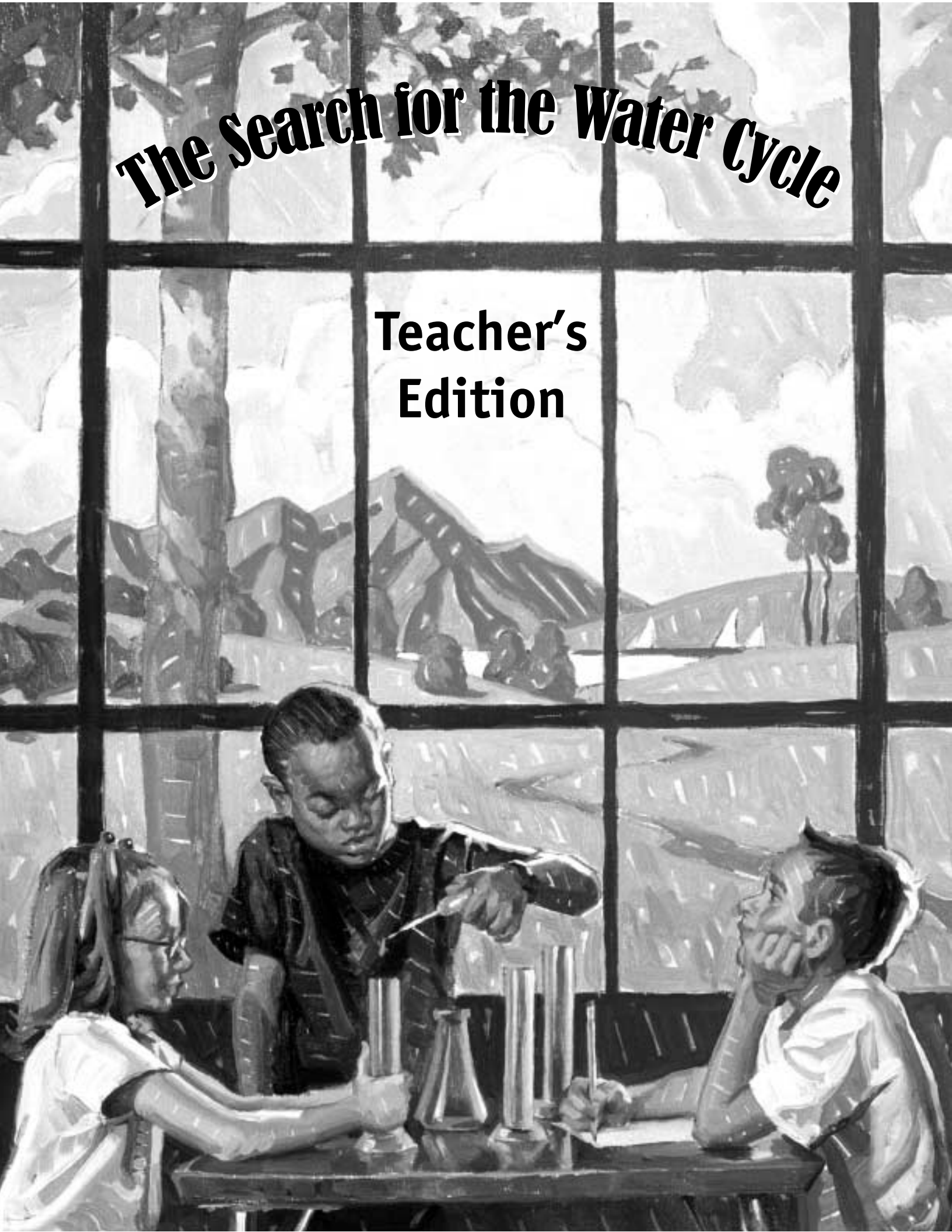
The Search for the Water Cycle

Teacher's Edition



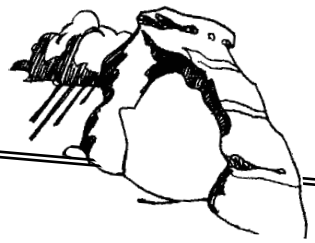
Acknowledgements

These materials were created under the direction of Max L. Longhurst. Appreciation is expressed to the numerous individuals who provided input and effort into the creation of this curriculum. The following Utah teachers and science leaders contributed ideas and lessons as part of a professional development project: Joy Brower, Linda Cullimore, Donald Daugs, Rachel Daugs, Nancy Digerness, Michelle Ditlevsen, Andrae Ferguson, Kathryn Foster, Joy Haws, Gwyneth Holladay, Teryl Jeffs, Kurt Johnson, Angela Justesen, Lorna McCleary, Elaine Negus, Carrie Kirk, Jana Lynn Poulsen, Kandace Riggs, Mark Smith, and Penny Archibald Stone.

The International Office for Water and Science Education staff, under the direction of Geoffrey G. Smith, wrote, compiled, edited, and formatted materials. Artwork by Robert Coombs.

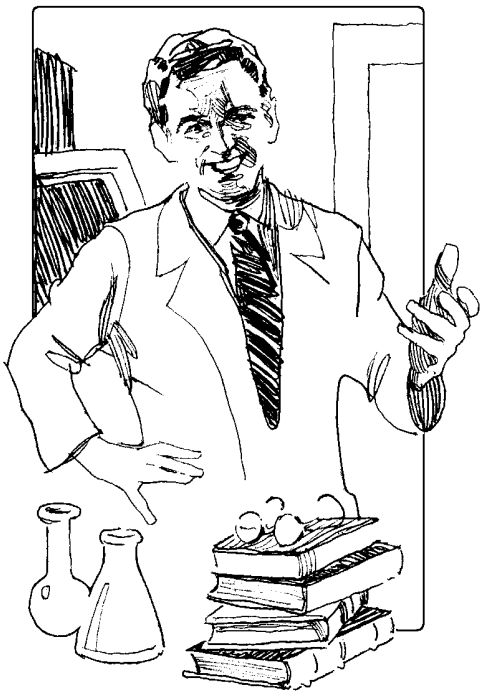
This book is provided with funding assistance from Central Utah Water Conservancy District, 355 West University Parkway, Orem, Utah 84058, 801-226-7100.

Additional copies of this curriculum may be obtained by contacting the Living Planet Aquarium, 522 South 400 West Suite 200, Salt Lake City, Utah 84101, 801-320-9951.



Fourth grade students, as scientists, should experience science as a process of learning about their world with a focus on the skills of classification. Science instruction should provide students with opportunities to actively engage in hands-on learning experiences. Exemplary science instruction requires educators to design educational activities with inquiry as a key-embedded component. *The Search for the Water Cycle* curriculum has been specifically created with the Utah Science CORE Curriculum in mind. The springboard questions and activities will encourage student inquiry and develop sound understanding of the key principles of the hydrologic cycle. Scientifically understanding the water cycle will enable students to make appropriate decisions related to their personal water use and allow them to influence how their community uses our precious resource of water.

Brett Moulding
State Science Specialist



How to Use the Teacher's Edition

The use of the activities in *The Search for the Water Cycle: Teacher's Edition* will be valuable and helpful in teaching fourth grade students about the water cycle. The *Teacher's Edition* provides activities designed to: introduce the science language of the water cycle (condensation, evaporation, precipitation, transpiration, etc.); establish an understanding of the complex processes of the water cycle, engage students in application activities and emphasize the important role the water cycle plays for all living things.

Activities in *The Search for the Water Cycle* are designed to meet the Utah Science Core objectives and are structured such that teachers can choose the learning activities that best meet their needs. The teaching strategies engage students in a variety of learning experiences that actively involve them in the scientific process.

Each lesson plan is structured with a background section related to the activity and includes a list of easily-obtainable materials. Teaching strategies include an invitation to learn, instructional procedures, extensions where appropriate, and assessment suggestions for each lesson. A teacher glossary, student glossary, additional resources, and a sample final exam are provided as well.

The invitation to learn section of each lesson is essentially an exploratory introduction to the lesson. The instructional procedures come next and are the concept development part of the lesson followed by extensions and assessment suggestions.

In addition to this *Teacher's Edition*, students are provided with a *Findings Booklet*. This resource includes a variety of sequenced formats directly tied to the teaching strategies found in the *Teacher's Edition*. A strength of the *Findings Booklet* is the variety of activities designed for home use as extensions or replications of classroom experiences. It is suggested that students take their booklets home and conduct investigations with family members. Teachers should promote responsible behaviors by instilling the need for the *Findings Booklet* to be constantly available for additional in-school learning experiences.

The *Teacher's Edition* also includes all of the materials found in the *Findings Booklet* along with appropriate answers. For most situations, answers will vary and the judgement of the appropriateness of the answer is left to the teacher.

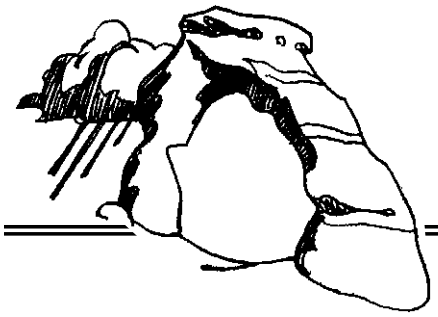
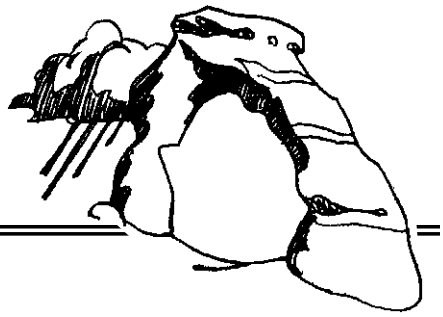


Table of Contents

Curriculum Organizers



Standard I of the Utah Science Core Curriculum for Fourth Grade centers around the changes of state that occur in water as it moves through the water cycle. The following explanation connects the Core Curriculum with the springboard questions and activities contained in *The Search for the Water Cycle*.

Science Benchmark

Matter on Earth cycles from one form to another. The cycling of matter on Earth requires energy. The cycling of water is an example of this process. The sun is the source of energy for the water cycle. Water changes state as it cycles between the atmosphere, land, and bodies of water on Earth.

STANDARD I: Students will understand that water changes state as it moves through the water cycle.

Objective 1: Describe the relationship between heat energy, evaporation, and condensation of water on Earth.

a. Identify the relative amount and kind of water found in various locations on Earth (e.g., oceans have most of the water, glaciers and snowfields contain most fresh water).
b. Identify the sun as the source of energy that evaporates water from the surface of Earth.
c. Compare the processes of evaporation and condensation of water.
d. Investigate and record temperature data to show the effects of heat energy on changing the states of water.

Objective 2: Describe the water cycle.

a. Locate examples of evaporation and condensation in the water cycle (e.g., water evaporates when heated and clouds or dew forms when vapor is cooled).
b. Describe the processes of evaporation, condensation, and precipitation as they relate to the water cycle.
c. Identify locations that hold water as it passes through the water cycle (e.g., oceans, atmosphere, fresh surface water, snow, ice, and ground water).
d. Construct a model or diagram to show how water continuously moves through the water cycle over time.
e. Describe how the water cycle relates to the water supply in your community.

Activities are designed to answer the following springboard questions:

- Where can you find water?
- What happens when you spill water on a hot sidewalk in the summer?
- How does water move?
- Why is water important to me?

Students should be encouraged to use scientific language such as: clouds, condensation, dew, energy, evaporation, groundwater, humidity, liquid, nuclei, precipitation, temperature, vapor, and water cycle.

Core Curriculum Connections

Springboard Question	Activity	Core Objective Connection	Findings Booklet	Teacher's Guide
1	Where is Water Found?	1 & 2	pp. 5-7	pp. 13-15
2	Why Does a Puddle Shrink?	1	pp. 8-10	pp. 17-19
	Condensation Chambers	1	pp. 11-12	pp. 21-22
	Heat Energy and Water	1	p. 13	pp. 23-24
3	The Water Cycle Model	1 & 2	p. 14	pp. 25-27
	Water on the Move	1 & 2	pp. 15-17	pp. 29-31
	A Water Cycle Chamber	1 & 2	p. 18	pp. 33-35
4	Water Cycle Celebration	1 & 2	p. 19	pp. 37-38

The Water Cycle

The **water cycle** is one of nature's never-ending processes. Water is a variable substance in that it exists on Earth as a solid, a liquid, and a gas. As the water in oceans, rivers, clouds and glaciers change from one form to another they impact Earth's water budget. An amazingly small portion of that budget is in the form of freshwater. Water covers 70% of Earth's surface. The total amount of water in the oceans, atmosphere, and on land is hard to comprehend. Oceans contain 97.5% of Earth's water. The atmosphere holds less than 0.001% and 2.4% is found on land. Annual precipitation amounts to 30 times the total water found in the atmosphere at any given time. These facts indicate how rapidly water recycles.

The sun provides the **energy** needed to change liquid water into **water vapor**. About 80% of all evaporation is from oceans, and the balance comes from inland water, soils, and vegetation. Winds carry the water vapor around Earth. When air rises and cools, the water vapor changes from gas to a liquid, forming clouds. **Condensation** is dependent on temperature, **humidity**, and **condensation nuclei**.

Precipitation is the process of transporting water from the atmosphere to the surface of Earth. Precipitation may fall as rain, snow, sleet, or hail and varies in amounts by location. For example, most of the western part of Utah receives less than ten inches of precipitation per year, while parts of the Wasatch Mountains receive over fifty inches of precipitation.

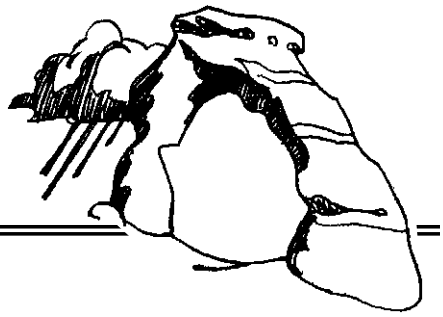
One of the unique characteristics of Utah precipitation is how the Great Salt Lake affects snowfall. As cold winds, generally from the northwest, blow across the lake they pick up warm humid air over the lake. Evaporation of warm surface water increases the moisture in the colder, drier air flowing over the lake. As the air becomes saturated, ice-crystal clouds form. As the air reaches the southeast shore and rises, snow falls along the Wasatch front and in surrounding mountains. This is sometimes referred to as the "lake effect."

Groundwater is the water that penetrates the soil and underlying rock layers. Water that flows off the surface is called "runoff". Most of Utah's runoff flows south in the Colorado River Drainage and a small amount leaves the northwest corner of the state and flows into the Snake River Drainage. Much of Utah's water never leaves the state. The Sevier River Drainage water flows into a sometimes-present lake. Other water flows into the Great Salt Lake. Water in Sevier Lake and the Great Salt Lake has only one way out, evaporation. Left behind are all the dissolved solids.

Using water wisely is the responsibility of every member of society. It is a valuable resource, and we are responsible for its management and reasonable consumption.

Suggestion: Prior to beginning the unit distribute a *Findings Booklet* to each student. Read and discuss the Welcome page (p. 3). Instruct students in how the booklet will be used. Have them record their names on this page. If working in groups, have them also write their group name or number in the space provided.

Activity A
Where is Water Found?



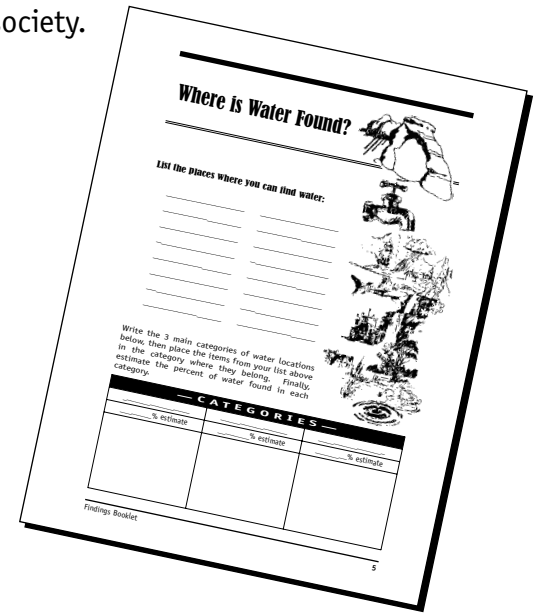
Springboard Question #1 Where can you find water?

Teacher Background:

Water covers 70% of Earth's surface and is found in different locations on Earth. The amount of water in the **oceans**, atmosphere, and on land is hard to comprehend. Approximately ninety-seven percent (97%) of it is found in the **oceans**. The atmosphere holds less than 0.001%, about two percent (2%) is found frozen on Earth in **glaciers**, and one percent (1%) is **freshwater** found in lakes, **rivers** and **groundwater**. Annual precipitation amounts to 30 times the total water found in the atmosphere at any given time.

In the western United States, water is a valuable resource that comes and goes with the seasons. During the winter the snow falls and accumulates in the mountains. As the snow melts in the spring and during the summer, the water is absorbed into Earth or forms small streams that flow down the mountains. **Groundwater** is all the water that penetrates the soil and underlying rock layers. Water that flows off the surface is called **runoff**.

Using water wisely is the responsibility of every member of society. It is a valuable resource, and we are responsible for its management and reasonable consumption.



Materials:

- 100 pennies for each group
- Earth globe

Invitation to Learn:

In small groups, ask students to brainstorm a list of all the places where water is found on Earth. Have them write this list on page 5 of their *Findings Booklet*.

Instructional Procedures:

1. After compiling their list, discuss how one might group or categorize the items in their list. Write the categories **oceans**, **glaciers**, and **freshwater** on the board. Discuss each category, and then have the students write these headings in their *Findings Booklet*. Have students list the items from the top of page 5 in the three categories.

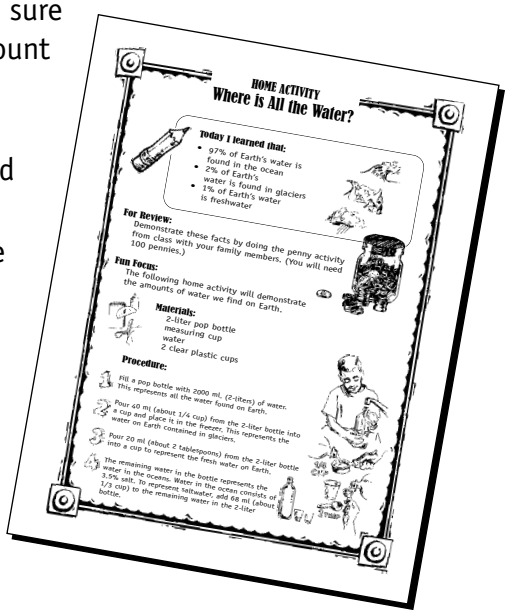
— CATEGORIES —		
_____	_____	_____
_____% estimate	_____% estimate	_____% estimate

2. Have students engage in a group discussion of estimating the percentage of water found in each of the categories. *Note: Based on the category lists most students will probably estimate that most water is found as freshwater.* Have students write their estimates in their *Findings Booklet*. The total of the percentages should add up to 100% correlating with 100 pennies.
3. Distribute 100 pennies to each group. Have them show their estimate using the pennies.
4. Provide students with the actual percentages: Oceans 97%, Glaciers 2%, and Freshwater 1%. As a class, compare group estimations to the actual percentages.
5. To help students conceptualize what 97% as **ocean** water, 2% as **glaciers**, and 1% as **freshwater** means, ask the students to recreate these percentages by stacking 97 pennies (97% **oceans**), 2 pennies (2% **glaciers**), and 1 penny (1% **freshwater**). Have students record the true percentages in their *Findings Booklet* on page 6. Discuss these proportions.
6. Review appropriate science language as the class discusses the various water sources. Looking at a globe of Earth, describe the difference between how much land you see compared to water. Point out that 70% of Earth's surface is covered by water.

7. Challenge students to come up with a "new name" for Earth based on what they now know about water. Have students assume they came here as space explorers. What would they see? (clouds, oceans, land, etc.) Have students record their answers in their *Findings Booklet*.
8. Have students respond to the Findings question on page 6 of their *Findings Booklet*.

Possible Extensions/Adaptations/Integration:

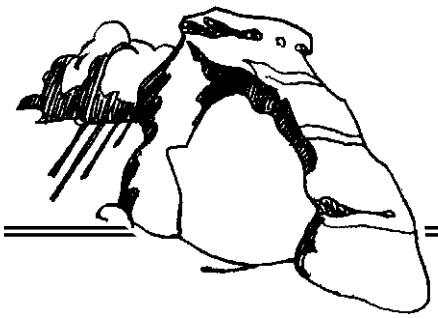
1. Create a mural of the locations of water on Earth. Be sure that this mural graphically represents the relative amount of water in each of the areas (**oceans**, **glaciers**, **freshwater**)
2. Describe in detail the places where water can be found around your home, school, or community.
3. Discuss and have students do the *Home Activity* in the *Findings Booklet*.


HOME ACTIVITY
Where is All the Water?
Today I learned that:
• 97% of Earth's water is found in the ocean
• 2% of Earth's water is found in glaciers
• 1% of Earth's water is freshwater
For Review:
Demonstrate these facts by doing the penny activity from class with your family members. (You will need 100 pennies.)
Fun Focus:
The following home activity will demonstrate the amounts of water we find on Earth.
Materials:
2-liter pop bottle
measuring cup
water
2 clear plastic cups
Procedure:
1 Fill a pop bottle with 2000 mL (2-liter) of water. This represents all the water found on Earth.
2 Pour 40 mL (about 1/4 cup) from the 2-liter bottle into a cup and place it in the freezer. This represents the water on Earth contained in glaciers.
3 Pour 20 mL (about 2 tablespoons) from the 2-liter bottle into a cup to represent the fresh water on Earth.
4 The remaining water in the bottle represents the water in the oceans. Water in the ocean consists of 3.5% salt. To represent saltwater, add 68 mL (about 1/3 cup) to the remaining water in the 2-liter bottle.

Assessment/Findings:

Check for students' understanding with the answers they record for the *Findings* and *Rename Earth* activity in their *Findings Booklet*.

— Notes —



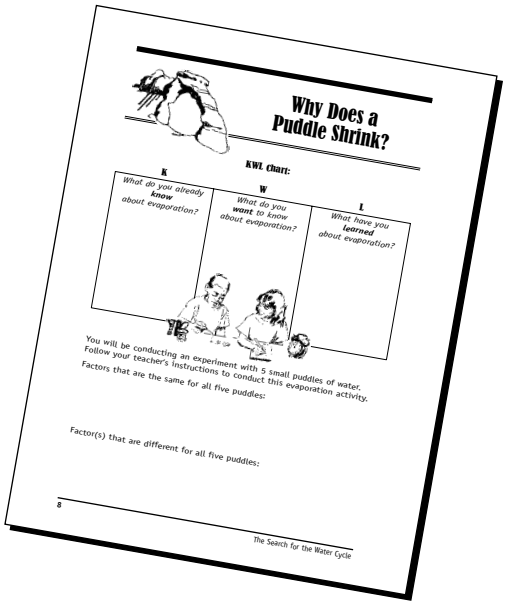
Activity B
Why Does a Puddle Shrink?

Springboard Question #2: What happens when you spill water on a hot sidewalk in the summer?

Teacher Background:

The sun provides the **energy** needed (**solar energy**) to change liquid water to **water vapor**. Approximately 80% of all **evaporation** is from oceans and the balance comes from inland water, soils, and transpiration from vegetation. Winds carry the water around Earth. When moist air rises and cools, the **water vapor** condenses from a vapor to very small liquid water droplets forming clouds.

Materials:


Why Does a Puddle Shrink?

KWL Chart:

K	W	L
What do you already **know** about evaporation?	What do you **want** to know about evaporation?	What have you **learned** about evaporation?

You will be conducting an experiment with 5 small puddles of water. Follow your teacher's instructions to conduct this evaporation activity.

Factors that are the same for all five puddles:

Factor(s) that are different for all five puddles:

8

The Search for the Water Cycle

(per student)

- water
- 1 cotton swab
- 1 paper towel
- 1 pipette (eye dropper)

(per group)

- 1 clipboard
- square of aluminum foil/or laminated sheet of paper
- 1 ruler (metric)

Invitation to Learn:

1. Begin this activity by having the students fill out the K section of the K-W-L chart found on page 8 of the *Findings Booklet*. Here the students will list every possible thing that they already know about **evaporation**. (In the K section the students list the facts that they already *know*, in the W section they list the items that they *want* to know, and in the L section they will list the new content that they have *learned*.)
2. Distribute a wet cotton swab and paper towel to each student. Have students compare **evaporation** rates when the back of the hand and an equal area of a paper towel are moistened with the wet swab.

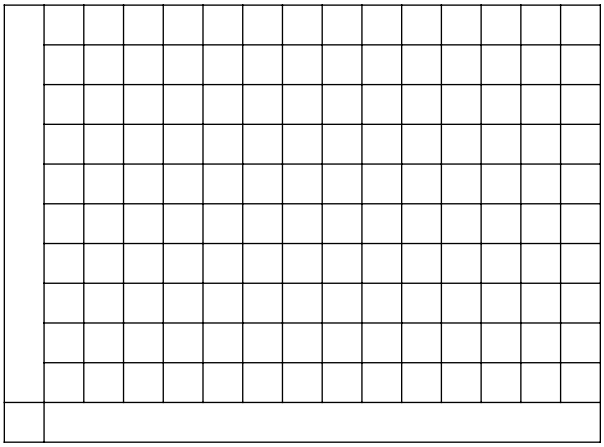
3. Discuss the results. Lead the discussion to inquire about the role heat energy plays in **evaporation**.
4. Allow the students to list the items that they would like to know about **evaporation** in the W section of their K-W-L chart.

Instructional Procedures:

1. Distribute clipboards, pipettes, a square of aluminum foil or a laminated sheet of paper, and water to each group of students. Instruct them to place the foil on the clipboard, and then place the clipboard in a level location where it will be kept for the remainder of the experiment (the clipboard needs to be somewhere that will not be disturbed overnight).
2. Students are to make five puddles of water on the aluminum foil or laminated paper. Each puddle should receive ten more drops of water than the previous one. The first puddle should be made using five drops of water, the second with 15, and so on. Have the students record the starting amount of water (number of drops) and the starting diameter (measure in centimeters) of the puddles in their *Findings Booklet* on page 9. *NOTE: Be sure that the puddles are as round as possible before the students measure them.*
3. Discuss the factors that will remain constant, for example, same surface, same temperature, and same air movement. Then help the students conclude that the factor that is different for each puddle is the surface area. Have them record these similarities and differences in their *Findings Booklet* on page 8.
4. After the water has sat overnight, have the students measure and record the diameter of each puddle in their *Findings Booklet* on page 9.
5. Have students determine the ending amount of water by drawing the remaining water into a pipette and then counting the drops as they are squeezed out. This information should also be recorded on page 9 of their *Findings Booklet*.

Measurements	Puddle A	Puddle B	Puddle C	Puddle D	Puddle E
Starting amount of water (number of drops)					
Starting diameter/ size					
Ending diameter/size					
Ending amount of water (number of drops)					
Amount of water evaporated*					

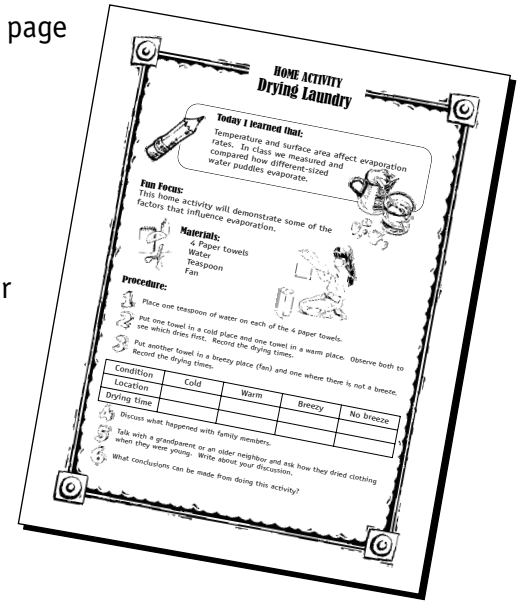
6. Have students use the formula (starting amount of water minus ending amount of water) in their *Findings Booklet* to determine the amount of water that evaporated.
7. Have students use the Evaporation Data Chart on page 9 to create a graph (i.e., bar graph or line graph) that represents their collective data. Example: amount of water evaporated, comparison of size, comparison of droplets initially with final measures.



8. Discuss findings and compare the two charts. Have students record these comparisons in their *Findings Booklet*.

Possible Extensions/Adaptations/Integration:

1. Introduce students to the take *Home Activity* – Drying Laundry, page 10 in the *Findings Booklet*. Go over what they need to do in order to carry out the experiment by reading and discussing all the components of the activity.
2. Do the *Evaporation Art* activity on the following page as a fun approach for an integrated science art experience.


HOME ACTIVITY
Drying Laundry

Today I learned that:
Temperature and surface area affect evaporation rates. In class we measured and compared how different-sized water puddles evaporate.

Fun Focus:
This home activity will demonstrate some of the factors that influence evaporation.

Materials:
4 Paper towels
Water
Teaspoon
Fan

Procedure:
1. Place one teaspoon of water on each of the 4 paper towels.
2. Put one towel in a cold place and one towel in a warm place. Observe both to see which dries first. Record the drying times.
3. Put another towel in a breezy place (fan) and one where there is not a breeze. Record the drying times.

Condition	Cold	Warm	Breezy	No breeze
Location				
Drying time				

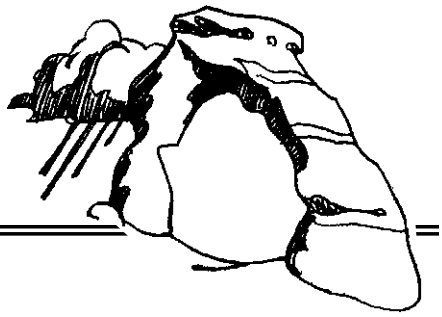
4. Discuss what happened with family members.
5. Talk with a grandparent or an older neighbor and ask how they dried clothing when they were young. Write about your discussion.
6. What conclusions can be made from doing this activity?

Assessment/Findings:

Check for students' understanding by viewing their evaporation data chart, evaporation graph, and their recorded conclusion.

Integration Activity

Evaporation Art

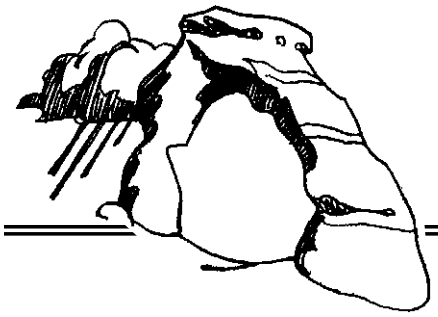


Materials:

- Paper Towels
- Metal or Plastic Trays (cookie sheet)
- Food Coloring in a variety of colors
- Cups
- Pipettes (eye dropper)
- Water

Instructional Procedures:

1. For each food color fill a cup with water. Add a few drops of food coloring.
2. Place a paper towel in a tray.
3. Using a pipette (eye dropper) and different colors of water, make a pattern on the paper towel.
4. Hang the paper to dry.
5. Observe changes as water EVAPORATES.
6. When dry, add lines to make pictures.



Activity C
Condensation Chambers

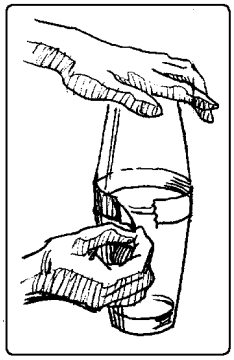
Discussion Question:

Why does water collect on the bathroom mirror when someone takes a hot shower?

Teacher Background:

The process by which **water vapor** turns into liquid water is called **condensation**. When warm, moisture-laden air is cooled, the **water vapor** in the air changes into its liquid state and forms water droplets. This is evident when water condenses on the cool surface of a mirror or window in a bathroom while you are taking a shower or when chilled car windows fog up on the inside. **Condensation** is generally associated with warm **water vapor** in contact with cold surfaces or other relatively cold solid particles.

Materials:



(teacher)

- small mirror

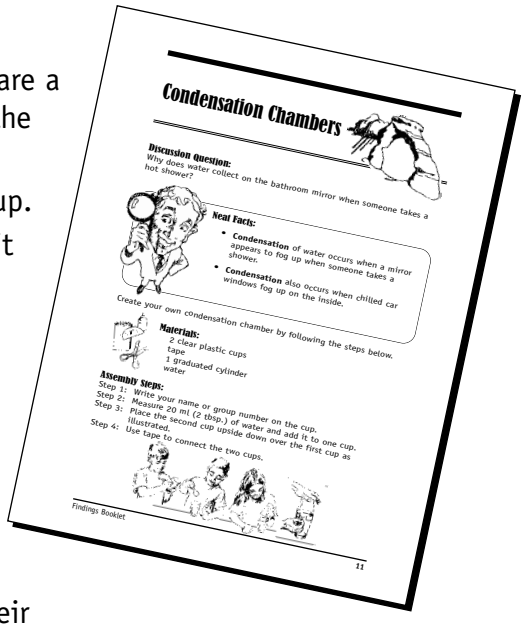
(per group)

- 2 small clear plastic cups
- water
- tape
- graduated cylinder

Invitation to learn:

1. Hold up a mirror. Ask students how they might get water to form on the mirror. If no one suggests breathing on it, do so and indicate that the warm moist air from your lungs hits the colder mirror and condenses.
2. Discuss the process of condensation. (Refer to the teacher background if needed, pp. 11-13.) Indicate that students are going to construct condensation chambers.

Instructional Procedures:



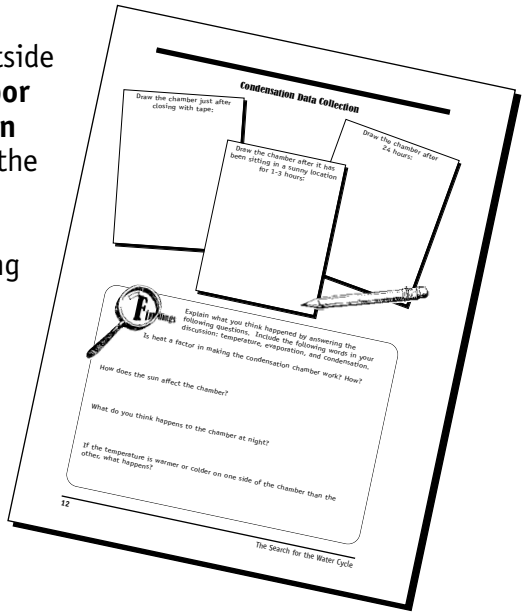
1. Refer to page 11 in the student *Findings Booklet*. Share a pre-constructed condensation chamber, and instruct the students to follow the steps outlined.
   - Write your name or group name/number on the cup.
   - Measure 20 ml (2 tablespoons) of water and add it to one cup.
   - Place the second cup upside down over the first cup as illustrated.
   - Use tape to connect the two cups.
2. Have each group place their chambers in a warm, sunny place. After it has sat for 1-3 hours, students should record their observations on page 12 of their *Findings Booklet*.
3. The following day have students record the rest of their observations on page 12 of their *Findings Booklet*.

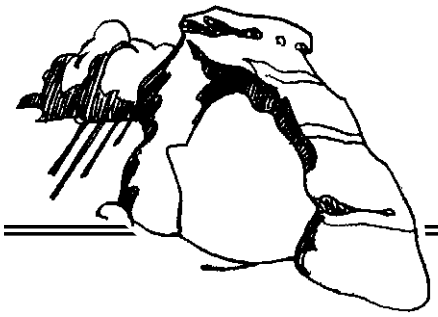
Possible Extensions/Adaptations/Integration:

As an open-ended experience, allow students to plan, carry out, and design experiments related to the findings questions found on page 12 of the *Findings Booklet*.

Assessment/Findings:

Using the questions found on page 12 of the *Findings Booklet* you may lead an oral discussion or have the students work individually to explore the process that took place with their condensation chambers. Have students review appropriate scientific language as you discuss the appearance of the **condensation** chamber before and after placing it in a warm, sunny place. Listen for facts such as the concept of **energy** from the sun warming the chamber and causing **evaporation** to occur within it. At night the cool air outside the chamber will make the lid cool off and the **water vapor** will condense on the inside of the chamber. **Condensation** will most likely be more concentrated on the side facing the window. Ask students to explain why there was more **condensation** on the side of the lid facing the window – the **temperature** outside was colder and so the side facing the window cooled more than the side facing the heated room.





Activity D
Heat Energy and Water

Discussion Question:

What is the best way to melt ice?

Teacher Background:

This activity is designed to develop the concept of heat's influence on solid and liquid water. The activity should also help students differentiate between heat and **temperature**. Heat is a form of energy that is passed from one object to another because of a difference in **temperature.** Solid water (ice) remains at approximately the same **temperature** until it is entirely melted. Heat is being applied throughout this experiment, but the ice absorbs the **heat energy** until it melts and then the heat increases the temperaature of the water.

Materials:

(per group)

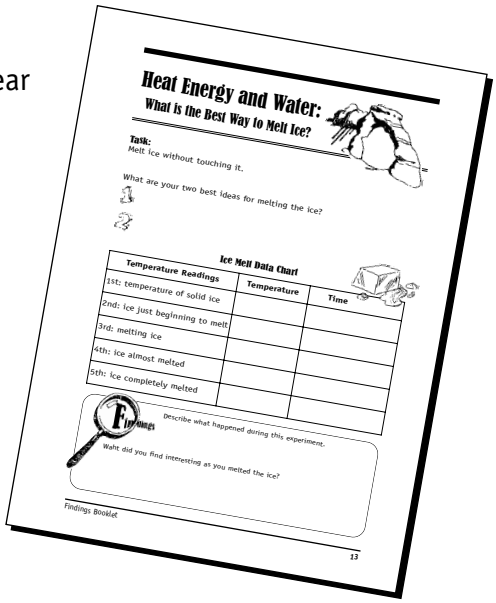
- 1 clear plastic cup
- 1 thermometer
- ice

NOTE: *Crushed ice will melt more quickly. However, cubes of ice will allow quantity of ice to be measured more accurately.*

Invitation to Learn:

Prepare the students for this activity by brainstorming with them ideas of how to melt ice in a cup without touching the ice.

Instructional Procedures:


Heat Energy and Water:
What is the Best Way to Melt Ice?
Task:
Melt ice without touching it.
What are your two best ideas for melting the ice?
1
2
Ice Melt Data Chart
Temperature Readings | Temperature | Time
1st: temperature of solid ice
2nd: ice just beginning to melt
3rd: melting ice
4th: ice almost melted
5th: ice completely melted
Findings
Describe what happened during this experiment.
Waht did you find interesting as you melted the ice?
Findings Booklet
13

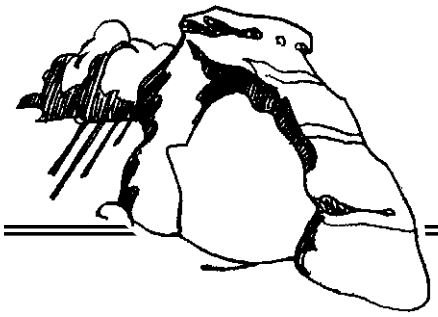
1. Have students place a specific amount of ice in their clear plastic cup (i.e., three cubes).
2. Have the students take the temperature of the ice and record the results on the Ice Melt Data Chart found on page 13 of their *Findings Booklet*.
3. Using the ideas that were brainstormed, allow the students to manipulate the cups and record the ice and water temperatures as outlined in the Ice Melt Data Chart.
4. When the ice has completely melted into liquid water, have the students take the temperature of the water. Record results.
5. Discuss the information from the Teacher Background with students.

Possible Extensions/Adaptations/Integration:

Using the data from the Ice Melt Data Chart, graph the change of temperature of melting ice.

Assessment/Findings:

Have students orally explain why the liquid water temperature is higher than solid water (ice) temperature.



Activity E
The Water Cycle Model

Springboard Question #3 How does water move?

Teacher Background:

Water is constantly moving from one location to another and changing state. Snow and rain fall to Earth from clouds. This is called precipitation. The rain water and melted snow run downhill into rivers and lakes, sometimes crashing over waterfalls. Eventually the water flows into **evaporation** basins such as the ocean or the Great Salt Lake, where water can return to the atmosphere.

As water **evaporates**, it changes from **liquid** into **gas**, and moves from oceans, lakes, and rivers into the atmosphere where it forms clouds. Then the cycle begins all over again. (Refer to Instructional Procedures for a discussion on how clouds are formed.)

Materials:

(teacher)

- 2 matches

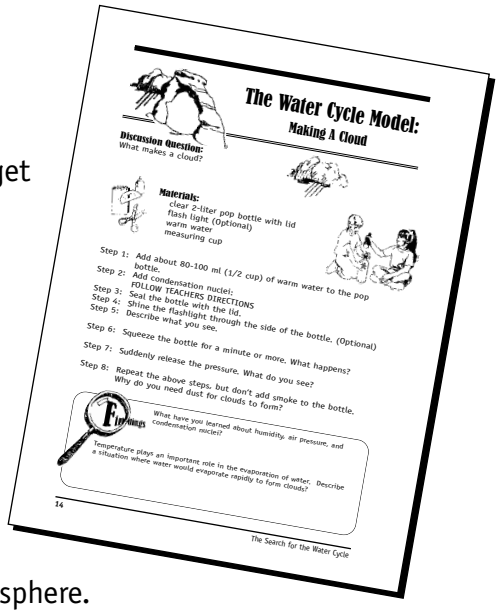
(per group)

- 1 clear empty 2-liter pop bottle
- about 80-100 ml (1/2 cup) of warm water
- flashlight
- measuring cup

CAUTION: ***This activity may require you or another adult to light the matches for each group of students. If necessary, obtain appropriate permission for the use of matches in the classroom.***

Invitation to Learn:

Take the students on a walk outside on a semi-cloudy day. Discuss with them how clouds are formed, what clouds are made of, why there are different types of clouds, and any other interesting questions that will get them thinking about the role clouds play in the water cycle.


The Water Cycle Model:
Making A Cloud
Discussion Question:
What makes a cloud?
Materials:
clear 2-liter pop bottle with lid
flash light (Optional)
warm water
measuring cup
Step 1: Add about 80-100 ml (1/2 cup) of warm water to the pop bottle.
Step 2: Add condensation nuclei:
FOLLOW TEACHERS DIRECTIONS
Step 3: Seal the bottle with the the lid.
Step 4: Shine the flashlight through the side of the bottle. (Optional)
Step 5: Describe what you see.
Step 6: Squeeze the bottle for a minute or more. What happens?
Step 7: Suddenly release the pressure. What do you see?
Step 8: Repeat the above steps, but don't add smoke to the bottle. Why do you need dust for clouds to form?
Findings
What have you learned about humidity, air pressure, and condensation nuclei?
Temperature plays an important role in the evaporation of water. Describe a situation where water would evaporate rapidly to form clouds?
14
The Search for the Water Cycle

Instructional Procedures:

1. Lead students to discover that, unlike their condensation chambers, there is no cold surface above them in the atmosphere on which water condenses. Teach the students that as water molecules cool in the higher atmosphere they are attracted to dust particles and other **condensation nuclei** that are present in our atmosphere. This activity is a miniature display of that process.
2. Have students follow the steps outlined on page 14 of their *Findings Booklet*. Start by having each group put 80-100 ml (1/2 cup) of water in their pop bottle.
3. Have students introduce extra particles (**condensation nuclei**) to the "atmosphere" inside the bottle by lighting a match, blowing it out, and quickly placing the smoldering match into the bottle to add some smoke to the bottle.

   NOTE: ***A safety warning or caution for the use of matches should be discussed with students.***

4. Repeat step three with a second match and quickly seal the bottle tightly with the lid. The smoke may disappear but particles are still in the air above the water.
5. Have the students shine a flashlight through the bottle and record what they see in their *Findings Booklet*.

6. Increase the pressure in the bottle by squeezing the bottle with both hands. Hold tightly for 60 to 90 seconds and notice any changes in the bottle. This pressure increases the temperature.
7. Then, instruct students to quickly release their squeeze. As the pressure is quickly released, a cloud will momentarily form. Have students record what they saw in their *Findings Booklet*. Releasing the squeeze causes the air pressure to decrease and the temperature to drop.

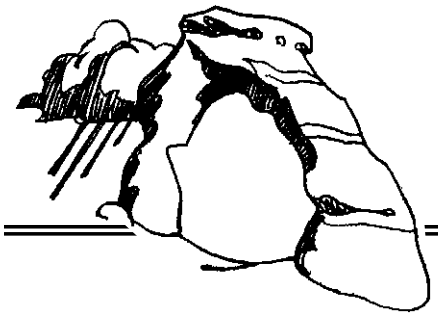
Possible Extensions/Adaptations/Integration:

1. As time permits, investigate the variables. Try the activity again, each time omitting one of the factors (humidity, an air pressure decrease causing a temperature drop, and particles in the air) and see if a cloud still forms.
2. Have students attempt to replicate the cloud chamber by using other forms of **condensation nuclei** of their choice (i.e., chalk dust). Some students may want to try the experiment without any condensation nuclei.

Assessment/Findings:

Check for students' understanding as they follow the procedures to make the water cycle model, explain why the experiment works, and answer the questions in the "Findings" section of their *Findings Booklet*.

— Notes —



Activity F
Water on the Move

Teacher Background:

This activity requires students to have a basic understanding of the following science language and processes:

- **Condensation** occurs when water vapor in the air turns into liquid water, as on the outside of a cold glass of water.
- **Evaporation** is the opposite of **condensation** in that liquid water turns into water vapor. How fast water evaporates depends on the amount of water vapor already in the air (**humidity**), the **temperature**, the amount of surface area exposed to the air, and air movement over the surface of the water.
- **Groundwater** is the water beneath Earth's surface often found in saturated soil and rock. **Groundwater** supplies wells and springs.
- Water that falls to Earth in the form of rain, snow, hail, or sleet is called **precipitation**.
- The process of water going from a solid such as snow or ice to vapor gas is **sublimation**.
- Plants absorb water usually through their roots. This water is eventually evaporated into the atmosphere from the plant surface such as leaf spores through a process called **transpiration**.
- Water in a gas form is called **water vapor**.

Materials:

two dice per group

Travel Key and Travel Log (pp. 16-17 of *Findings Booklet*)

Invitation to Learn:

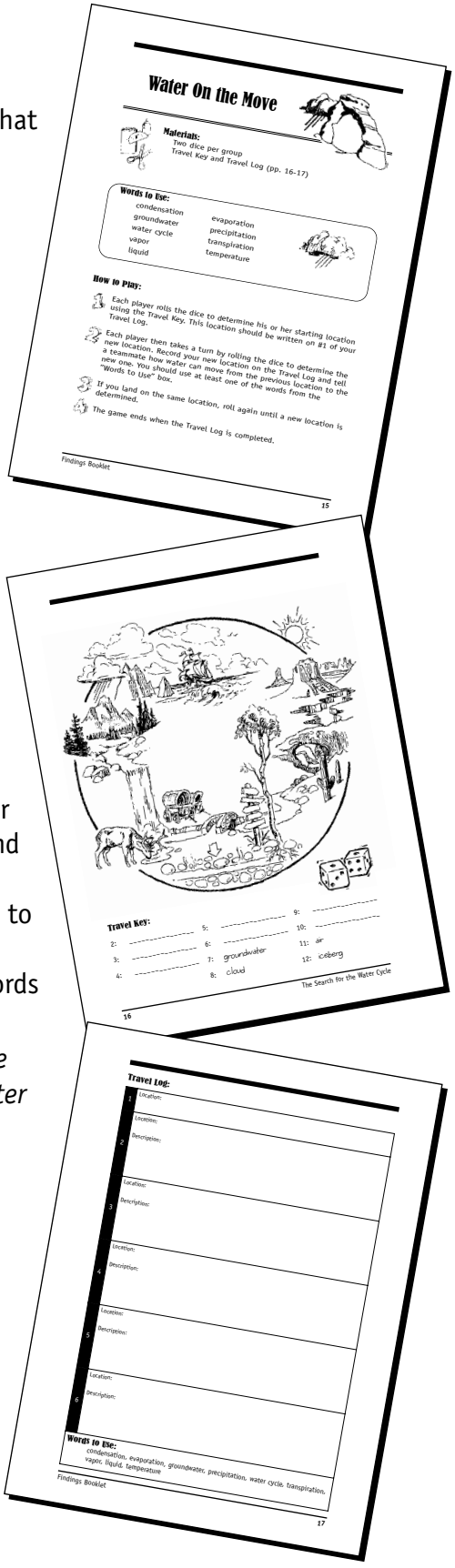
Take this opportunity to read one of the books listed in the appendix (pp. 59-60) of this book.

Instructional Procedures:

1. As a class, fill in the location blanks in the *Findings Booklet* on page 16. Below are the various locations that your class will want to use. Be creative and think of specific locations in your region. For example, use a particular tree species found in your area for number 3, name a lake or reservoir in your region for number 4, etc. Have fun and write specific locations on 3, 4, 5, 6, and 10. Use the general terms listed below for the other locations.

   2: waterfall; 3: tree; 4: lake/puddle; 5: river; 6: snowy mountain; 7: groundwater; 8: cloud; 9: ocean; 10: animal; 11: air; and 12: iceberg
2. Divide the class into teams of two, and give each team a pair of dice.
3. To play this game:
   - Each player rolls the dice to determine his or her starting location using the Travel Key. This location should be written on #1 of the Travel Log on page 17 in the *Findings Booklet*.
   - Each player then takes his or her turn by rolling the dice to determine the new location. The player then records his new location on his Travel Log and tells his teammate how water can move from the previous location to the new location, in addition to writing a description of the movement. A player should use at least one of the words from the "Words to Use" box.

     For example, if the previous location is <u>tree</u> and the next location is <u>air</u>, a player could say that the water in the tree moves to the air through transpiration when the water is evaporated into the atmosphere from the leaves of the tree.
   - If a player lands on the same location, he or she should roll again until a new location is determined.
   - The game ends when the Travel Log is completely filled in. Awards may be given as motivation.



Possible Extensions/Adaptations/Integration:

Have the students create a two dimensional model of the water cycle. One student draws, labels, and explains the role streams play in the water cycle. Another child draws, labels, and explains the role clouds play in the water cycle. The model must include all components of the water cycle including condensation, evaporation, mountains, oceans, surface runoff, groundwater, and precipitation.

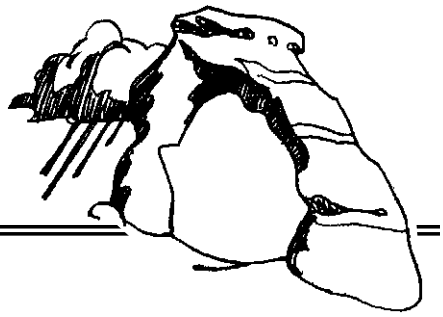
Assessment/Findings:

Check for the students' understanding of the water cycle by reading what they recorded in their Travel Log and verifying their use of water cycle vocabulary.

— Notes —

Activity G

A Water Cycle Chamber



Discussion Question:

When a cup filled with an ice-cold drink is placed in a warm room, what happens to the outside of the cup? Why?

Teacher Background:

Refer to "The Water Cycle" on pages 11-12.

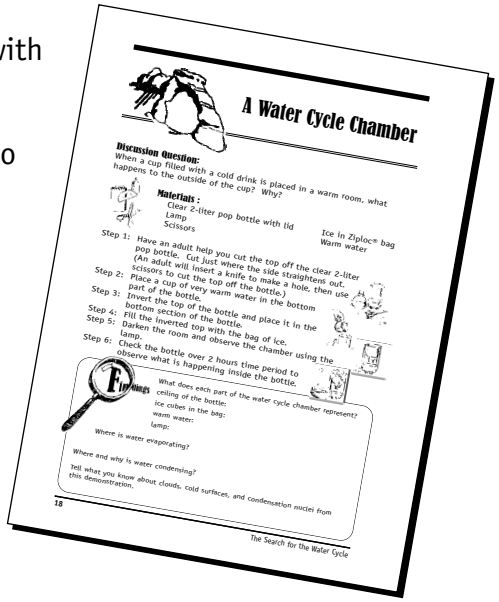
Materials:

(per group)

- clear 2-liter pop bottle with lid
- knife (teacher use)
- scissors
- ice cubes
- gooseneck lamp
- cup of warm water
- 1 plastic bag

Invitation to Learn:

At the beginning of the day place a water bottle filled with ice and water on the table in the classroom. If students bring water bottles, each student could conduct this experiment. Throughout the day observe what happens to the outside of the water bottle. Discuss what causes the bottle to "sweat."


A Water Cycle Chamber

Discussion Question:
When a cup filled with a cold drink is placed in a warm room, what happens to the outside of the cup? Why?

Materials:
Clear 2-liter pop bottle with lid
Lamp
Scissors
Ice in Ziploc® bag
Warm water

Step 1: Have an adult help you cut the top off the clear 2-liter pop bottle. Cut just where the side straightens out. (An adult will insert a knife to make a hole, then use scissors to cut the top off the bottle.)
Step 2: Place a cup of very warm water in the bottom part of the bottle.
Step 3: Invert the top of the bottle and place it in the bottom section of the bottle.
Step 4: Fill the inverted top with the bag of ice.
Step 5: Darken the room and observe the chamber using the lamp.
Step 6: Check the bottle over 2 hours time period to observe what is happening inside the bottle.

Findings

What does each part of the water cycle chamber represent?
ceiling of the bottle:
ice cubes in the bag:
warm water:
lamp:

Where is water evaporating?

Where and why is water condensing?

Tell what you know about clouds, cold surfaces, and condensation nuclei from this demonstration.

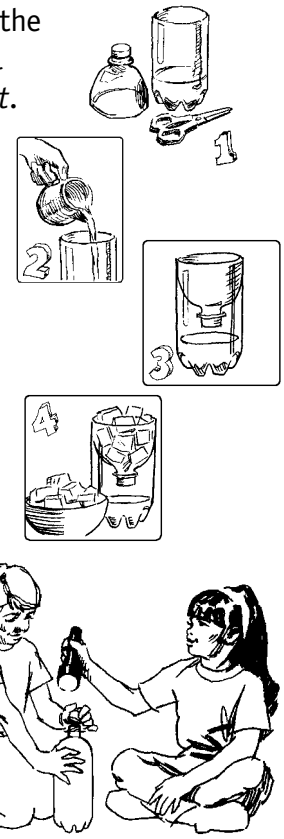
18

The Search for the Water Cycle

Instructional Procedures:

1. Demonstrate and review the **water cycle** using a commercial water cycle chamber or your own model.
2. With each of the 2-liter pop bottles, use a knife to poke a starter hole in the top portion of the bottle where it starts to straighten out.

3. Distribute one bottle to each group. Instruct the students to utilize the starter hole to cut off the top portion of the bottle with scissors. Tell them to look at the diagram found on page 18 of the *Findings Booklet*.
4. Instruct each group to place a cup of very warm water in the bottom of the pop bottle. (Use hot water to speed the **evaporation** process.)
5. Close the chamber with the top of the bottle inverted. See the adjacent diagram.
6. Place four or five ice cubes in a plastic bag and set the ice cube bag on top of the container.
7. Place the light source (lamp) within a few inches of the chamber to simulate heat energy from the sun. Be sure the area around the water is completely in the light.
8. Notice how the top begins to fog. Remind students that the water vapor **evaporating** provides the moisture in the air allowing **condensation** to occur.
9. After a couple of hours, the droplets on the ceiling of the bottle are so large that they will begin to drip, simulating **precipitation**.
10. Have the students record their findings on page 18 of the *Findings Booklet*.



Possible Extensions/Adaptations/Integration:

If resources permit, organize this activity as a take home science demonstration as found on page 18 of the *Findings Booklet*. Students can teach their family about the water cycle and report their experience to the class.

You may choose to extend this activity by having the students mold landforms out of clay in the bottom of their bottle. You may use the following recipe for Salt Ceramic Dough.

Salt Ceramic Dough

Mix together:

1 cup of salt
1/2 cup corn starch
3/4 cup cold water

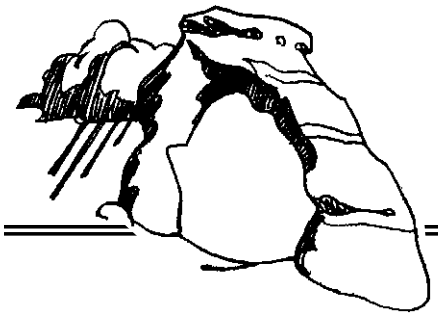
Heat this mixture on the stove. (A double boiler works best, but a saucepan on low to medium heat is satisfactory.)

Stir constantly (about 2-3 minutes) until it becomes so thick that it follows the spoon in the stirring process, similar to bread dough. Spoon out the mixture onto foil or wax paper. When it is cool enough to handle, knead the dough for several minutes, and store in a sealed plastic bag until ready to use.

Assessment/Findings:

Check for students' understanding as they operate their chambers and do a class review of appropriate science language including: **condensation**, **evaporation**, **precipitation**, and **water cycle**. Engage students in a classroom discussion of the roles **condensation**, **evaporation**, and **precipitation** play in the **water cycle**.

— Notes —



Activity H
Water Cycle Celebration

Springboard Question #4 Why is water important to me?

Materials:

Will vary according to student projects.

Invitation to Learn:

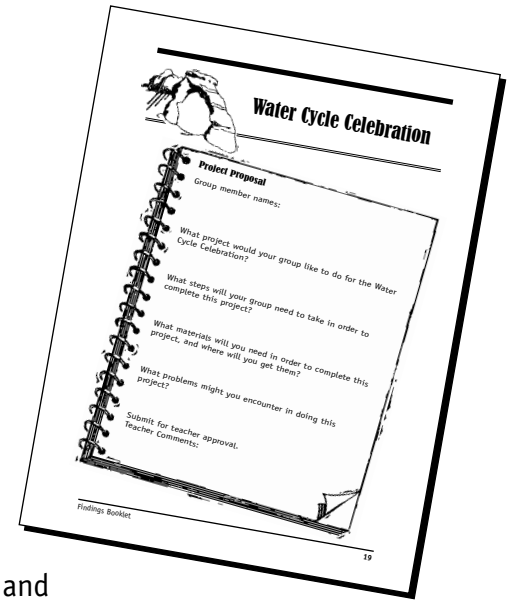
As a culminating activity, organize a water cycle celebration (mini water science fair). The intent of the water cycle celebration is: 1) to promote good classroom science, 2) to provide students with the opportunity to demonstrate knowledge they have learned about the water cycle, and 3) to extend student learning to relevant water issues in their community. The water cycle celebration could be spread over several days or utilize much of an entire day. It is suggested that the activity be initiated by discussing the celebration with students. Brainstorm ideas that relate to the standard objectives covered by the lessons. Encourage ideas by considering:

- Activities that have been done in the unit and extensions to those activities,
- Water-related vocabulary,
- Potential field trips and resource persons,
- How the water cycle components influence student lives,
- Potential videos on storms, floods, water cycle, etc. for inclusion in a view-a-thon,
- Potential posters, projects, displays, or experiments that could be up for visitors of the classroom,
- Water-related issues relevant to your community,
- Exhibitors that might share their assets (for example stream and groundwater models), or
- Having a water-related employment time for invited professional business people to share information about their jobs (hydrologist, water plant supervisor, laundromat operator, carwash owner, etc.).

For their projects, students might:

- Create a water cycle music video or organize a sing-a-long,
- Research the role water played in establishing their community,
- Create a recipe booklet of simple products containing water,

- Have a water cycle-related sharing time during which students share events that happened in their families. They may share about floods, plugged drains, storms, wet clothing, recreational events in water, or how ancestors came to America,
- Research local water supplies and concerns,
- Create a river model of the community,.
- Demonstrate an evaporation model,
- Create a model showing how the lake effect works,
- Describe why Utah claims to have the greatest snow on Earth, or
- Trace a water molecule through the water cycle using a narrative essay.

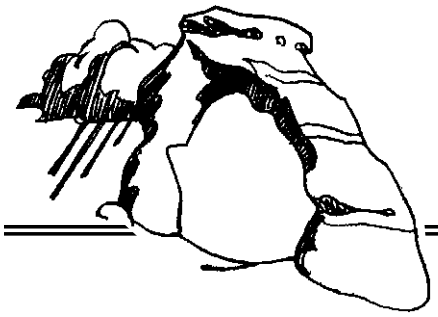


Instructional Procedures:

1. Have students use the proposal found on page 19 of the *Findings Booklet* to outline a plan for their project.
2. Have students discuss their plans and obtain teacher approval signatures before starting the process.
3. Organize student projects into a meaningful opportunity and extend appropriate invitations to parents and other classrooms.

Assessment/Findings:

Prior to celebration proposal, create with students an evaluation tool (i.e., a rubric) to assess student understanding and performance. Use the background information and science language as guides to create an evaluation tool that adequately measures student understanding.



Teacher's Guide
Glossary

aquifer: an underground bed or layer of dirt, gravel, or porous stone that stores groundwater for wells, springs, and other groundwater reserves.

clouds: when moist (wet air) rises and becomes cooler it cannot hold as much water vapor as warm air; the extra water vapor changes into tiny drops of water or crystals of ice to form clouds

condensation: the process of water vapor in the air turning into liquid water, as on the outside of a cold glass of water; condensation is the opposite of evaporation

condensation nuclei: a tiny particle in the air such as dust or smoke in which water vapor condenses around forming water droplets

conservation: to conserve and protect resources, e.g. water, from becoming contaminated and less valuable or usable

dew: condensation of water on cool objects such as grass

domestic water use: water used for household purposes, such as drinking, food preparation, bathing, washing, flushing toilets, and watering lawns and gardens

energy: the ability to do work; most of the energy on Earth comes from the sun, although some forms of energy are stored within the Earth itself, such as heat energy

evaporation: change of a liquid, such as water to vapor; how fast water evaporates depends on the amount of water vapor already in the air (humidity), the temperature of the water, the surface area exposed to the air, and air movement over the surface

freshwater: water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids; generally, water with more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses

glacier: a huge mass of ice formed on land by compacted snow that moves very slowly downslope or outward due to its own weight

groundwater: water beneath Earth's surface, often in saturated soil and rock that supplies wells and springs

hail: water that falls to Earth in frozen form; each hailstone consists of layers of ice formed as rain is carried high in a cloud, freezes, falls, collects another layer of water and is carried up, and again freezes- this process is repeated until the hail falls to the ground

heat energy: a form of energy that is passed from one object to another because of a difference in temperature; measured in calories

humidity: dampness or moisture in the air or atmosphere

impermeable layer: a layer of solid material, such as rock or clay, which does not allow water to pass through

industrial water use: water used for industrial purposes (steel, chemical, paper, and petroleum refining)

irrigation: the controlled application of water for agricultural purposes through manmade systems (ditches, channels, pumps, wells, sprinklers, etc.) to supply water requirements not satisfied by rainfall

lake effect: the effect of any lake in modifying the weather in nearby areas

leaching: the process by which soluble materials in the soil, such as salts, nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water

ocean: the entire body of salt water that covers 70% of Earth's surface; the whole body of salt water is thought of as being four separate entities or oceans called the Pacific, Atlantic, Arctic, and Indian Oceans

organic matter: plant and animal material, or substances originating from living organisms; all are based upon carbon compounds

potable water: water of a quality suitable for drinking

precipitation: water that falls to Earth as rain, snow, hail, or sleet

rain: water that falls to Earth in liquid water form; each raindrop is formed around a core of a dust particle

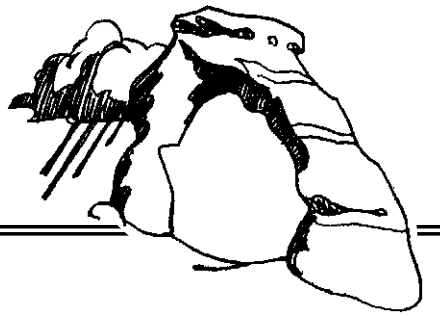
reservoir: a pond, lake, or basin, either natural or artificial, for the storage, regulation, and control of water

river: a natural stream of water of considerable volume, larger than a brook or creek

runoff:	precipitation that flows into surface streams, rivers, and lakes
sleet:	water that falls to Earth as frozen rain
snow:	water that falls to Earth as frozen flakes; snowflakes are frozen water vapor formed into six-sided crystals
solar energy:	energy produced from the sun
sublimation:	water that goes from a solid such as snow or ice to water vapor
surface area:	amount of water touching the air
surface water:	water that is on Earth's surface, such as in a stream, river, lake, or reservoir
temperature:	the degree of hotness or coldness of a body or environment
transpiration:	process by which water is transformed into the atmosphere from the plant surface, such as leaf pores
wastewater:	water that has been used in homes, industries, and businesses that is not for reuse unless it is treated
water cycle:	when water changes back and forth between solid, liquid and vapor as it travels in, on, and around Earth through various stages or processes such as precipitation and evaporation; also called the hydrologic cycle
water table:	the top of the water surface in the saturated part of an aquifer
water vapor:	water in a gaseous form

— Notes —

Student Glossary



clouds when moist, (wet air) rises and becomes cooler it cannot hold as much water vapor as warm air; and the extra water vapor changes into tiny drops of water or crystals of ice to form clouds

condensation the process of water vapor in the air turning into liquid water, as on the outside of a cold glass of water; condensation is the opposite of evaporation

condensation nuclei a tiny particle in the air such as dust or smoke on which water vapor condenses forming water droplets

conservation to conserve and protect resources, e.g. water, from becoming contaminated and less valuable or useful

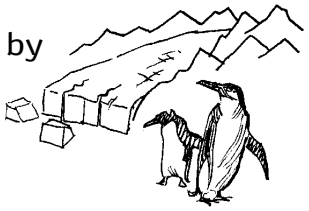
dew condensation of water on cool objects such as grass

energy the ability to do work; most of the energy on Earth comes from the sun, although some forms of energy are stored within the Earth itself, such as heat energy

evaporation change of a liquid, such as water to vapor; how fast water evaporates depends on the amount of water vapor already in the air (humidity), the temperature of water, the surface area exposed to the air, and air movement over the surface

freshwater water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids; generally, more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses

glacier a huge mass of ice formed on land by compacted snow that moves very slowly downslope or outward due to its own weight



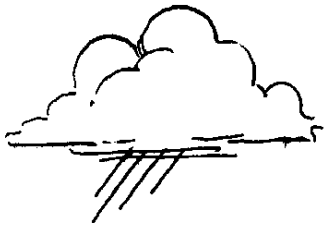
groundwater water beneath Earth's surface, often in saturated soil and rock that supplies wells and springs

hail water that falls to Earth in frozen form; each hailstone consists of layers of ice formed as rain is carried high in a cloud, freezes, falls, collects another layer of water and is carried up, and again freezes- this process is repeated until the hail falls to the ground

heat energy a form of energy that is passed from one object to another because of a difference in temperature

humidity dampness or moisture in the air or atmosphere

ocean the body of salt water that covers 70% of the Earth's surface

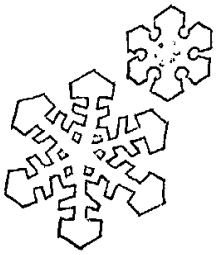


precipitation water that falls to Earth as rain, snow, hail, or sleet

rain water that falls to Earth in liquid water form; each raindrop is formed around a core of a dust particle

runoff precipitation that flows into streams, rivers, and lakes

sleet water that falls to Earth as frozen rain

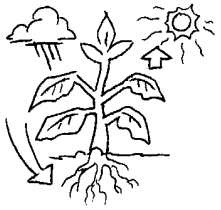


snow water that falls to Earth as frozen flakes; snowflakes are frozen water vapor formed into six-sided crystals

solar energy energy produced from the sun

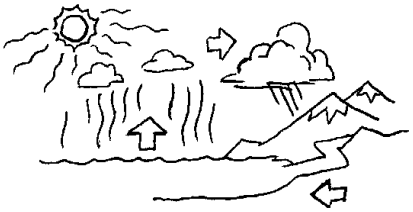
sublimation water that goes from a solid such as snow or ice to water vapor

surface area amount of water touching the air



temperature the degree of hotness or coldness of a body or environment

transpiration process by which water is transferred into the atmosphere from the plant surface such as leaf pores



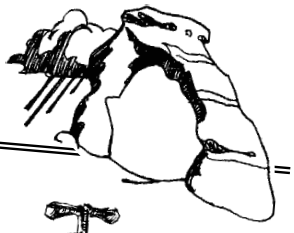
water cycle when water changes back and forth between solid, liquid and vapor as it travels in, on, and around Earth through various stages or processes such as precipitation and evaporation; also called the hydrologic cycle

water vapor water in a gaseous form

— Notes —

Answers to *Findings Booklet* and Final Exam

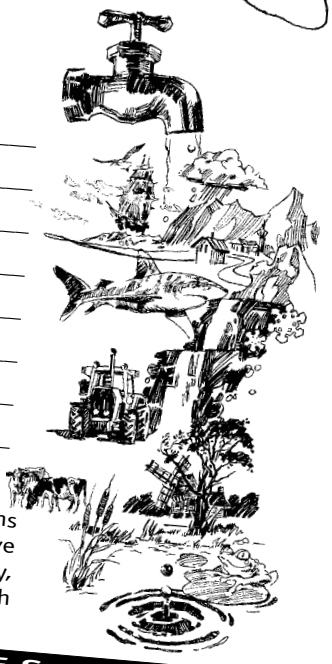
Where is Water Found?



List the places where you can find water:

answers will vary

drinking fountains
rivers
lakes
puddles
tap
wells, etc.



Write the 3 main categories of water locations below, then place the items from your list above in the category where they belong. Finally, estimate the percent of water found in each category.

CATEGORIES		
oceans _____% estimate	glaciers _____% estimate	freshwater _____% estimate
answers will vary	answers will vary	answers will vary

Findings Booklet

5

Actual percentages of water locations.

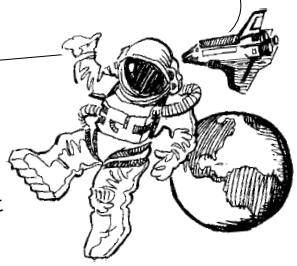
oceans ___97___%

glaciers ___2___%

freshwater ___1___%

Neat facts:

- 70% of Earth's surface is covered by water
- 0.001% of Earth's water is found in the atmosphere



Rename Earth

Assume that you landed anywhere on Earth as a space explorer. Based on what you now know about water, what would you see?

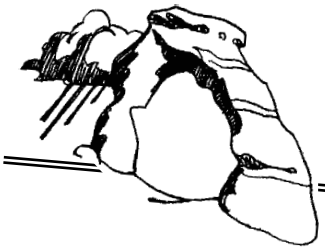
answers will vary

What would you name the planet? Why?

answers will vary

Choose one new thing you learned about water. How will this influence your future water use?

answers will vary



Why Does a Puddle Shrink?

KWL Chart:

K	W	L
What do you already ***know*** *about evaporation?*	*What do you* ***want*** *to know about evaporation?*	*What have you* ***learned*** *about evaporation?*
answers will vary	answers will vary	answers will vary

You will be conducting an experiment with 5 small puddles of water. Follow your teacher's instructions to conduct this evaporation activity.

Factors that are the same for all five puddles:

Same temperature

Same material surface

Same air movement

Same humidity

Factor(s) that are different for all five puddles:

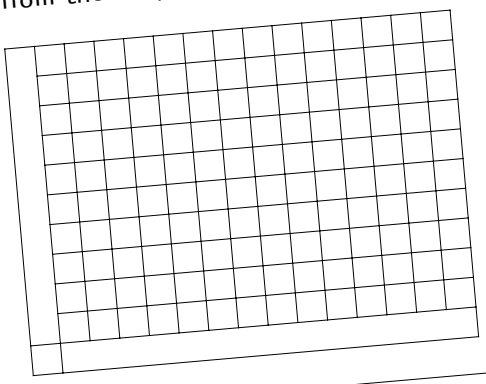
Surface area is different for each puddle

Evaporation Data Chart

Measurements	Puddle A	Puddle B	Puddle C	Puddle D	Puddle E
Starting amount of water (number of drops)	data	will vary			
Starting diameter/ size					
Ending diameter/size					
Ending amount of water (number of drops)					
Amount of water evaporated*					

**HINT: Starting amount of water minus ending amount of water equals amount of water evaporated.*

Convert your data from the evaporation data chart to the graph below.



Compare the two charts:

answers will vary

What can you conclude based on the information you collected?

basic concept: evaporation varies based on surface area. Surface area determines evaporation when all other variables are constant.

HOME ACTIVITY
Drying Laundry

Today I learned that:

Temperature and surface area affect evaporation rates. In class we measured and compared how different-sized water puddles evaporate.

Fun Focus:

This home activity will demonstrate some of the factors that influence evaporation.

Materials:

- 4 Paper towels
- Water
- Teaspoon
- Fan

Procedure:

1. Place one teaspoon of water on each of the 4 paper towels.
2. Put one towel in a cold place and one towel in a warm place. Observe both to see which dries first. Record the drying times.
3. Put another towel in a breezy place (fan) and one where there is not a breeze. Record the drying times.

Condition	Cold	Warm	Breezy	No breeze
Location	data will vary			
Drying time				

4. Discuss what happened with family members.
5. Talk with a grandparent or an older neighbor and ask how they dried clothing when they were young. Write about your discussion.
6. What conclusions can be made from doing this activity?

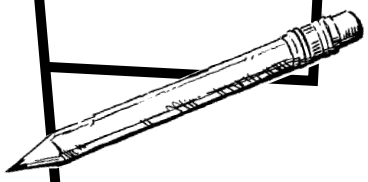
items dry best in a warm, breezy place which is ideal for rapid evaporation.

Condensation Data Collection

Draw the chamber just after closing with tape:

Draw the chamber after it has been sitting in a sunny location for 1-3 hours:

Draw the chamber after 24 hours:



Explain what you think happened by answering the following questions. Include the following words in your discussion: temperature, evaporation, and condensation.

Is heat a factor in making the condensation chamber work? How?

yes – heat is required to warm the chamber, causing evaporation

How does the sun affect the chamber?

the sun warms the chamber and allows evaporation to occur

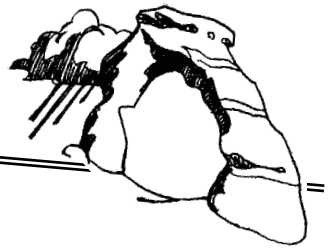
What do you think happens to the chamber at night?

the chamber lid cools and water condenses on it

If the temperature is warmer or colder on one side of the chamber than the other, what happens?

the water vapor will condense on the colder side of the chamber

Heat Energy and Water:
What is the Best Way to Melt Ice?

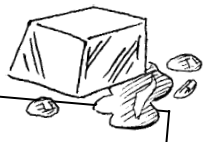


Task:
Melt ice without touching it.

What are your two best ideas for melting the ice?

1. answers will vary
2.

Ice Melt Data Chart



Temperature Readings	Temperature	Time
1st: temperature of solid ice	data	will vary
2nd: ice just beginning to melt		
3rd: melting ice		
4th: ice almost melted		
5th: ice completely melted		

Describe what happened during this experiment.
students will need to describe what they observed

What did you find interesting as you melted the ice?
answers will vary

The Water Cycle Model:

Making A Cloud

Discussion Question:
What makes a cloud?

Materials:
clear 2 liter pop bottle/lid
flash light (Optional)
warm water
measuring cup

Step 1: Add about 80-100 ml (1/2 cup) of warm water to the pop bottle.
Step 2: Add condensation nuclei:
FOLLOW TEACHERS DIRECTIONS
Step 3: Seal the bottle with the lid.
Step 4: Shine the flashlight through the side of the bottle. (Optional)
Step 5: Describe what you see.
Step 6: Squeeze the bottle for a minute or more. What happens?
Step 7: Suddenly release the pressure. What do you see?
Step 8: Repeat the above steps, but don't add smoke to the bottle.
Why do you need dust for clouds to form?
dust is the condensation nuclei that the water vapor is attracted to

What have you learned about humidity, air pressure, and condensation nuclei?
answers will vary

Temperature plays an important role in the evaporation of water. Describe a situation where water would evaporate rapidly to form clouds?
high temperature, low humidity

A Water Cycle Chamber

Discussion Question:
When a cup filled with a cold drink is placed in a warm room, what happens to the outside of the cup? Why?

Materials :

Clear 2-liter pop bottle with lid
Lamp
Scissors
Ice in Ziploc® bag
Warm water

Step 1: Have an adult help you cut the top off the clear 2-liter pop bottle. Cut just where the side straightens out. (An adult will insert a knife to make a hole, then use scissors to cut the top off the bottle.)

Step 2: Place a cup of very warm water in the bottom part of the bottle.

Step 3: Invert the top of the bottle and place it in the bottom section of the bottle.

Step 4: Fill the inverted top with the bag of ice.

Step 5: Darken the room and observe the chamber using the lamp.

Step 6: Check the bottle over 2 hours time period to observe what is happening inside the bottle.

What does each part of the water cycle chamber represent?
ceiling of the bottle: condensation nuclei
ice cubes in the bag: cooling temperature of upper atmosphere
warm water: ocean
lamp: sun/heat energy

Where is water evaporating?
from water into atmosphere

Where and why is water condensing? on ceiling, because there is a cooler temperature and a solid surface

Tell what you know about clouds, cold surfaces, and condensation nuclei from this demonstration. answers will vary

Assessment Philosophy:

The Final Exam has been provided to aid teachers in assessing student knowledge in a summative manner. It is expected that the majority of evaluation will occur on a daily basis throughout the instructional unit. One goal of this assessment is to allow students to verbalize in writing their understanding of the water cycle. This goal is accomplished with open-ended short-answer questions. Another goal is to introduce fourth grade students to multiple-choice questions that are found on the end of level testing. Assessment should guide instructional practice, allowing students the opportunity to show what they know.

Final Exam

1. How would you explain and demonstrate evaporation to another person?

   answers will vary, refer to pp. 12, 26

2. How would you explain and demonstrate condensation to another person?

   answers will vary, refer to pp. 16, 26

3. What conditions influence how fast water evaporates?

   humidity, temperature, surface area, air movement

4. Describe how a cloud is formed.

   answers will vary, refer to pp. 20–22, 26

5. What percent of Earth's water is found in:

   Oceans 97% ? Glaciers 2% ? Freshwater 1% ?

The Search for the Water Cycle

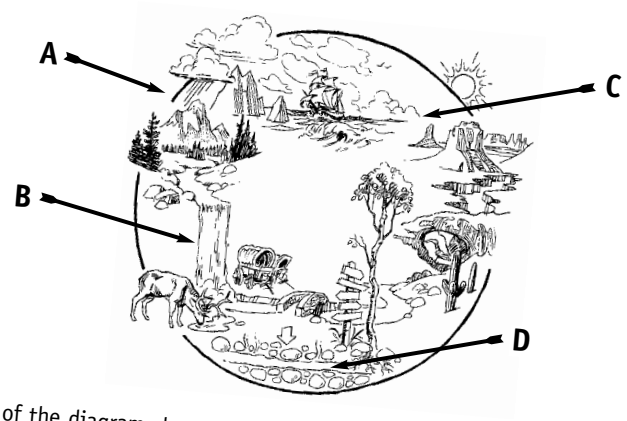
63

(Circle the correct answer)

6. Another name for rain or snow is:
   a. runoff b. condensation c. evaporation (d. precipitation)

7. Examples of runoff are:
   a. streams b. water falls c. lakes (d. all of the above)

Use the diagram below to answer questions 8-10.



8. What portion of the diagram shows groundwater?
   A B C (D)

9. The diagram has several examples of the water cycle. Which of the following is an example of condensation?
   (A) B C D

10. Which is an example of evaporation?
    A B (C) D

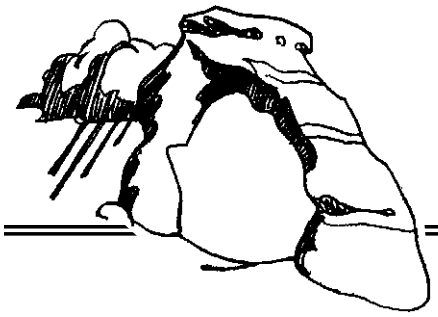
11. List four kinds of precipitation:

    rain, snow, sleet, hail

12. Why is the water cycle important to you?

    answers will vary

— Notes —



Resources

Teaching Resource Books:

The Comprehensive Water Education Book, Grades K-6

International Office for Water Education, Utah State University: 1994
Based on the assumption that children learn best by doing, this book provides lesson plans and activities to help students develop a scientific attitude. A great resource book for doing exciting things in the classroom with water! Available for purchase by calling 800-922-4693.

Water, Grades K-3 (CD-7298)
Water, Grades 4-6 (CD-7299)

Carson-Dellosa Publishing Company, Incorporated
These two books are from the Step-by-Step Science series and contain hands-on activities and creative science explorations designed to challenge and stimulate students' minds. The identification numbers are provided above and the books are available for purchase by calling 800-321-0943 or visiting your local school supply store.

Children's Literature:

A Drop Around the World

Barbara Shaw McKinney and Michael S. Maydak (illus.)
Dawn Publishing: 1998
ISBN: 1883220726
McKinney combines an accurate depiction of the water cycle with entertaining and engaging text.

The Drop in My Drink: The Story of Water on Our Planet

Meredith Hooper and Chris Coady (illus.)
Viking Penguin Childrens Books: 1998
ISBN: 0670876186
This book, designed for the reading level of children ages 9-12, provides a detailed representation of the water cycle and highlights some amazing facts about water.

A Drop of Water: A Book of Science and Wonder

Walter Wick
Scholastic Trade: 1997
ISBN: 0590221973
Wick's beautiful photographs make this a great book but the experiments and "tricks" throughout this book also highlight the wonder and beauty of water in all forms.

The Magic School Bus: At the Waterworks

Joanna Cole and Bruce Degen (illus.)
Scholastic Trade, Incorporated: 1988
ISBN: 0590403605
Ms. Frizzle takes her class into a cloud where they shrink to the size of drops of water and follow the journey of the water through a city's waterworks system. It gives great detail about the wastewater treatment processes.

The Magic School Bus Wet All Over: A Book About the Water Cycle

Patricia Relf, Joanna Cole, and Bruce Degan (illus.)
Scholastic Trade, Incorporated: 1996
ISBN: 0590508334
Experience evaporation, condensation, and precipitation with the wild Ms. Frizzle. Your students will enjoy the illustrations and the antics of the Magic School Bus crew.

The Rainstick: A Fable

Sandra Chisholm Robinson and Peter Grosshauser (illus.)
Falcon Publishing, Incorporated: 1994
ISBN: 1560442840
Includes step-by-step instructions to make a rainstick. This fable shows our need for water as a boy searches for rain. This book was published in conjunction with Project WET.

Water Dance

Thomas Locker
Harcourt: 1997
ISBN: 0152012842
This may work well as a beautifully illustrated introduction to the water cycle. The book talks of the many things water is as it dances through our world. The back of the book offers the illustrations in smaller size beside more detailed text of the phases in the water cycle.

Water Music: Poems for Children

Jane Yolen and Jason Stemple (photographer)
Boyds Mills Press: 1995
ISBN: 1563973367
A book of poetry inspired by all the forms and qualities of water. The photographs are fun and interesting. You could possibly use this book to integrate water across the curriculum.

Agency Contacts:

Below is a list of agencies available throughout the state that you may want to contact for further information about what they offer to educators and the public. If a resource is not listed for your area, contact an official in your city or town.

Central Utah Water Conservancy District

355 West University Parkway
Orem, Utah 84058
801-226-7100
Facility tours and display materials are available on request.

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088
801-565-8903
Tours are available of the state's largest water treatment plant in Bluffdale. The district's billing stuffers and door hangers offer fun ways to promote conservation practices. A demonstration garden is also onsite in West Jordan to show appropriate and conservative landscaping practices. The garden is oriented for public education but tours may be possible.

Metropolitan Water District of Salt Lake City
704 Tribune Building
Salt Lake City, Utah 84111
801-942-1391
Speakers are available to visit your classroom or you may choose to venture out and take a tour of the water treatment plant. Call for more information.

PineView Water System
1483 Wall Avenue
Ogden, Utah 84404
435-621-6555

Provo River Water Users Association
84 North University Avenue
Provo, Utah 84601
801-222-0710

Salt Lake City Department of Public Utilities
1530 South West Temple
Salt Lake City, Utah 84116
801-483-6700

U.S. Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 84606
801-379-1101

U.S. Bureau of Reclamation
Regional Office, Federal Building
Salt Lake City, Utah 84111
801-524-3774

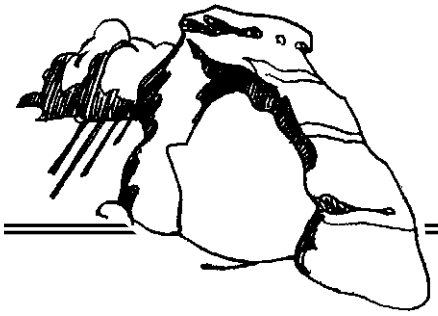
Uintah Basin Water Conservancy District
28 West 3325 North
Vernal, Utah 84078

Upper Colorado River Commission
355 South 400 East
Salt Lake City, Utah 84111
801-521-1150

Utah State Division of Water Resources
1636 West North Temple
Salt Lake City, Utah 84116
801-533-5401

Utah State University
International Office for Water Education
6516 Old Main Hill
Logan, Utah 84322-6516
800-922-4693

Weber Basin Water Conservancy District
2837 East Highway 193
Layton, Utah 84041
801-359-4494



Final Exam

1. How would you explain and demonstrate evaporation to another person?

2. How would you explain and demonstrate condensation to another person?

3. What conditions influence how fast water evaporates?

4. Describe how a cloud is formed.

5. What percent of Earth's water is found in:

   Oceans_____? Glaciers_____? Freshwater_____?

(Circle the correct answer)

6. Another name for rain or snow is:
   a. runoff b. condensation c. evaporation d. precipitation

7. Examples of runoff are:
   a. streams b. water falls c. lakes d. all of the above

Use the diagram below to answer questions 8-10.

8. What portion of the diagram shows groundwater?
   A B C D

9. The diagram has several examples of the water cycle. Which of the following is an example of condensation?
   A B C D

10. Which is an example of evaporation?
    A B C D

11. List four kinds of precipitation:

12. Why is the water cycle important to you?