Freshwater

Teacher's Guide
Middle School

Editors:
Brian A. Jerome, Ph.D.
Stephanie Zak Jerome

Assistant Editor:
Heidi Berry
Anneliese Brown

Visual Learning Company
Brandon, Vermont
1-800-453-8481
www.visuallearningco.com

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A Message from our Company ...

Dear Educator:

Thank you for your interest in the educational videos produced by the *Visual Learning Company.* We are a Vermont-based, family owned and operated business specializing in the production of quality educational science videos and materials.

We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher, and to earn a Ph.D. in education, and lead Stephanie to work on science educational programs at NASA.

In developing this video, accompanying teacher's guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome

Standards Correlations

National Science Education Standards

(Content Standards: 5-8, National Academy of Sciences, c. 1996)

Science as Inquiry - Content Standard A:

As a result of activities in grades 5-8, all students should develop:

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Earth Science - Content Standard D:

As a result of their activities in grades 5-8, all students should develop an understanding that:

- Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle". Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes.

Benchmarks for Science Literacy

(Project 2061 - AAAS, c. 1993)

The Physical Setting - The Earth (4B)

By the end of eighth grade, students should know that:

- The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns. Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow, and falls again to the surface. The water falling on land collects in rivers and lakes, soil and porous layers of rock, and much of it flows back to the ocean.
- Freshwater, limited in supply, is essential for life and also for most industrial processes.

Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students should be able to do the following:

- Understand that water exists in three states: solid, liquid, and gas, which are determined by the temperature of water;
- State the chemical composition and chemical formula of water;
- List some of the properties of water, including solvency and elasticity, and understand that these properties are determined by the chemical makeup of water;
- Understand that freshwater makes up a small percentage of the earth's water supply;
- Explain how glaciers are formed, and differentiate between valley glaciers and continental glaciers;
- List the three main steps in the water cycle: evaporation, condensation, and precipitation;
- Using the terms *surface runoff* and *watershed*, describe how water collects in bodies of running water and bodies of standing water; and
- Define the terms *groundwater*, *aquifer*, and *wells*.

Assessment

Preliminary Test:

The Preliminary Test, provided in the Student Masters section, is an assessment tool designed to gain an understanding of student preexisting knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

Video Review:

The Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. There are two main parts. The first part contains questions titled "You Decide" that can be answered during the video. The second series of ten questions consists of a video quiz to be answered at the conclusion of the video.

Post-Test:

The Post-Test, provided in the Student Masters section, can be utilized as an assessment tool following student completion of the video and student activities. The results of the Post-Test can be compared against the results of the Preliminary Test to assess student progress.

Introducing the Video

Before viewing this video, write the three states of water on the board: liquid, solid, and gas. Ask students to list examples of each form as they naturally exist in nature, such as in lakes, glaciers, and vapors in the atmosphere. Next, ask students if they know how one form of water changes into another form. Encourage students to use the words *evaporation, condensation,* and *precipitation*. Have the students brainstorm examples of how humans may influence water to change states. Examples may include humidifiers, melting ice cream, and making ice cubes. Tell students to pay close attention to the video to learn more about the nature of water.

Video Viewing Suggestions

The Student Master "Video Review" is provided for distribution to students. You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

The program is approximately 20-minutes in length and includes a ten-question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher's guide. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.

Student Assessments and Activities

Assessment Masters:

- Preliminary Test
- Video Review
- Post-Test

Student Activity Masters:

- Altering States
- Creating Groundwater
- Exploring Glaciers
- Vocabulary of *Freshwater*

Video Script: *Freshwater*

1. Imagine living a day without water.
2. You wouldn't be able to wash your hands . . .
3. ...or take a shower.
4. Imagine not being able to have a drink of water when you're thirsty...
5. . . . or flush the toilet.
6. Imagine not being able to brush your teeth, . . .
7. . . . or cook your food, . . .
8. . . . or wash the dishes used to prepare and serve your food.
9. Freshwater plays an extremely important role in our lives everyday!
10. During the next few minutes, we are going to explore some of the characteristics of freshwater, . . .
11. ...and investigate some of the sources of freshwater.
12. Let's first take a closer look at some of the properties of water.
13. **Graphic Transition - The Nature of Water**
14. What do these three things have in common: the ice on this lake,...
15. ...the water in this stream,...
16. ...and the steam from this teapot?
17. All are made of water.
18. Water is the only naturally occurring compound that can exist as a solid, liquid, or gas at normal earth temperatures.
19. As you probably know, water exists as solid ice at temperatures below zero degrees Celsius, or 32 degrees Fahrenheit.
20. Water exists as a liquid between zero degrees and one hundred degrees Celsius, or between 32 and 212 degrees Fahrenheit.
21. And above one hundred degrees Celsius, or 212 degrees Fahrenheit, water exists as a vapor, or a gas.
22. A single molecule of water is made of a relatively large oxygen atom and two smaller hydrogen atoms.
23. **You Decide!** What is the chemical formula for water?
24. Water has the chemical formula of H_2O.
25. The chemical makeup of water is responsible for many of the properties water exhibits.
26. For example, water possesses the ability to dissolve many other substances. When you add salt to this glass of water, it easily dissolves in the water.
27. Water is described as a good solvent because of its ability to dissolve many things.
28. **You Decide!**

Script (cont.)

29. What heats up quicker, the metal in this pan or this water?
30. The metal heats up more quickly than the water.
31. This is because water gains heat slowly and also retains it longer than many substances.
32. Water is also elastic. In other words, it's stretchy, as seen here in this drop of water.
33. Water is also not easily compressed.
34. In fact, if you try to push an object such as this board into water, the water feels as if it's pushing back.
35. These properties of water make water a very useful substance.
36. **Graphic Transition - The Blue Planet**
37. A view of earth from space shows a mostly blue planet.
38. That is because over 70 percent of the earth's surface is covered with water.
39. Most of this water is saltwater and is found in the oceans.
40. In fact, over 97 percent of the water on earth is saltwater.
41. But ocean water can't be used by many living things because it contains a great deal of salt.
42. Humans, as well as many other plants and animals, rely on water that is not salty.
43. Only about 2.8 percent of all the water on earth is freshwater,...
44. and over half of that is frozen in glaciers.
45. About 0.6 percent of freshwater is located underground.
46. The remaining freshwater is found in ponds, lakes, rivers, and streams.
47. The freshwater we use is either drawn from underground or taken from water on the surface.
48. To get a better idea of the amount of freshwater available to us, let's say these 97 cups are filled with saltwater and represent the water in the oceans.
49. And these two cups of frozen water represent frozen freshwater in glaciers and the ice caps.
50. **You Decide!**
51. How much water would represent freshwater that is readily available to humans?
52. Only about one cup would represent the amount of freshwater readily available on earth.
53. As you can see, freshwater represents a very small amount of the total amount of the earth's water.
54. **Graphic Transition - The Water Cycle**
55. The water you brushed your teeth with this morning may have once...

Script (cont.)

56. . . . existed as moisture in the air, . . .
57. . . . or as ice in an icicle, . . .
58. . . . or as water in a cool lake. How could this be?
59. This is due to the fact that water continually cycles from place to place ...
60. . . . and from phase to phase.
61. The movement or cycling of water is called the water cycle. Let's take a look at the water cycle in more detail.
62. There are three main steps in the water cycle.
63. The sun is the force that drives the water cycle.
64. The heat energy from the sun causes liquid water to change to a gas or water vapor.
65. Evaporation is the process of liquid water changing to a gas.
66. Water molecules are continually released into the air.
67. For example, large amounts of water evaporates from the oceans, even though this is not visible.
68. Water also evaporates from rivers, streams and lakes.
69. Plants are also a major contributor to water vapor in the atmosphere, transpiring water from their leaves.
70. A large tree can release up to 1,800 liters of water a day. That's equivalent to 1800 of these one-liter bottles of water.
71. Condensation is the second step in the water cycle.
72. **You Decide!** What is condensation?
73. Condensation is the process of water vapor changing or condensing into a liquid.
74. Condensation occurs as air containing water vapor is cooled.
75. You've probably noticed that a glass containing a cold drink develops beads of moisture.
76. That's because the water vapor in the air condenses on the cool surface of the glass.
77. Similarly, as air rises in the atmosphere, it cools and eventually condenses into small droplets of water or ice, which make up clouds.
78. When the particles of water or ice become too heavy, they fall in the form of precipitation.
79. Precipitation is the third step in the water cycle, and involves ...
80. . . . the process of water returning to earth in the form of snow,..
81. . . . rain, . . .
82. . . . sleet, . . .

Script (cont.)

83. . . . or hail.
84. The return of water to the earth completes the water cycle.
85. Water from precipitation that has collected in lakes, stream, rivers, or the ocean will eventually evaporate, starting the cycle over again.
86. Although you may not notice it, the water cycle is continually in action all around us.
87. **Graphic Transition - Frozen Water**
88. Looking out across the winter landscape, you see snow blanketing the ground.
89. What you may not realize is that snow is actually frozen water.
90. As the weather warms, the snow melts into liquid water.
91. But in some places, snow becomes compressed into layers of moving ice, called glaciers, which remain frozen throughout the year.
92. Glaciers are large masses of moving ice and snow.
93. High mountain valleys often provide places for the development of glaciers. These glaciers are called valley glaciers.
94. At the poles, snow and ice make up thick, wide glaciers called continental glaciers.
95. Continental glaciers may cover huge areas and can hold large amounts of frozen freshwater.
96. In some cases, continental glaciers may be over four kilometers, or two and a half miles, thick!
97. **Graphic Transition - Running Water**
98. Perhaps you've fished in a stream or creek.
99. Or maybe you have taken a boat ride on a river.
100. These bodies of water are referred to as running water.
101. Running water is water on the move and is sometimes described as flowing water.
102. Streams, brooks, and creeks are smaller bodies of running water.
103. Larger rivers, such as the St. Lawrence River seen here, move huge amounts of freshwater toward the ocean.
104. How does water collect in these bodies of running water?
105. Much of the precipitation that falls to the earth is soaked up by the ground,...
106. ...where it may stay for some time.
107. It may also be absorbed by plants.
108. Water that is not absorbed into the ground . . .
109. . . . flows over the surface of the land. This is called surface runoff.
110. Eventually surface runoff flows into a stream, river, or other body of water.
111. The land area over which surface runoff drains into a river, or system of rivers and streams, is called a watershed.

Script (cont.)

112. The Mississippi Watershed, seen here, encompasses a large part of North America.
113. The Otter Creek watershed in Vermont takes up a much smaller area.
114. **Graphic Transition - Standing Water**
115. In some sections of a watershed, water collects and forms bodies of standing water.
116. A pond is an example of a small body of standing water.
117. A lake is a larger body of standing water.
118. Ponds and lakes receive water from surface water ...
119. ...and from streams or rivers that flow into them.
120. In most cases, water flows out of a lake or pond, forming a stream or river.
121. **Graphic Transition - Groundwater**
122. The family that lives on this farm, . . .
123. . . . as well as the cows on this farm, drink water that is pumped deep from underground.
124. **You Decide!** What do you call water that is found underground?
125. Water located underground is called groundwater.
126. Groundwater comes from precipitation which seeps through the surface and collects in the spaces between particles of dirt, sand, or rocks.
127. Water continues to permeate the ground until it reaches an impermeable layer.
128. An impermeable layer of rock or clay prevents the downward movement of water.
129. When water reaches an impermeable layer, it fills the holes between particles, called pores. The water-soaked area is called the zone of saturation.
130. The top of the zone of saturation is called the water table.
131. You can see here that we dug to the top of the water table, or the place where the soil is saturated. The water table is quite shallow here.
132. The water table often moves up and down depending on how much water is in the ground.
133. In periods of drought, the water table sinks . . .
134. . . . and during periods of heavy precipitation, the water table rises.
135. Much of the water pumped from underground for human use comes from underground water sources called aquifers.
136. Aquifers are layers of permeable rock, such as sandstone, gravel, cracked limestone or sand, through which water flows freely.
137. This permeable layer is often trapped between two impermeable layers.
138. When a hole is drilled into the aquifer, water can be pumped out.
139. Water in the aquifer is replenished by water from the surface.

Script (cont.)

140. **Graphic Transition- Summing Up**
141. During the past few minutes, we have taken a look at some of the characteristics of freshwater.
142. We've seen that freshwater makes up a very small percentage of the total water on earth.
143. We also studied the different stages in the water cycle, including the process of evaporation, condensation and precipitation.
144. We took a look at the different forms of freshwater, including frozen freshwater,...
145. ...standing water,...
146. ...and running water.
147. Finally we took a look at some of the fascinating characteristics of underground water. So the next time you brush your teeth,...
148. ...take a drink of water,...
149. ...or swim in a lake, think about some of the characteristics of freshwater.
150. You might just think about freshwater a little differently.
151. Fill in the correct word when you hear this tone ___. Good luck and let's get started.

Video Quiz

1. Water can exist as a _____ , liquid, or gas.
2. Water has the ability to _____ many things.
3. Over _____ percent of earth is covered with water.
4. Less than three percent of water is _____.
5. The _____ drives the water cycle.
6. _____ is the process of a liquid changing to a gas.
7. _____ is the process of water vapor changing into a liquid.
8. _____ are large masses of moving ice and snow.
9. The top of the zone of water saturation is the water _____.
10. _____ water is water on the move.

Answers to Student Assessments

Preliminary Test

1. gas
2. solvent
3. sun
4. precipitation
5. glacier
6. running
7. surface runoff
8. saturation
9. aquifers
10. saltwater
11. true
12. false
13. false
14. true
15. true
16. true
17. true
18. false
19. true
20. true

Video Review

You Decide:

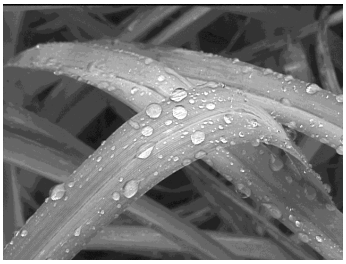
A. The chemical formula for water is H_20.
B. The metal heats up more quickly than the water.
C. Only one cup out of 100 cups would represent freshwater that is readily available to humans.
D. Condensation is the process of water vapor changing, or condensing, into a liquid.
E. Water located underground is called groundwater.

Video Quiz:

1. solid
2. dissolve
3. 70
4. freshwater
5. sun
6. evaporation
7. condensation
8. glaciers
9. table
10. running

Post Test

1. false
2. true
3. false
4. false
5. true
6. true
7. true
8. true
9. true
10. true
11. aquifers
12. precipitation
13. glacier
14. solvent
15. saturation
16. gas
17. running
18. sun
19. surface runoff
20. saltwater



Answers to Student Activities

Altering States

1. The group with the largest number of ice cubes had to wait the longest for the ice to melt. The group with the least amount of ice had to wait the least amount of time.
2. The group with the largest number of ice cubes had to wait the longest amount of time for the water to evaporate. The group with the least amount of ice had to wait the least amount of time.
3. The temperatures should not have differed between the groups. This is because the temperatures at which water changes states are constant, regardless of the quantity of water.

Creating Groundwater

1. Check diagrams.
2. An aquifer is a zone of water which flows through rock or sediment. It is often trapped between two impermeable layers. Wells are drilled into the aquifer and water is pumped to the surface.
3. The bottom layer of clay symbolizes an impermeable layer. The top layer of clay also represents an impermeable layer.
4. The top of the water table extends into the lower half of the top layer of sand. Drought would cause the water table to drop, and excessive precipitation would cause the water table to rise.
5. Source of contamination could be oil or gas leaks, or fertilizer and pesticides from agriculture.

Exploring Glaciers

Part I:

1. C
2. D
3. D
4. Calving is one piece of evidence of glacial movement.
5. Continental glaciers are made up of several valley glaciers that have come together to form one continuous sheet of ice.
6. Scientists are worried that excessive melting will cause the sea level to rise to dangerous levels.

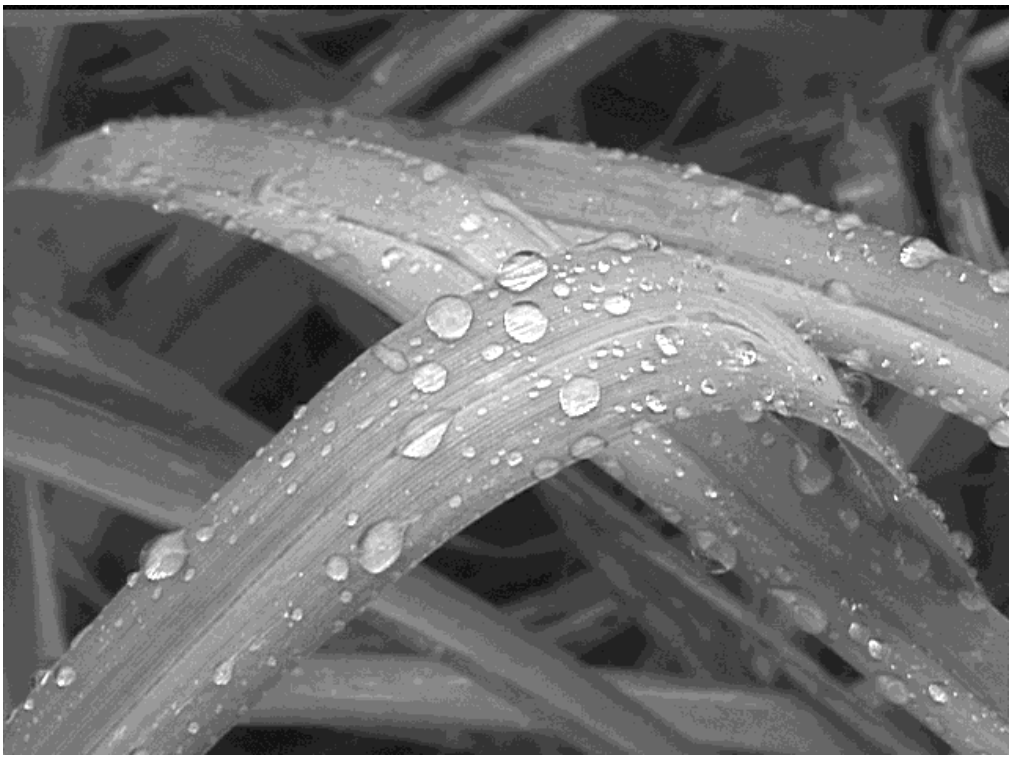
Part II:

1. Mendenhall: Alaska, valley
2. Greenland Ice Sheet: Greenland, continental
3. Franz Joseph: New Zealand, valley
4. Antarctica: Antarctica, continental
5. Nisqually: Mt. Rainier, Washington State, valley
6. Answers will vary

Vocabulary

1. saltwater, c
2. condensation, e
3. water, a
4. water table, i
5. aquifer, j
6. continental glacier, g
7. valley glacier, f
8. liquid, b
9. water cycle, d
10. surface runoff, h

Assessment and Student Activity Masters



Name_____

Preliminary Test

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. Water exists as a _____ above 100 degrees Celsius.

2. Water is described as a good _____ because it has the ability to dissolve many other substances.

3. The _____ is the force that drives the water cycle.

4. The water table rises during periods of heavy _____.

5. A _____ is formed when snow compresses into layers of moving ice.

6. Streams, creeks, and rivers are examples of _____ water.

7. Water that is not absorbed into the ground and flows over it is called _____ .

8. The zone of _____ refers to the water-soaked area that forms when water reaches an impermeable layer.

9. Much of the water used by humans comes from underground water sources called _____.

10. Over 97% of water on the earth's surface is _____.

freshwater	precipitation
saturation	sun
running	gas
liquid	glacier
solvent	surface runoff
saltwater	aquifers

Name_____

Preliminary Test

Directions: Decide whether the answer is True (T) or False (F).

11. A water molecule is made of two hydrogen atoms and one oxygen atom. T F

12. Water exists as a solid below 10 degrees Celsius. T F

13. Water can be easily compressed. T F

14. Approximately 2.8% of the earth's water is freshwater. T F

15. The water cycle is continually in action around us. T F

16. Water returns to the earth's surface in the form of precipitation. T F

17. A watershed refers to the land area over which surface runoff drains into a river or system of rivers and streams. T F

18. The water table rises during periods of drought. T F

19. Precipitation may exist in the form of rain, sleet, hail, or snow. T F

20. Evaporation is the process of liquid changing to gas. T F

Name_____

Video Review

Directions: During the course of the program, answer the "You Decide" questions as they are presented in the video. Answer the Video Quiz questions at the end of the video.

You Decide:

A. What is the chemical formula for water? Answer _____

B. What heats up quicker, the metal in this pan or this water? Answer _____

C. How much water would represent freshwater that is readily available to humans? Answer _____

D. What is condensation? Answer _____

E. What do you call water that is found underground? Answer _____

Video Quiz:

1. Water can exist as a _____, liquid, or gas.

2. Water has the ability to _____ many things.

3. Over _____ percent of earth is covered with water.

4. Less than three percent of water is _____.

5. The _____ drives the water cycle.

6. _____ is the process of a liquid changing to a gas.

7. _____ is the process of water vapor changing into a liquid.

8. _____ are large masses of moving ice and snow.

9. The top of the zone of water saturation is the water _____.

10. _____ water is water on the move.

Name_____

Post Test

Directions: Decide whether the answer is True (T) or False (F).

1. The water table rises during periods of drought. T F
2. Water returns to the earth's surface in the form of precipitation. T F
3. Water exists as a solid below 10 degrees Celsius. T F
4. Water can be easily compressed. T F
5. Evaporation is the process of liquid changing to gas. T F
6. A water molecule is made of two hydrogen atoms and one oxygen atom. T F
7. The water cycle is continually in action around us. T F
8. Approximately 2.8% of the earth's water is freshwater. T F
9. A watershed refers to the land area over which surface runoff drains into a river or system of rivers and streams. T F
10. Precipitation may exist in the form of rain, sleet, hail, or snow. T F

Name_____

Post Test

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

11. Much of the water used by humans comes from underground water sources called _____.

12. The water table rises during periods of heavy _____.

13. A _____ is formed when snow compresses into layers of moving ice.

14. Water is described as a good _____ because it has the ability to dissolve many other substances.

15. The zone of _____ refers to the water-soaked area that forms when water reaches an impermeable layer.

16. Water exists as a _____ above 100 degrees Celsius.

17. Streams, creeks, and rivers are examples of _____ water.

18. The _____ is the force that drives the water cycle.

19. Water that is not absorbed into the ground and flows over it is called_____ .

20. Over 97% of water on the earth's surface is _____.

freshwater	precipitation
saturation	sun
running	gas
liquid	glacier
solvent	surface runoff
saltwater	aquifers

Name_____

Altering States

Objective: In this lab, students will learn about the different states of water and the conditions under which each state exists.

Background: When most people are asked to describe water, they think of water as a liquid. However, water exists in two other forms - a vapor and a solid. The state of water depends on its temperature. Below 0 degrees Celsius, water exists as ice - a solid. Between 0 and 100 degrees Celsius, water is a liquid. Above 100 degrees Celsius, water exists as a vapor, or gas. We use all forms of water everyday, whether it be to hydrate ourselves, chill a drink, or soothe a sore throat with a humidifier.

Materials:
bag of ice cubes
cooking pot
Bunsen burner or hot plate
stop watch
thermometer
goggles or safety glasses

Procedure:
1. Your teacher will divide the class into groups.
2. Each group will be given a different number of ice cubes. One group will receive 10 cubes, another group will receive 20, another 30, etc.
3. The first task will be to change the ice into liquid water by melting the ice in a pot. **Be careful - The burner is very hot!! Wear safety glasses or goggles.**
4. Once the ice becomes completely melted, measure and record the temperature of the water. Also record the time that it took to reach this point.
5. Next you will change liquid water to a vapor by boiling the water until it completely evaporates. When about half the liquid has evaporated, measure and record the water's temperature. Once all of the water has evaporated, record the time.
6. Have the class share their data and create a table on the chalk board. The rows should contain the number of ice cubes each group began with, and the columns should list the temperatures and times recorded for steps 4 and 5.

Questions:
1. For which group did it take the most time for the ice to melt? For which group did it take the least amount of time?
2. For which group did it take the most time for the water to evaporate? For which group did it take the least amount of time?
3. Did the temperatures at which the water melted and evaporated differ for each group? If not, explain why. If they did differ, which group recorded the highest temperature? Which group recorded the lowest?

Name_____

Creating Groundwater

Objective: In this activity, students will learn how groundwater is formed.

Background: Many people obtain their water from above-ground water sources, such as reservoirs. However, other people depend on under groundwater sources, especially people who live in rural areas and are far from their town's main water source. Water found underground is called **groundwater**. Where does groundwater come from? Like all water, groundwater falls to the ground in the form of precipitation. The water seeps through the surface and continues to permeate the ground until it reaches a layer of rock or clay through which it cannot pass, called an **impermeable layer**. When the water cannot travel any further, it fills the spaces between particles, referred to as **pores**. This water soaked-area is the **zone of saturation**. The uppermost area of this zone is called the **water table**, which rises during periods of heavy precipitation and falls during periods of drought. Aquifers tend to be large concentrations of water that flow through permeable rock, such as sandstone, gravel, limestone, and sand. The layers of permeable rock are often located between layers of impermeable rock. Humans bring this water to the surface by pumping it from **aquifers**.

Materials:
Aquarium; large, clear tupperware container; or large jar
sand
fine gravel
dirt
clay
centimeter ruler

Procedure:
1. In this activity you will make a model of a cross section of the earth. By making the model you will be able to visualize the relationship between the earth and groundwater.
2. Obtain a container provided by your teacher.
3. Place two centimeters of sand in the bottom of the container. Spread it out evenly and gently press it down.
4. Place an even layer of clay over the sand. Make sure there are no holes in the clay. Try to get the edges of the clay layer to form a tight seal against the sides of the container.
5. Carefully pour two centimeters of fine gravel over the clay.
6. Pour water over the gravel until the level of water is just below the top of the gravel.
7. Next make a layer of clay above the gravel layer. Try to get the edges of the clay layer to form a tight seal against the sides of the container.
8. Place a two centimeter thick layer of dirt over the second clay layer.
9. Place a two centimeter layer of sand over the dirt layer.
10. Pour water into the container until the water goes half way up the sand layer.
11. Answer the following questions found on page 27.

Name_____

Creating Groundwater

Discussion:

1. Draw a diagram of your creation. Make sure to label the permeable and impermeable layers, as well as the zone of saturation, water table, and aquifer.
2. Describe the aquifer. How would you go about extracting water from the aquifer?
3. Which layers are impermeable?
4. Where is the water table? How would drought or excessive precipitation affect the height of the water table?
5. What could contribute to the contamination of the zone of saturation?

Diagram:

Name_____

Exploring Glaciers

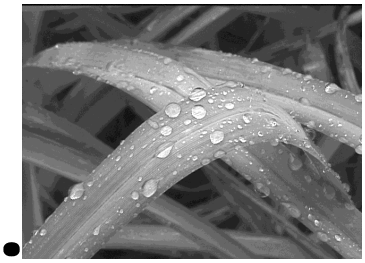
As you have already learned, glaciers are large masses of moving ice. But how are they formed, and how do they move? Glaciers form at high elevations, where snow is able to build up over many years without significant melting. These areas of formation are referred to as **accumulation zones**. Because the snow exists in layers, the snow at the bottom eventually becomes compacted by the weight of the snow above. Over time, the compacted snow, referred to as **firn**, becomes glacial ice. Once enough ice accumulates, gravity begins to pull the ice downward, causing it to flow like a river. You may be surprised by this, because glaciers flow so slowly that it appears as if they are not moving. One of the best ways to witness the movement of glaciers is to stand at the bottom or edge of a glacier. Here you can watch chunks of ice fall off the glacier into the surrounding water. This is referred to as **calving**. As long as enough snow accumulates at the top of the glacier and temperatures remain cold enough, glaciers remain in a constant state of movement. As the ice flows, it picks up debris, ranging from small pieces of sediment to large boulders. This is why glaciers, when viewed closely, can look dirty. During downward flow, the ice cracks, forming deep **crevasses**. These crevasses make exploration of glaciers difficult and potentially dangerous.

Now that you know how glaciers are formed, where can they be found? Because glaciers can only form in places where more snow accumulates than melts, cold temperatures are required. Therefore, people usually think of cold places, such as Alaska or Antarctica. But glaciers also exist in warmer areas, such as New Zealand and Chile. How is this possible? Glaciers found in warmer regions occur at high altitudes, where temperatures are cold. Glaciers formed in high mountain valleys are called **valley glaciers**. Valley glaciers tend to melt a lot in the summer, but they also receive a lot of precipitation in the winter.

Continental glaciers, the second type of glaciers, are found in polar regions. Continental glaciers are formed when several valley glaciers meet, creating a large ice sheet. In some places, continental glaciers are over 1,000 meters thick. The Antarctic Ice Sheet is the largest ice sheet, covering over 13 million square kilometers. It contains 70% of Earth's freshwater!

Glaciers play an important role in the earth's water cycle. Approximately 80% of earth's freshwater supply is frozen in glaciers. During summer months, when temperatures become warm enough for glaciers to begin melting, water flows downhill. This restores earth's water supply, and provides the world's people with water that is needed for survival. Although some melting is necessary, scientists are concerned with the current rate of melting. Based on scientific research, it appears as though global warming has caused glaciers to melt at a faster rate than before. Scientists are worried that a continued high rate of melting will cause the sea level to rise within the next century. This could potentially cause many populated areas to be submerged underwater!

Name_____



Exploring Glaciers (cont).

PART I: Answer the following questions.

A. Multiple Choice

1. What percentage of earth's freshwater supply is trapped in the Antarctic Ice Sheet?

A. 25% B. 55% C. 70% D. 80%

2. What factors are necessary for glacier development and movement?

A. heavy enough to be pulled by gravity
B. cold temperatures
C. more snow must accumulate than melt
D. all of the above
E. A & B
F. A & C

3. Where can valley glaciers be found?

A. New Zealand
B. Panama
C. Chile
D. A & C
E. B & C
F. A & B

B. Short Answer

4. Give one example of evidence that a glacier is moving.
5. What is the difference between valley glaciers and continental glaciers?
6. Why are scientists worried about the present rate of glacial melting?

PART II: Five glaciers are listed in the table below. Using library and internet resources, research the location and type (valley or continental) of each glacier. Be as specific as possible when determining the location. In the last row, research a 6th glacier of your choosing.

Glacier	Location	Type
1. Mendenhall		
2. Greenland Ice Sheet		
3. Franz Joseph Glacier		
4. Antarctic Ice Sheet		
5. Nisqually Glacier		
6.		

Name_____

Vocabulary of *Freshwater*

_____ 1. terlastwa

_____ 2. nesdconation

_____ 3. ertwa

_____ 4. ertwa bleta

_____ 5. aferqui

_____ 6. entalnitcon agcierl

_____ 7. vaelly ciergla

_____ 8. iduqli

_____ 9. twaer lecyc

_____ 10. acesurf offnur

a. a naturally-occurring compound that exists as a solid, liquid, or gas

b. the state at which water exists between 0^0 and 100^0 Celsius

c. type of water that makes up 97% of all water on earth

d. process that involves the moving or cycling of water from one state to another

e. the process of water vapor becoming a liquid

f. large, expansive glacier found in high mountain valleys

g. type of glacier found near the poles

h. water that is not absorbed into the ground and flows over the earth's surface

i. the top portion of the zone of saturation

j. underground water source usually found in rock fragments or sediment which allow water to flow freely