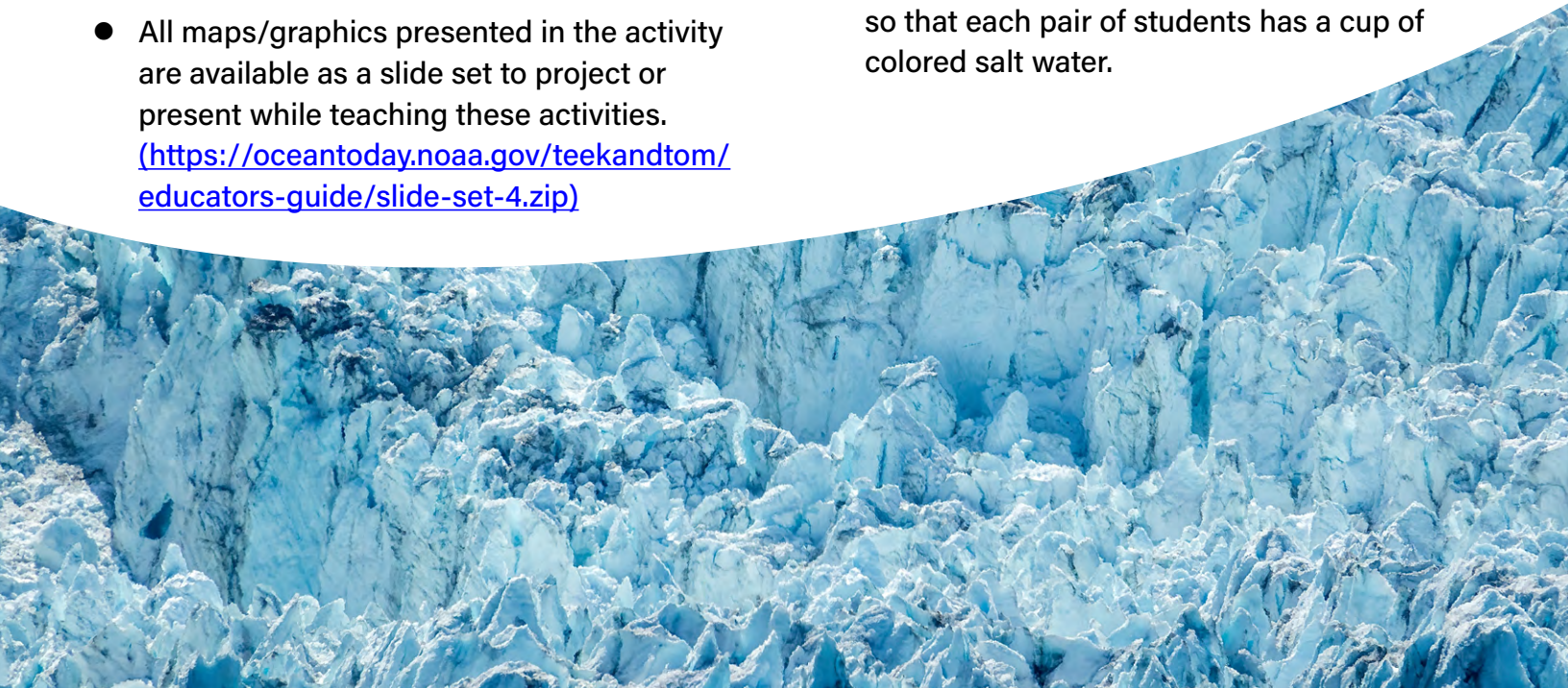
- Eye dropper
- Hand lens or magnifying glass
- Containers for each group or pair of students. Half of the containers need lids (these might include plastic pint containers from a deli or washed dairy containers)
- Small paper cups (suggest 4 or 5-oz cups for salt paint)
- Popsicle sticks - two for each group or experimental setup
- Small plastic rulers
- Plastic spoons
- Marker for teacher to make signs for the water demo
- Table salt
- Warm water (aids dissolving of the salt)
- Paint brushes
- Food coloring
- Students will need printouts of student record sheets, graphs, and/or maps to carry out the activities. Student record sheets are located at the end of this lesson.
- If you would like to provide the maps on a projection system, students will only need the student record sheets. Depending on the configuration of your classroom, we recommend one set per student or group.
- All maps/graphics presented in the activity are available as a slide set to project or present while teaching these activities. [(https://oceantoday.noaa.gov/teekandtom/educators-guide/slide-set-4.zip)](https://oceantoday.noaa.gov/teekandtom/educators-guide/slide-set-4.zip)

Preparation

1. Fill the 5-gallon container with water. Make four large signs labeled "Glaciers and Polar Ice Caps," "Fresh Water," "Groundwater, Rivers, and Lakes," and "Ocean." These should be large enough for the whole class to read what is on each sign. The 5-gallon container should be marked "Ocean." Label the container that will hold 2 cups of water "Fresh Water." Label the plastic container that will hold ½ cup of water with a sign that says "Groundwater, Rivers, Lakes." Label an ice cube tray with a sign that says "Glaciers and Polar Ice Caps."

2. Depending on the availability of materials, you may go through the exercises as a class rather than in small groups or pairs. The visuals can be displayed and discussed as a class. They are available as a slide set to project or present while teaching these activities.

3. Prepare 3 cups of salt water solution for part four of the activity. For each cup of salt water, add ¼ cup of table salt to 1 cup of warm tap water. Gently stir and then add several drops of food coloring. Prepare three different colors of salt water. You can reuse the containers from the first activity or use small paper cups for the salt water paint so that each pair of students has a cup of colored salt water.



InvesTeekation Pathway

ENGAGE

Part 1. Engage

1. In small groups or as a class, have students describe or list how they use water at home, at school, and in their daily activities. Consider having each student write down the specific way they use water and where they use it (e.g., washing hands at home or school) on a 4-by-6 card or sticky notes that can be collected and organized on a classroom board. On another part of the classroom board, gather students' ideas about how water is used in agriculture, industry, electricity generation, and recreation.

2. Ask students to identify the water source that their community uses (e.g., nearby lake, river, underground reservoirs such as a well). Students may not be able to identify where their water comes from. To them, it just streams from their faucet. You may have to do a little research to find out where your local water comes from.

3. **Class Demonstration:** Using a 5-gallon bucket of water marked with a sign that says "Ocean," ask a student to come up and remove 2 cups of water and put it into another container marked "Fresh Water." The 5-gallon bucket of water represents the salt water in the ocean (97%), and the 2 cups of water just removed represents the remainder of the fresh water on the planet (3%). Ask another student to remove 1/2 cup of water from the "Fresh Water" container and put it in a container marked "Groundwater, Rivers, Lakes." Pour the rest of the "Fresh water" (1.5 cups) into an ice cube tray to represent fresh water locked up in glaciers and the polar ice caps. From the container marked "Groundwater, Rivers, and Lakes," use an eyedropper to put one drop in a student's hand, representing the amount of fresh water that is clean and available to humans.

4. Students may understand the water cycle on a local level but struggle to apply the concept on a global scale or understand that the total amount of water on Earth has remained constant and has been conserved throughout time. Students may be aware of bodies of water in their region but have little concept of the vast quantities of salt water that exist on the planet and the relatively small amounts of fresh water.

Discussion questions

1. Compare the amount of salt water and fresh water on Earth. *Students should note that the amount of fresh water on Earth is very small.* Over 97% of the Earth's water is found in the ocean as salt water, and 2% is stored as fresh water in glaciers, ice caps, and snowy mountain ranges. That leaves only 1% of the Earth's water available to us for our daily water supply needs.

2. Why can't we use salt water for agriculture and household uses? *Large amounts of salt water is poisonous for plants and animals, including humans.*

3. If you use a half gallon of water each day for drinking and in your food, how many gallons would you use in a year? *182.5 gallons per year*

4. A person in the United States uses over 100 gallons of water each day for showers, cooking, washing clothes, and other indoor activities.How much water would be used in a year at this rate? *36,400 gallons per year*

5. Water use is very different in other countries. Some countries in Europe use less water,

about 38 gallons each day. Can you think about some ways that we can reduce our personal water use? Some Europeans use 13,870 gallons per year, almost half of what we use in the U.S. *There are many ways Americans can reduce water use. These include taking shorter showers, not letting the water run when brushing teeth, and not using water to defrost frozen foods.*

Part 2. Explore

1. Provide each student group with two containers (one should have a lid). Each container should be filled with the same amount of water, about half full. The students will cover one of the containers and leave the other one open. Ask each student pair to label the containers with their names.
2. Over the next few days, students will observe the containers to see what happens to the water over time. Ask them how they can use wooden sticks (popsicle sticks) to track changes in the water level over time. They should dip a wooden stick into the water along the side of the container until it touches the bottom. Then, use a ruler to measure the water level on the stick. If the sticks are wide enough, have them mark the water level on the stick with the date of the measurement.
3. The students should record their findings in the table on the student pages. Students should check the containers on a regular basis (daily or every other day).
4. If time allows, have the students complete the first activity using water at different temperatures. Warm water will encourage quicker evaporation, so if there is a warmer place in your room, place one of the containers there. Leave the lids off and place the other container in a cooler place.

Part 3. Explain

It is best to allow the containers to sit undisturbed for at least four days so that the students can see a pattern emerge. Once the experiment is complete, ask students to draw an image of their two containers and mark the water levels each day. Ask them to discuss the differences between the conditions experienced in each container and the resulting water levels.

Discussion questions

1. What happened to the level of the water in the closed container?
2. What happened to the level of the water in the open container?
3. Was there a difference in the water levels between the two containers? Explain.
4. Would there be a difference in how fast the water level drops if we had used larger containers? Why or why not?
5. Ask students to draw what happened to the water levels in the two containers over time. Have them share their results with the other groups.
6. If you had a glass of water that you wanted to save, should you leave it open or closed? Why?

ELABORATE

Part 4. Elaborate

Review the results of the water container simulation and circle back to the idea that the ocean covers over 70% of Earth's surface, and evaporation happens over this large area.

Discussion questions

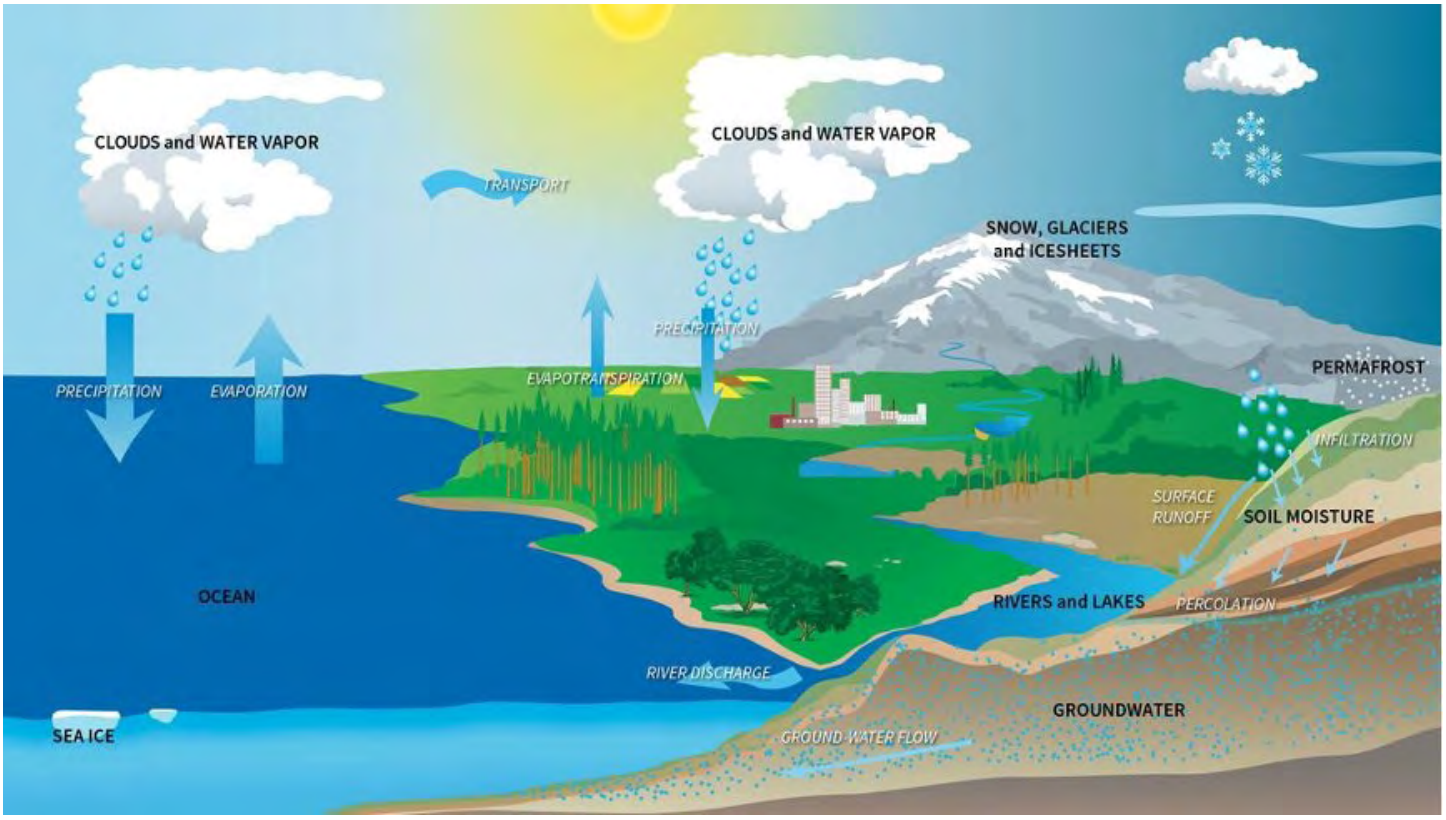
1. Based on the experiment you just finished, what do you think will happen when energy from the sun warms the water in bodies of water like the ocean and lakes? *Help them connect the simulation they did with the containers to what happens on a larger scale on Earth. The water vapor in the air condenses into clouds. The clouds become filled with water, and rain (or snow) falls back into the ocean and onto the land.*
2. Ask students to create their own drawings of the water cycle. *Their drawing should include at least the following parts: Evaporation from the ocean, clouds, precipitation, rivers, or lakes.*

You may want to use an image of the water cycle to assist with the follow-up discussion.

You can review the basics of how the water cycle works with your students in one of Ocean Today's most popular videos, The Water Cycle (2:42) (https://oceantoday.noaa.gov/watercycle/).

The United States Geological Survey offers an interactive water cycle for kids that can help students explore the various interactions within the water cycle (https://water.usgs.gov/edu/watercycle-kids-adv.html). This can be used as a whole class investigation. A more comprehensive water cycle diagram is available as a PDF in English and Spanish (https://www.usgs.gov/media/files/water-cycle-poster-pdf).

The Water Cycle



Credit: NASA

EVALUATE

Part 5. Evaluate

When water evaporates from the ocean, the salt is left behind. This is the principle behind creating fresh water from sea water, known as desalination. Students will paint their names (as elaborate as they wish) with salt water paints and then watch as the water evaporates, leaving the colored salt behind. Provide paper, paintbrushes, and small cups of salt water with food coloring. Once the students have completed their paintings, allow them to dry overnight. The following day, students will examine their paintings to find that the water has evaporated, but the colored salt remains. Provide hand lenses or magnifying glasses so students can see the salt crystals left behind.

Discussion questions

1. What do you observe about the appearance of your name on the paper **before** it dries?
2. What do you observe about the appearance of your name on the paper **after** it dried?
3. Write a brief summary about how evaporation changed your painting. *Their explanation should include the idea that the water has evaporated, but the colored salt was left behind.*
4. When water evaporates from the ocean and forms clouds in the atmosphere, what happens to the salt in the water? *The salt is left behind in the ocean. Water that forms in the clouds is salt-free. Reinforce that this idea is used in processes of desalination. Desalination is becoming more common around the world. The largest desalination plant in the world is located south of Tel Aviv, Israel, and produces over 137 million gallons of fresh water a day. Desalination plants are also running in California, and more are planned.*

Earth Curiosities

Dead Sea Salt Water

This picture shows students from Idaho enjoying the unique experience of "floating high" in the Dead Sea. Located in Israel, the surface of the Dead Sea is 430.5 meters (1,412 feet) below sea level, making its shores the lowest land-based elevation on Earth. Notice how the students seem to be sitting up as if in a chair. The chair is actually very salty water! The Dead Sea has an exceptionally high salt content because the water does not have a way to flow out. It is also very hot in this area, and there is a lot of evaporation. The salt that washes in from the surrounding area concentrates over time. This sea water is much saltier than regular seawater.
Photo Credit: USGS/U.S. Dept. of State

Posted by USGS. Photo Credit: U.S. Dept. of State

Credit: Shutterstock

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Extensions

This Ocean Today Video will be helpful for student understanding during discussions about their ideas.

- The Water Cycle (https://oceantoday.noaa.gov/watercycle/)

Fresh water can be in short supply in many parts of the world. As the human population grows, shortages of fresh water will occur more often. Salt water can be turned into fresh water for drinking. An easy method to do this is to heat the sea water, capturing the steam and condensing it back into water (distillation). You can demonstrate this process using a glass bowl, a plastic cup, plastic food wrap, tape or a rubber band large enough to go around the bowl, a small rock or weight, and salty water.

- Put the salty water in the bowl.
- Place the cup in the middle of the bowl and wrap plastic wrap over the top. Secure the wrap with tape.
- Place the rock or weight in the center of the plastic wrap above the cup so that the evaporated water will drip into the cup.
- Set in a sunny and/or warm space and observe.

Illustration from https://www.energy.gov/eere/education/articles/rain-machine-solar-still

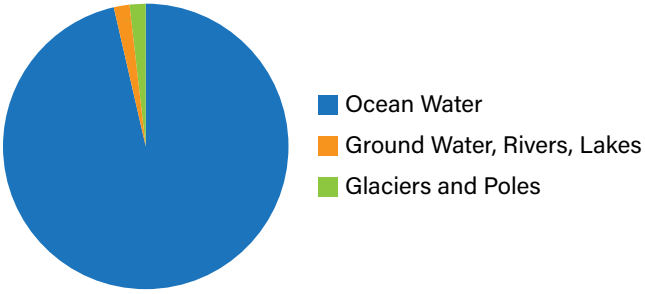
Student Record Sheets

PART 1. WATER ON EARTH

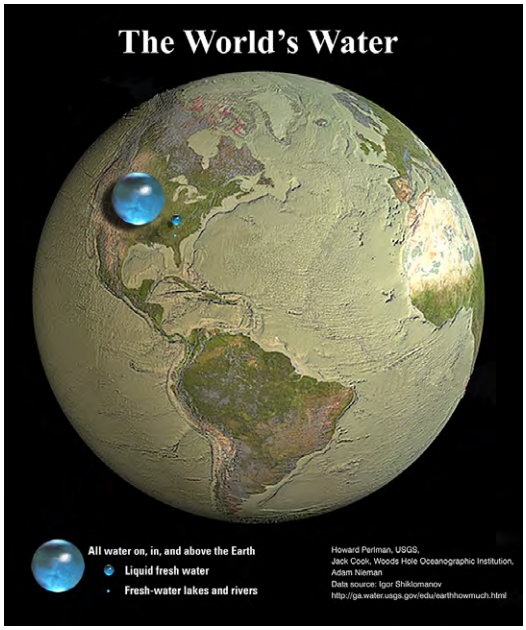
We will model the amount of water on Earth. A full 5-gallon bucket of water will represent all of the water on Earth. Your teacher will ask for someone to remove some water to represent the fresh water available on Earth. The remaining water in the bucket represents salt water, which no animals, plants, or humans on land can use. Complete the chart below as directed by your teacher.

	Total Amount of Fresh Water	Amount of Fresh Water in Glaciers	
5 Gallons			

Percentages of Water on Earth



This graph shows the amount of salt and fresh water found in different places on Earth. The ocean contains salt water. Fresh water is made up of groundwater, rivers, lakes, glaciers, and ice at the North and South Poles.



A representation of the amount of water on Earth. This image shows blue spheres representing relative amounts of Earth's water in comparison to the size of the Earth. Are you surprised that these water spheres look so small? They are only small in relation to the size of the Earth.

https://www.usgs.gov/media/images/all-earths-water-a-single-sphere

Credit: Getty Images

Questions

1. Compare the amount of salt water and fresh water on Earth.

2. Why can't we use salt water for agriculture and household uses?

3. If you use a half gallon of water each day for drinking and in your food, how many gallons would you use in a year?

4. A person in the United States uses over 100 gallons of water each day for showers, cooking, washing clothes, and other indoor activities. How much water would be used in a year at this rate?

5. Water use is very different in other countries. Some countries in Europe use less water, about 38 gallons each day. Can you think about some ways that we can reduce our personal water use?

PART 2.

You will work with another student for this experiment. Label two containers with your names. Fill each container about half full. Cover one of the containers and leave the other one open.

Over the next four or five days, you will observe the containers to see what happens to the water over time. You will use a wooden stick (popsicle stick) to measure the water level in each container by dipping the stick into the water along the side of the container until it touches the bottom. Then, use a ruler to measure the water level on the stick. Mark the water level on the stick for each date. Record your measurements in the table below. Check the containers each day.

Date	Water Level in Closed Container in Centimeters	Water Level in Open Container in Centimeters

PART 3.

1. What happened to the level of the water in the closed container?

2. What happened to the level of the water in the open container?

3. Was there a difference in the water levels between the two containers? Explain.

4. Would there be a difference in how fast the water level drops if we had used larger containers? Why or why not?

5. Make a drawing that shows what happened to the water levels in the two containers over time. Share your results with the other groups.

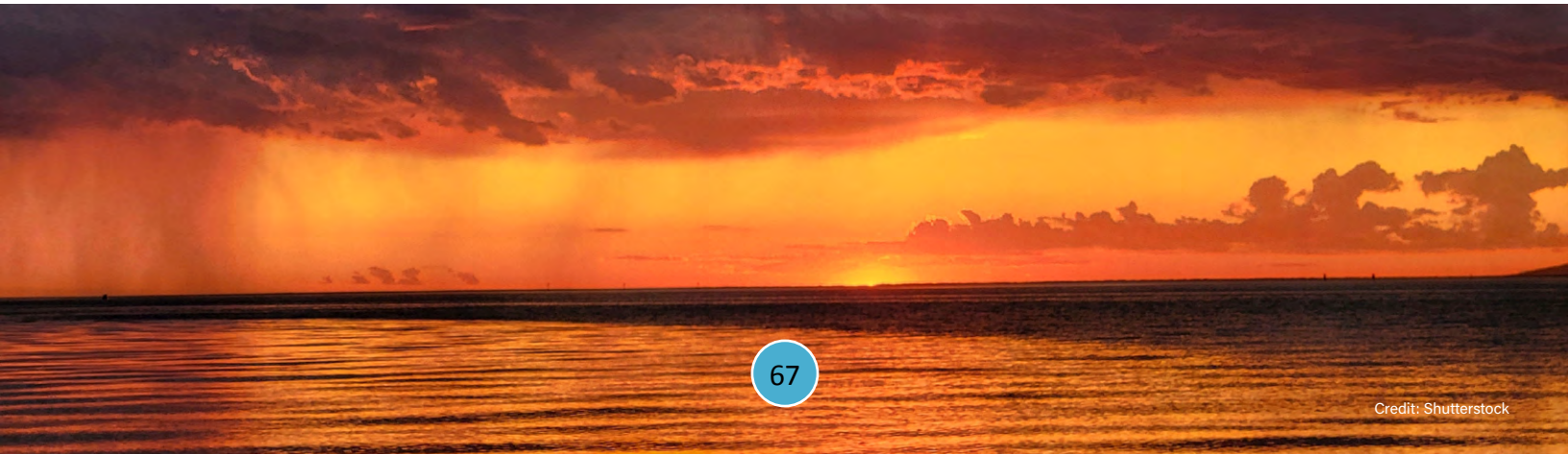
6. If you had a glass of water that you wanted to save, should you leave it open or closed? Why?

PART 4.

1. Based on the experiment you just finished, what do you think will happen when energy from the sun warms the water in bodies of water like the ocean and lakes?

2. Make a simple diagram of the water cycle showing the following parts:

   Evaporation from the ocean, clouds, precipitation, rivers, or lakes.



Credit: Shutterstock

PART 5.

You will use paint made from salt water and food coloring. Paint your name on a fresh piece of paper. Let the paper sit overnight to dry.

1. What do you observe about the appearance of your name on the paper before it dries?

2. What do you observe about the appearance of your name on the paper after it dried?

3. Write a brief summary about how evaporation changed your painting.

4. When water evaporates from the ocean and forms clouds in the atmosphere, what happens to the salt in the water?