WHAT IS THE WATER CYCLE?

Overview

Students play a game in which they model the cyclical path water takes on Earth.

(This activity works particularly well when used in conjunction with the EXTENSION ACTIVITY: "Model Earth Terrarium." If using the EXTENSION ACTIVITY, please plan for an extra day, plus additional time on a third day to observe changes in the terrarium.)

Objectives

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

- name the three states of matter;
- give examples of where water exists on Earth as a liquid, solid, and gas; and
- describe the water cycle and show that water circulates through the crust, oceans, and atmosphere of Earth.

Alaska Standards
Alaska Science Standards / Grade Level Expectations

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

[3] SA1.2 The student develops an understanding of the processes of science by observing and describing the student's own world to answer simple questions

[3] SA2.1 The student will demonstrate an understanding of the attitudes and approaches to scientific inquiry by answering, "how do you know?" questions with reasonable answers

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

[3] SD1.2 The student demonstrates an understanding of geochemical cycles by describing the water cycle to show that water circulates through the crust, oceans, and atmosphere of Earth.

Alaska Cultural Standards

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B2] make effective use of the knowledge, skills, and ways of knowing from their own cultural traditions to learn about the larger world in which they live

[B3] make appropriate choices regarding the long-term consequences of their actions

[E] Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to:

[E2] understand the ecology and geography of the bioregion they inhabit

[E4] determine how ideas and concepts from one knowledge system relate to those derived from other knowledge systems

Bering Strait School District Scope & Sequence

2nd Grade Sequence #10: Weather
3rd Grade Sequence #7: Water Cycle

Materials

- 9 six-sided dice
- Teacher Overhead "Water Cycle"
- Teacher Information Sheet "Water Cycle Movement"
- Student Worksheet "Water Cycle Game"
- 100 pennies (or other small items: beans, seeds, grains of rice, etc.)

Laminated Student Information Sheets

- "Soil Surface"
- "Plant"
- "River"
- "Ocean"
- "Lake"
- "Animal"
- "Ground Water"
- "Glacier"
- "Clouds"

Additional Resources

HSP II: Ch. 7, Lessons 1–3

HSP III: Ch. 9, Lessons 1–3

Activity Preparation

1. Read through the entire lesson, including the "Whole Picture" section for teacher background information.
2. Arrange student desks or tables as shown in the diagram below, with room to walk between the stations. Tape one laminated Student Information Sheet and place a single die on each desk / table.

Arrangement of student desks

Animal	Plant	Clouds
Lake	Soil Surface	Glaciers
River	Ground Water	Ocean

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 terrestrial 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 phase 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

condense	change from water vapor (gas) into liquid water (water vapor condenses when it is cooled)
condensation	the process by which water vapor changes into liquid water
evaporate	to change from liquid water into a gas (water evaporates when heat is added)
evaporation	the process by which liquid water changes into water vapor precipitation rain, snow, sleet, or hail
precipitation	rain, snow, sleet, or hail
water cycle	the movement of water from Earth's land, through rivers, toward the ocean, to the air, and back to the land

Activity Procedure

1. Remind students that matter on Earth is found in solid, liquid, and gas forms. Ask students to describe solids (things that keeps their shape), liquids (things that take the shape of the container they occupy), and gasses (things that change shape easily).
2. Ask students the following questions about water:
   a. What is solid water called? (ice)
   b. What is liquid water called? (water)
   c. What is water as a gas called? (vapor)
3. Brainstorm with students where water on Earth is found (lakes, rivers, streams, glaciers, oceans, etc.)
   a. Ask students if any of that water cannot be used for drinking water (ocean water, because it contains salt)
   b. Explain that only 1% of Earth's water can be used for drinking water.
      i. To demonstrate, show students 100 pennies (beans, grains of rice, or seeds). Remove 1 penny and explain that 1% is 1 item out of 100. If the 100 pennies were all the water on Earth, the drinkable amount would be just one penny.

Water Cycle Game

1. Ask students to brainstorm where various forms of water (liquid, solid, gas) can be found on Earth. List student ideas on the board.
   a. Where can liquid water be found on Earth? (lakes, rivers, oceans, etc.)
   b. Where can solid water be found on Earth? (glaciers, sea ice, etc.)

   c. Where can water vapor be found on Earth? (clouds)
   d. Explain that water can be found in all living things. It is also in the air and soil.
      i. If necessary, explain that water is not in things like rocks, metal, and man-made items like plastic.
2. Explain that students will play the Water Cycle Game — they will role play water as it moves through Earth.
3. Display the Teacher Overhead "Water Cycle" and ask students to explain where water exists on Earth and how it gets there.
4. Distribute the Student Worksheet "Water Cycle Game" and divide students evenly among the desk stations.
5. Explain that when the signal is given, students will roll the die at their station (note: if more than one student is at a station, students will take turns rolling the die).
   a. Students match the number on the die with the chart on the desk.
   b. The chart indicates where the student will go next

Example

If a student rolls a 3 at the Soil Surface Station, he or she will move to the Ground Water Station next.

6. As students move from station to station, they should chart their paths on their Student Worksheets.
7. At the next station, the student should roll the die and move according to the chart at the new station.

Teacher's Note

Sometimes the chart will indicate that a student should stay at the station. In this case, the student should mark an 'X' on his / her chart, and roll again. By the end of the game, a student may have several 'X's next to a particular station.

8. Play a mock round to ensure that students understand the rules. Then indicate that students should begin, and allow play for 15–20 minutes. Assist as necessary.
9. At the end of the game, instruct students to share the path they ended up taking. Lead the discussion so that all students understand how the water cycle works. You may choose to diagram each student's path on the board for clarity.
   a. If needed, introduce the term "water cycle." Explain that a cycle is something that repeats over and over. For example, a year is a cycle. Twelve months of the year repeat over and over every year. Water moves on Earth in a cycle, as well. Even though water moves in a variety of ways, it always returns to its original position.

b. Critical Thinking: Ask students the following questions, based on the paths they took during the game. List student ideas on the board and discuss.

   i. Where can water from a plant go?

   ii. How does water get to a river?

   iii. Where can water go from a glacier?

   iv. How does water get to a cloud?

Alternative Think-Pair-Share Method for Critical Thinking

1. Divide students into small groups at each station.
2. Ask groups to list ways that water is carried or moves from that station to other stations. (For example, water moves from a river to an animal when the animal drinks the water.)
3. Remind students that water does not go to every station, just the ones on the chart.
4. Students then share their ideas with the class.

Answers

Answers will vary. However, students should only illustrate paths that are allowed within the rules of the game.

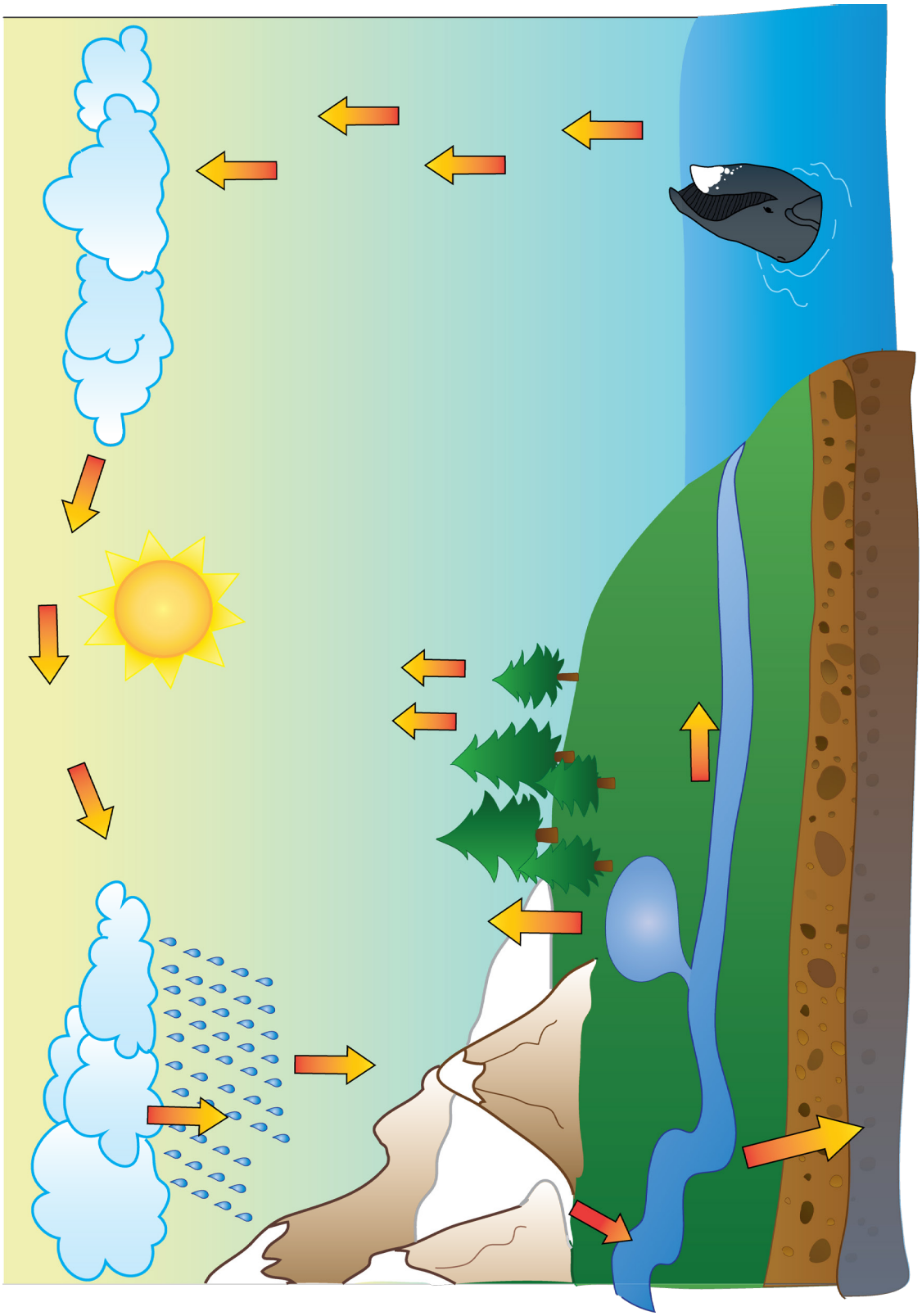
References

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

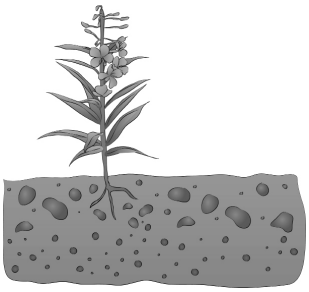
Teacher Information Sheet: "Water Cycle Movement"

Location	Moves To	Process of Movement
Soil Surface	Plant	The roots of plants absorb water.
	River	Water runs off the soil into a river.
	Groundwater	Water is filtered through the soil to the ground.
	Clouds	Water is heated until it evaporates and forms clouds.
	Soil Surface	Water stays on the surface of the soil.
Plant	Clouds	Water leaves the plant in the form of water vapor through transpiration and forms clouds.
	Plant	The plant uses water.
River	Lake	Water flows from a river to a lake.
	Groundwater	Water is filtered through the soil to the ground water.
	Ocean	Water flows from a river to the ocean.
	Animal	An animal drinks the water.
	Clouds	Water is heated until it evaporates and forms clouds.
	River	Water remains in the current of the river.
Clouds	Soil Surface	Water condenses, precipitates, and falls onto the soil.
	Glacier	Water falls as snow onto a glacier and becomes part of the glacier.
	Lake	Water condenses, precipitates, and falls into a lake.
	Ocean	Water condeneses, precipitates, and falls into the ocean.
	Clouds	Water remains as a water droplet within a cloud.
	River	Water condenses, precipitates, and falls into a river.
Ocean	Clouds	Water is heated until it evaporates and forms clouds.
	Ocean	Water remains in the ocean.
Lake	Groundwater	Water is filtered through the soil to the groundwater
	Animal	An animal drinks the water.
	River	Water flows into a river from the lake.
	Clouds	Water is heated until it evaporates and forms clouds.
	Lake	Water remains in the lake.
Animal	Soil Surface	Animals excrete water through urine and feces onto the soil.
	Clouds	Water vapor is emitted by animals through respiration and rises to form clouds.
	Animal	The animal uses the water.
Ground Water	River	Water filters through the soil to a river
	Lake	Water filters through the soil to a lake.
	Groundwater	Water stays underground.
Glacier	Groundwater	Ice melts and the water filters underground.
	Clouds	Ice evaporates through the process of sublimation. The water vapor forms clouds.
	River	Ice melts and flows into a river.
	Glacier	Ice remains in the glacier.

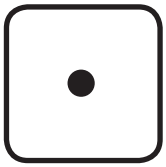
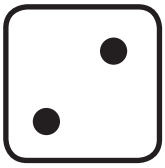
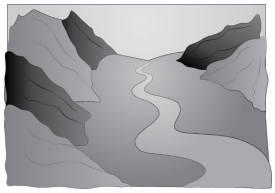
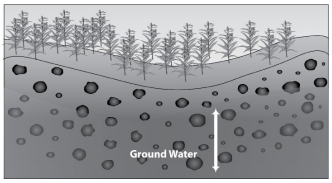
Teacher Overhead "Water Cycle"



Student Information Sheet "Soil Surface"



SOIL SURFACE

1 	Plant 
2 	River 
3 	Groundwater 
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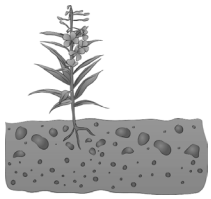
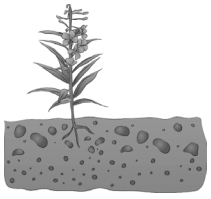
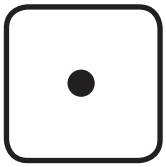
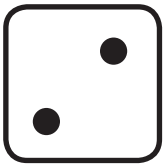
5 	Soil Surface 
6 	Soil Surface 

Student Information Sheet "Plant"

PLANT

1 	**Clouds** 
2 	**Clouds** 
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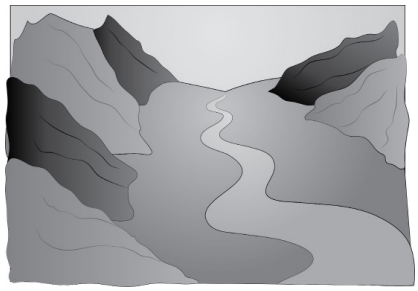
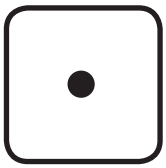
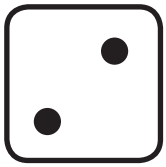
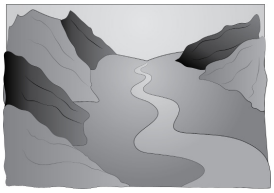
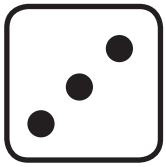
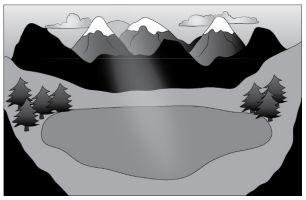
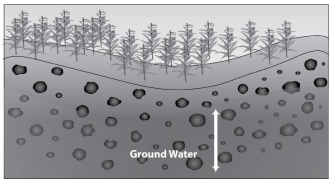
Student Information Sheet "River"



RIVER

1 	Clouds 
2 	River 
3 	Lake 
4 	Groundwater 
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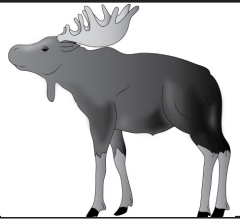
6 	Animal 

Student Information Sheet "Clouds"

CLOUDS

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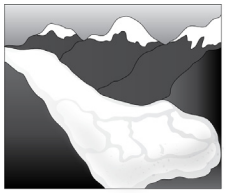
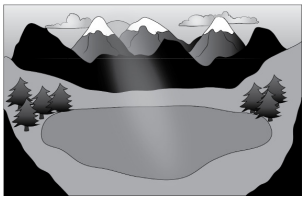
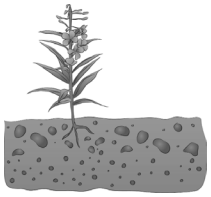
2	**Glacier** 
3	**Lake** 
4	**Soil Surface** 
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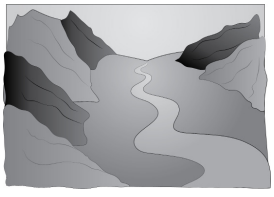
6	**River** 

Student Information Sheet "Ocean"

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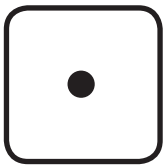
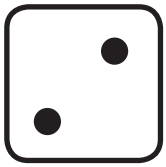
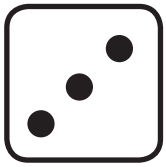
1 	Clouds 
2 	Clouds 
3 	Ocean 
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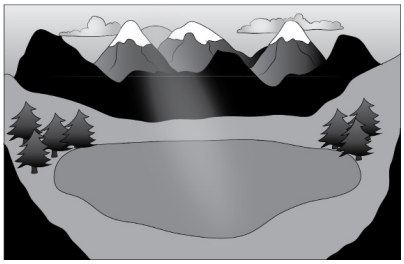
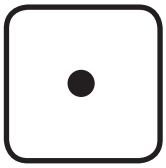
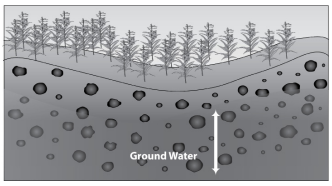
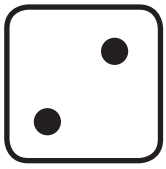
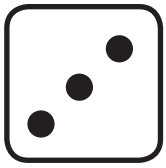
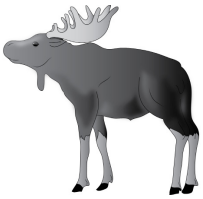
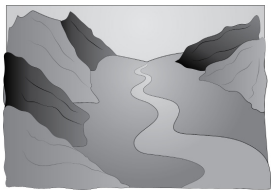
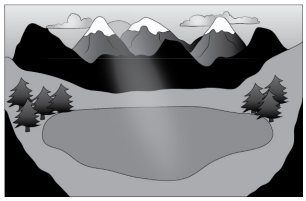
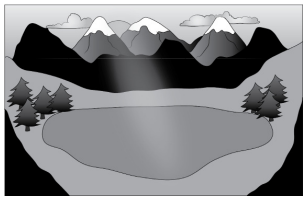
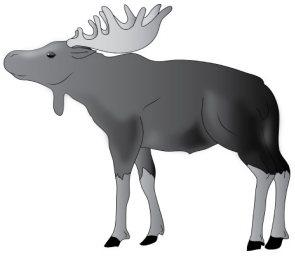
Student Information Sheet "Lake"



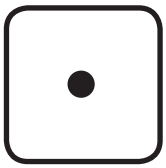
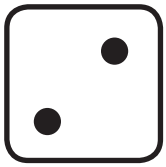
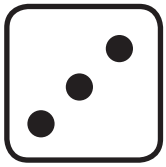
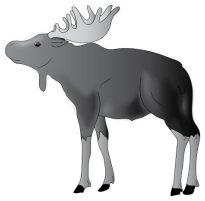
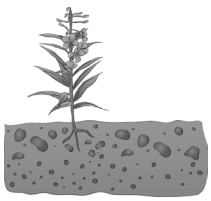
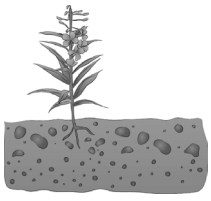
LAKE

1 	**Groundwater** 
2 	**Clouds** 
3 	**Animal** 
4 	**River** 
5 	**Lake** 
6 	**Lake** 

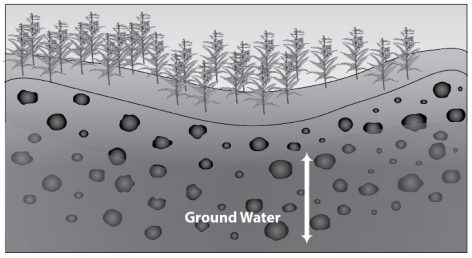
Student Information Sheet "Animal"



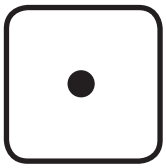
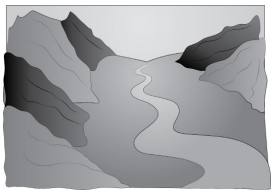
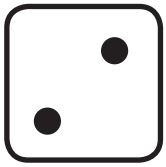
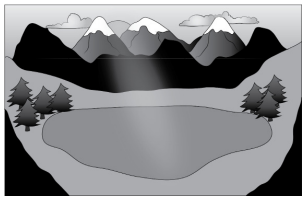
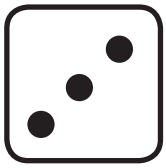
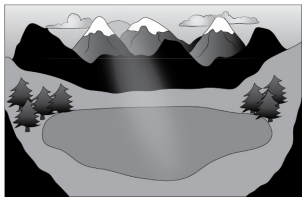
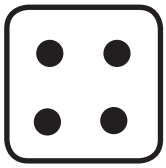
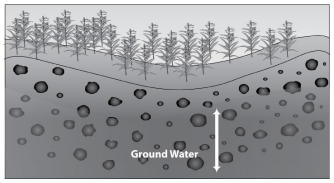
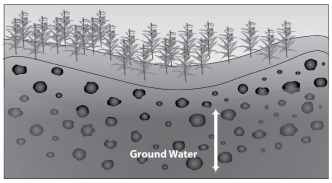
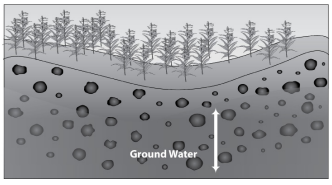
ANIMAL

1 	**Clouds** 
2 	**Clouds** 
3 	**Clouds** 
4 	**Animal** 
5 	**Soil Surface** 
6 	**Soil Surface** 

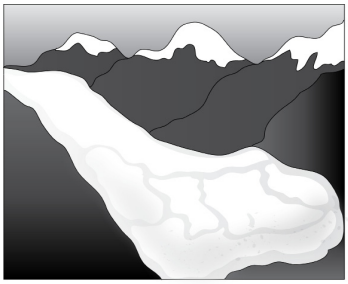
Student Information Sheet "Groundwater"



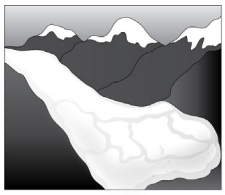
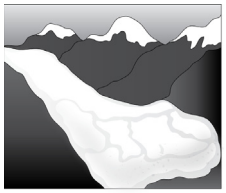
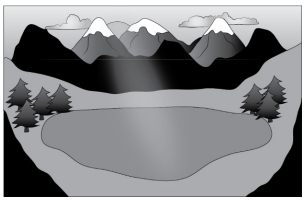
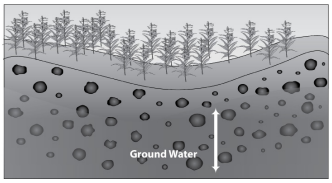
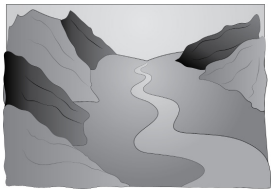
GROUNDWATER

1 	River	
2 	Lake	
3 	Lake	
4 	Groundwater	
5 	Groundwater	
6 	Groundwater	

Student Information Sheet "Ground Water"



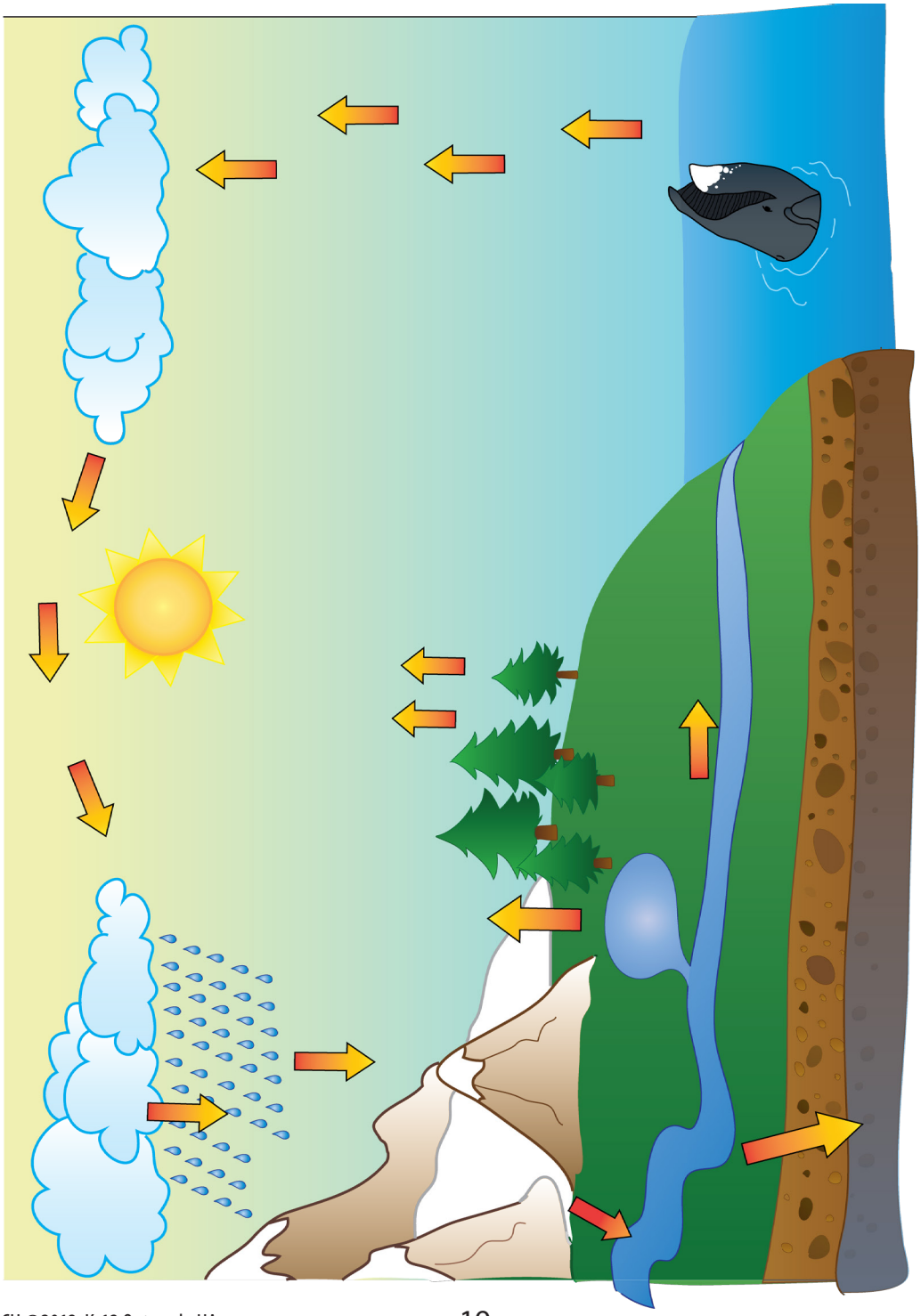
GLACIER

1	Glacier	
2	Glacier	
3	Glacier	
4	Groundwater	
5	Clouds	
6	River	

Student Worksheet: "Water Cycle Game"

Name _____

On the picture below, chart the path you take during the game. Draw a star where you begin. Draw a water droplet where you end. Use arrows to show your path. Mark an 'X' each time you do not move.



Extension Activity "Model Earth Terrarium"

This extension activity can be used in addition to the Water Cycle Game, or as an activity on its own. In this activity, students review the water cycle process by building a terrarium and witnessing the cycle firsthand. If used in conjunction with the Water Cycle Game, build the terrarium before playing the game, then revisit the terrarium on day two, asking students to recall their own movements in during the game. Depending on class size and time, you may wish to have individual students, or pairs, build their own terrarium. Alternatively, the class may build one terrarium.

Extension Activity Materials

- Wide-mouth glass jar
- Small rocks
- Sand
- Soil
- Small plant
- Plastic wrap
- Rubber band
- Water
- Small, spouted container (to use for watering the terrarium)
- Teacher Information Sheet "Model Earth"
- Student Worksheet "Model Earth"

Extension Activity Preparation

1. Determine the number of terrariums to build (individual students, pairs, or whole class)
2. If individual students or pairs of students will be building their own terrarium, build a model terrarium as a demonstration prior to teaching the lesson.

Extension Activity Procedure

Day 1 — Building the Model Earth Terrarium

1. Using the attached TEACHER INFORMATION SHEET: "Model Earth" instruct students to help you build a terrarium. Alternatively, assist students in building their own.
   a. Once built, ask the students the following questions:
      i. Is there water in the terrarium? How do you know? (Yes. We wet the soil and watered the plant)
      ii. Can you see the water? (No.)

2. Pass out the STUDENT WORKSHEET: "Model Earth"
   a. Instruct students to observe the terrarium and to draw and label its components.
   b. When students have completed their drawings, collect their papers and save them for tomorrow.
3. Set the terrarium in a sunny location, and explain that students will observe changes tomorrow.

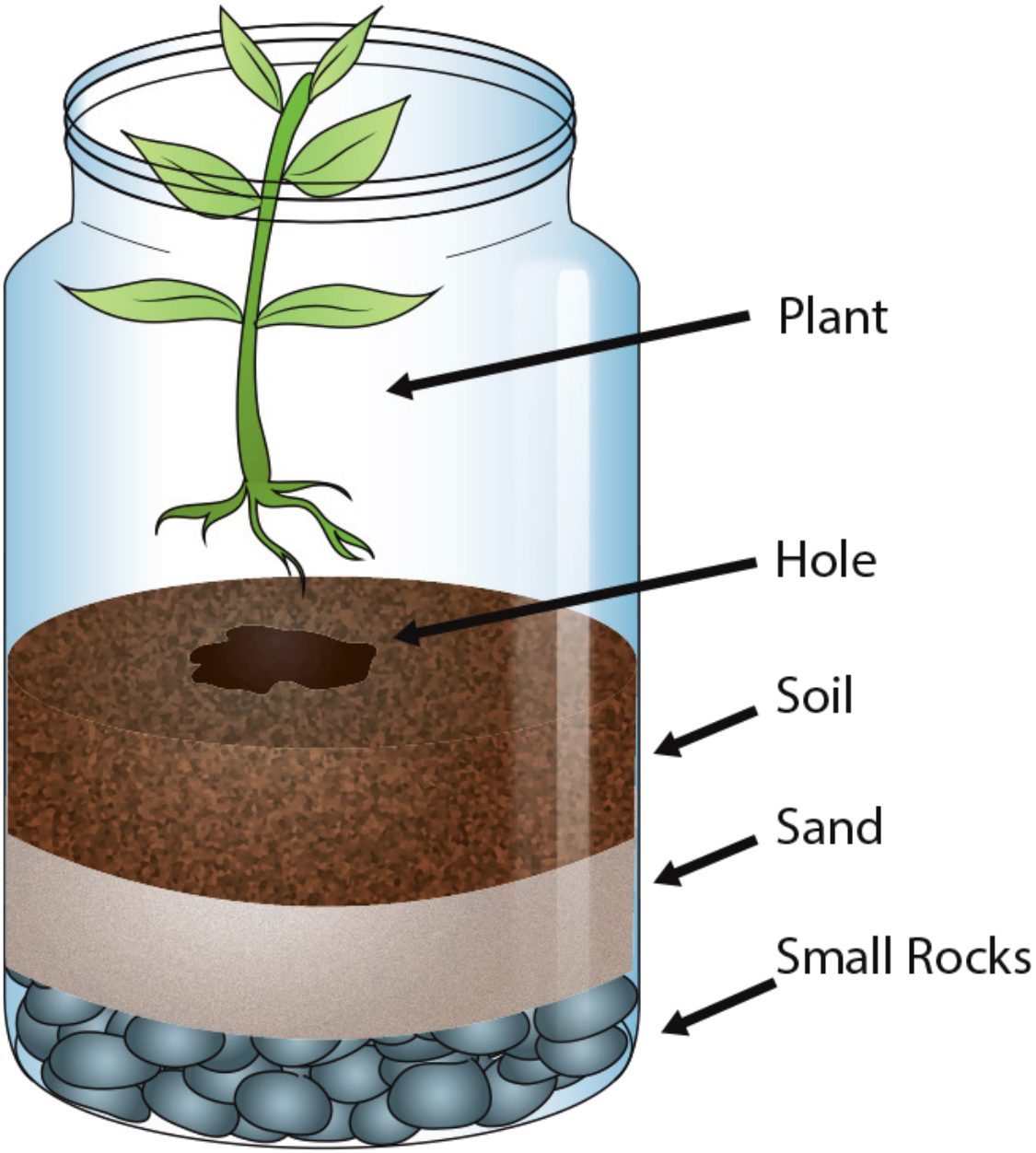
Day 2 — Model Earth Revisited

1. Instruct students to observe the terrarium you built as a class yesterday. Ask the following questions:
   a. Is there water in the terrarium (model Earth)? (yes)
   b. How do you know? (I can see water droplets on the sides of the jar / the plant / the plastic. We added water yesterday when we built the terrarium.)
   c. What is different about the model today from yesterday? (Yesterday, we couldn't see the water, today we can)
   d. Where did the water come from? (It moved through the cycle, from the soil into the air)
2. Re-distribute the STUDENT WORKSHEET: "Model Earth"
3. Instruct students to observe the terrarium, and to make additions to their drawings. (Students should add water droplets.)

Extension Activity Answers

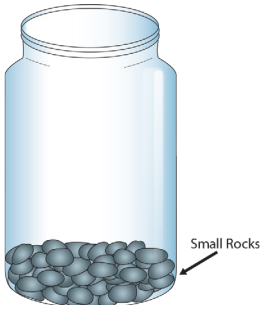
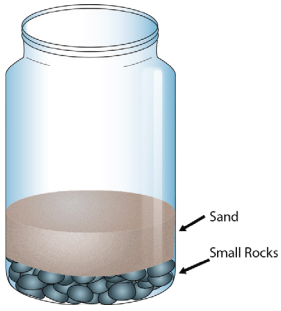
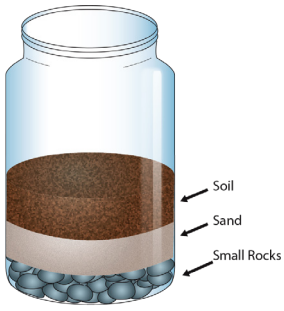
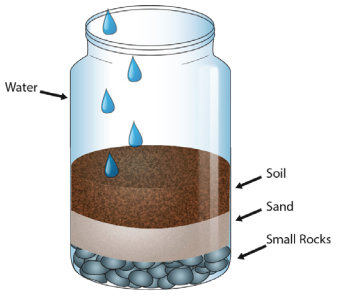
Student diagrams should resemble the model(s) you build in class. All parts should be labeled, as below.

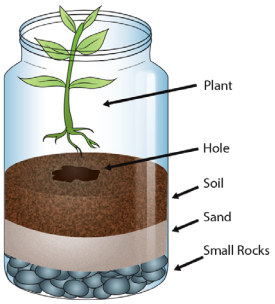
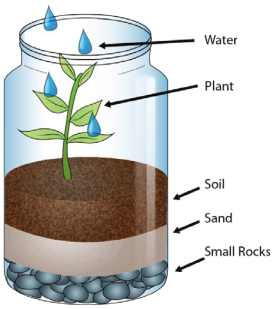
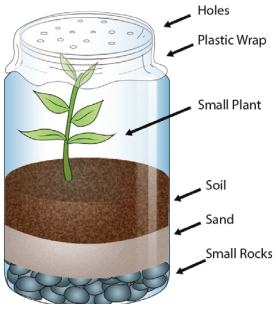
On day two, students should indicate where water droplets formed overnight (on the jar, the plant, and / or the plastic).


Plant
Hole
Soil
Sand
Small Rocks

Extension Activity Teacher Information Sheet: "Model Earth"

After building the terrarium, set it in a sunny location (or under a heat lamp) to watch how water moves from the soil into the air (on the plastic), and back through the plant.

1. Place a layer of small rocks in the bottom of a glass jar.	
2. Place a layer of sand over the layer of rocks in the jar.	
3. Place a layer of soil on top of the layer of sand and rocks in the jar. Add enough soil so that it fills approximately ½ the jar.	
4. Wet the soil so that it is moist to the touch.	

5. Make a small hole in the middle of the soil and place a small plant in the hole.	
6. Water the plant thoroughly.	
7. Cover the jar with plastic wrap, securing the plastic with a rubber band. Poke a few small holes in the plastic wrap.	
8. Set the jar in a sunny location (or under a heat lamp).	
9. Tomorrow, observe where the water is (water will have condensed on the sides of the jar and on the plastic).	

Extension Activity Student Worksheet: "Model Earth"