Chapter 1: Water Cycle and Watersheds

Goals

Students will understand that:

1. All the water on the Earth is part of a cycle and that the amount of water we have never changes, it just changes in state (solid, liquid, gas) and location (atmosphere, land surface, underground, etc.).
2. Within the landscape, water flows from high points to low points until it reaches a water body. The area of land that drains to a particular water body is called a watershed.
3. They live in the Ossipee River Watershed and Saco River Basin.

Background Information

Water is unique in that it is the only substance on Earth that exists naturally as a solid, liquid, and gas. In the solid form, water exists as ice (ice cubes, hailstones, frozen surface water, etc.) or as a crystal (snowflakes). Water as a liquid can be found in rivers, lakes, streams, and underground. Water vapor is an example of water as a gas and consists of molecules suspended in the air. Fog and clouds are actually examples of water in the liquid form, composed of tiny water droplets suspended in the air.

Temperature influences the state in which water exists. Water freezes and becomes a solid when temperatures drop below 32°F (0°C). Temperatures above the freezing point and below the boiling point (212°F or 32°C) allow water to remain as a liquid. Water changes from a liquid to a gas when temperatures rise above the boiling point.

Water Cycle

Although the amount of water that exists on Earth is constant, water is perpetually in motion changing in state (solid, liquid, and gas) and in location (underground, land surface, atmosphere, etc.). All the water in our environment moves continuously above, on, and below the surface of the Earth in a process called the **water (hydrologic) cycle** (Figure 1). Important phases in this process include: evaporation, transpiration, condensation, precipitation, and percolation.

- **Evaporation:** process by which vapor is created when the sun heats water in lakes, streams, rivers, or oceans.
- **Transpiration:** process by which water absorbed by plants is evaporated through plant surfaces.
- **Condensation:** process by which water vapor in the air is changed to liquid water, often as water vapor rises into the atmosphere and cools.
- **Precipitation:** water that falls from clouds to the land surface as rain, freezing rain, sleet, snow, or hail.
- **Percolation:** downward movement of water through openings in rock or soil.

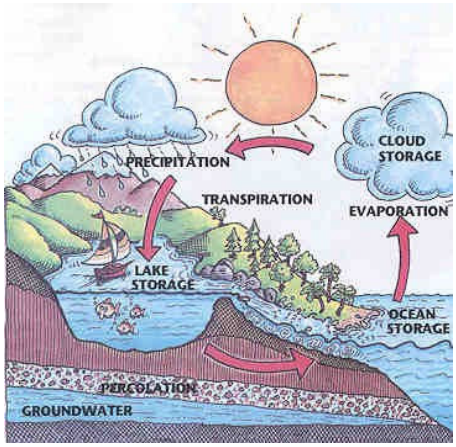


Figure 1. Water cycle diagram. (http://www.commwater.com).

Water on the Earth's surface turns into water vapor through the processes of evaporation and transpiration. This invisible water vapor, most of which comes from the world's oceans, travels up into the atmosphere and

condenses to form clouds. The water molecules in the clouds condense more and more until they become water droplets. Water falls to the earth as precipitation and when the water reaches the Earth's surface, some of it will flow along the land surface as runoff while the rest of it percolates through the soil to recharge groundwater. Runoff flows along the Earth's surface and eventually collects in surface bodies of water (see Chapter 2 for more information about surface water). Groundwater can stay in an aquifer for hundreds of years or slowly travel back up to the land surface to become a spring or part of a stream or lake (see Chapter 3 for a more thorough description of groundwater and aquifers).

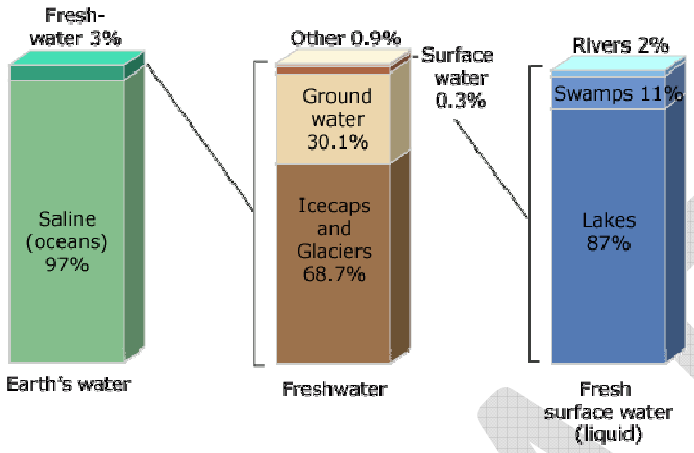


Figure 2. Distribution of Earth's water (http://ga.water.usgs.gov/edu/waterdistribution.html)

The majority of the water on the Earth, about 97.2%, exists in our oceans and is salt water (Figure 2). Only a small percentage, 2.8%, is freshwater. Of the small amount that is freshwater, about 70% is frozen in glaciers and polar icecaps. Another 30% is mostly present as soil moisture or lies in underground aquifers. Ultimately, less than 1% of the world's fresh water (or about 0.029% of all the water on Earth) is easily accessible for human use as drinking water. More than one in six people worldwide (894 million) don't have access to sufficient amounts of safe freshwater. In addition, this limited amount of fresh water is constantly being influenced by land use practices that intentionally or unintentionally pollute drinking water supplies. For example, it is estimated that each day 2 million tons of human waste is disposed of in waterways untreated. Pollution can come from a wide-range of sources across a watershed and it is important to know the best strategies for protecting our limited freshwater resources (see Chapter 7 for more information on water protection).

Watershed

The part of the water cycle that occurs on the land surface is influenced by topography. Precipitation falling to the Earth either becomes surface runoff or percolates through the soil to become groundwater and flows downward until it collects in a water body, such as a stream, river, wetland, lake, or the ocean. The land area that drains into a particular water body is known as a watershed or basin (Figure 3). Watersheds are separated from each other by areas of higher elevation called ridge lines or divides and are nested within each other; smaller watersheds (subwatersheds) make up larger watersheds. Watersheds exist throughout the landscape so that every point on the Earth is part of at least one watershed.

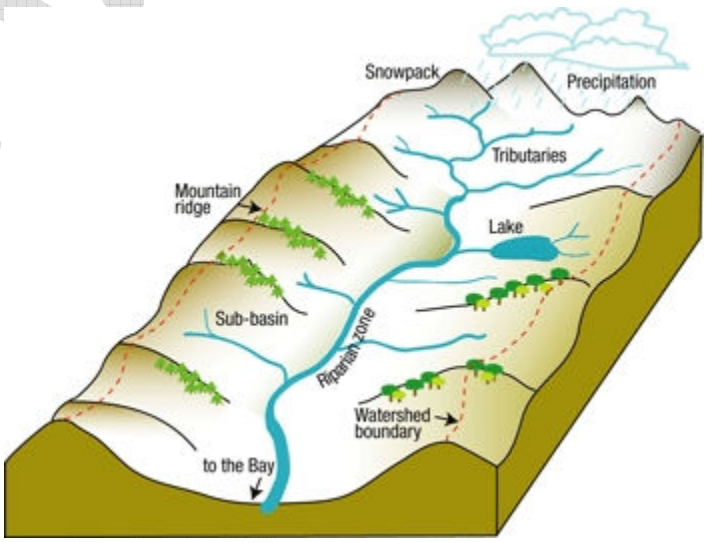


Figure 3. Diagram of a watershed (http://www.thewatershedproject.org/)

Ossipee Watershed

The Ossipee Watershed is a 379 square mile area in east-central New Hampshire defined by Ossipee Lake, located in the center of the watershed, and the Ossipee River, which flows east from the lake to connect with the Saco River in Maine (Figure 4). Including portions of 14 towns in New Hampshire and 1 town in Maine, the majority of the watershed is made up of the six towns of Effingham, Freedom, Madison, Ossipee, Sandwich, and Tamworth. The Ossipee Watershed consists of 13 distinct subwatersheds.

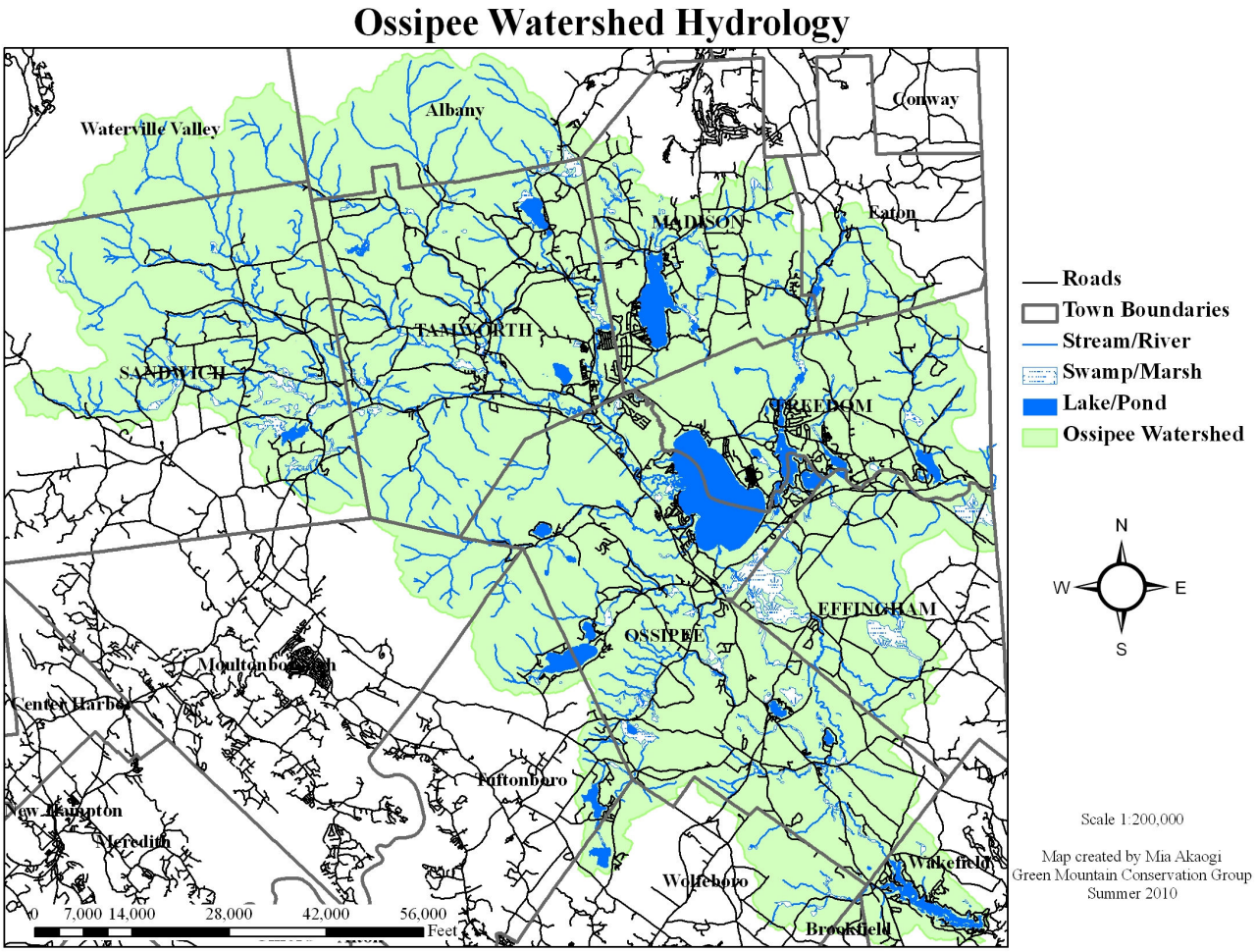


Figure 4. Map of the Ossipee Watershed. (http://www.gmcg.org/)

Because the Ossipee River flows into the Saco River, the Ossipee Watershed is also part of the Saco River Basin (Figure 5). The Saco River Basin covers a 1,700 square mile area that includes 63 municipalities in New Hampshire and Maine. The Saco River starts in the White Mountains of New Hampshire, is joined in Cornish, Maine by the Ossipee River, and ends at Saco Bay on the Maine coast.

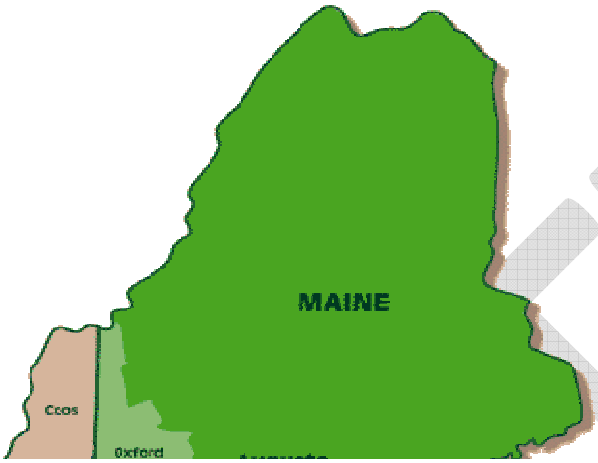


Figure 5. Map of the Saco River Watershed.
(http://www.gmcg.org/)

Indoor Activities

Activity 1: The Incredible Journey

Thank you Project WET (Water Education for Teachers) Foundation for permission to use the activity: "The Incredible Journey" as published in the *Ossipee Watershed Workbook: A Student & Teacher Workbook for Watershed Education*, pp. 6-10. Copyright 2006 by the Project WET Foundation. Used with permission.

Additional Information

- Clip art for the dice, developed by NH Project WET, can be found on the Workbook CD. These templates are designed to be printed on 8.5x11 size paper, cut out, pasted on mug boxes, and covered with contact paper. Mug boxes (4inch cubes) can be purchased online from various sources.
- A variation of this activity with materials, dice and station labels related to this activity, can be found at the NOAA Water Cycle Game website: http://www.education.noaa.gov/Freshwater/Water_Cycle.html. These materials are also available on the CD included with this Workbook.
- There is also another variation of this activity that can be found on the Arctic Climate Modeling Program website (http://www.arcticclimatemodeling.org/subject_water_cycle.html) under "The Water Cycle Game" which uses a normal 6-sided die instead of creating dice specifically for the activity.

New Hampshire State Science Standards

ESS1 – The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.

7 – Water

PS1 – All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).

2 – Properties

PS2 – Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.

3 – Energy

SPS1 – Scientific Inquiry and Critical Thinking Skills

4 – Representing and Understanding Results of Investigations

Associated Student Workbook Activities

- Solid, Liquid, or Gas? Activity (Chapter 1, page 2)
- Once Upon a Raindrop Story (Chapter 1, page 3)
- Water Cycle Diagram (Chapter 1, page 4)
- Water Distribution on Earth (Chapter 1, page 6)

The Incredible Journey

Grade Level:
Upper Elementary, Middle School

Subject Areas:
Earth Science

Duration:
Preparation time:
50 minutes

Activity time: two 50-minute periods

Setting:
A large room or playing field

Skills:
Organizing (mapping); Analyzing (identifying components and relationships); Interpreting (describing)

Charting the Course
Other water cycle activities include "Water Models" and "Imagine!" In-depth investigations of how water moves can supplement this activity: condensing and evaporating ("Water Models"), filtering through soil ("Get the Ground Water Picture"), traveling over Earth's surface ("Branching Out!"), and moving through the atmosphere ("Piece It Together").

Vocabulary
condensation, evaporation, electromagnetic forces

Where will the water you drink this morning be tomorrow?

Summary

With a roll of the die, students simulate the movement of water within the water cycle.

Objectives

Students will:

- describe the movement of water within the water cycle.
- identify the states of water as it moves through the water cycle.

Materials

- *9 large pieces of paper*
- *Copies of* ***Water Cycle Table*** (optional)
- *Marking pens*
- *9 boxes, about 6 inches (15 cm) on a side*
  Boxes are used to make dice for the game. Gift boxes used for coffee mugs are a good size or inquire at your local mailing outlet. There will be one die [or box] per station of the water cycle. [To increase the pace of the game, use more boxes at each station, especially at the clouds and ocean stations.] The labels for the sides of the die are located in the *Water Cycle Table*. These labels represent the options for pathways that water can follow. Explanations for the labels are provided. For younger students, use pictures. Another option is to use a spinner—see the activity "A Drop in the Bucket" for spinner design. It is necessary to design a spinner for each station.
- *A bell, whistle, buzzer, or some sound maker*

Making Connections

When children think of the water cycle, they often imagine a circle of water, flowing from a stream to an ocean, evaporating to the clouds, raining down on a mountaintop, and flowing back into a stream. Role-playing a water molecule helps students to conceptualize the water cycle as more than a predictable two-dimensional path.

Background

While water does circulate from one point or state to another in the water cycle, the paths it can take are variable.

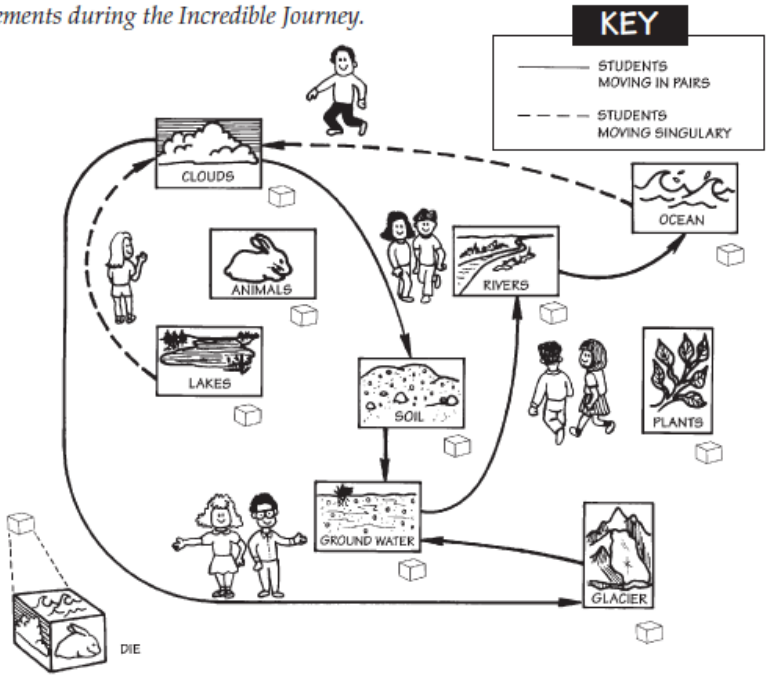
Heat energy directly influences the rate of motion of water molecules (refer to the activity "Molecules in Motion"). When the motion of the molecule increases because of an increase in heat energy, water will change from solid to liquid to gas. With each change in state, physical movement from one location to another usually follows. Glaciers melt to pools which overflow to streams, where water may evaporate into the atmosphere.

Gravity further influences the ability of water to travel over, under, and above Earth's surface. Water as a solid, liquid, or gas has mass and is subject to gravitational force. Snow on mountaintops melts and descends through watersheds to the oceans of the world.

One of the most visible states in which water moves is the liquid form. Water is seen flowing in streams and rivers and tumbling in ocean waves. Water travels slowly underground, seeping and filtering through particles of soil and pores within rocks.

Although unseen, water's most dramatic movements take place during its gaseous phase. Water is constantly evaporating, changing from a liquid to a gas. As a vapor, it can travel through the atmosphere over Earth's surface. In fact, water vapor surrounds us all the time. Where it condenses and returns to Earth depends upon loss of heat energy, gravity, and the structure of Earth's surface.

Using station illustrations, create a one page graphic on which students record their movements during the Incredible Journey.



Water condensation can be seen as dew on plants or water droplets on the outside of a glass of cold water. In clouds, water molecules collect on tiny dust particles. Eventually, the water droplets become too heavy and gravity pulls the water to Earth.

Living organisms also help move water. Humans and other animals carry water within their bodies, transporting it from one location to another. Water is either directly consumed by animals or is removed from foods during digestion. Water is excreted as a liquid or leaves as a gas, usually through respiration. When water is present on the skin of an animal (for example, as perspiration), evaporation may occur.

The greatest movers of water among living organisms are plants. The roots of plants absorb water. Some of this water is used within the body of the plant, but most of it travels up through the plant to the leaf surface. When water reaches the leaves, it is exposed to the air and the sun's energy and is easily evaporated. This process is called transpiration.

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

Procedure

▼ *Warm Up*

Ask students to identify the different places water can go as it moves through and around Earth. Write their responses on the board.

▼ *The Activity*

1. **Tell students that they are going to become water molecules moving through the water cycle.**

2. **Categorize the places water can move through into nine stations: Clouds, Plants, Animals, Rivers, Oceans, Lakes, Ground Water, Soil, and Glaciers. Write these names on large pieces of paper and put them in locations around the room or yard. (Students may illustrate station labels.)**

3. **Assign an even number of students to each station. (The cloud station can have an uneven number.) Have students identify the different places water can go from their station in the water cycle. Discuss the conditions that cause the water to move.** Explain that water movement depends on energy from the sun, electromagnetic energy, and gravity. Sometimes water will not go anywhere. After students have come up with lists, have each group share their work. The die for each station can be handed to that group and they can check to see if they covered all the places water can go. The *Water Cycle Table* provides an explanation of water movements from each station.

4. **Students should discuss the form in which water moves from one location to another.** Most of the movement from one station to another will take place when water is in its liquid form. However, any time water moves to the clouds, it is in the form of water vapor, with molecules moving rapidly and apart from each other.

5. **Tell students they will be demonstrating water's movement from one location to another.** When they move as liquid water, they will move in pairs, representing many water molecules together in a water drop. When they move to the clouds (evaporate), they will separate from their partners and move alone as individual water molecules. When water rains from the clouds (condenses), the students will grab a partner and move to the next location.

6. **In this game, a roll of the die determines where water will go.** Students line up behind the die at their station. (At the cloud station

they will line up in single file; at the rest of the stations they should line up in pairs.) Students roll the die and go to the location indicated by the label facing up. If they roll **stay**, they move to the back of the line.

When students arrive at the next station, they get in line. When they reach the front of the line, they roll the die and move to the next station (or proceed to the back of the line if they roll *stay*).

In the clouds, students roll the die individually, but if they leave the clouds they grab a partner (the person immediately behind them) and move to the next station; the partner does not roll the die.

7. **Students should keep track of their movements.** This can be done by having them keep a journal or notepad to record each move they make, including stays. Students may record their journeys by leaving behind personalized stickers at each station. Another approach has half the class play the game while the other half watches. Onlookers can be assigned to track the movements of their classmates. In the next round the onlookers will play the game, and the other half of the class can record their movements.

8. **Tell students the game will begin and end with the sound of a bell (or buzzer or whistle). Begin the game!**

▼ *Wrap Up and Action*

Have students use their travel records to write stories about the places water has been. They should include a description of what conditions were necessary for water to move to each location and the state water was in as it moved. Discuss any *cycling* that took place (that is, if any students returned to the same station).

Provide students with a location (e.g., parking lot, stream, glacier, or one from the human body—bladder) and have them identify ways water can move to and from that site. Have them identify the states of the water.

Have older students teach "The Incredible Journey" to younger students.

Assessment

Have students:

- role-play water as it moves through the water cycle (step 8).
- identify the states water is in while moving through the water cycle (step 4 and ***Wrap Up***).
- write a story describing the movement of water (***Wrap Up***).

Extensions

Have students compare the movement of water during different seasons and at different locations around the globe. They can adapt the game (change the faces of the die, add alternative stations, etc.) to represent these different conditions or locations.

Have students investigate how water becomes polluted and is cleaned as it moves through the water cycle. For instance, it might pick up contaminants as it travels through the soil, which are then left behind as water evaporates at the surface. Challenge students to adapt "The Incredible Journey" to include these processes. For example, rolled-up pieces of masking tape can represent pollutants and be stuck to students as they travel to the soil station. Some materials will be filtered out as the water moves to the lake. Show this by having students rub their arms to slough off some tape. If they roll *clouds*, they remove all the tape; when water evaporates it leaves pollutants behind.

Resources

Alexander, Gretchen. 1989. *Water Cycle Teacher's Guide*. Hudson, N.H.: Delta Education, Inc.

Mayes, Susan. 1989. *What Makes It Rain?* London, England: Usborne Publications.

Schmid, Eleonore. 1990. *The Water's Journey*. New York, N.Y.: North-South Books.

Where will this student go next on her incredible journey?

Water Cycle Table

STATION	DIE SIDE LABELS	EXPLANATION
Soil	one side *plant*	Water is absorbed by plant roots.
	one side *river*	The soil is saturated, so water runs off into a river.
	one side *ground water*	Water is pulled by gravity; it filters into the soil.
	two sides *clouds*	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	one side *stay*	Water remains on the surface (perhaps in a puddle, or adhering to a soil particle).
Plant	four sides *clouds*	Water leaves the plant through the process of transpiration.
	two sides *stay*	Water is used by the plant and stays in the cells.
River	one side *lake*	Water flows into a lake.
	one side *ground water*	Water is pulled by gravity; it filters into the soil.
	one side *ocean*	Water flows into the ocean.
	one side *animal*	An animal drinks water.
	one side *clouds*	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	one side *stay*	Water remains in the current of the river.
Clouds	one side *soil*	Water condenses and falls on soil.
	one side *glacier*	Water condenses and falls as snow onto a glacier.
	one side *lake*	Water condenses and falls into a lake.
	two sides *ocean*	Water condenses and falls into the ocean.
	one side *stay*	Water remains as a water droplet clinging to a dust particle.

Water Cycle Table, continued

STATION	DIE SIDE LABELS	EXPLANATION
Ocean	two sides *clouds*	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	four sides *stay*	Water remains in the ocean.
Lake	one side *ground water*	Water is pulled by gravity; it filters into the soil.
	one side *animal*	An animal drinks water.
	one side *river*	Water flows into a river.
	one side *clouds*	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	two sides *stay*	Water remains within the lake or estuary.
Animal	two sides *soil*	Water is excreted through feces and urine.
	three sides *clouds*	Water is respired or evaporated from the body.
	one side *stay*	Water is incorporated into the body.
Ground Water	one side *river*	Water filters into a river.
	two sides *lake*	Water filters into a lake.
	three sides *stay*	Water stays underground.
Glacier	one side *ground water*	Ice melts and water filters into the ground.
	one side *clouds*	Ice evaporates and water goes to the clouds (sublimation).
	one side *river*	Ice melts and water flows into a river.
	three sides *stay*	Ice stays frozen in the glacier.

Activity 2: Water Cycle Mural

New Hampshire State Science Standards

ESS1 – The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.

7 – Water

PS2 – Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.

1 – Composition

SPS3 – Personal, Social, and Technological Perspectives

SPS4 – Science Skills for Information, Communication and Media Literacy

Source: Adapted from Elementary GLOBE Cloudscape activity by Carolyn Hemingway (Ossipee Central School 6th grade teacher).

Summary: This activity involves using a variety of art supplies to create a mural of the water cycle.

Objectives: Students will be able to describe the water cycle through a mural of their own creation.

Estimated Time: 1 hour

Materials:

- Large poster paper/board for each group of students
- Various art supplies
  - Construction paper
  - Cotton balls
  - Cellophane
  - Pipe cleaners
  - Fiberfill stuffing
  - Markers
  - Colored pencil
  - Paint
  - Glue
  - Scissors

Directions:

1. Divide students in groups of 2-4.
2. Provide each group with a piece of large poster paper or board.
3. Have them create a diagram of the water cycle using the assortment of art supplies. Cotton balls can be used as clouds, pipe cleaners as arrows showing the direction of the water cycle, etc.

Associated Student Workbook Activities

- Solid, Liquid, or Gas? Activity (Chapter 1, page 2)
- Once Upon a Raindrop Story (Chapter 1, page 3)
- Water Cycle Diagram (Chapter 1, page 4)
- Water Distribution on Earth (Chapter 1, page 6)

Activity 3: Paper Watersheds

New Hampshire State Science Standards

ESS4 – The growth of scientific knowledge in Earth Space Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.

4 – Career and Technical Education

SPS2 – Unifying Concepts of Science (including NECAP Science Assessment Targets by Big Idea)

3 – Models and Scale (MAS)

4 – Systems and Energy (POC)

SPS3 – Personal, Social, and Technological Perspectives

2 – Environment, Natural Resources, and Conservation

SPS4 – Science Skills for Information, Communication and Media Literacy

4 – Problem Identification, Formulation, and Solution

Source: Southwest Florida Water Management District's Watershed Excursion Teacher's Guide
Summary: This is a fun and easy activity that creates a paper landscape model, which can then be used to identify watersheds, demonstrate water flow, and explain pollution runoff.
Objectives: Students will be able to identify a watershed, explain the direction of water flow, and how pollution can get into surface water features.
Estimated Time: 30 minutes
Materials:

- spray bottle of water

A set of the following materials for each student or pair of students

- sheet of white paper (one sided scrap paper is sufficient)
- shallow pan (optional)
- permanent green marker
- blue and other water-based colored markers

Directions:

1. Take the sheet of paper and crumple it. Next, partially smooth it out, leaving some ridges.
2. Use the permanent green marker to color along the edge of the creases (the ridges or watershed boundaries)
3. Use the blue water-based marker to color where water might flow (the low points).
4. Use other colored markers to draw roads, houses, businesses, etc. across the landscape.
5. Put the paper on the shallow pan or on a table and use the bottle of water to depict rain and gently spray the landscape. Keep spraying the paper until the colors begin to flow.
6. Describe what happened when it rained. What are some types of pollution that could run off of the roads and buildings that were drawn on the landscape? Point out a watershed and describe how many watersheds you have and what they drain into.

Associated Student Workbook Activities

- What is a Watershed? (Chapter 1, page 5)
- Ossipee Watershed (Chapter 1, page 7)

Outdoor Activity

Activity 1: Raindrop Rollplay Activity

New Hampshire State Science Standards

ESS1 – The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.
4 – Observations of The Earth From Space
PS1 – All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).
2 – Properties
SPS1 – Scientific Inquiry and Critical Thinking Skills
4 – Representing and Understanding results of Investigations
SPS2 – Unifying Concepts of Science (including NECAP Science Assessment Targets by Big Idea)
4 – Systems and Energy (POC)
SPS3 – Personal, Social, and Technological Perspectives
2 – Environment, Natural Resources, and Conservation
SPS4 – Science Skills for Information, Communication and Media Literacy
1 – Information and Media Literacy
4 – Problem Identification, Formulation, and Solution

Source: Bryn Mawr College, Science and a Sense of Place: Watershed Education for K-12 Students
Summary: Drainage basins and watersheds are abstract concepts, and therefore often hard for students to fully understand. One of the biggest problems is scale: typically the examples of watersheds presented to students are huge (e.g., the Mississippi basin, the Chesapeake basin, etc.). This activity is designed to be small in scale so the students can see an entire drainage basin at once. Because it involves the students moving around, it also gets the blood flowing at the beginning of class.
Objectives: Students will learn the definition of a drainage basin, how to recognize a small drainage basin in a landscape, and which processes play a role in the water cycle
Estimated Time: 1 hour
Materials:

- Outdoor space that has interesting topography
- Optional: Sports jerseys (or other designation) to distinguish the students in different drainage basins, cones, clipboards

Directions:
Each student is a raindrop that has just reached the ground. Randomly distribute the "raindrops" across the study area. At "Go," each student will follow the path that they think the raindrop will go. Stop the students when they have converged to one or two points. Discuss the results. Repeat, if needed. Then, have the students map out the extent of one or two drainage basins by standing on the drainage basin divides.
Discussion questions:

1. How do you know which path the raindrops will take?
2. Do all the raindrops reach the lowest part of the drainage basin?
3. What role does evaporation, vegetation, and groundwater play in dictating the flow of water in the drainage basin?
4. What is an appropriate definition of a drainage basin? Of a drainage divide?

Associated Student Workbook Activities

- What is a Watershed? (Chapter 1, page 5)
- Ossipee Watershed (Chapter 1, page 7)

Analysis

Graphing

- Using the values from Figure 2, make a bar or pie graph of how much of each type of water exists on the earth.

Mapping

- Investigate GLOBE Watershed Dynamics Module which displays precipitation, evaporation, and surface runoff levels across the United States (http://wd.fieldscope.us/).
- Use Google Earth to identify the school's location in relationship to streams, lakes, ponds, etc. and investigate nearby land uses using the "Where in the World are We?" activity developed by the Stroud Water Research Center (http://www.stroudcenter.org/education/CurricularResources/index.htm).
- Look at a topographic map of the Ossipee Watershed. Define the watershed boundary based on ridgelines and see how well it correlates with the real watershed boundary.

Extensions

- Create brochure or pamphlet to distribute to the community about the Ossipee Watershed and how to protect the limited amount of freshwater we have on Earth.
- Create handouts that talk about the importance of water and water conservation within the home that can be distributed locally.
- Take a walk from the school to a nearby river, stream, or lake and take photos of where it starts or ends and any interesting observations along the way.
- Create a water cycle wheel using model on Illinois Environmental Protection Agency website (http://www.epa.state.il.us/kids/fun-stuff/water-cycle/wheel-part-1.html).
- Invite a geologist, hydrologist or other water quality professional to school.
- Create a presentation for younger students (3rd grade and below) in the same school or at another school.
- Create a public service announcement about clean water in the Ossipee Watershed.
- Follow Activity 3: Paper Watersheds with creating a paper model or paper mache model of the Ossipee Watershed or local sub-watershed.

Assessment Tools

- Draw a diagram of the water cycle and label the major processes.
- Look at a landscape and know which direction water would flow from a particular point.
- Spelling test of vocabulary.
- Student quiz (Appendix A)

Glossary

Aquifer: Underground sediments, which can be soil or rock, that are saturated and yield significant quantities of water.

Boiling point: The temperature at which a liquid becomes a gas. For water, it is 212 degrees Fahrenheit (100 degrees Celsius) at sea level.

Condensation: The process by which water vapor in the air is changed into liquid water, often as water vapor rises into the atmosphere and cools.

Evaporation: Process by which vapor is created when the sun heats water in surface waters (lakes, streams, rivers, or oceans).

Freezing point: The temperature at which a liquid becomes a solid. For water, it is 32 degrees Fahrenheit (0 degrees Celsius) at sea level.

Gas: The state of water in which individual molecules are highly energized and move about freely. Also known as water vapor.

Groundwater: Water found in spaces between soil particles underground (located in the saturation zone).

Liquid: The state of water in which molecules move freely among themselves but do not separate like those in the gaseous state.

Percolation: Downward movement of water through openings in rock or soil.

Precipitation: Water that falls, in a liquid or solid state, from clouds to the land surface as rain, freezing rain, sleet, snow, or hail.

Recharge: Process where precipitation moves through the soil and reaches groundwater, replenishing aquifers.

Runoff: Downhill movement of precipitation that flows overland to surface streams, rivers, and lakes.

Solid: The state of water in which molecules have limited movement.

Subwatershed: A smaller section of a larger watershed or drainage basin that drains into a specific body of water.

Surface water: Water above the land surface, including lakes, rivers, streams, ponds, floodwater, and runoff.

Transpiration: Process by which water absorbed by plants (usually through the roots) is evaporated and released into the atmosphere through plant surfaces (usually leaf pores).

Water cycle: The paths water takes through its various forms (solid, liquid, and gas) as it moves throughout the Earth's systems (oceans, atmosphere, groundwater, streams, etc.). Also known as the hydrologic cycle.

Water pollution: The introduction of any substance that changes the physical, chemical, or biological properties of water and makes it harmful to use.

Watershed: Area of land in which all water, whether above or below the ground, is constantly moving downhill towards the same body of water (river, stream, pond, lake, ocean, etc.). It is also known as a basin or drainage basin.

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Appendix A: Student Quiz

Chapter 1: Water Cycle and Watersheds

Student Quiz

Define the following words.

1. Water cycle: _____

   _____

   _____

   _____

2. Watershed: _____

   _____

   _____

   _____

Match these words with their definition in the box.

3. _____ Evaporation
4. _____ Transpiration
5. _____ Condensation
6. _____ Precipitation
7. _____ Percolation

A. Water falls to the Earth as rain or snow.

B. Air rises and cools to form tiny droplets of water (clouds).

C. Water moves down through the ground.

D. Plants and trees give off moisture (water vapor).

E. The sun heats water in lakes, streams, rivers, or oceans and it turns into a gas.

Fill in the blank.

8. The school is in the _____ Watershed.

9. This watershed is also part of the _____ Watershed or Basin.

10. Of all the water that is on Earth, about _____ % is fresh water.

11. Water freezes at _____ °F or _____ °C.

12. Water boils at _____ °F or _____ °C.

13. What are the names of the six towns that make up most of the Ossipee Watershed?

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

14. Give at least one example of water as a solid, a liquid, and a gas.

a. Solid _____

b. Liquid _____

c. Gas _____

<u>True/False</u>

15. _____ Every year we have more and more water on Earth than the year before.

16. _____ Most of the fresh water on Earth is frozen and cannot be used for drinking.

17. _____ Everyone on Earth has enough clean drinking water.

18. _____ It doesn't matter where you stand on Earth, you will always be part of a watershed.

19. _____ The Ossipee River flows into the Saco River and then the Atlantic Ocean.

20. _____ Water never travels downhill.

Draw a diagram of the water cycle in the box below:

Make sure to label surface water, groundwater, precipitation, evaporation, condensation, transpiration, and percolation.

Chapter 1: Water Cycle and Watersheds

Student Quiz Answer Sheet

Define the following terms.

1. Water cycle:

   The paths water takes through its various forms (solid, liquid, and gas) as it moves throughout the Earth's systems (oceans, atmosphere, groundwater, streams, etc.).

2. Watershed:

   The area of land in which all water, whether above or below the ground, is constantly moving downhill towards the same water body (river, stream, pond, lake, ocean, etc.).

Match these words with their definition in the box.

3. __E__ Evaporation
4. __D__ Transpiration
5. __B__ Condensation
6. __A__ Precipitation
7. __C__ Percolation

F. Water falls to the Earth as rain or snow.

G. Air rises and cools to form tiny droplets of water (clouds).

H. Water moves down through the ground.

I. Plants and trees give off moisture (water vapor).

J. The sun heats water in lakes, streams, rivers, or oceans and it turns into a gas.

Fill in the blank.

8. The school is in the __Ossipee_____ Watershed.
9. This watershed is also part of the __Saco River_____ Watershed or Basin.
10. Of all the water that is on Earth, about __3_____ % is fresh water.
11. Water freezes at __32_____ °F or __0_____ °C.

12. Water boils at __212_____ °F or __32_____ °C.

13. What are the names of the six towns that make up most of the Ossipee Watershed?

a. __Effingham_____

b. __Freedom_____

c. __Madison_____

d. __Ossipee_____

e. __Sandwich_____

f. __Tamworth_____

14. Give at least one example of water as a solid, a liquid, and a gas.

a. Solid __glacier, iceberg, ice cube, snowflake, hail_____

b. Liquid __stream, river, lake, ocean, rain_____

c. Gas __water vapor, air_____

True/False

15. __F__ Every year we have more and more water on Earth than the year before.

16. __T__ Most of the fresh water on Earth is frozen and cannot be used for drinking.

17. __F__ Everyone on Earth has enough clean drinking water.

18. __T__ It doesn't matter where you stand on Earth, you will always be part of a watershed.

19. __T__ The Ossipee River flows into the Saco River and then the Atlantic Ocean.

20. __F__ Water never travels downhill.