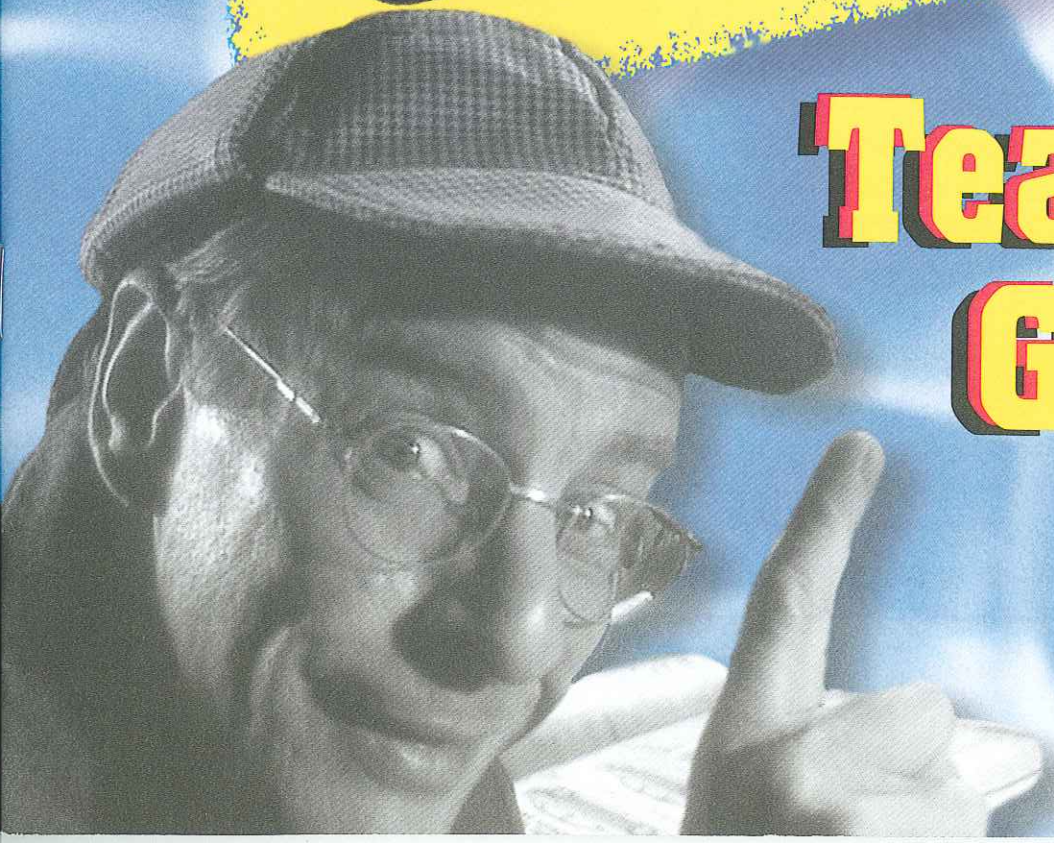
Professor Water & The Amazing Water Cycle



Teacher's Guide

Web Sites

The American Water Works Association
http://www.awwa.org/dww/

The Hydrologic Cycle (NASA)
http://www.earth.nasa.gov/science/index.html

Hydrogeology (EPA)
http://www.epa.gov/seahome/gwprimer.html

Water Science for Schools (USGS)
http://ga.water.usgs.gov/edu/

Groundwater Foundation
www.groundwater.org

Water Science Kits

Available From:

Tom Snyder Productions
80 Coolidge Hill Road
Watertown, MA 02373
1-800-342-0236—Phone
1-617-926-6222—Fax
www.tomsnyder.com

Delta Education
PO Box 3000
Nashua, NH 03061-3000
1-800-442-5444—Phone
1-800-282-0560—Fax
www.delta-ed.com

Professor Water & the Amazing Water Cycle

Teacher's Guide

- Evaporation
- Condensation and Precipitation
- Runoff and Infiltration
- Putting It All Together: The Water Cycle

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Dedicated to Safe Drinking Water

Table of Contents

Writers:
Kenneth Mirvis, Ed.D.
Cathryn M. Delude, M.A.
Neil Clark, M.Ed.

Consultants:
Joseph J. Bernosky, P.E.
Ivan Golakoff, M.S.
Steve Jacobs, M.S., Ed.D.
Chris Willems, B.S., B.A.
Amy Bebell, B.S.
Dan Cedrone, M.S.

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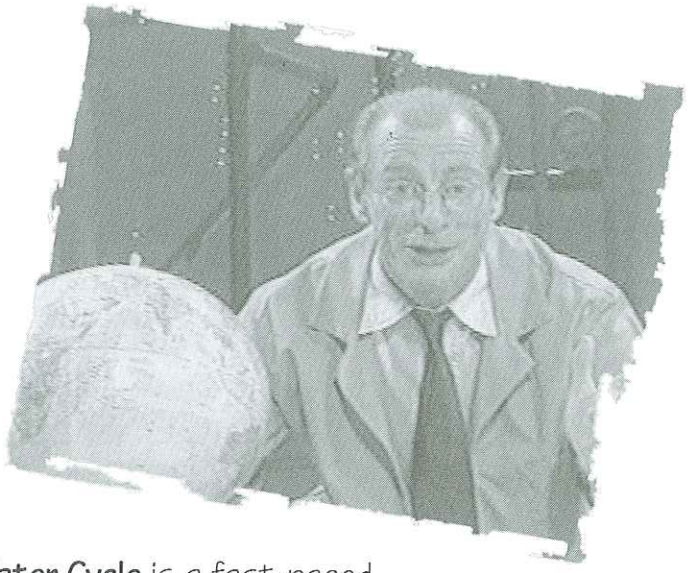


Professor Water and the Amazing Water Cycle is a fast-paced instructional science video series created to help students in grades 4–8 understand the water cycle.

Who is Professor Water?

Professor Water is a slightly weird, sometimes wacky, and often wondrous guide who shows and teaches the wonders of the natural world. Working with young scientists, he helps unravel the mysteries of the world around us—like where rain comes from, what happens to the water once it has fallen to the Earth, and how it gets into the air. The Professor is the facilitator who helps the young scientists (and the viewing audience) discover the answers to their scientific questions.

How to use this Teacher's Guide

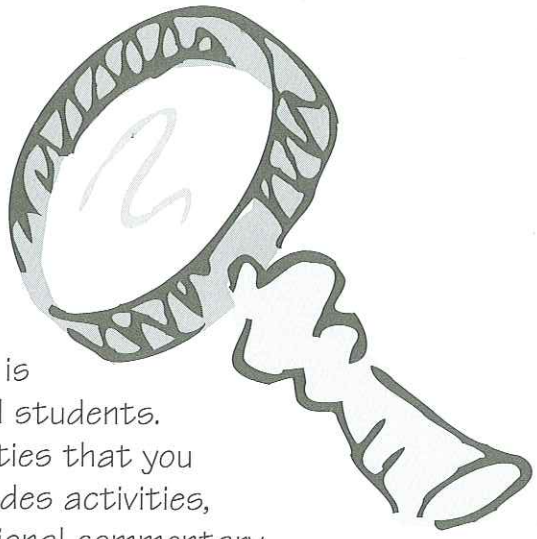
The video is designed to engage the attention of upper elementary and middle school students and introduce them to the concept of the water cycle.

Professor Water and the Amazing Water Cycle is divided into segments that can be discussed apart from the overall program. The video can be "paused" at the end of any segment discussed. The timeline below lists start points, pause points, segment duration, and the segment title.

Start Pause	Duration	Segment
00:00–06:35	6:35	Evaporation Part 1
06:35–14:45	8:10	Condensation and Precipitation Part 2
14:45–20:40	5:55	Runoff and Infiltration Part 3
20:40–26:40	6:00	Completing the Cycle Part 4

If you have purchased the video set, you have two VHS videotapes designed for classroom presentation. The timelines for the two tapes are different. The first is the broadcast version (26:40) listed above. The second tape contains the program divided into four separate segments for easy classroom use. Each segment is a stand-alone science lesson referenced in the Teacher's Guide.

Start Pause	Duration	Segment
00:00–06:40	6:40	Evaporation Part 1
07:00–15:20	8:20	Condensation and Precipitation Part 2
15:45–22:00	6:15	Runoff and Infiltration Part 3
22:20–28:10	5:50	Completing the Cycle Part 4



Introduction

This *Professor Water* video on the water cycle is aimed at upper elementary and middle school students. Each video includes demonstrations of activities that you can do in the classroom. This Teacher's Guide includes activities, an edited copy of the script, vocabulary, and additional commentary. Each of the four parts of the video addresses an aspect of the water cycle:

Part 1: Evaporation

Part 2: Condensation and Precipitation

Part 3: Runoff and Infiltration

Part 4: Putting It All Together: The Water Cycle

The video provides a new twist to the standard treatment of the water cycle: the self-cleaning property of water. The structure of the H_2O molecule encourages it to attract or dissolve other substances. As a result, "pure water" is more theory than reality. Most water on earth is either a solution, a suspension, or both. Despite this fact, water is purified through the natural water cycle. As a result, we have a self-cleansing planet capable of sustaining life for millennia on a finite and relatively small quantity of available fresh water.

Learning Objectives

At the end of the lesson, students will be able to define, give examples of, and create experiments related to phase changes and the processes of the water cycle, including condensation, evaporation, precipitation, runoff, and percolation.

Science Standards

The National Science Standards cautions that elementary schoolchildren may have difficulty understanding key concepts of the water cycle. For example, students are familiar with the phase-change of water to ice, but most elementary students have difficulty with the concept that water exists as a gas when it boils or evaporates. They are more likely to think that water disappears into the sky. Please remember that these concepts are counterintuitive; they must be explicitly taught, because they're unlikely to be just absorbed.

Composite of Science Standards Addressed in These Materials

- Water exists in three states (solid, liquid, and vapor); it changes from one phase to another through three processes: evaporation, condensation, and freezing or melting.
- The water cycle involves evaporation, condensation, precipitation, infiltration, and runoff in cyclic patterns that move water through the environment.
- There are many qualities of water, and most water is salt water.
- Water continuously circulates through the atmosphere, oceans, glaciers, across the earth's surface, and underground.
- Water is finite; the amount of water on earth is always the same, so freshwater resources are limited.

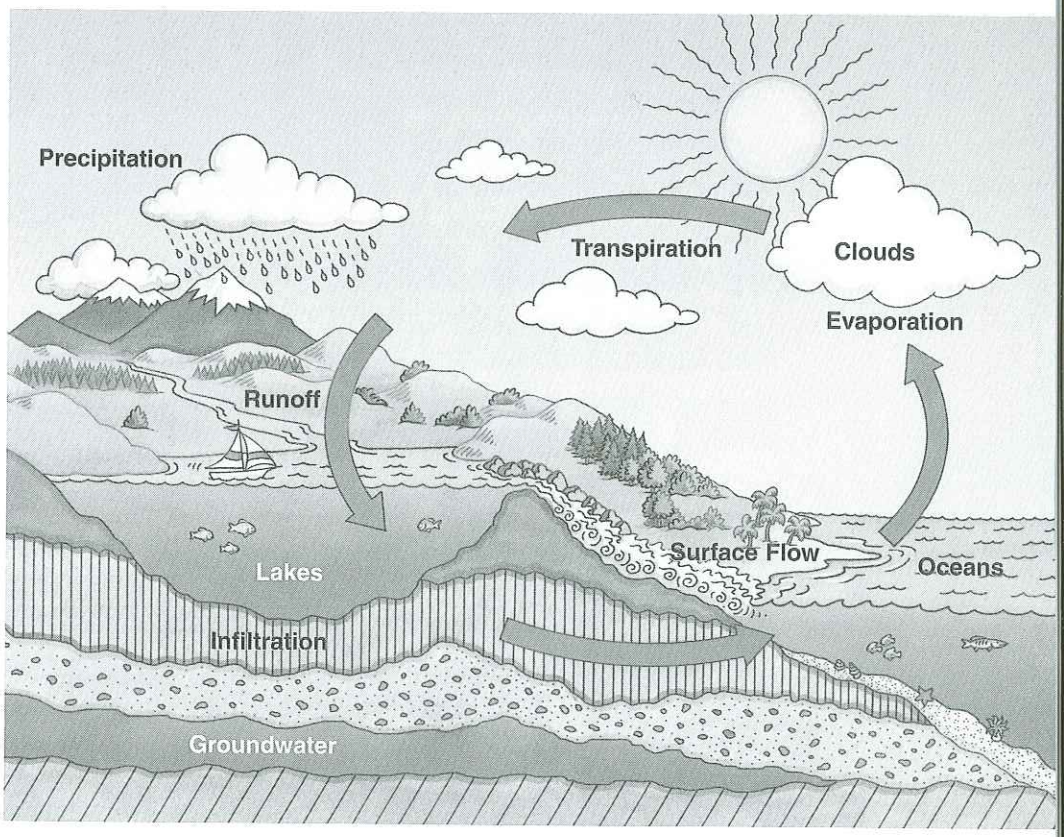
Related topics you may choose to pursue as extensions include

- The effect of the water cycle on weather and climate.
- The four major interacting components of the earth system: geosphere (crust, mantel, core), hydrosphere (water), atmosphere (air), and the biosphere (all living things).

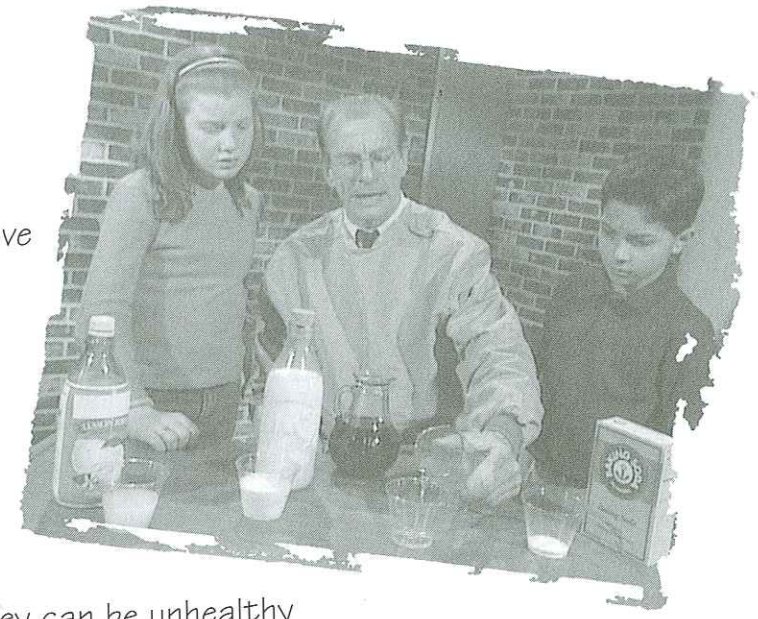
The Water Cycle

Water moves through the water cycle in three states: liquid, solid, and vapor. While we know pure water to be H_2O, virtually all of the "water" we find throughout nature is more than just the water molecule: it usually contains other molecules, either in solution (such as salt water) or a mixture or suspension (such as muddy water).

Solar energy and ***gravity*** drive the motion of the water cycle. Heat from the sun causes water to evaporate into the atmosphere. It also causes the winds that move water vapor great distances over the earth. Loss of heat causes condensation of vapor into liquid droplets. Gravity pulls the water droplets to earth and causes them to run downhill or seep into the earth.



As water moves through the water cycle, it dissolves and suspends other substances, thus generating a continuous change in its chemistry. But the water molecule itself is inert and remains unchanged. ***Just as the water cycle adds constituents to water, it also purifies water.*** When water molecules evaporate, they are freed from the other molecules. Thus, the water cycle "recycles" the same water molecule over and over. All the water that exists today has existed since the earth was formed, and each water molecule has moved continuously through the water cycle in different paths and at different rates throughout time.



Many of the constituents that interact with water have occurred naturally throughout earth's history, and life forms have adapted to them. Organisms depend on these ingredients in water for nutrients. But many other constituents in today's water supply are caused by pollution, and they can be unhealthy for humans and other life forms. Because of water's movement through the water cycle, almost everything we do affects the water through the substances it picks up.

Teaching Notes

The handouts of vocabulary and fast facts may be helpful to your students before or after viewing the video. Likewise, the discussion notes may be used to introduce the film, to discuss during pauses, as a follow-up activity, or as background to a specific activity.

Discussion Points

Part 1: Evaporation

*EVAPORATION is a **PHASE CHANGE** from a **LIQUID** state to a **GASEOUS/VAPOR** state caused by heating. Evaporation represents a **PROCESS** in the **WATER CYCLE.***

Note: Water can evaporate directly from ice, a process called "sublimation." It also evaporates from the leaves of plants, a process called "transpiration."

- **Where does water come from?**

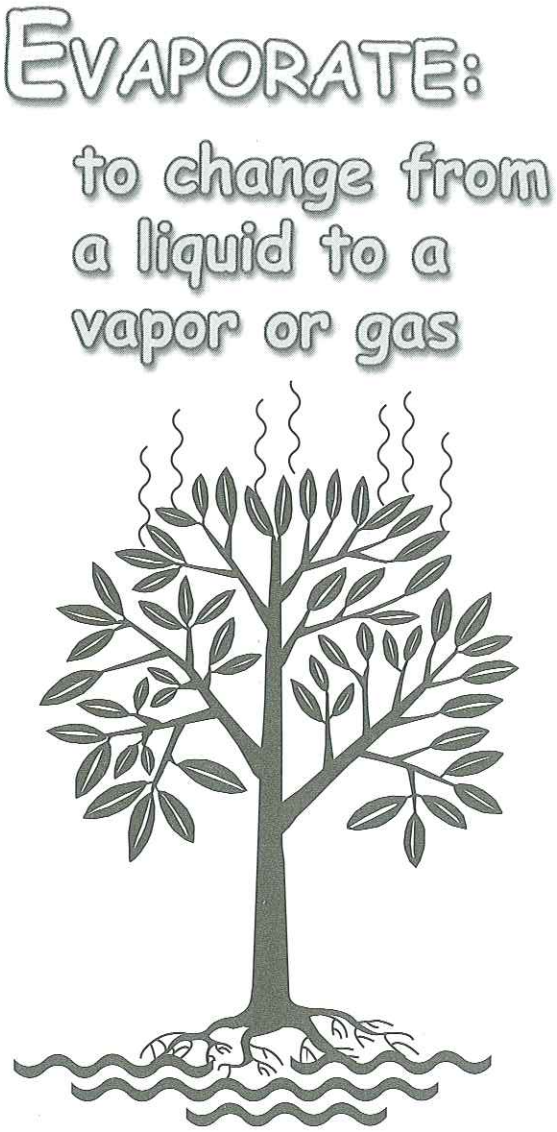
  This seemingly simple question is scientifically complex and can foster discussion and research. Was water created when the earth was formed? Was it brought to Earth by comets? If so, where did that water come from?

- **When puddles dry up after a rain, where does the water go?**

  When mud dries, and the water evaporates, does the dirt go with it, or is it left behind?

  What affects how fast puddles dry?

  The water molecules evaporate into the air and leave the dirt particles behind. Heat, sunshine, relative humidity (the amount of water vapor in the air), and whether the surface absorbs some of the water all affect the speed of evaporation.



- **Can you think of any other substance that exists in all three phases (solid, liquid, and vapor) in nature?**

  Water is the only substance that exists in three states at earth's normal range of temperatures and atmospheric pressure.

- **What are several examples of the fact that the human body contains a lot of water?**

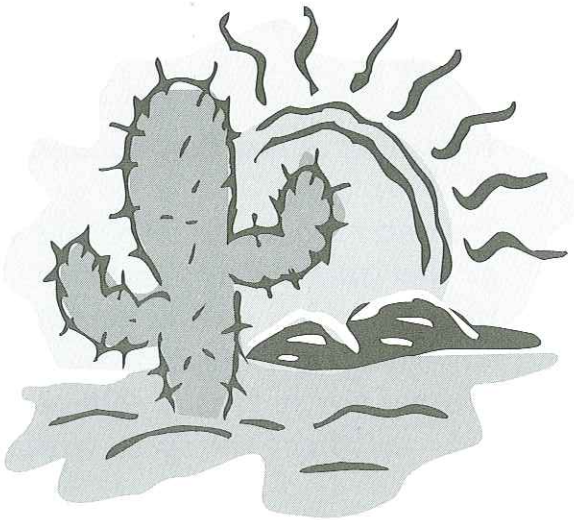
  Sweat, urine, and the fact that we are buoyant in a swimming pool.

- **How do we describe the amount of water in the air?**

  Humidity.

- **Would water evaporate at the same rate in a desert and a tropical rain forest if the air were the same temperature?**

  No. The tropics contain more water vapor in the air—more humidity—so surface water evaporates much more slowly.



Part 2: Condensation and Freezing

CONDENSATION is a PHASE CHANGE from a GASEOUS state to a LIQUID state caused by cooling. When condensation or precipitation FREEZES, it undergoes another PHASE CHANGE, from a LIQUID to a SOLID. CONDENSATION and PRECIPITATION represent PROCESSES in the WATER CYCLE.

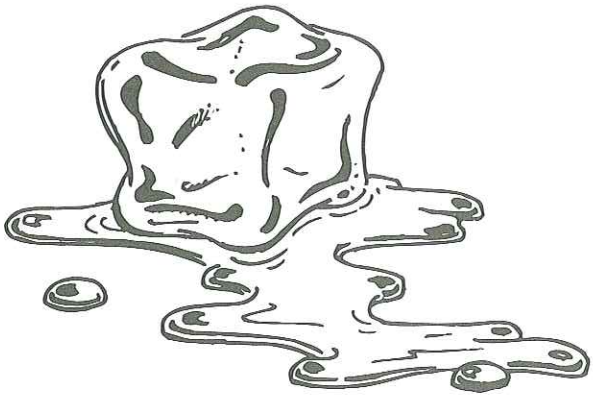
- **If heat causes water molecules to separate from the surface of liquids and evaporate, what happens when the water vapor loses heat?**

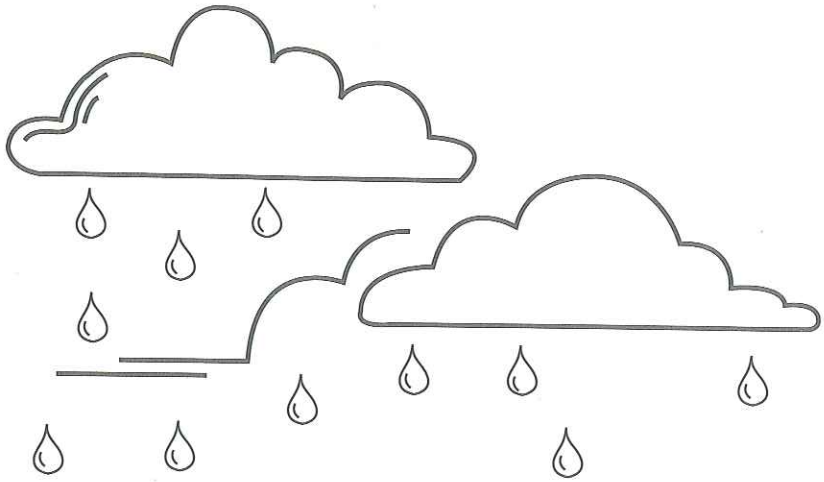
  The water vapor condenses into droplets.

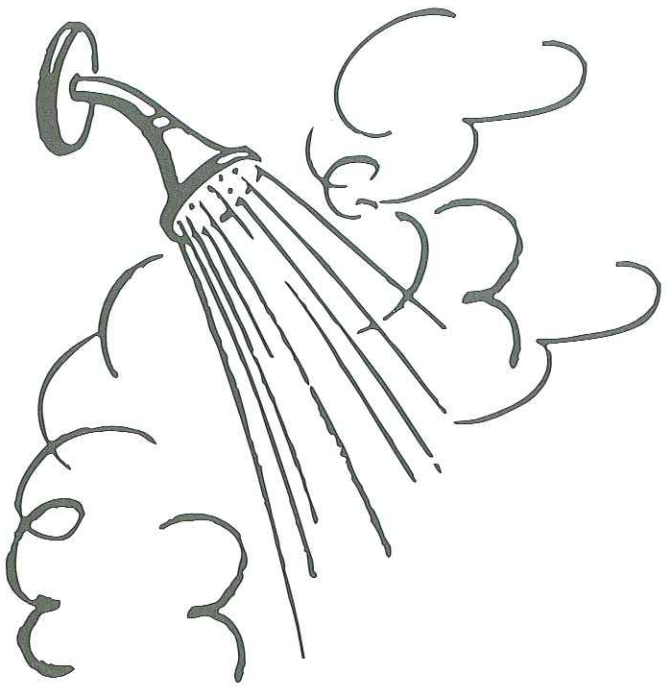
- **What are several examples that show that air contains water?**

  Fog on a windshield, dew on grass, droplets on a glass of ice water, and visible breath in cold weather.

CONDENSE:
to change a gas or vapor into a liquid by cooling







- **What important force on earth causes precipitation?**

  Gravity, which pulls the water droplets to earth.

- **Is rainwater clean? Is it pure?**

  Clean and pure are relative words. Strictly speaking, the only "pure" water in nature is water vapor where the water molecule is not mixed with any other substance. Otherwise, water in nature is a mixture or a solution. Whether or not water is "clean" depends on its use, such as whether it is to be used to drink, to manufacture microchips, to water a crop, or to sustain the creatures in a wetland.

- **Why is rainwater generally somewhat acidic?**

  Air contains other gases besides water vapor, and water droplets dissolve these gases, including carbon dioxide. When it mixes with water, carbon dioxide creates carbonic acid. At other times, precipitation becomes acidic when it mixes with acid-forming compounds in the atmosphere that result from human-caused combustion. (Students can explore this chemical change in an activity suggested on pages 18 and 19.)

Part 3: Runoff and Infiltration

INFILTRATION *and* RUNOFF *are two* PROCESSES *in the* WATER CYCLE.

- **Why are some deep underground aquifers called "fossil aquifers"?**

Sometimes runoff infiltrates into aquifers that are very deep and cannot easily be tapped. That water may stay underground for centuries in pockets that neither drain nor refill. Because of their age and stability, these centuries-old aquifers are often called "fossil aquifers."

RUNOFF:

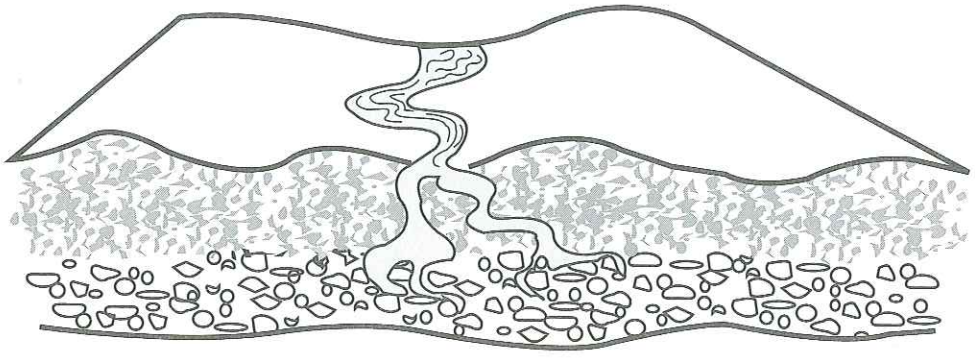
water from rain or melted snow that flows over the earth's surface into a river, lake or ocean

- **How can dirt and rocks make water cleaner?**

  When water infiltrates the ground, it squeezes through ever-smaller spaces in the rocks, which strip away the solid particles suspended in the water.

- **What other paths could a water droplet's obstacle course on earth include?**

  Water can be sucked up into the roots of plants and transported out to leaves, where it evaporates—a process called transpiration. It might also become a "drink" for an animal, where it is then carried around as blood, urine, or sweat.



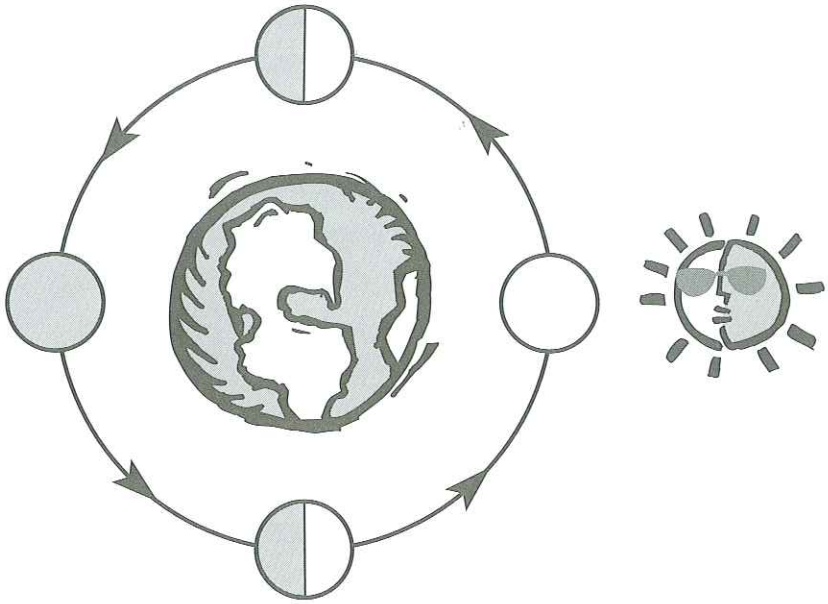
- **What are ways that nature changes the quality of water as it moves through the processes of infiltration and runoff?**

  Infiltration can add minerals and salts to the water; it can also strip away particles. Runoff over forests and fields causes water to pick up many particles and bacteria. Both processes will change the water's quality.

- **What are some ways that human beings change the quality of water as it moves through the processes of infiltration and runoff?**

  Human-made surfaces can reduce the amount of water that can infiltrate and increase runoff, causing erosion. These surfaces may also contain other substances, such as oil, that get dissolved in water and seep into the groundwater. Farming, industry, transportation, and other activities add many chemicals to the water in a way that nature is not able to purify. For example, if an aquifer becomes polluted, the water from the aquifer will become purified as it moves through the water cycle, but the aquifer itself—and the water in it—will remain polluted.

Part 4: The Water Cycle



- **What is a cycle?**

  A cycle repeats a series of processes without a beginning or an end.

- **What are other examples of cycles in nature?**

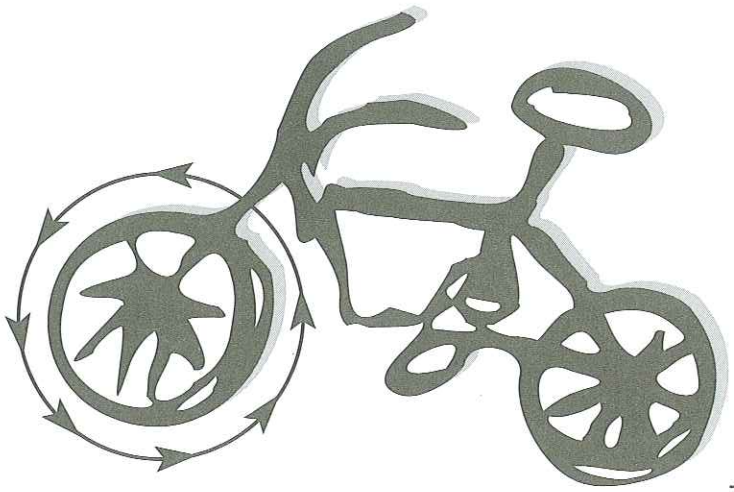
  Day and night, seasons, lunar phases, planetary orbits, and biochemical cycles like the nitrogen and carbon cycle.

- **How does a cycle differ from a circle?**

  Cycles do not have just one path. There are many possible routes to travel between processes.

- **Is water finite? Is it a renewable resource?**

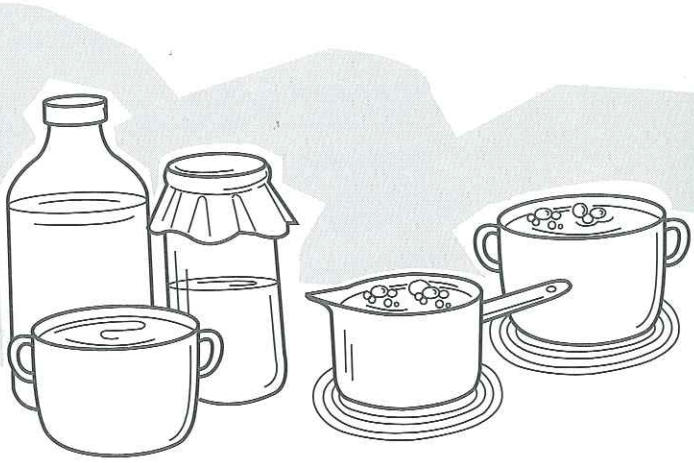
  Water is a finite resource: all the water that will ever exist on earth exists now, and no more will be created. However, it is also renewable: it is not used up. With care, water can be reused infinitely.



Activities

Part 1: Evaporation

Activity 1: Observing and Measuring Evaporation



What affects the speed at which a container of water evaporates?

Purpose

To demonstrate that water evaporates, turning from liquid to gas. By adding variables to the experiment, you may demonstrate conditions that accelerate evaporation.

Time Required

2 class periods separated by roughly one week.

Materials

- Pie plates (2 per team)
- Clear cups or jars (2 per team)
- Tap water
- Plastic wrap or waxed paper and a rubber band
- Grease pencil or felt-tipped pen
- Ruler
- Calculator (optional)
- Fan (optional: to create wind)
- Lamp (optional: to create heat)

Procedures

1. On the day you introduce this topic, pour about 250 milliliters of water into each pie plate and an equal amount of water into each cup. Use the plastic wrap or waxed paper to cover one pie plate and one cup, and hold the covers in place with a rubber band.

2. Ask the students what will become of the water in each of the containers if you leave it untouched for one week. Will each vessel undergo the same changes? Why or why not?

3. Observe the rate of evaporation for one week.

4. Summarize and explain your observations.

5. Measure the amount of water that evaporated from each container with the ruler.

Thought Questions

1. If you wanted to slow the rate of evaporation, would you want to cover or uncover a water storage reservoir? Explain your answer.

2. If you wanted to speed the rate of evaporation, would you want to store the water in a tall skinny container or a shallow wide container?

   Explain your reasoning.

3. If you wanted to increase the concentration of a substance dissolved in the water, would you leave the container covered or uncovered?

Extenders

1. How will temperature affect the rate of evaporation?

   Place equal amounts of water in two plates or jars. Control the temperature by keeping one at room temperature and placing the other under a heat lamp.

   Discuss this phenomenon by explaining that this is why plants dry out more on a sunny day and why people need to drink so much more water when it is hot—the water evaporates from their bodies.

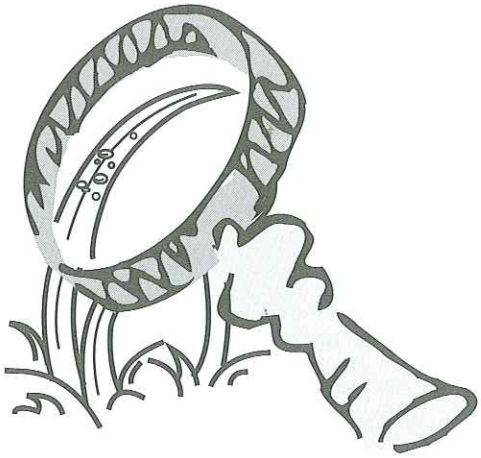
2. How does wind affect the rate of evaporation?

   Place one sample in a still area and another sample in the draft of a fan.

   Discuss the phenomenon by explaining that this is why clothes on a clothesline dry faster in a breeze than in still air.

Activities

Part 2: Condensation



Activity 2: Stop! You Are Surrounded... by Water!

Is there water in the air around you?

How can you know?

Purpose
To observe atmospheric water vapor and measure the "dew point" of your classroom.

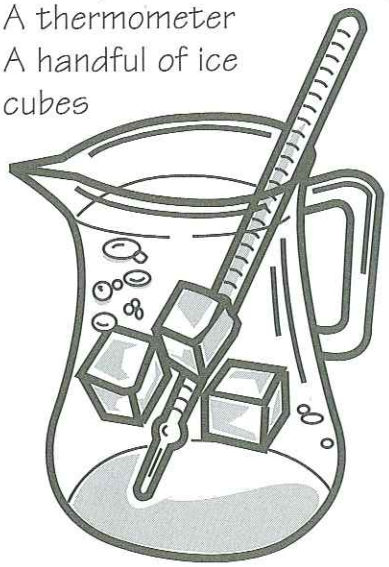
Time Frame
One class period.

Warm-up: How can you see if there is water in the air?

Break your class into groups of about six students each. Have each group create two lists: The first list should include everything they can think of that would indicate that there is water in the air. The second should list everything they can think of that would indicate that there is no water in the air. Discuss the lists as a class.

Introduction
"Dew point" is the temperature at which the water vapor in the air will condense into droplets. You see it in action all the time, such as when the car windshield or the bathroom mirror fogs up ... or when dew forms on the grass. The dew point depends on both temperature and relative humidity; dew will form at different temperatures depending on how saturated the air is with water. In this activity, however, we will not measure relative humidity.

Materials
- An empty can or cooking pot
- A thermometer
- A handful of ice cubes



Procedure

1. Fill the pot with water that is somewhere between room temperature and body temperature. It should not be too hot or too cold.

2. Place the thermometer in the water and measure the temperature. Keep the thermometer in the water in a position so you can read it as the temperature of the water changes.

3. Put the handful of ice into the water.

4. Carefully observe the outside of the container.

5. When you see water droplets starting to form on the outside of the container, read the temperature of the water. That temperature is the "dew point."

Thought Questions

1. **Where did the droplets of water come from?**

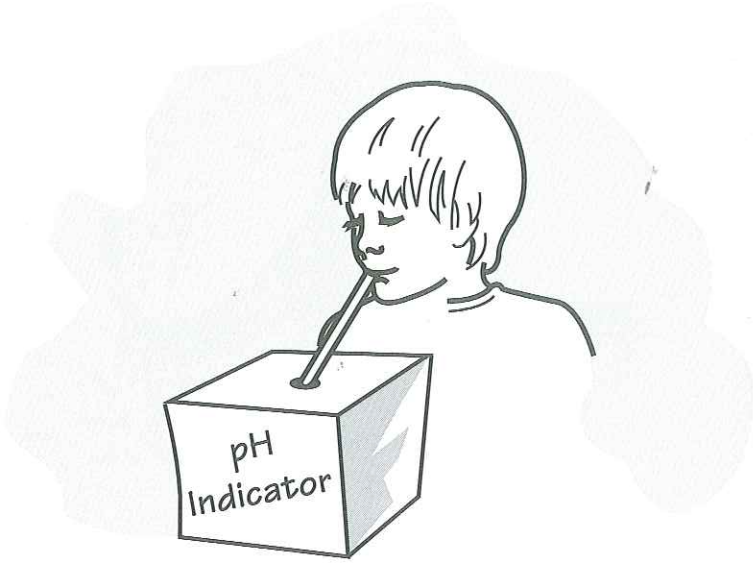
   What caused them?

   As the wall of the container cools, it reaches a temperature at which the water vapor in the room air condenses into droplets. That temperature is the "dew point." It changes from day to day depending on the "relative humidity" of the air.

2. **Why do you think the "dew point" is named the "dew point"?**

   The "dew point" is the temperature at which water vapor in the air condenses into liquid, which is the phenomenon that forms dew on the grass.

Activity 3: Of Cabbages and Kings: Acids and Bases



Why is rain slightly acidic?

Purpose

To observe changes in water chemistry as it dissolves gases and minerals.

Time Period

One class period.

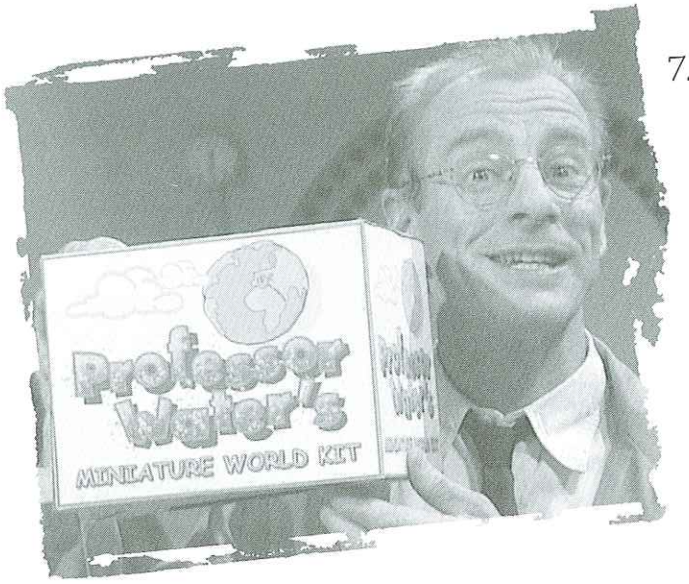
Materials

- Distilled water
- Red cabbage juice: This is an excellent low-cost pH indicator that will turn pink in the presence of acidity and blue in the presence of alkalinity. Make it by boiling about 1/4 of a head of red cabbage (from any grocery store) in a pot of distilled water (also from any grocery). The juice will be deep purple in color (It will start to smell in a few days, so discard it after using it.)
- Carbonated water (seltzer or club soda)
- Baking soda
- Lemon juice
- A drinking straw
- Clear drinking cup

Procedures

1. Pour about 1 cm of the red cabbage solution into a small drinking cup.
2. Have a student blow bubbles through a drinking straw into the cup and have the class observe the color change.
3. Have students devise a hypothesis to explain the color change and then devise an experiment to test their hypothesis.

   Our bodies consume the oxygen in the air and release carbon dioxide (CO_2) as a waste by-product. Carbon dioxide reacts immediately with water, forming carbonic acid (H_2CO_3). While the gas we exhale is not actually acidic, it becomes acidic when dissolved in water.
4. Now pour some carbonated water into the red cabbage juice. Do students see a color change? Describe it. It is called "carbonated water." Have them hypothesize about what makes it acidic.



Hint: *Find the root word hidden in "carbonated."*

5. Add a few drops of lemon juice to the red cabbage juice. Have students observe the color change and ask them if the lemon is more or less acidic than the air you exhale or the carbonated water?

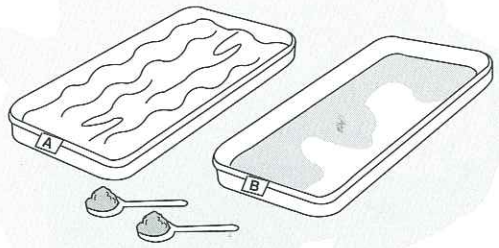
6. Add a pinch of bicarbonate of soda (baking soda) to the red cabbage solution, and observe the color change. Do they think baking soda is an acid or a base? Why do they think that?

7. Now have a student blow bubbles through a straw into the solution of red cabbage juice and baking soda. Have students observe the color change and devise a theory to explain what happened.

   The baking soda is a base that also works as a buffering agent when it dissolves in water. It can absorb acid without causing a significant change in pH. (That is why bicarbonate of soda is a remedy for excess stomach acid—heartburn.)

8. Set your students free with their own containers of red cabbage juice and a variety of safe and common household substances, such as soap, cleanser, and vinegar, with which to experiment. Then have them discuss their observations.

Activity 4: Watching Water Cleanse Itself



What happens to the things dissolved in water?

Purpose

To discover whether salt evaporates with water.

Time Frame

One-quarter hour to set up, and repeated observations for several days.

Materials

- Salt
- Distilled water
- 2 Evaporation trays

Procedure

1. On the day before this lesson, mix about three to five tablespoons of table salt (NaCl) into about one-fourth liter of distilled water, and mark the container so you know which one contains the salt.

2. On the day of the lesson, fill an identical container full to the same level with pure distilled water.

3. Pass the containers around the room and have students devise methods for testing which of the two samples is pure and which is "polluted" using materials found in the classroom. (Do not let them taste the water: to do so is unsanitary and poor practice!)

4. Pour the solutions into the two evaporation trays and label them A and B. Allow them to evaporate, which may take a few days. You can speed the process by boiling the water or circulating air over it.

5. When the water has evaporated, ask them if they now know which sample contained the "pollution." How do they know?

6. Tell the class how much salt you added to the water. You should be able to retrieve most of it.

Thought Questions

1. **If you could collect the water vapor from the saltwater container, would it be salty?**

   No. Water leaves the salt behind when it evaporates.

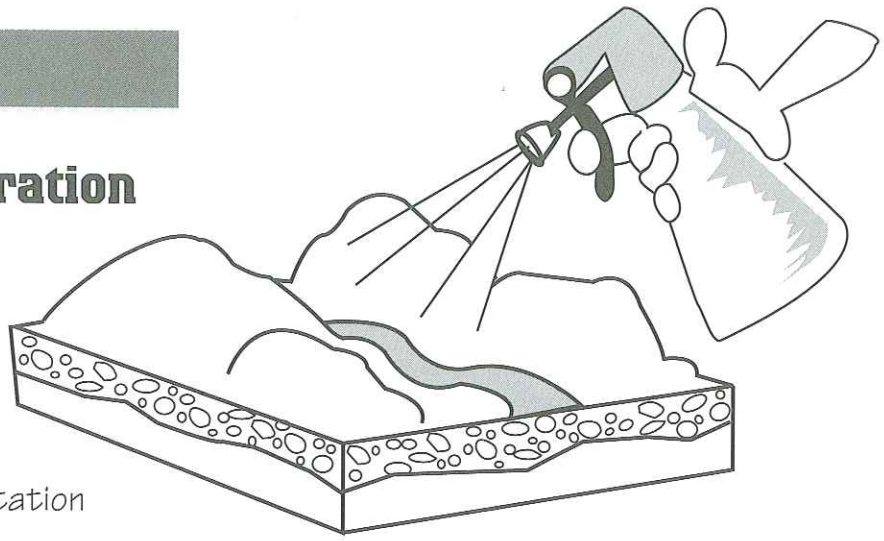
2. **If the tray were a lake and the salt were a pollutant, what would happen to the lake?**

   The lake would keep the pollutants that were in the water. When water running into a lake contains pollutants, those pollutants remain in the lake (unless they are flushed out and run someplace else).

Activities

Part 3:

Runoff and Infiltration

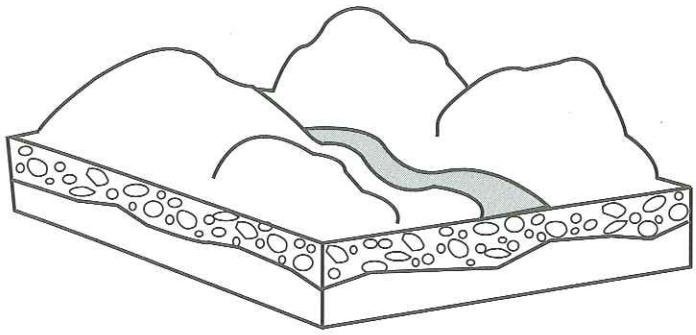


Activity 5: Building a Watershed

Where does the rain go?

Purpose

To demonstrate how precipitation runs off and infiltrates a watershed.



Time Frame

One class period.

Materials

- A rectangular plastic basin, about the size of a shirt box
- Newspaper
- A white kitchen trash bag
- Paper towels
- A spray bottle of water
- Food coloring (optional: to demonstrate the spread of pollution)

Procedure

1. Tell the class they are going to make a watershed to demonstrate how the water runs downhill and collects into rivers and ponds or seeps underground.

2. Have the students crumple newspaper and use it to fashion hills and valleys.

3. Cover the paper completely with the white plastic.

4. Add a few folded paper towels in places to represent porous soil.

5. Make it rain! Spray water over the watershed until runoff forms.

Hint: *If you color the water slightly blue with food coloring, it will be easier to see.*

6. Have the students note the direction and speed of the runoff, as well as how much seeps underground.

7. Have students observe how the watershed dries out over the next few days. Which surfaces hold water the longest?

8. ***(Optional)*** To demonstrate the spread of pollution, add a drop or two of food coloring to a high point. Tell the students it represents places where people spilled oil or used too many garden chemicals. Make it rain again and have students observe where the pollution travels. (You may want to remind your students that this is only a simple model. In nature, pollutants behave differently as they move through a watershed.)

Thought Questions

1. **Why did the rainwater behave the way it did?**

   Gravity pulled it downhill over the easiest course.

2. **Which surfaces and soils might have a "flood" if it rained really hard? Why?**

   The "harder" surfaces might contribute to flooding because all the water runs off these surfaces—none seeps into the ground.

3. **Which places hold water the longest? Why?**

   The places with the paper towels, because they are porous and soak up and store water.

4. **If you do the optional pollution extension, ask students to describe the path of pollution. When the watershed dries up, what happens to the pollution?**

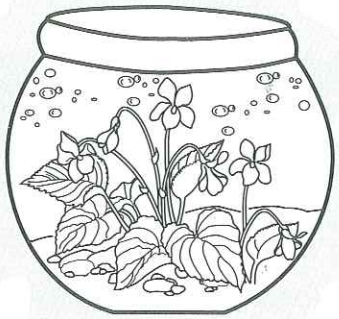
   The pollution travels with the water and can end up far away from the original site. It will stay behind in the watershed when the water dries up.

Extension

1. Research Activity: Have the class name the water bodies in their home community. Have them locate different types of water bodies on local, state, national, or world maps. Have them choose one body of water to research and learn what kind of circumstances affect its quality. For an additional challenge, have them consider how the quality of that water affects creatures in the area.

Activities

Part 4: The Water Cycle



Activity 6: Build a Model of the Earth

Can we watch the water cycle?

Purpose

To demonstrate evaporation (and transpiration), condensation, precipitation, infiltration, and runoff.

Time Period

Half-hour for set-up, then a few minutes to observe and discuss every few days for the next few weeks.

Materials

- covered terrarium or a large, covered glass jar
- Potting soil, sand, and pebbles
- Pieces of sponges
- Moss and small plants
- Water

Procedure

1. Place the pebbles in the bottom of the terrarium. These represent the rocks and bedrock.

2. Cover the pebbles with a layer of sand.

3. Cover the sand with a layer of potting soil.

4. Gently place little plants and moss in the soil.

5. Water the soil so that it is evenly moist but not soaking.

6. Cover the terrarium.

7. Observe how water seeps through the soil.

8. Over the next few weeks, observe as condensation forms on the cover and then "precipitates." Have students relate these events to the water cycle.

Thought Question

How does this model represent the water cycle?

Have students relate what they observe at a particular time to the scenes in the video.

Extension

1. Writing Activity: Have the students imagine they are a water molecule. Each one could take a completely different path through the water cycle. Have them write a "first person" story or a poem to describe their odyssey. They can begin their journey at any point in the water cycle, but they must return to that point at the end of their story.

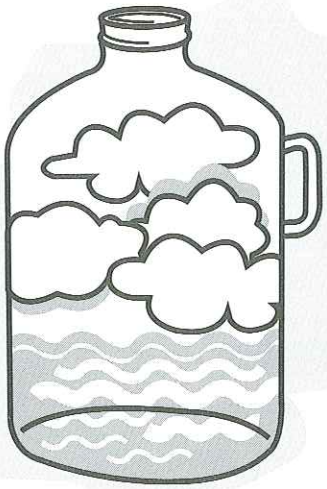
Demonstration: Let It Pour! Let It Pour!

How do clouds form?

Purpose
To build a model of a cloud chamber and observe the behavior of a cloud.

Time Frame
One-half class period.

Materials



- A hot plate
- A beaker of heated water (hot, but not necessarily boiling)
- A large, clear container with a lid (such as a one-gallon pickle jar or a five-gallon water jug that you can cover)
- A bag of ice
- A match

Procedure

1. Heat the water on the hot plate to about 85° to 90° C. (185° to 194°F.)

2. Pour the water into the clear container and put on the lid.

3. Shake the container vigorously to saturate the air with water vapor.

4. Cool the sides of the container with the ice. Your goal is to bring the air temperature inside the cloud chamber to the dew point.

5. Open the container. Strike a match, blow it out, and wave the now-smoking match over the top and slightly inside the container. The smoke will provide the particles necessary for the water vapor to condense onto. A wispy cloud will form immediately, and it will stay there until the water has cooled enough to stop condensing.

Thought Question
Why do clouds accumulate at a certain altitude?

Clouds form at the point in the atmosphere where the temperature matches the dew point for that level of humidity.

Assignment
Watch the clouds on a day with thin, fast-moving clouds in the sky. You can see them appear and disappear as they move through the range of temperature from just above to just below the dew point. Have your students write a poem or short story about the appearance and disappearance of the clouds.

Professor Water & the Amazing Water Cycle

Cast of Vocabulary
(in the order of appearance)

Write down the definition for— or give examples of—these important words that appeared in the video.

Part One: Evaporation

Molecule _____
Solid _____
Vapor _____
Liquid _____
Evaporate _____

Part Two: Condensation

Condense _____
Precipitation _____
Solvent _____
Acid _____
Base _____
Neutral _____

Part Three: Runoff and Infiltration

Infiltration _____
Gravity _____
Groundwater _____
Aquifer _____
Runoff _____
Bacteria _____
Natural Surface _____
Human-made Surface _____
Glacier _____

Part Four: The Water Cycle

Cycle _____
Model _____
Pure _____
Contaminant _____

Professor Water & the Amazing Water Cycle

Cast of Vocabulary
(in the order of appearance)

Part One: Evaporation

Molecule	A small unit of matter.
Solid	Matter that has its molecules tightly connected and is hard, such as ice.
Vapor	Matter with molecules that move rapidly and are far apart, so it is in a gaseous form, such as air.
Liquid	Matter with molecules that are loosely connected and can flow, such as water.
Evaporate	To change from a liquid to a vapor (gas).
(Humidity)*	The amount of water vapor in the air.
(Transpiration)*	The evaporation of water from the leaves of plants into the atmosphere.

Part Two: Condensation

Condense	To change from a vapor to a liquid, typically by cooling.
Precipitation	Rain, sleet, snow, or hail.
Solvent	A substance that can dissolve other substances.
Acid	A substance with a pH level below 7, like lemon juice or vinegar.
Base	A substance with a pH level above 7, like soap or baking soda.
Neutral	A substance with a pH level of 7. The standard is distilled water.
(pH)	The measure of acidity and alkalinity on a logarithmic scale from 1 to 14.

** Words in parentheses are additional vocabulary you may choose to introduce to your class.*

Professor Water & the Amazing Water Cycle

Cast of Vocabulary
(in the order of appearance)

Part Three: Runoff and Infiltration

Infiltration	The process of water seeping into the earth. It is also referred to as "percolation."
Gravity	The force that pulls things toward the earth.
Groundwater	Water that is stored underground (as opposed to on the surface in lakes or rivers).
Aquifer	A place where groundwater collects.
Runoff	Water from precipitation that flows over the earth's surface into a river, lake, or ocean.
Bacteria	Microscopic organisms.
Natural Surface	Surfaces that exist in nature, like fields or woods.
Human-made Surface	Constructed surfaces that often cover the earth and may prevent infiltration, like roofs or pavement.
Glacier	Ice formations that exist in very cold regions.

Part Four: The Water Cycle

Cycle	Something that goes around and around without a beginning or an end.
Model	Miniature, controllable representations of reality that help scientific study.
Pure	Having no other ingredients.
Contaminants	Substances mixed with water.

Professor Water's Fast Fun Facts

Part One: Evaporation

- Water comes in three states: solid, liquid, and vapor.
- Clouds, fog, and steam are composed of tiny droplets of water vapor.
- Heat causes water molecules to evaporate.
- Air contains water vapor (which is measured as "humidity").
- More than two thirds of your body is water.

Part Two: Condensation (and Precipitation)

- Water vapor condenses into a liquid when it cools (loses heat).
- Gravity pulls water droplets down to earth as precipitation.
- Water vapor is only pure H_2O for a moment; as it condenses, it dissolves gases and picks up dust particles.
- Some of the dissolved gases in the air can make water acidic.
- Some minerals and salts are bases that can neutralize acids in water or make it basic (alkaline).

Professor Water's Fast Fun Facts

Part Three: Runoff and Infiltration

- Precipitation can take several different routes: infiltrate into the soil, run off over the surface of the land, become frozen in glaciers, or end up in the oceans.
- Wherever precipitation falls and travels, it will eventually evaporate again to begin the water cycle anew.
- Water picks up many new substances (dissolved and suspended) through runoff and infiltration.
- Infiltration through sand and gravel can strip water of suspended particles to make it cleaner.
- During evaporation, water molecules enter the atmosphere as pure water vapor, leaving dissolved substances behind.
- Human-made surfaces cause different runoff and infiltration patterns from those of natural surfaces.
- Oceans cover about 70 percent of the earth's surface; about 97 percent of the earth's water is in the oceans.

Part Four: The Water Cycle

- A cycle has no beginning or end, but water can take different paths through the water cycle.
- Models are miniature, controllable representations of reality and of great help to scientists.
- The earth always has the same amount of water, which is always moving through the water cycle.

Professor Water's Drinking Water Facts & Myths

A lot of things many people believe just don't hold water. Here are a few ideas about water that the experts say are all wet:

Myth: We have less water today than we did 100 years ago.

Fact: There is the same amount of water on earth today as there was a 100 years ago and three billion years ago. The difference is that today, many more demands are placed on the same amount of water. Because our demands on water continue to grow but our supply doesn't, everyone needs to be concerned about decisions that affect water resources.

Myth: There are more pollutants in drinking water today than there were 25 years ago.

Fact: Scientists are not sure. Unlike 25 years ago, we now have more sophisticated testing instruments that enable us to know more about our water than ever before. With this knowledge, the drinking water community is taking steps to treat what's in our water, to curb the flow of pollution and keep our water safe and wholesome.

Myth: Bottled water is safer than tap water.

Fact: The safety of bottled and tap water depend on the source. Monitoring and source protection, treatment and testing ultimately determine the quality of the finished product. In the United States, tap water is monitored and tested rigorously.

Water Proverbs

A proverb is a short phrase or saying that expresses a simple truth or idea. Many proverbs are rooted in a country's ancient cultural heritage or religion. Read each proverb and discuss its meaning.

You can't learn to swim in a field. (Spanish)

No snowflake ever falls in the wrong place. (Zen)

One step too few is enough to miss the ferry. (Chinese)

Help your brother's boat across and lo! your own has reached the shore. (Hindu)

Other Science Education Products

The Waterworks

Ever wonder where water comes from? Or how it gets to your house? Take this fun-filled virtual tour of a waterworks! Created with kids in mind, students explore water science in a context they can really understand. A great classroom field trip where you never leave the classroom!
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$100

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Part II: Source to Tap

Part III: Water Treatment

Part IV: Source Water Protection

Part V: Fun Facts About Water Conservation

VHS, 8 minutes each.
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Show young people the excitement and opportunity of a career in the water profession. This 10-minute video shows seven challenging occupations: Plant Design Engineer; Plant Operator; Lab Chemist; Distribution System Operator; Customer Service Representative; Information Technologist; and Water Resources Specialist.
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Professor Water: Fantastic Facts About H_2O

An entertaining and educating video for kids of all ages! Join Professor Water and his wily sidekick as they take viewers from Niagara Falls to the South Pole to Death Valley to the O.K. Corral. You'll pick up a world of information on water cycles, water treatment, and water wonders along the way.
VHS, 28 minutes.
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Professor Water and the Amazing Water Cycle!

The Teacher's Guide

He's weird! He's wacky! He's the waterguy! Professor Water returns with more fun-tastic facts about the liquid everybody knows and loves (except at bath time)—Water!

Professor Water has done it again, but this time with a complete Teacher's Guide that meets National Standards for Science Education. The guide includes

- Real Science Experiments for Home and School
- Outcome-based Learning Lessons
- Fun Games and Activities
- Water Glossary for Young Scientists
- And much, much more!

The perfect learning companion for the video!

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