



THE WHEEL OF WATER

Grade 2

Lesson at a Glance

Students learn water's physical properties and the water cycle, play a classroom game to test their understanding of water, and simulate the water cycle by growing plants in a closed terrarium.



Key Concept

Water is continually cycled between the earth and the atmosphere through the processes of evaporation, transpiration, condensation, precipitation, runoff and infiltration. In the water cycle, water's physical properties change continuously. Our water resources, however, must be protected and conserved.

Hawai'i Content and Performance Standards III, Science

Strand		Physical, Earth and Space Sciences	
Standard 6: Physical, Earth and Space Science: NATURE OF MATTER AND ENERGY: Understand the nature of matter and energy, forms of energy (including waves) and energy transformations, and their significance in understanding the structure of the universe.			
Topic		Nature of Matter	
Benchmark SC.2.6.1		Identify ways to change the physical properties of objects (<i>identify how the physical properties of water change in the water cycle</i>).	
Sample Performance Assessment (SPA)		The student: Provides examples of a variety of techniques (<i>e.g., heating and cooling in the water cycle</i>) to change the properties of objects (<i>water</i>).	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Explain how the physical properties of objects (<i>water</i>) can be changed through a variety of techniques.	Identify a variety of ways to change the physical properties of objects (<i>water</i>).	Identify a few ways to change the physical properties of objects (<i>water</i>).	Recall that there are ways that physical properties of objects (<i>water</i>) can be changed.

Objectives

Students will be able to:

1. describe, draw and/or label the water cycle;
2. describe some properties of water and how they relate to the water cycle;
3. describe the value of our water resources and how to conserve and protect them;
4. describe the importance of preventing water pollution; and
5. cooperate with classmates to answer questions related to the water cycle.

Time

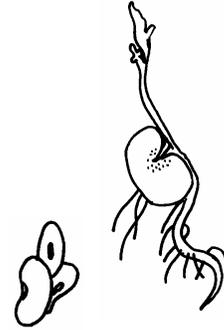
Six class periods; however, terrarium activity can be ongoing depending on the amount of time it takes the beans to sprout and grow, and how much students want to continue observing the terrarium.

Subject Areas

science

Materials

water cycle diagram, labeled and unlabeled (provided)
game cards and answers (provided)
game board (provided)
student activity sheets (provided)
2 sheets of overhead transparencies
overhead projector or dry erase board
colored markers, or colored cardboard pieces, or different
mini-sized magnets
transparent tape
potting soil
beans or any other fast-germinating seeds; alternative: moss and ferns
plastic container or small aquarium or fish bowl large enough to accommodate bean sprouts
water for beans or seeds



Preparation

If you are using an overhead projector, copy the water cycle diagram and the game board onto transparency sheets. The water cycle diagram and game board can be enlarged onto 11x17-in cardstock, laminated, and taped to a wall. If you have a dry erase board on your wall, you can enlarge the water cycle diagram and game board onto 11x17-in paper and stick it to the dry erase board using magnets. If you are using a computer and a digital projector, scan the water cycle diagram. Preview questions and remove any that pertain to material that the class has not covered.

Prerequisites

All other Grade 2 Geography Unit activities are suggested prerequisites.

Teacher Background

Water's Amazing Physical Properties

The physical properties of water make it amazing and unique. Some properties can be described by our senses—tasteless, odorless, and colorless. An interesting physical property of water is that it has a high heat index and can conduct heat better than any liquid with the exception of mercury. Water can absorb a lot of heat before there is a temperature change. This is why the Pacific Ocean helps keep Hawai'i's temperatures stable year round as opposed to a continental area such as Arizona where it can be scorching hot in the summer and cold in the winter.

Another physical property of water is its state. Water is the only substance that manifests in three states: liquid, solid (ice, hail, and snow), and gas (water vapor). Water changes from its liquid

state to its gas state at 100°C (212°F), its boiling temperature. It changes from its liquid state to its solid state at 0°C (32°F), its freezing temperature. Between those two temperatures, water remains a liquid. Compared to other substances, that's quite a temperature range!

Water is a universal solvent. It can cause erosion and dissolve substances. Its high surface tension makes it sticky enough to allow molecules to cling together to form water drops instead of a thin watery layer. Still more physical properties are its mass (measure of matter such as weight) and density (mass per volume).

Water Cycle

Where do we get our fresh water? In our islands, a lot of our drinking water comes from the ground. We also use surface water, meaning water that flows above ground such as in streams. How did the water get there? To find out, we must understand the water cycle. Water itself is not lost; it is simply changing from one form to another. The water cycle is a great way to learn some of water's physical properties.

The **water cycle** is the continual flow of water evaporating and blowing across the ocean by trade winds, until they reach the islands, where it hits the mountains and is carried upwards into the atmosphere, rising, cooling (from lower atmospheric temperatures), condensing back into liquid or solid form, and falling back to earth as **precipitation** (rain, fog, snow or sleet).

Evaporation is the process of water changing from a liquid state to a gaseous state. During evaporation, the sun's energy heats water, causing it to evaporate into the air in the form of water vapor. Evaporation helps cool the area from which the water is evaporating (this is why we are cooled when perspiration evaporates). **Transpiration**, a form of evaporation, is the transfer of water from plants to the atmosphere. In transpiration, water evaporates from pores, or stomata, on a plant's leaves, cooling the plant in the process. **Condensation** is the reverse process of evaporation. As the moist air rises, it cools and can no longer hold all the water vapor. The excess water vapor then condenses to form clouds. If there is enough condensation, the water will begin to precipitate as rain.

Most (about 87 percent) precipitation falls directly into the oceans and begins the water cycle again. The water that falls on land may become **runoff**, which is the transfer of water on land to the ocean via lakes, streams and rivers. Some of the water will evaporate back into the air or enter the soil and drain down to the water table in a process known as **infiltration**. Some of this water is absorbed and used by plants and then transpired.

The cycling times for individual molecules of water vary from almost instantaneous (as rain evaporates before it hits the ground on a hot day) to thousands of years (when water is trapped in the ground). In Honolulu, it takes an average of 25 years for a drop of rain to move through the ground until it finally comes out of faucets.

The Water Cycle and Watersheds

The **water cycle** is one of the natural processes of an ecosystem. An **ecosystem** is a community of living things, people, their environment and the way they interact with one another. Our native mountain forests that grow in our watersheds are ecosystems vital to Hawai'i's water supply. Watersheds are areas that drain to a particular body of water, such as a stream. For more

information on watersheds, see *Be a Water Watcher*. Since people are a part of our ecosystems, we have a significant impact on them, whether positive or negative. The alteration of the watershed by activities such as logging or clearing for agriculture or development can negatively affect the water cycle. There would be few plants and trees to soak water on the ground or to trap rain clouds and moisture in the air. Without rain, there would be no groundwater recharge. The living organisms in the ecosystem would die from a lack of water. With no vegetation, there would be erosion and runoff. Every living thing on earth depends on water. Without the wheel of water, there would be no water for drinking, bathing, washing the dishes, or swimming.

Water Pollution

Pollution can destroy our ecosystems, water quality and water supply. Pesticides, herbicides, fertilizers, paint, oil, gas, cleaning solvents, and other contaminants such as lead in computers sitting in landfills can seep into the soil and reach our groundwater supply. Pollutants also enter streams and oceans via sewer systems, killing stream and ocean life. Beaches in Hawai‘i have been closed periodically due to pollution washed down from streams or overflowing sewer systems. Human activities that modify our ecosystems can inadvertently interfere with the water cycle. Many industries release waste gases into the air. When it rains, the gases are absorbed in the falling rain. This is acid rain. An acid is a chemical that can burn substances. Acid rain has been responsible for the destruction of forests in industrial nations. Since water is a universal solvent, many substances are dissolved by rain only to find their way in surface runoff and groundwater.

Teaching Suggestions

1. Discuss the properties of water and how they relate to the water cycle. Give examples such as boiling water in a pot or making ice cubes.
2. Ask the class “Where does our drinking water come from?” Create a list of all students’ answers (faucet, hose, shower, river, lake, stream, pond, waterfall, rain, clouds, refrigerator, etc.).
3. Project the water cycle transparency and review it. Later you can have students draw and label the water cycle or use the blank diagram and label it.
4. Discuss the importance of protecting our water resources, ways to conserve water, and ways to prevent water pollution
5. Divide the class into three or four teams, placing some students with more advanced skills in each group. For game board on transparency, project the game board onto butcher paper on the wall. Assign a different colored marker to each group and mark a dot with each team’s color on the game board. For a laminated game board, tape it to a wall. Use colored cardboard with tape in the back for game pieces. For a paper game board, attach it to a large dry erase board. Use different types of magnets for game pieces. The game begins at the Go arrow on the left bottom corner of the game board.

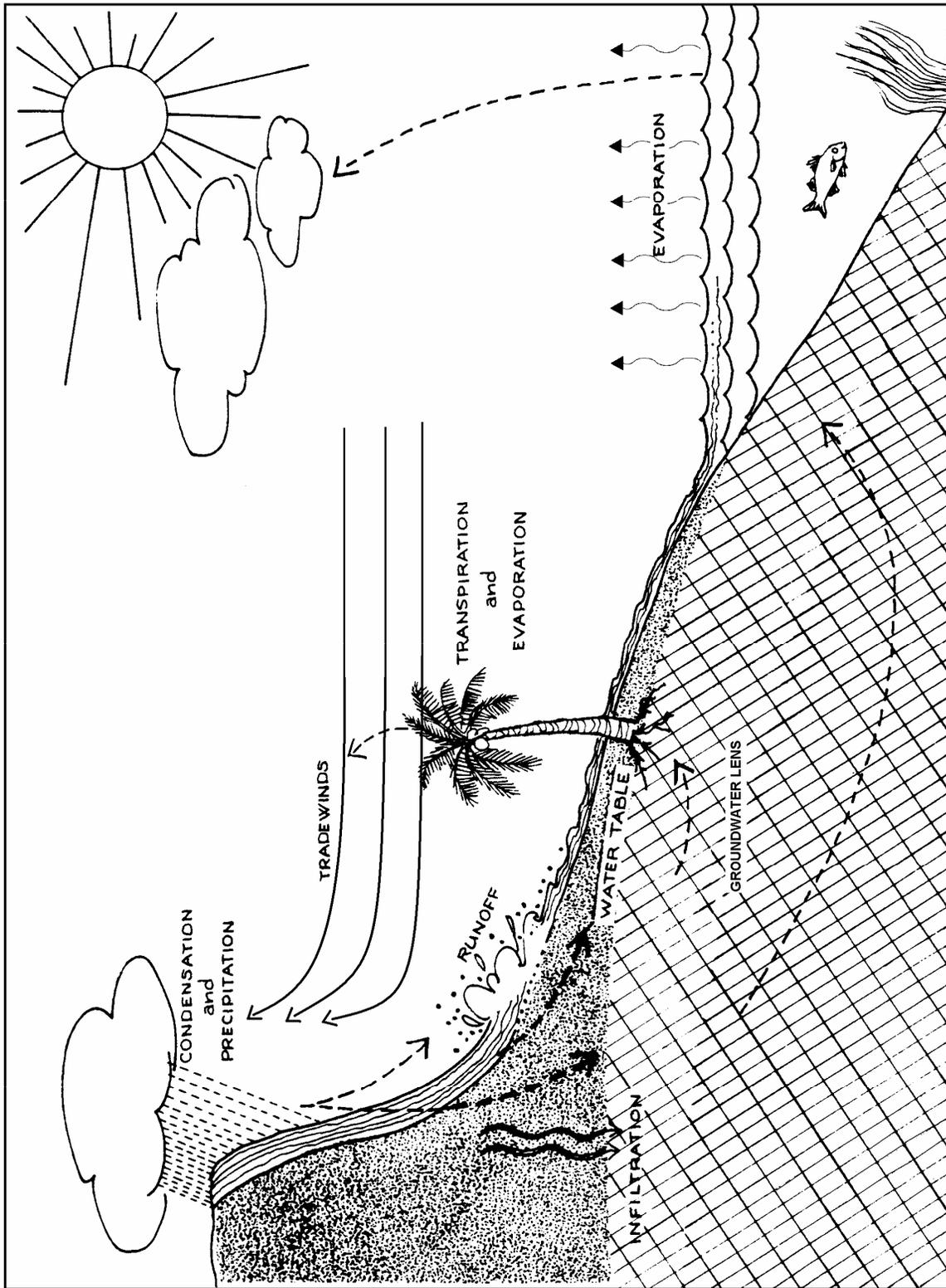
6. Photocopy the game cards. Cut, shuffle, and stack the cards. Select a card and read it to the first team. Explain that the team members must agree upon an answer before responding and that if a group takes too long, a time limit will be established.
7. If the group answers correctly, move game pieces according to the card. For transparency, draw its marker from the arrow space to the next space. Some questions are worth two spaces. If the answer is incorrect, pass the question to the next team. Continue passing unanswered questions to each team until all teams have tried.
8. The first team to reach End wins first place. All other teams that make it through the game board win second place.
9. Distribute the “Family Water Saving Tips Activity Sheet” and encourage students to share them with their families. Complete the activity sheet by practicing the tips together. When the students come back to school, have them share their results.
10. Distribute the “Family Water Pollution Prevention Tips Activity Sheet” and encourage students to share them with their families. Complete the activity sheet by practicing the tips together. When the students come back to school, have them share their results.
11. Have students break up into groups and ask each to create a terrarium. Alternatively, each student could create his/her own terrarium. See “Your Own Water Cycle” activity sheet. The terrarium activity can be ongoing depending on the amount of time it takes the beans to sprout and grow, and how much students want to continue observing the terrarium. Have students share and discuss results with the class.

Extended Activities

- Have students write their own questions for the Wheel of Water game.
- Have students create a water drop named “Kawai” (“the fresh water”). Draw Kawai’s water cycle and write a short story about where s/he came from and where s/he goes in his/her travels.
- Ask students to draw a “Kawai the Water Drop” family album. Include pictures of Kawai as a baby, leaving home, and returning for a reunion.
- Investigate puddles on the school grounds. How long does it take for the water in the puddles to evaporate? Where does the water go? Which puddles dry out fastest and which dry out slowest? Why? Alternatively, wet several pieces of cloth. Place one in the sun, one in the wind, one in the shade and one in a plastic bag. Note how long it takes each one to dry. Students can also carry out their investigations by helping with the laundry at home. Ask students to hang a few wet clothes out to dry and keep track of how long each takes to dry.
- Have students look for examples of condensation. With adult supervision, students can help prepare hot foods at home and cover them with plastic wrap before they are fully cooled. The steam from the heated foods will condensate. Condensation also occurs when a pot of boiling water is covered with a lid.

- Conduct the water conservation campaign in “Be a Water Watcher,” Grade 2, Humans and the Environment Unit so students can practice water conservation at home.
- Students can contact a local environmental agency or organization such as the Department of Land and Natural Resources or county water department to see how they can participate in projects that preserve our ecosystems and water resources.





Family Water Saving Tips Activity Sheet

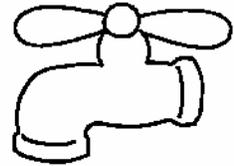
Earn points by caring for our water resources. Check each water saving tip that your family does and earn one point for each and be a:

- Water Watcher 1-4 points
- Water Winner 5-8 points
- Water Wizard 9-10 points



- Grow “unthirsty” plants in your yard. This is called xeriscaping.
- Store drinking water in a container in the refrigerator rather than letting the tap run to get a cool glass of water.
- Take short showers instead of tub baths.
- Ask your parents to replace your showerhead with one that produces a lower flow of water. It will save money on your water bill.

- Don't let the water run while washing your face or brushing your teeth.



- Always run a full load of laundry when using the washing machine. If your parents are planning on buying a washing machine, look for one that saves water and energy.

- When washing the family car, use a bucket or hose with a nozzle. Do not let the runoff flow into our streets and down the gutter.

- Never use your toilet to flush away bugs!



- Something I will do at school to save water is:

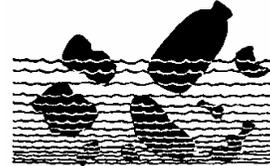
- Something my family will do to save water is:

Family Water Pollution Prevention Tips Activity Sheet

Earn points by caring for our water resources. Check each water pollution prevention tip that your family does and earn one point for each and be a:



on Watcher 1-4 points
on Winner 5-8 points
on Buster 9-10 points



- Never litter! At picnics, throw all rubbish away in the trash can. Recycle bottles, aluminum cans, and paper.
- Old computers and monitors should be recycled instead of thrown away because there are harmful contaminants in them.
- When washing the car at home, use biodegradable detergent and park the car on the lawn or on gravel so the runoff won't flow down the storm drain.
- Don't dump anything into our storm drains or it will flow into streams and out to the ocean.
- When changing the car's oil, use an oil change box or kitty litter. Oil-based paint can be disposed of this way too.
- Use rechargeable batteries whenever possible. They can be used in portable video games, portable music players, cameras, power tools, cell phones, laptops, and camcorders. Rechargeable batteries should be recycled after they've been completely used up.
- Clean up after your pet. Animal wastes can be thrown in the trash, flushed down the toilet, or buried deeply.
- Instead of buying hazardous household products and chemical fertilizers, use natural methods instead.
- When buying a new car battery, turn in your old one at the same time.
- Something I will always do to prevent water pollution is:

<p>What brings evaporated water to our islands? (<i>winds</i>)</p>	<p>What happens when the sun shines on a puddle of water? (evaporation)</p>
<p>Where does the water end up after it goes down your drain? (<i>In the sea where it later evaporates back into the air.</i>)</p>	<p>What are clouds made of? (<i>millions of drops of water vapor</i>)</p>
<p>What happens to water after it is used by plants? (<i>It transpires from the leaves.</i>)</p>	<p>Which rises faster—cold air or warm air? (<i>warm air</i>)</p>
<p>In Hawai'i, what happens to rain that isn't used by plants or soaked up by the land? (<i>It evaporates or flows off the land into the sea.</i>)</p>	<p>In Hawai'i, where does more rain fall—near the mountains or near the beach? (<i>near the mountains</i>)</p>

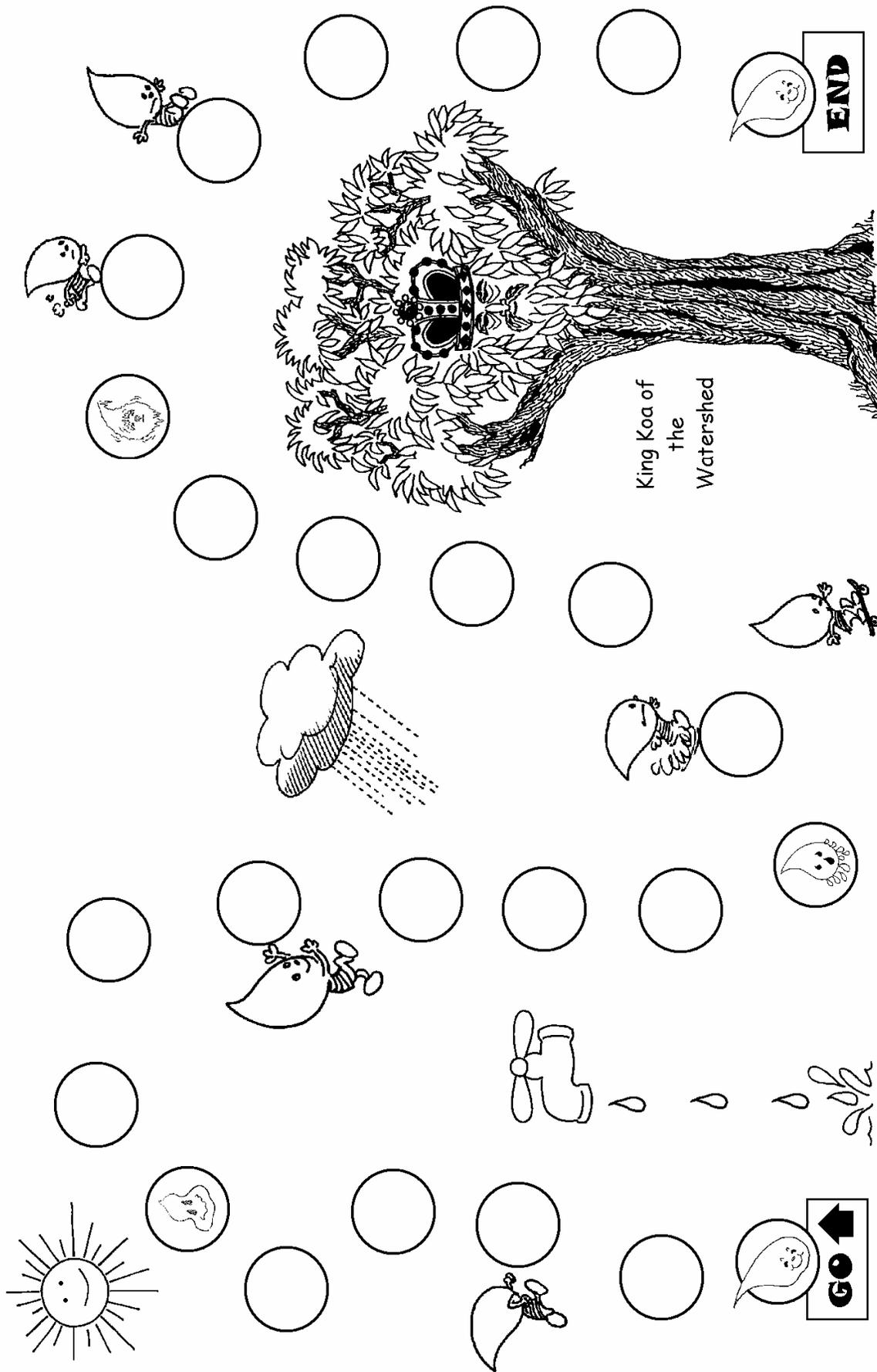
<p>You used too many chemicals on your farm to control bugs. Lose a turn.</p>	<p>There has been too much development in your town. You have less water than the water cycle can provide. Lose a turn.</p>
<p>You forgot to repair a leaky faucet and wasted lots of water. Lose a turn.</p>	<p>You used too much fertilizer on your lawn and a heavy rain washed the fertilizer into a storm drain and down to the ocean. Lose a turn.</p>
<p>Thanks for not flushing that dead roach down the toilet. Move ahead 1 space.</p>	<p>You wasted water by not fully loading your washing machine. Lose a turn.</p>
<p>Your favorite beach is closed due to heavy rains washing soil into the ocean. The beautiful ocean water is now brown. Yuck! Lose a turn.</p>	<p>You conserved water by taking a short shower instead of a tub bath. Move ahead 1 space.</p>

<p>What is an ecosystem? Move ahead 2 spaces if you answer correctly. (<i>A community of living things, people, their environment and the way they interact with one another.</i>)</p>	<p>Describe the water cycle. Move ahead 2 spaces if you answer correctly. (<i>Water evaporates, condenses, falls as precipitation, runs off or infiltrates into the ground, and evaporates again.</i>)</p>
<p>Name two kinds of precipitation. Move ahead 2 spaces if you answer correctly. (<i>rain, snow, fog, hail, sleet</i>)</p>	<p>The water that forms around a cold can on a hot day is called _____. (<i>condensation</i>)</p>
<p>Is water always liquid? (<i>No. It can be a solid like ice, or a gas like steam.</i>)</p>	<p>What happens to the air temperature as you go higher up a mountain? (<i>It cools.</i>)</p>
<p>Is there more salt water or fresh water in the world? (<i>Most of the water is salt water.</i>)</p>	<p>True or false. Logging can affect the water cycle. (<i>True</i>)</p>

<p>Which part of a plant takes up water from the soil? (Roots)</p>	<p>Does it rain more on the windward or leeward side of your island? (<i>probably the windward side</i>)</p>
<p>If there were no mountains in Hawai‘i, would there be less or more rain? (<i>Less—there would be nothing to force the air to rise, cool, condense and fall as rain.</i>)</p>	<p>Do all places in the Hawaiian Islands receive the same amount of rain? (<i>no</i>)</p>
<p>Do all plants and animals need the same amount of water to survive? (<i>no</i>)</p>	<p>What makes rain turn into snow? (<i>freezing temperatures</i>)</p>
<p>Give two examples of surface water. Move ahead 2 spaces if you answer correctly. (<i>stream, river, pond, lake, pool, waterfall</i>)</p>	<p>Name something made of solid water. (<i>snow, hail, ice</i>)</p>

<p>True or false? Watersheds are areas that drain to a specific body of water. (<i>true</i>)</p>	<p>True or false? Without plants, there would be soil erosion and runoff. (<i>true</i>)</p>
<p>True or false? The amount of water people use is greater than what our water cycle provides us. (<i>true</i>)</p>	<p>How can pollution reach our groundwater supply? (<i>Pollutants can seep through the soil and reach our groundwater supply.</i>)</p>
<p>Name 2 kinds of pollution that can contaminate our groundwater supply. Move ahead 2 spaces if you answer correctly. (<i>pesticides, herbicides, fertilizers, paint, oil, gas, cleaning liquids</i>)</p>	<p>Water that moves from land to the ocean through lakes, streams, and rivers is known as _____. (<i>runoff</i>)</p>
<p>Water that enters the soil and drains down to the water table is known as _____. (<i>infiltration</i>)</p>	<p>What type of pollution can kill forests? (<i>acid rain</i>)</p>

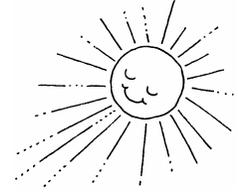
<p>One of water's physical properties is that it is found in three states. (True)</p>	<p>In the water cycle, water in the ocean is lost when it turns into water vapor. (False. Water is not lost; it merely changed form.)</p>
<p>What makes water change to gas? (heat)</p>	<p>What makes water change to ice? (cold)</p>
<p>Water can dissolve most things. (True; it's a universal solvent.)</p>	<p>In the water cycle, the heat from the sun creates water vapor that rises to form clouds. (True)</p>
<p>When rain falls from the cloud, water is turning from a gas to a liquid. (False; clouds are formed by water droplets.)</p>	<p>Besides water, all substances can be found as a liquid, solid, or gas. (False)</p>



King Koa of
the
Watershed

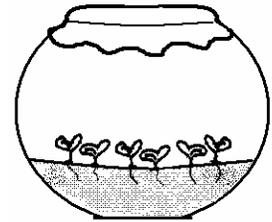
WHEEL OF WATER GAME

Students can study the water cycle up close by raising beans in a closed terrarium. It's also a great way to observe how a plant grows.



Instructions:

1. Fill the containers with a couple of inches of potting soil.
2. Plant the beans and water well but be careful not to disrupt the soil and the beans.
3. Cover with lids or tightly seal the containers with plastic wrap.
4. Have students place their terrariums in various locations around the classroom, such as a sunny window sill, a shady window sill, or an area where the sun does not shine.
5. Each terrarium should be numbered for easy identification.
6. Have students hypothesize what kind of results they expect to get from each terrarium in each location.
7. Have students observe the terraria every day for several days after the beans have sprouted. Students should keep a journal that records the date, time, weather, and observations of the environment in the terraria. It might be interesting to record observations at different times of the day.
8. At the completion of the experiment, have students share their results.



Note: The plants should take up water through their roots and transpire it through their leaves. The moisture will condense on the glass and “rain” back into the soil so you should not have to add water to this system. Alternative: instead of seeds, use shade plants such as ferns and mosses. Water the terrarium lightly and then cover it with glass or plastic.



Discussion Questions

- Was there any evidence of evaporation, condensation, and precipitation?
- How does this relate to the water cycle?
- Are there any differences in the results between the various terrariums? If so, why?

