Cave Water Cycle Game

Adapted from the Water Cycle activity from the Virginia Living Museum's 3rd Grade Gifted curriculum, which was modified from "the Incredible Journey," Project WET Curriculum & Activity Guide, ©2003 The Watercourse and Council for Environmental Education.

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Grades: 3-8

Setting: large room or playing field

Summary: With a roll of a die, students simulate the movement of water within a water cycle that includes a cave.

Objectives:
Students will:
Describe the movement of water within the water cycle.
Discover how water moves through caves and how it is a part of the water cycle

Materials:
A bell, whistle, buzzer or some sound maker
1 6-inch chenille stem per student, one end curled so that beads can't roll off.
8 different colors of pony beads matched to each die & station
8 small lidded containers labeled to match stations
A key to the bead color coded to each station
8 large pieces of paper and markers
8 station signs [see Cave Water Cycle Table below]
8 dice*, one for each station.
Copies of the Water Cycle Table [optional]
*[Boutique tissue or other boxes about 6 inches [15 cm] on a side can be used to make dice or foam dice at least 2.5 inches to a side can be made or purchased. The text labels for the sides of each die, which represent options for the paths water can follow through the landscape, are in the Cave Water Cycle Table below. Explanations for the labels are provided. Another option: make a spinner for each station. To increase the pace of the game, use more boxes/spinners at each station, especially the Clouds, Ocean & River stations.]

Making Connections

When students learn about the water cycle, it is often presented as a circle of water, flowing from a river to an ocean, evaporating to the clouds, raining down on the mountains, and flowing back into the river. Role-playing a water drop helps students consider the water cycle as more than a predictable two-dimensional path.

Background

While water does circulate from one point or physical state to another in the water cycle, the paths it takes vary.

Heat energy influences the state water is in & as it moves through the cycle it can change from solid to liquid to gas. With each change in state, physical movement from one location to another usually occurs. Snow melts into pools which overflow to streams & rivers, where liquid water may evaporate into the clouds.

Water's most dramatic movements happen during its gaseous phase. Water is constantly evaporating. As a vapor, it can travel through the atmosphere over Earth's surface & it surrounds us all the time. Where it condenses and returns to Earth will depend upon the loss of heat energy, gravity, and the structure of Earth's surface.

Gravity will influence the ability of water to travel over, under & above Earth's surface. Most water travels slowly underground, seeping & filtering through particles of soil and pores within rocks. But in certain kinds of rocks that are easy to dissolve, like limestone and dolomite, water will chemically weather the rocks to create larger cracks, passages and cavities. This chemical weathering takes place over long periods of time and creates solution cavities we call caves. Enlarged cracks, passages & cavities in the earth can allow gravity to pull water quickly through to groundwater, springs and streams.

Some water can remain in a cave for long periods of time while most of the water entering a cave flows on to streams and groundwater in a matter of hours or days. Cave water drops may drip onto cave floors or into drip pools, seep into the mud and/or join underground streams, rivers or springs. In some large passages, water can enter, evaporate and very slowly deposit calcite & other minerals on the cave's walls, floors and ceilings. These deposits are called cave formations [e.g. soda straws, stalactites, stalagmites] and can take thousands of years to form. For more information on how water creates passages and moves through caves, please refer to Project Underground curriculum materials or links at www.vacaveweek.org

Water condensation can be seen as dew on plants, drops on cave walls and ceilings or drops on the outside of a cold glass of ice tea. In clouds, water molecules collect on tiny dust particles. Eventually, cloud water droplets become too heavy and gravity pulls the water to Earth as rain or other precipitation from clouds.

Living organisms also help move water, carrying water within their bodies, transporting it from one place to another. Water is either directly consumed by animals or digestion removes it from food. Water exits the body through urine, as a gas through respiration, or through perspiration. People transport and use water for many manufacturing processes, agriculture, indoor and outdoor gardening, everyday health and hygiene, cooking, and the upkeep and maintenance of vehicles, pets and homes.

Plants are the greatest living movers of water. Water moves from the roots through the body and into the leaves. The leaves use up some of the water during photosynthesis & allows the evaporation of the rest, which is transpiration.

All these process work together to move water around, through, and over Earth.

PROCEDURE

Warm up

Solicit from students the different places water can go as it moves through and around Earth. Write responses on the board.

Discuss with students the amount of time it might take for water to move from place to place. For older students, discuss what conditions are necessary to move water from place to place & what form it takes when it moves.

Activity

1. Tell students they are going to become water drops moving through the water cycle.
2. Establish the following places water can move through into eight stations: Clouds, Plant, Animal, River, Ocean, Ground Water, Soil, and Cave. Place station signs & closed bead containers around the room or yard.
3. Assign an approximately equal number of students to each station. Have students identify the different places water can go from their station in the water cycle & list on a large paper with markers. [Older grades: Discuss the conditions that cause the water to move.]

Explain that water movement depends on energy from the sun, electromagnetic energy & gravity. Sometimes, water will not go anywhere & stay in place for a long time. After students come up with lists, have each group share their work. The die for each station can be handed to that group & they can check to see if they covered all the places water can go. The Cave Water Cycle Table provides an explanation of water movements from each station.

4. Tell students they will be demonstrating water's movement from one location to another. To keep track of their journey, they will each get a chenille stem. They must hold the stem so that the folded end points downward. Each location has a container of pony beads they will be threading onto the stem to keep track of their journey. Emphasize to students that this is not meant to be a race to visit every station, but a way to record their journey.
5. In this game, a roll of a "die of destiny" at each station determines where water will go. Students line up behind their first assigned station sign, die and bead container. When they arrive at the sign and bead container, they add one bead to their stem to mark that they were there, and then the student rolls the die <u>once</u> and <u>goes to the location indicated by the instructions facing up</u>. If they roll ***stay***, they move to the back of any line at the station before adding another bead & rolling the die again.
6. When students arrive at the next station, they get in line [if there is one]. When they reach the front of the line, they add a bead to their stem, roll the die & follow its instructions.
7. Other ways students can keep track of their movements
   a. by having them keep a journal or notepad to record each move, including stays
   b. by placing a sticker on a sheet next to a listing of the stations and noting the order in which they visited

9. Tell students the game will begin & end with the sound of a bell [or buzzer or whistle].

<u>Option</u>: Tell students the game ends once a certain number of beads [station visits, or stickers] are accumulated.

Begin the game!

Wrap up & action

Students can use their travel records to:

- Write stories about the places water traveled to.
- [Older students] Describe what conditions were necessary for water to move to each location & the state the water was in when it moved [i.e., gas, liquid].
- Discuss any returns to the same location over and over [where does water tend to collect or accumulate in the cycle?]
- Provide students with a location [e.g., parking lot, stream, human nose, bat's breath, etc.] and have them identify ways water can move to and from that site. Older students can identify the states of the water.

Extensions

- To adapt the game for younger students, use pictures on the side of the dice that match station images.
- Students can analyze their journey by creating a bar graph of the number of times they visited each station. Data for this graph can be accumulated over several runs of the game or one long session that allows at least 7-10 beads to be gathered as a minimum number of data points. Discuss with the students the following questions: Which stations did you visit the least? Which the most? Why did water stay longer in some places rather than others?
- Have students compare the movement of water during different seasons or habitats in Virginia. Students can adapt the game by changing the faces of each die, or add

alternative stations [e.g., lake, Chesapeake Bay], etc. to represent those different conditions or locations.

- Have students research cave-adapted animals and change the Animal station die accordingly. If the cave-adapted animal spends much of its time inside a cave, versus spending most of its time OUTSIDE a cave, how will that affect the water movement through the cave and other parts of the water cycle outside of it?
- Use activities in the Project Underground curriculum to explore more about how water moves through limestone to form caves and formations. Salt Block Cave http://www.virginia.edu/blandy/blandy_web/education/Bay/SaltBlockCave.pdf and Sinkholes in a Cup http://www.earthsciweek.org/forteachers/sinkholes.html#Questions are 2 examples.
- Arrange for you and students to visit your community's water treatment facility or invite a speaker to your classroom to explain how water is provided to your community. Have students add a "human water use" die station to the game after this visit. Modify one of the River or Groundwater cube ***stay*** sides to include drops being drawn up a well into a home or into a community water system to connect to the Human Use die. The Human Use die could include irrigation of gardens or fields; washing clothes, livestock, pets or vehicles; taking showers; brushing teeth; drinking; cooking; etc and then lead to other dice in the water cycle.
- Have students investigate how water becomes polluted & is cleaned as it moves through the water cycle. Challenge students to adapt the activity to include this pollution. For example, rolled up pieces of masking tape or neon post-it notes can represent pollutants & be stuck to students as they travel to the Soil station. Some materials will be filtered out as water moves to Rivers, Groundwater or Cave stations [show this by having students rub the pollutants off], others will be passed on [have students keep the tape/notes]. If they roll ***clouds***, or any time they evaporate, they remove all the tape or notes, because when water evaporates it leaves pollutants behind.

Resources: Project Underground http://www.dcr.virginia.gov/underground.shtml
Virginia's Coordinators for Project WET http://projectwet.org/where-we-are/location/virginia/

Cave Water Cycle Table

Station	Die side labels	Label Text
Soil	1 side *plant*	Water is absorbed by plant roots. Go to PLANT
	1 side *river*	Soil is saturated by irrigation, so water runs off. Go to RIVER.
	1 side *ground water*	Water is pulled by gravity down into soil. Go to GROUNDWATER.
	1 side *clouds*	The sun warms the wet ground. Go to CLOUDS.
	1 side *cave*	Water filters into a limestone crack. Go to CAVE
	1 side *stay*	Water puddles on the surface after rain. STAY.
Cave	1 side *ground water*	Water is pulled by gravity down below the cave mud. Go to GROUNDWATER.
	1 side *river*	Water gathers into a passage as a spring & flows out. Go to RIVER.
	1 side *soil*	Water drips out a crack and into the soil. Go to SOIL.
	1 side *stay*	Water flows through a crack, and then condenses on the cave ceiling. STAY.
	1 side *animal*	An animal drinks drip pool water. Go to ANIMAL.
	1 side *stay*	Water flows down a stalactite & drops into a drip pool. STAY.
Plant	4 sides *clouds*	Water leaves the plant through transpiration. Go to CLOUDS
	2 sides *stay*	Water is used by the plant & stays in its cells. STAY.
River	1 side *cave*	Water flows into a sinkhole in limestone. Go to CAVE.
	1 side *ground water*	Water is pulled by gravity down into the river bottom. Go to GROUNDWATER.
	1 side *ocean*	Water flows downstream to the Ocean. Go to OCEAN
	1 side *animal*	An animal drinks river water. Go to ANIMAL
	1 side *clouds*	Warm sun evaporates some river water. Go to CLOUDS.
	1 side *stay*	Water remains in the river. STAY
Animal	2 sides *soil*	Water is excreted through feces & urine. Go to SOIL
	2 sides *clouds*	Water is respired or perspired from the body. Go to CLOUDS.
	2 sides *stay*	Water is used by the body & stays in the cells. STAY.
Ground water	1 side *river*	Water filters into spring & flows to a river. Go to RIVER
	1 side *cave*	Water filters into a limestone crack & enlarges it. Go to CAVE.
	1 side *cave*	Water filters into a large limestone crack & runs down a wall in an underground passage. Go to CAVE
	3 sides *stay*	Water remains underground. STAY.
Ocean	2 sides *clouds*	Sun's heat evaporates some water. Go to CLOUDS.
	4 sides *stay*	Water remains in the Ocean. STAY.
Clouds	2 sides *soil*	Water condenses & falls on soil. Go to SOIL.
	1 side *ocean*	Water condenses & falls into the ocean. Go to OCEAN
	1 side *river*	Water condenses & falls into the River. Go to RIVER.
	2 sides *stay*	Water droplet clings to a tiny dust particle. STAY.