# Water Wonders

Rain Forest Ecology

**National Science Education Standards**

- Standard B: *Physical Science* — Transfer of energy.
- Standard B: *Physical Science* — Properties and changes of properties in matter.
- Standard C: *Life Sciences*— Populations and ecosystems.
- Standard C: *Life Sciences* — Diversity and adaptation of organisms.

## OVERVIEW

The water cycle is the system by which Earth's fixed amount of water is collected, purified, and distributed from the environment to living things and back to the environment. Plants play a large part in the cycle by absorbing water with their roots and transpiring it as vapor through their leaves. This activity will introduce students to the various steps of the water cycle and to the various paths water can take. They will also make connections between the water cycle and all living things.

## OBJECTIVES

Students will:

1. Simulate the paths that water takes in the water cycle.
2. Describe the importance of hte water cycle to living things.
3. Conduct an experiment to discover how plants affect the movement of water in a watershed.
4. Describe how plants are important in maintaining water quality,
5. Describe how energy from the sun powers the water cycle.

## SUBJECTS

Science, Language Arts, Social Studies

## VOCABULARY

water cycle, evaporation, watershed, erosion, groundwater, runoff, transpiration

## TIME

Part A—Preparation-30 minutes; Activity-50 minutes

Part B—Preparation-several hours; Activity-50 minutes

## MATERIALS

**Part A:** station sections cut from Student Page 1; copies of Student Page 2; seven dice; label for each station; watch or stopwatch.

**Part B:** two long planter boxes filled with soil; several small plants; bricks or scrap wood; watering can with spray head or coffee can with holes poked in bottom.



## BACKGROUND

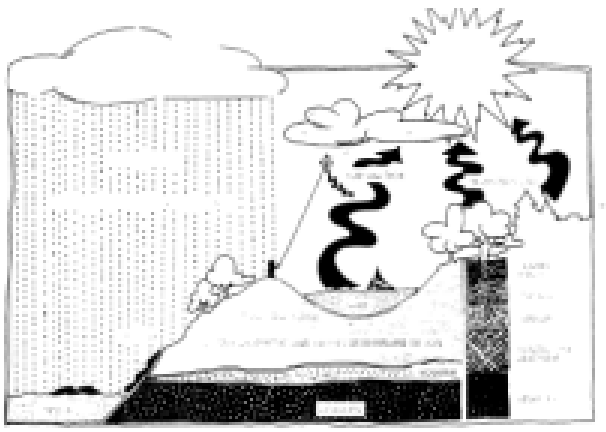
Water covers 71 percent of Earth. It constitutes 50-70 percent of the weight of all plants and animals, including humans. Water consists of two parts hydrogen to one part oxygen. It can exist in liquid, vapor, or solid (ice) forms. Its unique physical properties enable life to exist on Earth. Those properties include water's ability to remain liquid in a wide range of normal Earth temperatures and its ability to dissolve and transport other substances.

Water is constantly moving. In general, it evaporates from oceans into the atmosphere (air), condenses into clouds, falls as rain or snow, and eventually returns to oceans through a drainage system of streams and rivers. This movement is called the water cycle. Energy from the sun, which allows evaporation, and gravity are the driving forces that power the cycle. In the coldest regions of Earth, water is stored for a long time as ice and hard-packed snow. But even ice and snow are in motion; glaciers slowly melt as they move inch by inch. Icebergs break away from glaciers and float in the ocean, slowly melting as they move toward the equator.

The movement of water is greatly influenced by the contour of land and geographic features such as mountains, valleys, and hills. A watershed is the area of land that guides water through small streams toward a major stream or river. Water's movement in the watershed, in turn, creates contours of the land by erosion and sedimentation. In addition to clouds, oceans, rivers, and land, living organisms are part of the water cycle. All living things need water to live because it is essential to their bodily functions. Plants and animals take in water and return it to the atmosphere as vapor (breathing, transpiring) or to the soil as liquid (excreting).

Forests greatly affect watersheds. When rain falls on the forest, it drips down through the forest canopy to the forest floor. Trees, other plants, and layers of plant litter absorb rainwater, reducing erosion and runoff. Tree roots also help to hold soil in place so that it doesn't wash away. But, when rain falls on bare ground, the full force of raindrops can wash soil into streams, making them muddy.

Forests also help improve water quality by filtering out impurities that could be potentially harmful in streams or groundwater. Through the process of transpiration, water that is absorbed by tree roots is released as vapor through the leaves, impurities (many of which are good for a tree) remain in the tree.



Although the gradual wearing down and erosion of soil is a natural process, without proper management human activities such as clearing vegetation for development, logging, dam building, farming, and draining wetlands will increase the rate of erosion in watersheds and can reduce water quality. By the same token, reforestation, certain types of farming and landscaping, and restoring wetlands can reverse those trends.



## BEFORE THE ACTIVITY

**For Part A,** photocopy ***Student Page 1*** and cut the stations apart. Also copy ***Student Page 2*** for each person. Using paper and marking pens, make a large label for each of seven stations: Cloud, Mountain, Stream, Groundwater, Ocean, Plant, and Animal. Use those labels to set up seven stations around the room. At each station, put a die and the station section designated for that station.

**For Part B**, on or near the school grounds, find two sloped sites with about the same angle of slope: one should have little or no vegetation on the soil (a roadway cutbank, or steep bare slope, works well), and one should be covered with plants (grass, shrubs, or trees).

Alternatively, you can build two boxes about 16" long x 12" wide x 4" deep (40.6 cm x 30.5 cm x 10.2 cm). Make them watertight by lining with plastic material or aluminum foil. (You may use planter boxes, cake pans, or aluminum foil roasting pans with the approximate dimensions.) At one end of each box cut a v-shaped notch about 1.5" (3.8 cm) deep, and fit it with a spout of stiff paper so water is directed into a container (see diagram on page 145). Put a piece of sod (cut from a pasture, field, fence row, or lawn) in one box, and place bare soil (preferably from the same location) in the other. Set both boxes on a table so the spouts extend over the edge; place boards under the opposite ends to give both boxes the same slope. Place jars on stools underneath the spouts

## ACTIVITY

**1.** Ask students, "What is a cycle?" *(A sequence of recurring events.)* Invite them to name some cycles that are part of their life *(morning, afternoon, night; fall, winter, spring, summer)*. Ask students whether they have heard of the water cycle before. Divide the class into pairs. Ask pairs to write down words that describe what they know about the water cycle or what they think the term water cycle might mean. Then ask them to write their own description of the water cycle. Ask volunteers to share their descrip tions with the whole class.

**2.** On the chalkboard, draw a sketch of the water cycle as shown on this page. Make sure that students understand the terms evaporation, groundwater, and condensation (see "Glossary"). Use the following questions to focus their attention:

- If every living thing needs so much water, how come water isn't used up?
- Where does the water go when a puddle dries up?
- Why don't oceans and lakes dry up like puddles do?
- Where does rain come from?
- Do you think water always follows the same path as shown in the water cycle?

**3.** Explain that the water cycle is really a simplified model for looking at the "journey" of a water molecule. So students may learn more about the different paths water might take, invite them to play a game in which they each will be a water molecule. Have them use the score card on ***Student Page 2*** to record the path they followed in the game. Later, they will compare score cards.

## ACTIVITY

**4.** Divide students into seven approximately equal groups, and have each group begin at one of the stations.

**5.** Have students roll the die and read the statement at their station corresponding to the number on the die. They should write on their water cycle score card their current station stop, what happens to them, and their destination. When you call out "cycle", students should go to the next station as directed on the paper.

**6.** Repeat Step 5 about 10 times or until most students have cycled through the Cloud station a couple of times.

**7.** Ask students to go back to their seats, and write a brief story from a water molecule's point of view that describes the journey they just took through the water cycle. For example, a student whose journey was

Mountain-->Groundwater-->Plant-->Cloud-->Ocean-->Ocean-->Cloud-->Stream-->Animal-->Mountain

might start a story, "I was a lonely water molecule frozen in ice on top of a mountain. When the spring came and the ice thawed, I slid down the mountain and sank deep into the earth.

**8.** On the chalkboard, write the names of the seven stations. Beginning with Cloud, ask students to share all the different ways they got to Cloud. *(For example, they evaporated from the ocean and transpired from the plant.)* On the chalkboard, show each response by drawing arrows to Cloud. Repeat with the other stations.

**9.** Discuss the following questions:

- Even though individual molecules took different paths, was anything similar about the journeys they took?
- In the game, which stations seemed to be visited by the most water mol- ecules, regardless of their particular journey? What can we infer from this?
- Can you think of other parts of the water cycle that were not included in the game? (lakes, reservoirs, rivers, wells, puddles) Where might they be included in the cycle?
- The water cycle is usually shown like this (point to sketch from Step 2). Do you think this is a useful way to show the cycle, even if the sketch doesn't include all the paths water might take?
- What makes water move through the cycle? (sun, gravity, physical properties of water) What would happen if the sun's energy were blocked from Earth?
- What might happen if all of Earth's water stayed in the oceans? In the clouds?
- How is the water cycle important to plants and animals? (It moves water to them; it makes water available at different times.)

## ACTIVITY

DON'T MUDDY THE WATER

**1.** Ask students, "Have you ever wished water didn't act the way it does? For example, you might have wished that it didn't rain on a day when your family was going to the zoo, that a puddle didn't evaporate because you enjoyed stomping in it, or that snow didn't melt because you wanted to ski." Discuss these questions:

- Is there anything people can do to control or alter the water cycle? *(build dams, cover reservoirs, seed clouds, make snow)*
- Do you think plants have any effect on the water cycle?

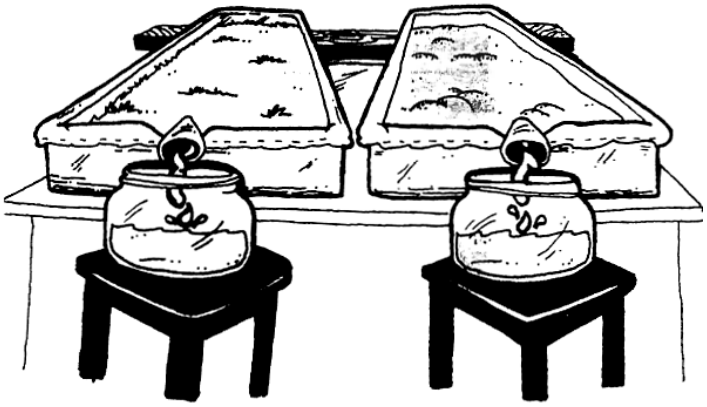
**2.** Explain to students that the class will conduct an experiment to find one way that plants might affect the water cycle and protect soil from erosion. Take them to the slopes you identified in Getting Ready, or use the two boxes. Describe the experiment to students (see Step 3). Then have them predict whether there will be any difference in what occurs on the two slopes.

**3.** Fill the watering can or coffee can with water. Help students hold the can at the same height so they can pour or sprinkle water at the same rate over the same point of each slope. Have students look for the following:

- The plants' effect on the water's speed
- The amount of run-off on each slope
- The appearance of the run-off water
- The water's effect on the contour (shape of the surface) of each slope

**4.** As you lead class members in a discussion about what they observed, ask questions such as these:

- What happened to the water on the bare slope? What do you think will be the water's next stop in the water cycle? *(probably a stream).*
- What happened to the water on the planted slope? What do you think will be the water's next stop in the water cycle? *(plants, groundwater, or stream)*
- In what ways do plants affect the movement of both water and sedi- ment (soil carried in water) through the water cycle? *(They slow down the water so more of it can soak into the ground and plants rather than running off into streams. They hold soil with their roots so it doesn't wash away.)*
- What effect did the two slopes have on the quality of the water? How did the change occur? *(Water on the bare slope might have been muddier.)*
- How are forests important for maintaining the balance of water in a watershed?



## EXTENSIONS

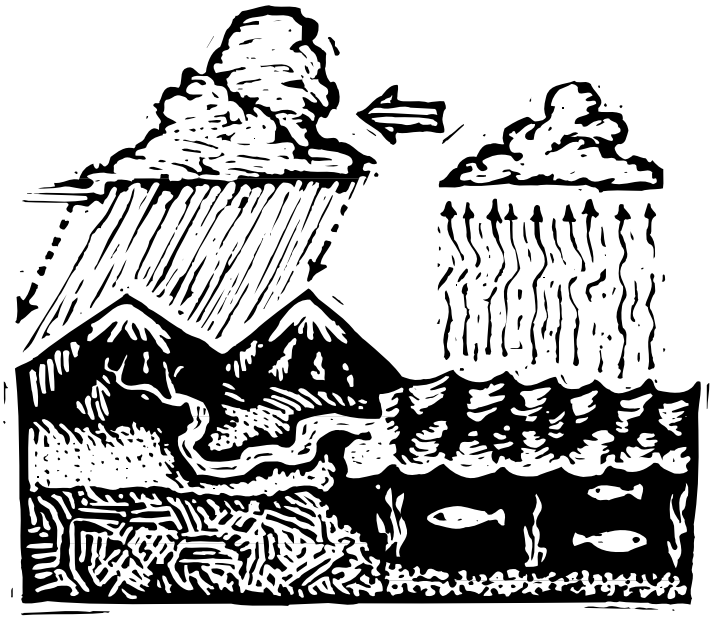
Build a terrarium to observe the water cycle in action. Put a small cup filled with water (to simulate a pond) in the center, and surround it with a 2" (5-cm) layer of soil. Place small potted plants (like ferns or house plants) in the soil. Then moisten the soil and plants lightly using a spray bottle. Cover the container tightly with plastic wrap and place the terrarium in indirect sunlight. What do your students observe happening as time passes? What causes the changes?

(Plants should thrive. Moisture should condense on the underside of the plastic and the side of the container. The water level in the pond may rise if water drips into it.) If possible, build a second terrarium to the same specifications. Cover the second terrarium with aluminum foil and as time passes, have students observe what is happening. Comparing the two experiments, what role does the sun's energy seem to have in the water cycle?

## ASSESSMENT

Ask students to revise their definition of water cycle (from Part A) to reflect any new understanding they've gained from 'the activity. Give students the following scenario to write about individually or in groups: Imagine that two pieces of land are exactly alike, except one area is bare and the other is covered by a forest. Now imagine a stream running through each piece of land.

- What are the differences in the way the stream might move through each piece of land?
- How would the water quality of the stream differ in each area?
- What physical changes might take place in each area?



## CREDIT

This activity is adapted with permission from Project Learning Tree (PLT). PLT is a program of the American Forest Foundation. Go to *http://www.plt.org/* for more information about this award-winning environmental education curriculum.

Student Page 1

STUDENT PAGE

# GO TO THE HEAD OF THE CLOUD

*(Make two copies; then cut station sections apart.)*

### STATION 1—CLOUD

1- You fall as rain onto a mountain. Go to Mountain.

2- You fall as snow onto a mountain. Go to Mountain.

3- You fall as rain onto a stream. Go to Stream.

4- You fall as rain onto an ocean. Go to Ocean.

5- You fall as snow onto the ground. Go to Groundwater.

6- You fall as rain onto a parking lot. Go to Stream.

### STATION 2—MOUNTAIN

1- You evaporate into the air. Go to Cloud.

2- You soak into the ground and become part of the groundwater. Go to Groundwater.

3- You soak into the ground and get absorbed by a plant's roots. Go to Plant.

4- You roll downhill and become part of a stream. Go to Stream.

5- You roll downhill and become part of a stream. Go to Stream.

6- You get frozen in ice and stay there. Stay at Mountain.

### STATION 3—OCEAN

1- You are one of countless water molecules in an ocean and you stay there. Stay at Ocean.

2- You are one of countless water molecules in an ocean and you stay there. Stay at Ocean.

3- You evaporate into the air. Go to Cloud.

4- You evaporate into the air. Go to Cloud.

5- A kelp plant takes you in, releases you through its leaf, and transpires you into the air. Go to Cloud.

6- A kelp plant takes you in. Go to Plant.

### STATION 4—STREAM

1- You evaporate into the air. Go to Cloud.

2- You evaporate into the air. Go to Cloud.

3- An animal comes to the stream and licks you up. Go to Animal.

4- You continue rolling downhill and become part of an ocean. Go to Ocean.

5- You continue rolling downhill and become part of an ocean. Go to Ocean.

6- A human drinks from the stream. Go to Animal.

### STATION 5—GROUNDWATER

1- You move slowly underground and eventually flow into an ocean. Go to Ocean.

2- You move slowly underground and eventually flow into an ocean. Go to Ocean.

3- You move slowly underground between grains of sediment and eventually flow downward into a wetland, and from there into a stream. Go to Stream.

4- You move slowly underground between grains of sediment and eventually flow downward into a wetland, and from there into a stream. Go to Stream.

5- A plant takes you in through its roots. Go to Plant.

6- You are pumped out of the ground from a well to irrigate a farm. Go to Plant.

### STATION 6—ANIMAL

1- After using you to process food, the animal urinates and you end up on the ground. Go to Mountain.

2- After using you to process food, the animal urinates and you end up soaking into the ground. Go to Groundwater.

3- You are exhaled from a human's lungs into the air as vapor. Go to Cloud.

4- You are exhaled from a human's lungs into the air as vapor. Go to Cloud.

5- A person uses you for brushing his or her teeth. Go to Stream.

6- You are exhaled from an animal's lungs into the air as vapor. Go to Cloud.

### STATION 7—PLANT

1- The plant transpires you through its leaves into the air as vapor. Go to Cloud.

2- The plant transpires you through its leaves and you evaporate into the air. Go to Cloud.

3- The plant transpires you through its leaves and you evaporate into the air. Go to Cloud.

4- The plant uses you to grow. Stay at Plant.

5- The plant stores you in its edible fruit. Go to Animal.

6- The plant stores you in its edible leaves. Go to Animal.

Name _____

Student Page

# WATER CYCLE SCORE CARD

STUDENT'S NAME:

| STATION STOP | WHAT HAPPENS | DESTINATION |
|---|---|---|
| EXAMPLE | | |
| Cloud | Fall As Rain | Mountain |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

Describe your entire journey on the back of the card.