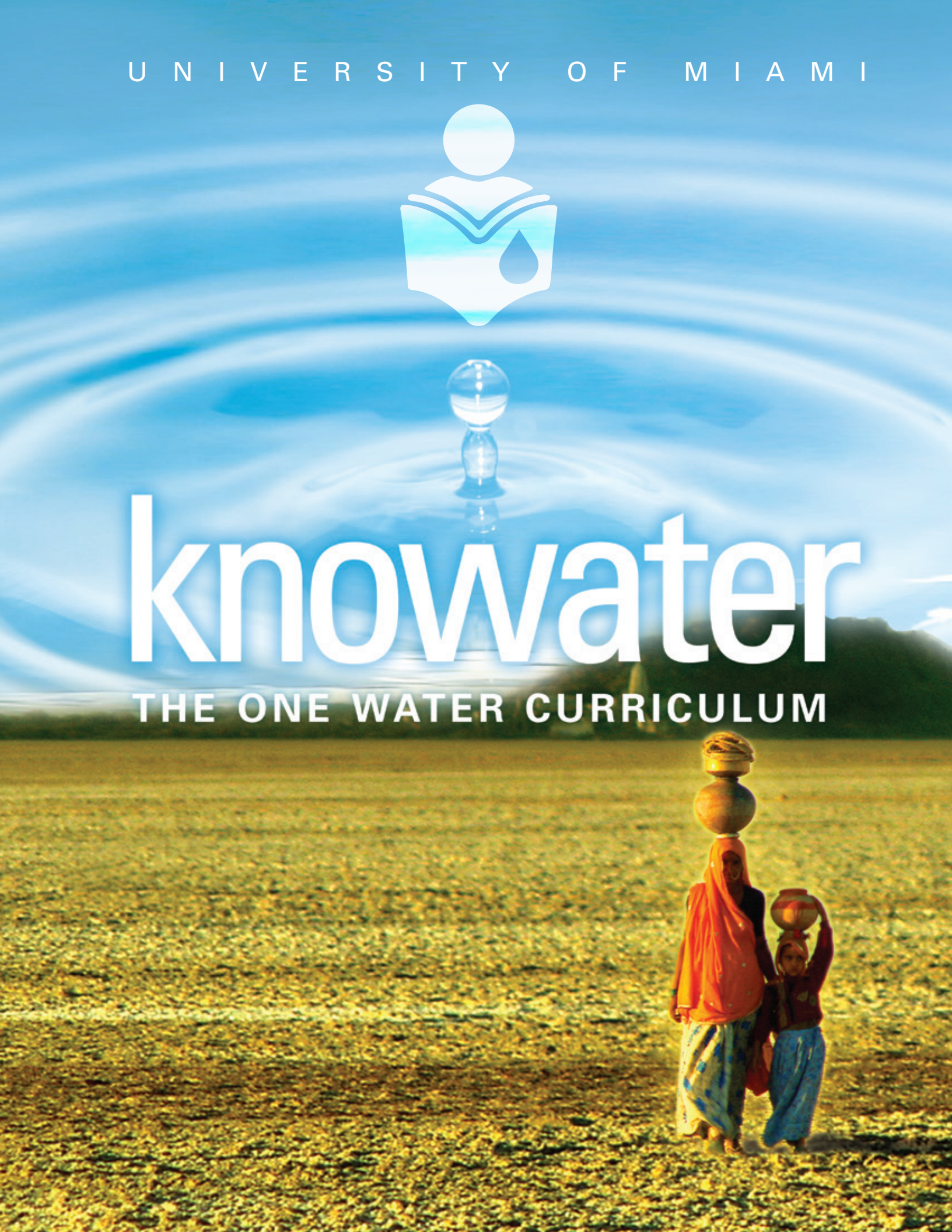
UNIVERSITY OF MIAMI



knowater

THE ONE WATER CURRICULUM

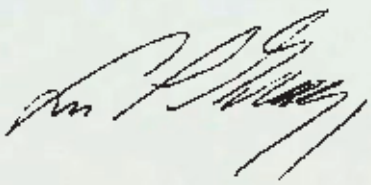
In our automatic sprinklered and fashionably water-bottled environment, we have only the slightest awareness that water is something to be cared for, protected and appreciated. The movies have oft told the story of desert survival, the dramatic thirst-driven pleading for water, the hallucinations of an oasis of fountains and pools of clear, clean water and the final rescue with what seems an inexhaustible supply of the rejuvenating liquid.

Sam L Grogg
Dean

One Water is not one of those timeless tales of the cycle of life neatly tied up with a happy ending. It is a story of time running out. It is a tale of human trial and increasing peril. It is a flash of the here and now, of a world that is in dire need of answers to a problem of the greatest magnitude.

Access to water is quite simply taken for granted – it's often the occasion for a joke – when a hydrant is knocked off its platform and water shoots into the air as the punch-line to a comic car chase, when a party guest dressed in the fanciest clothes falls into the pool or a pail of water is dumped on the unsuspecting target of a practical joke. Water is a powerful charm, we baptize our children with it, we douse winning coaches with it, we throw coins into it with a wish, we pray for it, we curse it, we absolutely depend on it. Water is a utility, a commodity, a wonder, a nuisance, a healer, a destroyer, and is the essence of all life.

The need to teach our children to care for water—to recognize its precarious state and to do everything in their power to protect the essential source of life on our planet—is what these curricular materials hope to support. More importantly, the contents of the *knowater* booklet attempt to inspire a learning experience that raises both consciousness and conscience about the sustainability of all our natural resources. Let *One Water* become the centerpiece of a continuing responsible refrain for the future that our children will insure.



Sam L Grogg
University of Miami
School of Communication

one water

In 2002, we began to develop the One Water project. At the time, we were simply interested in making a film about our changing relationship to water. The depictions of human circumstances around water – especially of those that live in poverty around the world – turned out to be a first step. Without the use of words, the film has emotionally engaged audiences all over the world through the use of compelling imagery, natural sounds and music. We believe that compelling visual storytelling opens a window for action. More work is needed to make a difference.

This *Knowater* curriculum is the next major step in the process. It provides a way for students to explore a substance that is so pervasive in our lives that we tend to take it for granted. The earth, like our own bodies, is made of over 70 percent water. Water is essential to existence and it flows through spiritual, creative and practical aspects of our lives. As the earth's snowcaps melt and freshwater resources succumb under the pollution load created by humans, every passing day demands action to improve the situation. But action can only follow understanding and knowledge. *Knowater* is dedicated to help students understand water through exploration.

Like the various film versions of *One Water* that were created for different audiences, we expect to work with partners around the world to adapt the *Knowater* curriculum to suit their socio-cultural context internationally. We expect the http://knowater.org website to be a resource for teachers and students alike. We will also use the website to keep you updated on adoptions and adaptations of this curriculum internationally.

Sanjeev Chatterjee, Ed Talavera and Ali Habashi in India during the filming of *One Water* in 2003.

It is our sincere hope that you will find the *Knowater* curriculum to be of value.

Sanjeev Chatterjee
Vice Dean, Professor and Executive Director,
Knight Center for International Media
School of Communication, University of Miami

Clean water is delivered by tanker to settlements without pipe water in Guayaquil, Ecuador.

Water from the Colorado River makes the desert bloom in states like Nevada, Arizona and California.

Curriculum developed by
EUGENE F. PROVENZO, JR.
and
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SCHOOL OF EDUCATION,
University of Miami.

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Knight Center for International Media
University of Miami School of Communication

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knowater.org

KNOWATER
curriculum development

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John S. and James L. Knight Foundation
www.knightfoundation.org

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UNIVERSITY OF MIAMI COLLEGE of ENGINEERING

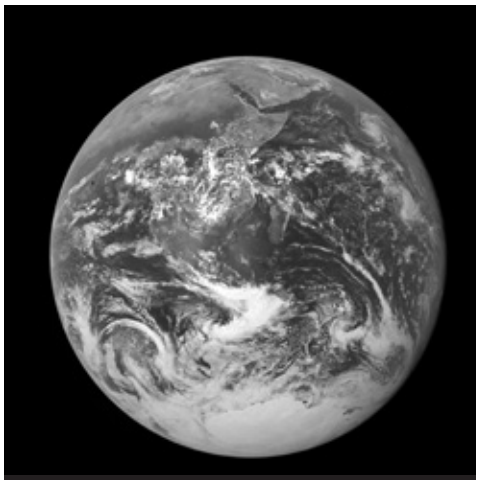
UNIVERSITY OF MIAMI FROST SCHOOL of MUSIC

1 Earth's Drinkable Water

Florida Sunshine State Standards Benchmark	
SC.A. 1.2.1	The properties of materials (in this case, volume) can be compared and measured.
SC.D. 1.2.2	70 percent of the surface of the Earth is covered by water.
SC.D. 2.2.1	Reducing, reusing, and recycling natural resources improves and protects the quality of life.

Water, Water, Everywhere: But Hardly a Drop to Drink

Water is found nearly everywhere on Earth. It is found in the air, on land, and in all living things. It is also found in oceans, lakes, rivers, streams, and ponds. Approximately 75% of the Earth's surface is covered by water. Much of Florida's water is found in marshes, swamps, and wetlands. One of the major wetlands in Florida is the Everglades. An abundant supply of water can also be found below the ground in the form of groundwater. Most people in the United States get their drinking water from groundwater. On average, Florida receives about 54 inches of rain per year. Where does all that water go?



Apollo 17 photograph of the Earth.

Courtesy of the National Aeronautics and Space Administration.

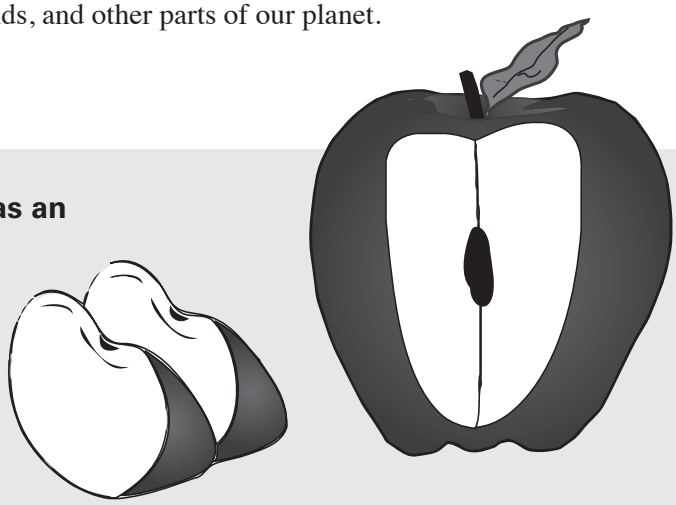
- 8 inches flow over the land and into streams, rivers, or lakes
- 10 inches are absorbed into the ground
- 36 inches evaporate back into the air

That is a lot of water. When astronauts look down on the Earth from space, they see a planet that is mostly water.

You can get a sense of how much of the Earth is covered with water by using an apple as a model for the Earth.

Activity: The Earth As an Apple

In the following activity, you will learn about the different parts that make up the Earth. You will use an apple as a model of the Earth and will cut the apple into slices to represent the oceans, mountains, farmlands, and other parts of our planet.



To make your model of the Earth as an apple, follow the steps below:

Materials Needed

- a whole apple
- a plastic knife
- paper towels

1. Using the plastic knife, slice your apple into four equal quarters. Set aside three of the quarters. These three quarters represent the oceans of the world. The fourth quarter of the apple represents the total land area left.

2. Slice this land quarter in half, giving you two ⅛ pieces. Set aside one piece. This piece represents land where it is very hard for people to live (polar areas, deserts, swamps, very high or rocky, mountainous areas). The other ⅛ piece represents the land where people live on Earth.

3. Slice this ⅛ piece of the apple into four sections, giving you four 1/32 pieces. Set aside three of these pieces. These three pieces represent area that are too rocky, too wet, too cold, too steep, or with soil too poor to produce food. These pieces also include land that could produce food but is buried under cities, highways, suburban developments, shopping centers, and other structures that people have built.

4. This leaves one 1/32 slice of the Earth. Carefully peel this slice. This tiny bit of peeling represents the surface, the very thin skin of the Earth's crust upon which humankind depends. Less than five feet deep, it is a fixed amount of food-producing land.

When we see the small amount of land that produces our food, it is easy to understand that protecting land resources is very important. With a fixed amount of land resources available, and an ever-increasing number of people who need to eat, each person's portion becomes smaller and smaller over time.

What about the water? How much of the apple represented water? It probably seems like a lot of water, and it is. You need to remember two things, however, about this water. First, Earth's water is composed of 97% salt water, 2% ice, and only 1% groundwater and surface water (lakes, rivers). Only the last two sources (groundwater and surface water) provide our useable water. Second, the water we have on Earth today is all the water we'll ever have. Every use of water also pollutes it. We need to clean up polluted water in order to make it safe for consumption. We will not get any more, so we need to protect the water we have.

Have students review the following summary questions:

1. Why do you think the Earth is sometimes called a water planet?

2. When we used an apple as a model for the Earth, what did the skin of the apple represent?

All of us need to be concerned with how scarce useable water is on the Earth. Even those of us who live in places where water seems plentiful have an obligation not to waste water. In the following activities, students should become more aware of water conservation issues and how they can contribute to protecting this precious resource.

Exploring *One Water*

How is the perception of water different for people living in Rajasthan, India where fresh and drinkable water is scarce compared to a place like Florida where water is abundant?

Look at the following clip from *One Water*. How would your life, and the life of your family, be different if water was as scarce for you as for the people shown in the film?

How would your day-to-day life be affected?

Would there be things that you would gain from water being scarcer for you and your family?

Women carrying water in Rajasthan, India.

East Indians Gathering Water
http://knowater.org/videos/

Consider the Quote

"When drinking water think about its source." — Anonymous

Extension Activities

Elementary School Students

Create a list with students of the different ways water is part of their lives. Discuss with them which uses are essential to living and which are recreational or a luxury. For example, is a long shower necessary? Ask them to consider what it would be like to have a day without any access to water.

Multimedia

Have students draw a visual map of their house that shows all the places where water is used.

Middle School Students

Have students work in teams to compile a list of twenty-five ways that water can be saved in their households (use water restricting showerheads; when washing dishes, use a sink full of water, do not let the water run; fix leaky faucets - a steady drip can waste 20 gallons of water per day, and so on.)

Multimedia

Using a digital camera, have students photograph places in their houses where water is being wasted. Have them create Power Point™ presentations or posters that document what they have discovered. A bulletin board display can be created incorporating materials from different students.

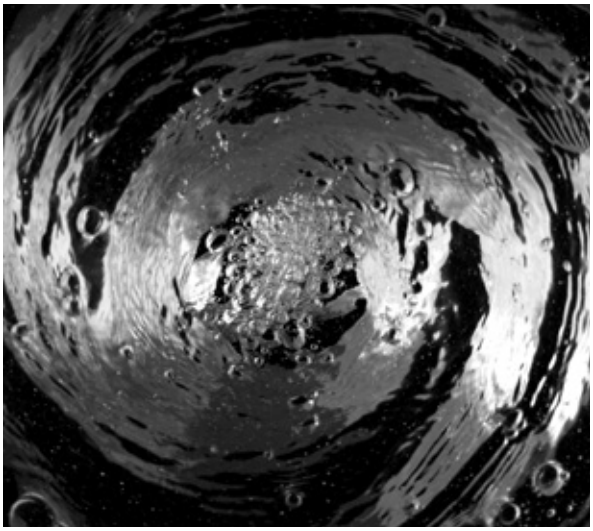
Secondary School Students

Estimates are that the average American uses 80-100 gallons of fresh water per day. Have students do research on the Internet to find out what constitutes the largest personal use of water (flushing toilets followed by showers). Have students determine how much water is saved by using water-efficient toilets (most new toilets use half the water of toilets manufactured twenty years ago - some only a quarter). Have students determine how much water is used if everyone in the state used older toilets versus newer and more efficient systems (assume that people use the toilet on average five times per day). Determine how much water could be saved by the state in one day if we all switched to water efficient-toilets.

Multimedia

Have students create a film for *YouTube* or some other public site documenting how we waste water in showers and toilets and what we can do to decrease this water wastefullness.

2 The Water Cycle



Florida Sunshine State Standards Benchmark	
SC.B. 1.2.6	The student knows ways that heat can move from one object to another.
SC.D. 1.2.3	The student knows that the water cycle is influenced by temperature, pressure, and the topography of the land.
SC.H. 1.2.5	The student knows that a model of something is different from the real thing, but can be used to learn something about the real thing.

Modeling the Water Cycle

Heating and cooling makes water change from one state to another. When we heat liquid water it evaporates into water vapor. Cooling the water vapor will cause it to change back into liquid water. The liquid water that falls back to Earth is called precipitation. This water cycle continues over and over.

Evaporation

Evaporation occurs when a liquid changes into a gas. The rate of evaporation is affected by heat - the hotter the liquid gets, the faster it evaporates. The more heat, the more evaporation. This is why it is so humid in hot climates near the ocean, such as Florida. There is a great deal of evaporation taking place.

Condensation

Condensation is the opposite of evaporation. Condensation occurs when a gas, such as water vapor, changes into a liquid, for example, the water we get from a tap. Water vapor is always present in the air. When the air is cool enough, the water vapor condenses and forms tiny drops of water.

Precipitation

As more and more droplets of liquid condense, such as water in clouds, the liquid droplets become bigger and heavier. Soon, they are so big and heavy that they can no longer stay suspended in the atmosphere. The drops fall back to Earth as rain.

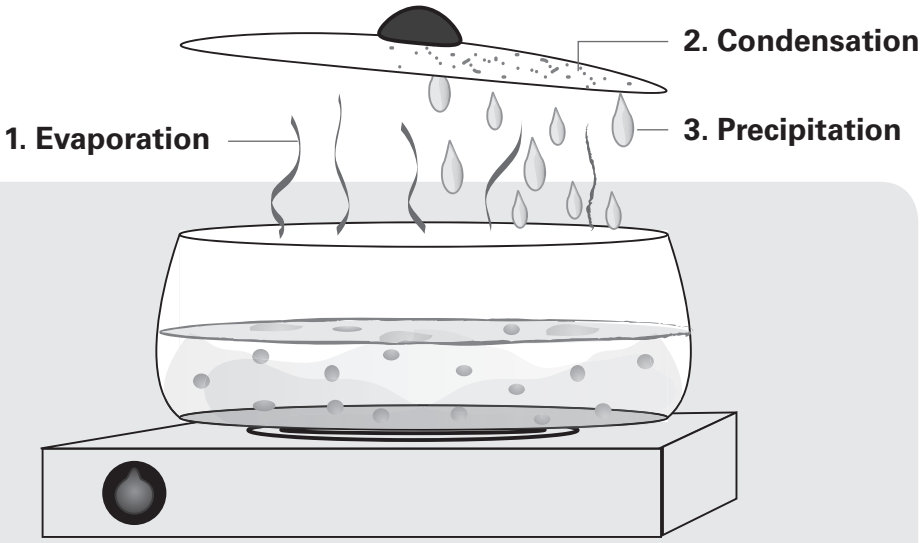
Clouds are mostly made up of water vapor.

A Cycle

A cycle is something that happens over and over again. The evaporation, condensation and precipitation of water in the atmosphere is an example of a cycle. You can observe the water cycle in action on a rainy day. You can also model the water cycle in your classroom or at home using the following simulations.

Simulation 1: Rain in a Pot

The following activity simulates how rain is created as part of a weather system.



Materials Needed

- water
- a hot plate
- a clear glass pot
- a glass lid
- a hot pad
- copy of Water Cycle Simulation Activity Worksheet on page 53

To make your model of rain in a pot, follow the steps below:

1. Pour 2 cups of water into a glass pot.
2. Heat the water to boiling on a stove or hot plate.
3. Carefully hold the glass lid 6–8 inches above the boiling water.
4. Using the Water Cycle Simulation Worksheet available on the *Knowater* curriculum website, record your observations.

Video

A video recording with instructions for completing this activity can be referenced on the *Knowater* curriculum website.

In the illustration, the water vapor from the boiling water is rising into the air. When the water vapor touches the cool glass lid, it condenses from a vapor back into a liquid. The water vapor, which is invisible, slowly becomes visible as small droplets of water. When the drops of water on a glass lid become large and heavy enough, they fall, like rain. This cycle repeats itself as long as the hot water keeps evaporating.

Have students review the following summary questions:

1. Why do you think it rains more in some places than in others?

2. Why do you think it often rains more in the summer than in the winter?

Simulation 2: Rain in a Plastic Cup

The following activity provides another simulation of how rain is created as part of a weather system.

Materials Needed

- three clear plastic cups
- hot water
- ice cubes
- food coloring (preferably blue or green)
- masking tape
- copy of Water Cycle Simulation Activity Worksheet on page 53

To make your model of rain in a plastic cup, follow the steps below:

1. Place hot water in one plastic cup.
2. Immediately cover this cup with another plastic cup turned upside down.
3. Using masking tape, seal the two cups tightly.
4. Place a few ice cubes in another cup on top of the middle cup.
5. Put some food coloring in the cup with the ice cubes.
6. Using the Water Cycle Simulation Activity Worksheet, record your observations.

Video

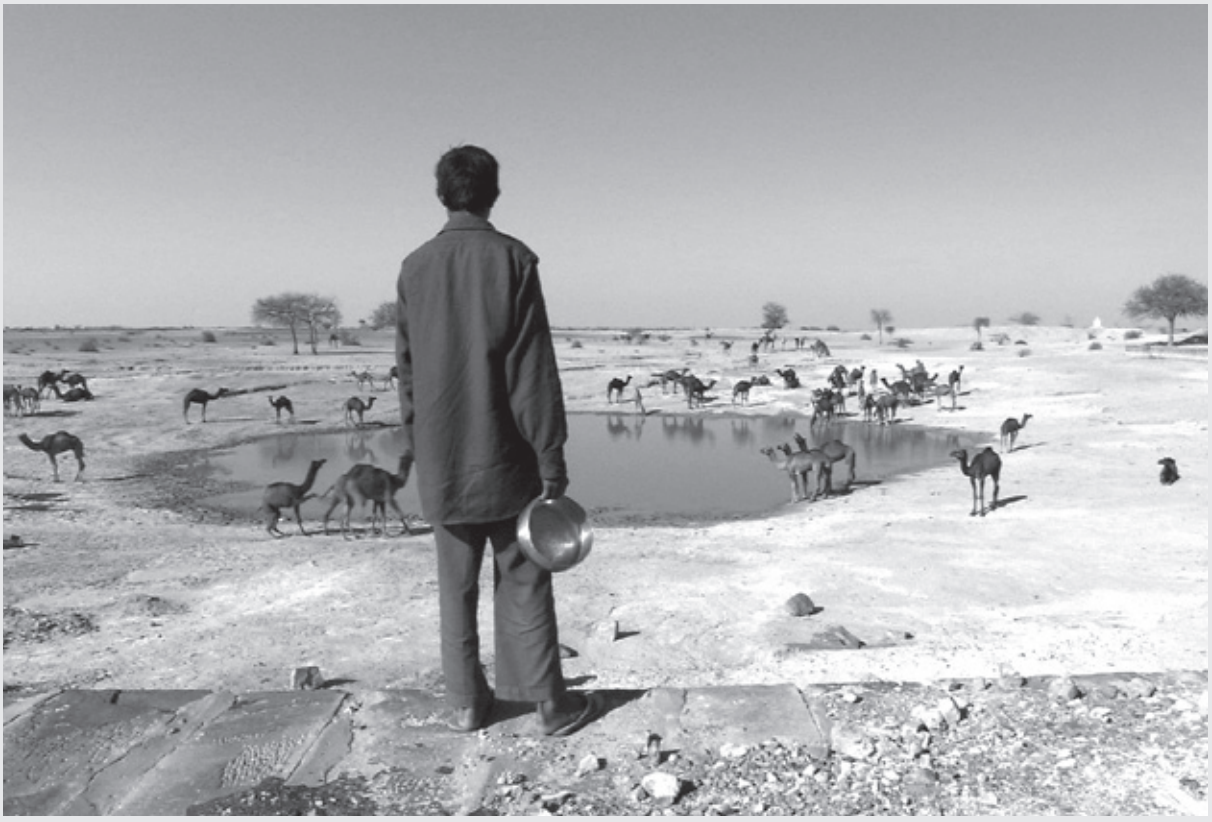
A video recording with instructions for completing this activity can be referenced on the *Knowater* curriculum website.

Exploring *One Water*

How is climate change potentially affecting rain and water cycles? If the actions of people in one part of the world affects the livelihoods and existence of others, should those causing the change be held responsible? How should this be done?

Video Clip

http://knowater.org/videos/



It is believed that climate change will affect the poorest populations of the world most severely.

Consider the Quote

"Man is not an aquatic animal, but from the time we stand in youthful wonder beside a Spring brook till we sit in old age and watch the endless roll of the sea, we feel a strong kinship with the waters of this world."

—Hal Borland (1900-1978), Sundial of the Seasons, 1964

Extension Activities

Elementary School Students

Students can learn about the basics of measurement by making a rain gauge and recording how much rain falls on a monthly basis where they live.

Materials Needed

- scissors
- a 1-quart empty clear plastic water bottle
- an old ruler
- masking tape

Cut the plastic bottle at about ¾ of its height from its base. Tape the ruler to the side of the bottle. Its bottom should line up with the base of the bottle. Place the rain collector in a safe open area that has no overhangs from buildings or trees nearby as this may interfere with the collection of rainwater. Keep a daily record of rainfall.

This activity can be extended over an entire school year. Students can compile the data they have collected into tables and graphs showing seasonal changes, and so on.

Video

A video recording with instructions for completing this activity can be referenced at the *Knowater* curriculum website.

Multimedia: Rain Sticks

Rain sticks are traditional folk instruments that, according to legend, were first made by Chilean Indians to make rainy weather. When turned over, they sound like rain falling. Have students make their own rain sticks.

Materials Needed

- a paper towel tube or other long cardboard tube
- aluminum foil
- popcorn seeds or dry rice
- scissors
- masking tape

Cut two pieces of aluminum foil six inches wide and ¾ as long as your tube. Scrunch the foil into two long pieces. Close up one end of the tube with tape and insert the pieces of foil into the tube.

Pour some rice or popcorn into the tube. You probably want to fill it about 1/10 of the way full. Tape the open end shut and gently turn the tube over. You should hear a sound like rain. Have students experiment with the sounds they can create. They can then create songs or dances using the rain sticks for sound effects or rhythm. Students can also record the sounds of the rain sticks and use them as the background for creating a sound poem about rain, or they can recite a poem they have created, shaking the rain stick and using its sound as part of their presentation.

Extension Activities

Middle School Students

Ask students if they have ever heard the expression "raining cats and dogs." Probably most students know that the phrase refers to the idea of it raining very hard. Actually there are numerous recorded instances of animals "raining" from the sky, as in the case of the 1555 French illustration on the right. Have students go online to discover whether or not animals raining from the sky is something that actually happens, and if it does, why? (Have them use the search term "raining animals"). Have each student compile a list with three examples of animals "raining" down and then ask them to write a short paragraph describing what happens in each of their examples. Finally, have them see if they can discover a meteorological explanation for why animals sometimes "rain" from the sky.

A 1555 engraving of fish raining to the Earth.

SOURCE: *Pluie de poissons, gravure d'O. Magnus*, 1555. Courtesy of the Wikipedia Commons.

Mutlimedia

Using Power Point™, have students create a simple electronic children's story that starts out: "Once upon a time, the animals rained from the sky." This can be done as an individual activity or as a collective writing project. Encourage the use of illustrations and sound effects.

Secondary School Students

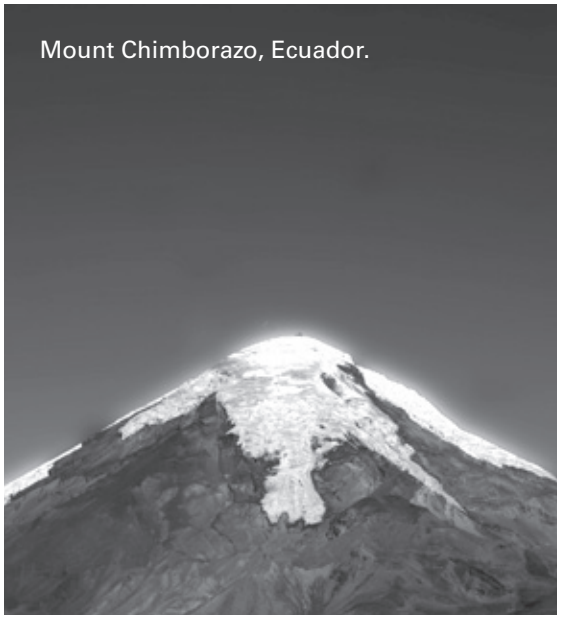
When precipitation (rain or snow) falls, it runs off and collects in a stream, river, or lake and may eventually flow to the ocean. All the land area that drains to a common body of water is called a watershed. Use the watershed website of the Environmental Protection Agency *http://cfpub.epa.gov/surf/locate/index.cfm* to locate the watershed where you live. Research the amount of precipitation that falls in your watershed each year and where it collects and flows.

Multimedia

Create a poster showing your watershed. Include arrows that indicate the flow of water that has collected from precipitation. Highlight areas where this water may have become polluted during its journey.

3 Climate Change: Glacial Melt & Sea Level Rise

Florida Sunshine State Standards Benchmark	
SC.A. 1.2.2	Common materials (e.g., water) can be changed from one state to another by heating and cooling.
SC.B. 2.2.2	The student recognizes the costs and risks to society and the environment posed by the use of nonrenewable energy.
SC.D. 1.2.5	Some changes in the Earth's surface are due to slow processes and some changes are due to rapid processes.
SC.H. 2.2.1	Natural events are often predictable and logical.



Mount Chimborazo, Ecuador.

Climate Change and Melting Glaciers

As you learned in the unit on Earth's Drinkable Water, about 2% of the Earth's total water is frozen as ice in the form of glaciers near the North and South Poles. This may not seem like a lot compared to all the water in the oceans, but these glaciers could play an important role in our lives over the next few decades. You have probably heard that climate change is occurring due to mankind's increased energy use, such as from cars, power plants, and factories.

Melting glacier creating streams of water in Iceland, which is east of Greenland.

One effect of the rising temperatures of global climate change is an increased melting of the world's ice. This melting is most noticeable in the shrinking ice sheets of Greenland and Antarctica. Scientists have been studying this increased loss of glacier ice in recent years, as well as the geologic records of past periods of warming. Both trends have been linked to the fossilized coral reefs found in the Florida Keys. By studying the present and the past, scientists are trying to predict future ice loss and the associated sea level rise.

Video: Museum of Natural History

Watch the short video, called "Melting Ice, Rising Seas" on the website of the Museum of Natural History.

http://www.amnh.org/sciencebulletins/?sid=e.f.melting_ice.20070514&src=e

As you are watching the video, take notes about the methods that the scientists use to formulate and test their hypotheses. Also, try to answer the following questions:

1. What evidence do scientists have that the global temperatures are two degrees celsius higher than they were fifty years ago?

2. What evidence do scientists have that, in the past, sea levels were higher than they are today?

3. What do scientists hypothesize will happen if global temperatures continue to rise?

Activity: Sea Level Rise

In the following activity you will make your own model of the effects of sea level rise on an imaginary island.

Materials Needed

- a plastic "shoe box" size container
- a pound of modeling clay
- a measuring cup
- a ruler
- water
- copy of Global Warming Activity Worksheet on page 55

To make your model of the effects of sea level rise, follow the steps below:

1. Use the modeling clay to form the shape of your island. Consider if it is flat or mountainous. Maybe it has a volcano? Place your clay island in the plastic shoe box. You can decorate your island with small pieces of plants to represent trees, add some sand for the beaches, etc.

2. When there is no water in the box, what is the depth of the water? What percentage of the island is covered by water? Using the Global Warming Activity Worksheet, fill in the first row of the data table for 0 cups of water.

3. Measure 1 cup of water in the measuring cup and pour it into the box. Use the ruler to measure how deep the water is in the box. Estimate the percentage of the island that is under water. Record the data in Row 2 of the data table for 1 cup of water.

4. Repeat Step 3 a total of five more times until there are 6 cups of water in the shoe box. For each cup of water added, fill in the next row of the data table.

Exploring *One Water*

Why is glacial runoff and ice cap melting such a serious issue?

Video Clip
http://knowater.org/videos/

The world's highest mountains are rapidly losing their snow caps as a result of the climate change.

Have students review the following summary questions:

1. Why do you think it rains more in some places than in others?

2. Why do you think it often rains more in the summer than in the winter?

3. Look at the following interactive map of sea level rise:

   https://www.cresis.ku.edu/research/data/sea_level_rise/index.html.

   It shows the actual effects of sea level rise from 1-6 meters on coastal areas and islands. How are these maps similar or different from your model island and data table?

Consider the Following Poem

"The River Speaks," by Gene Lindberg (published on the front page of the Denver Post Weekly Magazine - February 5, 1933)

Down from the mountains of eternal snow
The streams come tumbling, joining as they flow
To send a river winding toward the sea.
I listen, and the river speaks to me.
It tells of meadows on a thirsty plain;
Of gardens blooming where there is no rain;
Of mighty cities built upon its banks;
Of living things that owe the river thanks.
The waters speak to me, and hurry on,
Eager to come and eager to be gone.
Almost it seems as if the river knew
How many things there are for it to do.
Sometimes it pauses, to lay up a store
of liquid wealth in lake and reservoir,
Then leaps a dam and hastens on again,
Turning a wheel to light the homes of men.

The river speaks, and deserts cease to be;
Wide fields grow green, and ships go down to the sea,
I hear the water singing as it goes:
"Let life go on, because the river flows."

Extension Activities

Elementary School Students

The movement of glaciers is similar to that of melting ice cream. Show students how this is the case with the following demonstration.

Materials needed

- a pint of vanilla ice cream
- three or four dark sugar cookies (ginger snaps will work well)
- long narrow pan
- book about an inch thick
- serving spoon

Procedure

1. Place the book on a table and use it to prop up one end of the pan.

2. Crumble some of the cookies and place them in the top ¼ of the pan. Keep about a ¼ of the cookie crumbs on the side.

3. Spread and flatten the ice cream over the cookies.

4. Sprinkle some of the cookies a few inches below the ice cream.

5. Leave the ice cream to melt.

What will happen

As it melts, the ice cream will carry bits of the cookies down the pan and pick up additional cookie crumbs as it continues to melt. This is similar to what happens when a glacier melts and it pushes stones and earth along with it.

Multimedia

Have students create a stop-action movie of the ice cream "glacier" melting. Have them take a frame every thirty seconds. This can be done with a video camera or with a still camera on a tripod, one picture being taken every thirty seconds.

Extension Activities

Middle School Students

What makes a glacier? Where are glaciers found? How does climate affect glaciers? Have students go online and write paragraph-length answers to each of these questions.

Multimedia

Have students make lecture or presentation cards with answers on the back for the questions included above. Have them create four or five additional information cards with a definition of what a glacier is along with images of interesting glaciers. Have them give a presentation using the cards. This can be done individually or as part of a group.

Note: This project can also be done using software such as Power Point™, Keynote™, etc.

Secondary School Students

There has been a great deal of controversy over the extent to which Global Warming is actually taking place. At first, many people denied that it was even occurring. While it is now almost universally accepted that Global Warming is underway, many argue that its potential impact is being exaggerated. Divide your class into two groups and have them go online and research the basic arguments for and against global warming. In a debate, have one side of the class defend the position that "Global Warming is Exaggerated as a Problem." Have the other side take the position that "Global Warming is a Crisis."

Multimedia

Have students videotape the class's debate, edit it and post it on the Internet.

4 Bottled Water: A Good or Bad Thing

Florida Sunshine State Standards Benchmark	
SC.A. 1.2.1	The properties of materials (in this case, taste) can be compared and measured.
SC.D. 2.2.1	Reducing, reusing, and recycling natural resources improves and protects the quality of life.
SC.H. 1.2.2	A successful method to explore the natural world is to observe and record, and then analyze and communicate the results.

Bottled Water: A Good or Bad Thing?

Throughout the world, bottled water has become enormously popular in recent years. Besides its convenience, bottled water is often thought to be purer and better tasting than tap water from municipal sources. Much of this perception is a result of advertising which emphasizes the idea that bottled water comes from crystal clear mountain springs or the run-off of pure glacial water. This "exotic" water comes in designer bottles that are often prominently displayed by restaurants, catered events or by people proclaiming their "good taste." Research by groups such as the Natural Resources Defense Council, however, suggests that the bottled water sold in the United States is not necessarily purer or safer than most tap water. In a four-year study, the NRDC tested over 1,000 bottles of 103 different bottled water brands. They concluded that there was no significant difference in the content of municipal tap water versus bottled water.

Bottling water creates the additional problem of disposing the used plastic containers.

Does bottled water taste better than municipal tap water? The following activity will have you test the hypothesis that bottled water tastes better than municipal tap water.

Have students consider the following summary question:

Why do you think people buy bottled water (other than the fact that it is convenient)? Are there ways we could carry drinking water with us without having to buy a bottle of it each time we need a drink?

Activity: Does Bottled Water Taste Better

In the following activity you will have people sample bottled water and municipal tap water and determine which tastes the best.

Materials Needed

- a large bottle each of two different samples of tap water collected from different places in the community (such as one from a school water fountain and one from home)
- a large bottle each of three different brands of bottled water
- small paper cups (five for each person participating in the test)
- copy of Water Taste Sample Activity Worksheet on page 55

To conduct the taste test, follow the steps below:

1. Remove or totally cover the labels on each bottle (note that if one or more brands of the bottled water comes in a bottle of unique shape, color, etc., the water should be transferred into a more generic bottle).

2. Using a permanent marker, number the bottles from 1-5 making sure that you have recorded which water sample is in which bottle.

3. Give each student five small paper cups and have them number the cups 1-5.

4. Pour a small amount (1-2 ounces) from each bottle into the students' cups, making sure to match the bottle number to the cup number.

5. Using the Water Taste Sample Activity Worksheet, have each student conduct the water taste test.

6. Tally the results and then construct a bar graph. How do the commercially bottled waters compare with the tap water samples? If the results of the research of the Natural Resources Defense Council described at the beginning of this activity are accurate, your results should be largely random.

Consider the Quote

"I have always been a big advocate of tap water—not because I think it harmless but because the idea of purchasing water extracted from some remote watershed and then hauled halfway round the world bothers me. Drinking bottled water relieves people of their concern about ecological threats to the river they live by or to the basins of groundwater they live over. It's the same kind of thinking that leads some to the complacent conclusion that if things on Earth get bad enough, well, we'll just blast off to a space station somewhere else."

—Sandra Steingraber, Having Faith, 2001

Exploring *One Water*

How does the bottling of water use valuable resources? Does the use of bottled water potentially contribute to the polluting of our environment? Look at the "bottling" clip from the *One Water* video library. What does it suggest to you about the cost of bottled water? What is a bottle of water when you remove the bottle? Where does it come from? What is the water's real cost?

Video Clip: Bottling

http://knowater.org/videos/

Extension Activities

Having students become aware of where water resources are found in their communities is a first step to helping in its preservation. In the following activities, students should become more aware of where water resources are in their local neighborhoods and where there is water that is polluted and needs restoration.

Elementary School Students

Create a list with students of the different places where water is found in their community (ponds, streams, rivers, lakes, water-processing plants, etc.). Talk with them about which water they would be willing to drink and which is not drinkable. Ask them why there are different types of water (drinkable water, polluted water, fresh water, salt water). Have them complete "cloze" types of sentences:

Ex. Polluted water cannot be (drunk).

Drinking water must be kept (clean).

* Additional "cloze" items are available on the curriculum website for *Knowater.*

Multimedia

Have students draw a picture of the different types of water that are found in their communities.

Extension Activities

Middle School Students

Have students map the water resources found in the neighborhood where they live or near the school they attend. Have them determine who controls the water that is in their community. Is it owned by a local municipality? By a private owner? Also have them find out where the water comes from that they use every day. See if information can be obtained from the local water management district's website. If information cannot be easily found, have them call members of the local water management district to obtain information.

Multimedia

Have students record different sounds of water on a tape or digital recorder. For example, have them record the sound of splashing water, the drip of a faucet, the whistle of a tea kettle. Play the recordings and have students write descriptions of what they hear. Then have them create short, one sentence poems using what they have described. An example of this type of poem could look and sound like this.

Ex. The water drip……..ped, ever sloowwwwwwwwwwly out of the tap.

Secondary School Students

Have students research the production of the following commercially bottled waters and determine how far each bottle has to travel if it is to be sold in a store in Omaha, Nebraska (approximately the middle of the United States).

Aqua Fiji, bottled in the remote highlands of the Pacific Fiji Islands

Arrowhead Mountain Spring Water, bottled on the slopes of the San Bernardino Mountains in California

Hawaiian Spring Water, bottled on the slopes of Mauna Loa Volcano in Hawaii

Virga Pure Tasmanian Water, bottled water from the island of Tasmania, Australia

Multimedia

Have students create a presentation or a film for *YouTube* or some other public site documenting the distance and resources involved in transporting any of the bottled waters from the point where they are taken from the Earth to the point where they are purchased in a store in Omaha, Nebraska. Have them describe the resources consumed in delivering the water, starting with plastic for the bottle, the gasoline to fuel the transportation for shipping the water, the "carbon footprint" of the product, etc. Students may wish to research the above companies or other water bottling companies to discover how they transport water, what it costs, and so on.

5 Virtual Water & Your Water Footprint

Florida Sunshine State Standards Benchmark	
SC.A. 1.2.1	The properties of materials (in this case, volume) can be compared and measured.
SC.B. 1.2.1	The student knows how to trace the flow of energy in an ecosystem.
SC.G. 2.2.2	The size of a population is dependent upon the available resources within its community.
SC.H. 1.2.1	It is important to keep accurate records and descriptions of experiments.

Virtual Water: How Much Water Does It Take to Produce Things?

Farmer taps into a water channel that runs hundreds of gallons of water in southeast Turkey every day.

"Virtual water" refers to the amount of water it takes to grow or manufacture something. The phrases "embedded water," "hidden water," and "embodied water" refer to the same concept. Understanding how much water it actually takes to grow a plant or manufacture an item is essential to understanding how we can protect our fresh water resources.

Did you know that people in the United States consume about 2,500 cubic yards of water per year; that it takes just under 150 quarts of water to produce every cup of coffee we drink; that the manufacture of a small car takes roughly 400,000 quarts of water, and that building a small home requires roughly 5 million quarts of water?

Activity: Determing Your Water Footprint

Do you know how much water you use in a year? This is your "water footprint." You can find out by visiting the following website, which has a water footprint calculator:

Water Footprint

http://www.waterfootprint.org/?page=files/home

Find out what your specific consumption is per year. If you don't know your family's annual income, use the figure of $48,000 for your "gross yearly income." The calculator estimates in cubic meters. A cubic meter is slightly larger (about 39 inches) than a box one yard high, wide and deep.

Using the calculator, determine the water footprint for someone in the United States, Egypt, Fiji, Turkey, and China. Why do you think there are such large differences between some of the countries?

Have students consider the following questions:

1. If water is a limited and finite resource, should some countries be allowed to consume much more water than others?

2. Are some uses of water better than others (for example, producing basic food rather than luxury goods)?

3. When we consume water to make different products, are we, in fact, consuming other people's water (Hint: If it takes water to create a pair socks that we buy from China, then we are consuming Chinese water, and the amount is therefore part of our water footprint).

Consider the Quote

"Every human should have the idea of taking care of the environment, of nature, of water. So using too much or wasting water should have some kind of feeling or sense of concern. Some sort of responsibility and with that, a sense of discipline."

—The 14th Dalai Lama Tenzin Gyatso

Exploring *One Water*

Would you use water as carefully as the Indian woman does, taking a small amount to bathe her child, wash clothes, and water a tree? How do you use water on a day-to-day basis in your family?

Video Clip: Indian Village Water Sequence
http://knowater.org/videos/

Extension Activities

Elementary School Students

If you have a sink in your classroom, have students leave the water running full blast and ask each of them to pretend to brush their teeth—just like they do every day. Instead of running the water down the drain, collect it in gallon milk bottles. Then measure the amount of water that has been used. Have students compare this amount with how much water would be required to just wet their toothbrush and rinse (assume that at most this would take a quart of water).

Have students now estimate how much more water they use by leaving the tap running (ten times, twenty times as much per brushing). Have students calculate how much water they consume in a week by leaving the water running; how much in a year; how much in an eighty-year lifetime.

Multimedia

Have students create posters about how to save water by not letting the water run when they brush their teeth.

Extension Activities

Middle School Students

Have students complete the following survey and then have them compile the statistics on their use of water for a year.

How much water do you use in the bathroom? Seventy-five percent of all water use takes place in the bathroom. Answer the following questions to determine how much water you use every day.

1. How often do you brush your teeth each day? _____ **X See Below** = _____

   If you turn off water while brushing, write 1 quart. If you leave the water running while brushing, write 4 gallons.

2. How long do you spend in the shower? _____ **X See Below =**_____

   If you have a low-flow showerhead, write 2 gallons; If you have a standard showerhead, write 5 gallons.

3. How many times per day do you flush the toilet? _____ **X See Below =**_____

   If you have a low-flush toilet, write 3 gallons. If you have a standard toilet, write 5 gallons.

TOTAL _____

Multimedia

Have students create a Power Point™ presentation or poster that explains how much water can be saved by low-flow showerheads and smaller flush toilets.

Secondary School Students

The water footprint of a nation is the amount of water needed for the consumption of goods and services of the country. In the United States, the average water footprint is 2,500 m3/cap/yr. In China, the average water footprint is 700 m3/cap/yr. Assume that fresh water is going to become an increasingly scarce resource. Now imagine that you are a scientist/policy maker trying to make the use of water more equitable. Write a position paper, one page in length, that would outline a policy for making water consumption and use more equitable. Consider the idea of special taxes, incentives, and so on.

Multimedia

Create a Power Point™ slide show that presents how much water it takes to produce specific consumer goods, such as cars, houses, as well as food, such as a half-pound hamburger or a loaf of bread.

6 Water in Religion & Ritual

Photo courtesy of The Miami Herald

Florida Sunshine State Standards Benchmark	
SS.A. 1.2.2	The student uses a variety of methods and sources to understand history.
SS.A. 2.2.3	The student understands various aspects of family life, structures, and roles in different cultures and in many eras.
SS.B. 2.2.2	The student understands how the physical environment supports and constrains human activities.

Water in Religion and Ritual

Water is commonly included in the ritual and ceremony of most religions—typically having a purifying function. Religions such as Christianity, Hinduism, Islam, Shintoism and Judaism, just to name a few, include ritual cleansing as part of their religious ceremonies. In Christianity, for example, people are immersed in water as part of the sacrament of baptism. In the Muslim faith, individuals proceed to their prayers only after they have ritually washed themselves.

Activity: Discovery of Themes of Water in Religion

Have students talk to a local minister, priest, rabbi or other religious leader, or else a knowledgeable parent or adult friend, about how water is used in the services and rituals of a specific religious group in their community. Start off by asking students whether or not they have been involved in the use of water in any religious ceremony (a baptism, a blessing with holy water, etc.). Do they know why water was used in the ceremony?

*__Note:__ Many teachers are reluctant to talk about religion in public school classrooms because they are concerned about issues of the separation of church and state. Discussing religion from a historical and cultural point of view is perfectly alright. What is not acceptable in a public school classroom is to teach dogma, or to pass judgment on specific religious practices. This is necessary as part of maintaining the religious freedom of students guaranteed as part of the Constitution.

Have students review the following summary questions:

1. How is water used in different religious traditions?

2. What role does art play in representing how religion uses water?

Exploring *One Water*

Look at the following clip of worshippers bathing in the Ganges River. How is water used as part of ritual in other religions?

In Christianity, for example, what role does water play in baptism? How is holy water used? In what way is water used in Judaism or Islam?

Water plays an important role in most of the world's religions.

Video Clip: Ganges River Sequence
http://knowater.org/videos/

Thinking about the ways water is used in religious rituals provides insight into the role that water plays in shaping the religious and spiritual consciousness of different cultures. In the following activities, students will explore how water and water themes are incorporated into religion.

Consider the Quote

" *Be praised, My Lord, through Sister Water; she is very useful, and humble, and precious, and pure."*

— Francis of Assisi (1181-1226) Canticle of the Sun circa 1225

Extension Activities

Elementary School Students

Have students go online and find out as much as they can about the five following gods associated with the sea and water: 1. Neptune or Poseidon (Greek and Roman); 2. Proteus (Greek); 3. Aegir (Norse); 4. Varuna (Hindu); and 5. Osiris (Egyptian). Have them complete the following cloze sentences:

The God Proteus could _____.

Poseidon is the _____ name for Neptune who is a _____god.

Aegir is the _____ god of water.

Varuna is the Indian god of _____ and _____.

Osiris is associated with the flooding of the _____ river.

Multimedia

Have students create a Power Point™ presentation about the five water gods listed above. They should include a picture and a one-paragraph description of each god. Their presentations can be printed out and made into pamphlets, presented in class or published on the Internet.

Middle School Students

Have students see how many water gods from different cultures they can find in the following word search puzzle (there are seventeen). Have them do a scavenger hunt online in competition with each other to identify the largest number in the puzzle and then identify the religion and culture from which they came.

AEGIR	NEPTUNE	PROTEUS
DAGON	NEREUS	SCYLLA
ENKI	OANNES	TRITON
FUXI	OCEANUS	VARUNA
GLAUCUS	OLOKUN	WATER
GODS	OSIRIS	
NAIAD	POSEIDON	

Q C F J L Z U W I M J O S M R
Z I X U F M T Z X P V S C D U
E P K O W L V P R M A U Y X H
I E S N S A L O A E R N L K K
N B D E E I T S U C U A L G J
C V M G N E R E U S N E A T D
N T I C U N N I R Y A C G P K
D R G S W U A D S F N O G A D
A I T A T K I O W Y D O D E G
E T Z P Z O A N F S H U M E Q
P O E T N L D H M Q O E E W A
N N D H F O B N K E C P M I D
N E C G A I B K R F C L H M B
O N I G B T P V I F P T Y M V
L E Y Y O T Y H X R O K U O K

* Note: If you think the puzzle is too difficult for your students without the names, give them the seventeen names and have them search for the words in the puzzle.

Extension Activities

Middle School Students
(Continued)

Multimedia

Have students design all of the features for a water god or goddess and then create a simple animated story or myth about their god having to do with water.

They can present their myth as a stop-motion animation with cut outs or as a slide-based story using Power Point™ or a similar program.

Word Puzzle Answers

+	+	+	+	+	+	+	+	+	+	+	+	S	+	+
+	I	X	U	F	+	+	+	+	P	V	S	C	+	+
+	+	K	O	W	+	+	P	R	+	A	U	Y	+	+
+	+	S	N	S	A	+	O	+	+	R	N	L	+	+
+	+	+	E	E	I	T	S	U	C	U	A	L	G	+
+	+	+	G	N	E	R	E	U	S	N	E	A	+	+
+	T	I	+	U	N	N	I	R	+	A	C	G	+	+
+	R	+	S	+	U	A	D	S	+	N	O	G	A	D
+	I	+	+	T	K	I	O	+	+	D	+	+	+	+
+	T	+	P	+	O	A	N	+	S	+	+	+	+	+
+	O	E	+	+	L	D	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Secondary School Students

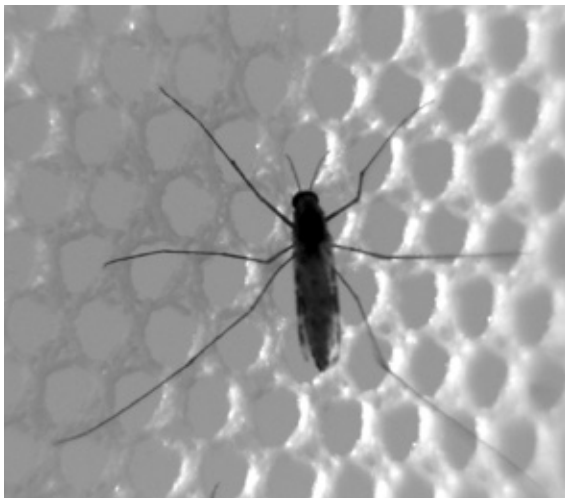
Many consider certain bodies of water to be sacred. For Catholics, the waters found in the spring at Lourdes, France are thought to be holy, as is the River Ganges for Hindus. Have students develop a three-page, single-spaced essay that compares the traditions and rituals centering on water for both Lourdes and the River Ganges. Ask them to emphasize what is different and what is the same about each body of sacred water.

Multimedia

There are many different symbols for water in world culture. Have students collect at least ten symbols, such as the Chinese symbol for water. Have them create a Power Point™ slide show or video in which the symbols are set next to images of water found in the culture they are from. These can be posted by the students on *YouTube* or a website.

7 Water & Disease

Florida Sunshine State Standards Benchmark	
SC.G. 1.2.1	Plants, animals, and protists interact in different ways.
SC.G. 2.2.2	The size of a population is dependent upon the available resources within its community.
SC.H. 1.2.2	A successful method to explore the natural world is to observe and record, and then analyze and communicate the results.



Cholera, Dr. Snow, and the Origins of Epidemiology

John Snow (1813-1858) was a British physician who became interested in finding ways to prevent the cholera epidemics that struck London in the 1840s. Cholera is a disease that is transmitted via water and food caused by the bacterium Vibrio cholerae. Snow wrote an article in 1849 in which he theorized that the disease was transmitted by infected water. His theory contradicted the more popular belief that the disease was caused by poisonous vapors.

The Ganges, India's sacred river, is beseiged by trash, sewage and other forms of pollution.

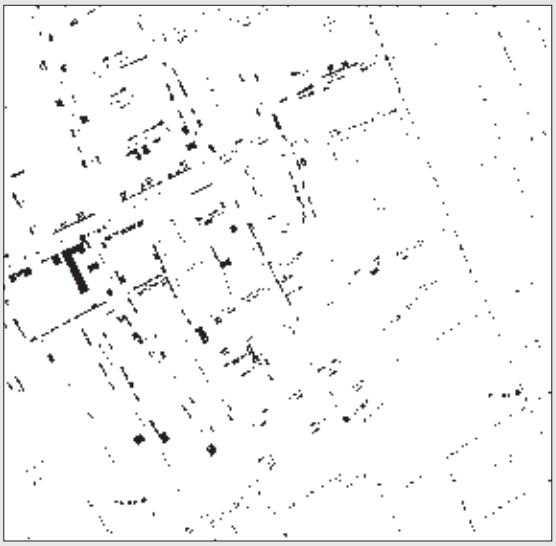
In 1854, there was a particularly bad outbreak of cholera. Snow began collecting data, specifically mapping where the deaths occurred from the disease. He found that the center of the neighborhood where the deaths occurred had a well that had been used by all of the people who died. After he had the handle to the well removed by public officials so that no one could use it, the epidemic came to an end. While he could not determine the specific cause of the disease (something that would not take place for some years), he identified, through a process of deduction, the source of the disease's transmission—i.e., infected water.

Activity: Finding the Source of the 1854 London Cholera Epidemic

In the following activity, you will look at the map of the 1854 cholera outbreaks in just the same way John Snow did. Can you determine which of the London water pumps was the carrier of the disease? Use the same logic that Snow did and see if you can come up with the same answer.

Materials Needed

John Snow's map showing the cholera outbreak of 1854 in London. Each line indicates an individual who died from cholera. There are thirteen water pumps included in the map. There are 578 recorded deaths noted on the map.



Print off the Snow map from the *Knowater* website. Divide it into thirty-six equal squares as shown below.

1	6	7	8	9	10
11	12	13	14	15	16
17	18	19	20	21	22
23	24	25	26	27	28
29	30	31	32	33	34
35	36	37	38	39	40

Count up the total number of deaths in each square of the map. Then have students find the water pump which is closest to the heaviest concentration of deaths. It should lead them to the Broad Street Pump, which was, in fact, the site responsible for the infections. This method that the students have used is essentially the same one as that employed by John Snow over 150 years ago. His approach is widely recognized as the beginning of modern epidemiological research.

Have students review the following summary questions:

1. How do logic and deduction lead to scientific knowledge?

2. Can we treat a disease such as cholera without actually understanding what causes the disease? Why or why not?

Exploring *One Water*

In the film, Hindus are shown drinking water from the River Ganges. Is this celebration of water as a source of health potentially dangerous from a disease perspective?

Even though it is part of their religious belief that the Ganges water is good for one's health, should people be prevented from drinking it? How could the water be made safer?

Lack of access to clean, safe drinking water plagues communities in the developing world.

Video Clip: Ganges River Sequence
http://knowater.org/videos/

Consider the Quote

"It is an extraordinary fact that the deliberate introduction of poisons into a reservoir is becoming a fairly common practice. The purpose is usually to promote recreational uses, even though the water must be treated at some expense to make it fit for its intended use as drinking water. When sportsmen of an area want to improve fishing in a reservoir, they prevail on authorities to dump quantities of poison into it to kill the undesired fish, which are then replaced with hatchery fish more suited to the sportsmen's taste. The procedure has a strange Alice-in-Wonderland quality. The reservoir was created as a public water supply, yet the community, probably unconsulted about the sportsmen's project, is forced either to drink water containing poisonous residues or to pay our tax money for treatment of the water to remove the poisons - treatments that are by no means foolproof."

— Rachel Carson (1907-1964),
"Surface Waters and Underground Seas," Silent Spring, 1962

All of us need to be concerned with protecting our drinking water. Are there water pollution problems in the town or area where your students live? In the following activities, students will learn about pollution and how to prevent it.

Extension Activities

Elementary School Students

Create a list with students of the different ways water can become polluted. Talk with them about how we can help prevent pollution.

Multimedia

Have students write a contract that outlines ways they will try to prevent water from becoming polluted in their homes and at school.

Middle School Students

Have students work in teams to compile a list of ten ways that groundwater can be kept clean. This includes things like making sure that old paint around their homes is not poured down a drain, but taken to a hazardous waste disposal site. Similarly, batteries need to be taken to waste disposal sites and not simply thrown away. Have students design and create posters pointing out five ways people can do things around their homes to make sure that our groundwater remains as safe as possible.

Multimedia

Have students create a slide show talking about how to dispose of hazardous materials found around the house so that they will not cause damage to groundwater.

Secondary School Students

Have students go to the United States Environmental Protection Agency's superfund site for Florida *(http://www.epa.gov/superfund/sites/npl/fl.htm)*. Have them find three sites in their county or as nearby as possible and have them summarize in a brief one-page report what types of problems there are at sites, their cause, and what has to be done to get them cleaned up.

Multimedia

Have students create a film for *YouTube* or some other public site documenting hazardous or potentially dangerous conditions affecting water in their community or a nearby area.

8 Water in Art, Literature & Music

Mural on wall in small town of Ecuador.

Florida Sunshine State Standards Benchmark	
VA.B. 1.2.1	The student understands that subject matter used to create unique works of art can come from personal experience, observation, imagination, and themes.
VA.B. 1.2.3	The student knows how to identify the intentions of those creating works of art.
VA.C. 1.2.1	The student understands the similarities and differences in works of art from a variety of sources.
SC.H. 1.2.2	The student understands how artists have used visual languages and symbol systems through time and across cultures.

Representations of Water in Art

Water and oxygen are the most important elements for sustaining human life. We cannot live without water. Water surrounds us. We live on a water planet. It should not be surprising, therefore, that water is often a theme found in art. Drawings by the great Renaissance painter and inventor Leonardo da Vinci give us a sense of water's movement and dynamic quality. In Japanese culture there is perhaps no more famous image than *The Breaking Wave Off Kanagawa* (also called *The Great Wave*), by Katsushika Hokusai (1760-1849).

In Western music there are few more famous pieces than George Frideric Handel's (1685-1759) *Water Music*, an orchestral suite that was written for the King of England. Sea shanties and water songs are a worldwide tradition.

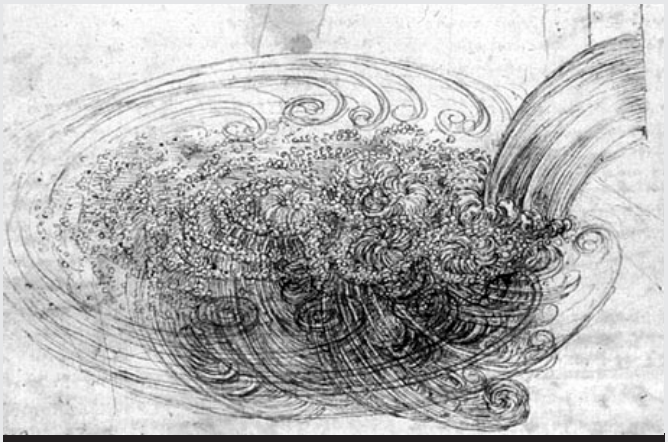
Water is also the subject of poetry found around the world, from the Muslim/Sufi poet Shaikh Abu-Said Abil-Kheir (967-1049) "Mansoor, that whale of the Oceans of Love" to the American poet Emily Dickinson (1830-1886) "I taste a liquor never brewed."

The Breaking Wave Off Kanagawa. Also called The Great Wave by Katsushika Hokusai (1760-1849). Woodblock print from Hokusai's series *Thirty-six Views of Fuji*. This work is widely considered the greatest of all Japanese wood prints. The original is at the Hakone Museum in Japan.

Activity: Discover Themes of Water in Art

In the following activity, students will explore representations of water in art. The activity will take them online to search for materials on the Internet.

They will be required to find a painting, an engraving, or some other graphic piece of art that represents water. Students will have to develop an argument that explains why they think a particular work represents or portrays water in a special or unique way.



Studies of Water passing Obstacles and falling (c. 1508-1509) by Leonardo da Vinci (1452-1519).

Have them make a print, at least 4x6 inches, of the work. Have them accompany the print with a short statement (for younger children, a sentence; for secondary students, a paragraph) that summarizes why they have chosen the work.

Then, using paper, pencil, colored markers, or any other convenient medium, have them create a work of their own that represents the same theme as the artwork they have chosen (in the case of the illustrations found above, this would be the movement of water).

Students should feel free to use traditional methods of drawing and painting, as well as techniques such as collage.

The works done by students can be collected together and put onto a bulletin board, or they can be scanned and put up as an exhibit on a website.

Have students review the following summary questions:

1. How is water represented in different artistic traditions and different cultures?

2. Are there universal themes in the representation of water in art across different cultures? If yes, what are these themes?

Consider the Following Poem

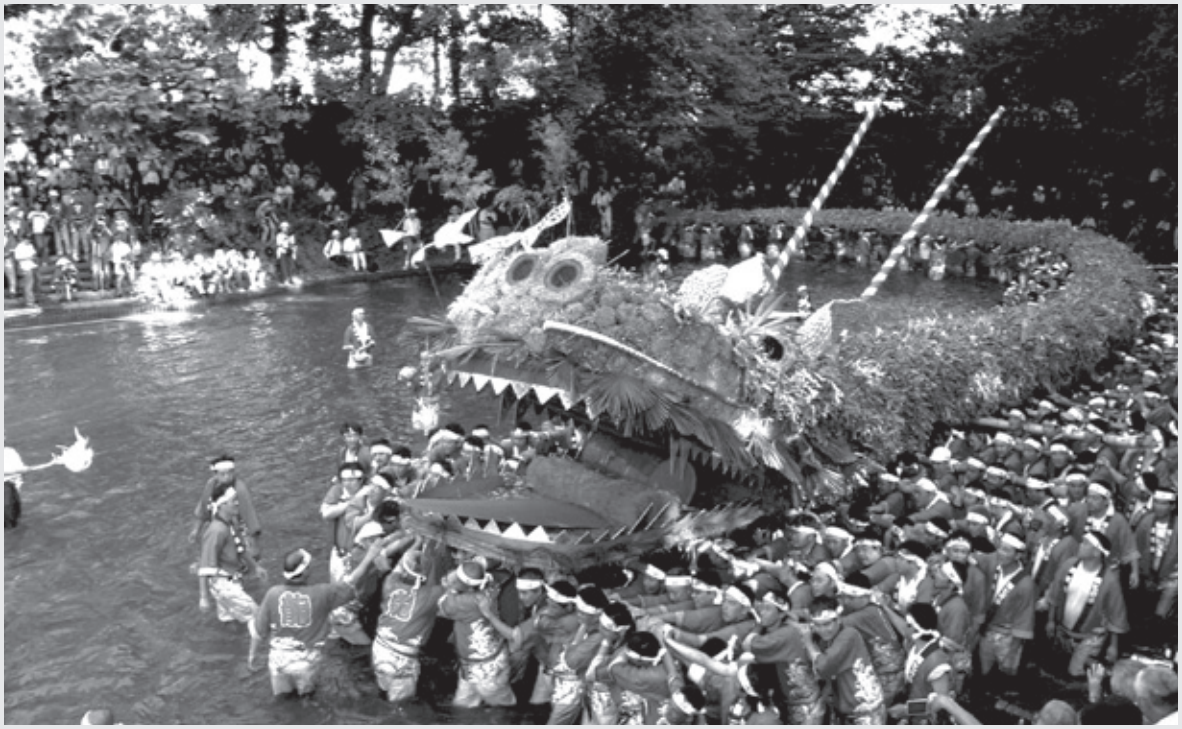
The taste, by the American writer
Jack Keroauac (1922-1969):

The taste of rain—Why kneel?

Exploring *One Water*

Look at the following clip of the celebration of Suneori Amagoi, in Tsuvugashima, Japan.

Video Clip: Japanese Clip of Carp
http://knowater.org/videos/



Suneori Amagoi celebration is a ritual for which hundreds turn out every four years to pray for rain.

Thinking about how water is represented in art gives us the opportunity to explore our personal selves and to be creative. In the following activities, students will use water to explore different artistic mediums and to create art of their own.

Extension Activities

Elementary School Students

Have students bring in at least five or six images of water from a newspaper, a magazine, or from something printed off the Internet. Have them create their own collage from the images. Encourage them to add their own drawings or words to their collages. The collages they create can be shared and talked about, as well as used for a bulletin board display.

Multimedia

Color copy the collages created by the students and use them to make a giant collage pasted down to several poster boards or a giant piece of brown wrapping paper. You can also scan the collages with the students and have them put together a slide show of the class's work.

Middle School Students

Have students compile a collection of poems that use water as a major theme. An excellent resource is the website Poetry Chaikhana: Sacred Poetry from Around the World *(http://www.poetry-chaikhana.com/Themes/Water.htm).* This site includes collections of poems organized by different themes, including water. Have the students choose a poem they like and copy it electronically for inclusion in a class anthology. Have them write a paragraph introducing the poet and his or her work.

Multimedia

Have students write their own poems about water and then, using a digital recorder, have them recite their work. Create a Power Point™ presentation with the text of the poem and a "clickable" reading of it by its student creator. The materials created can be distributed as CD-ROM anthologies, or they can be posted on a website for others to see and hear.

Secondary School Students

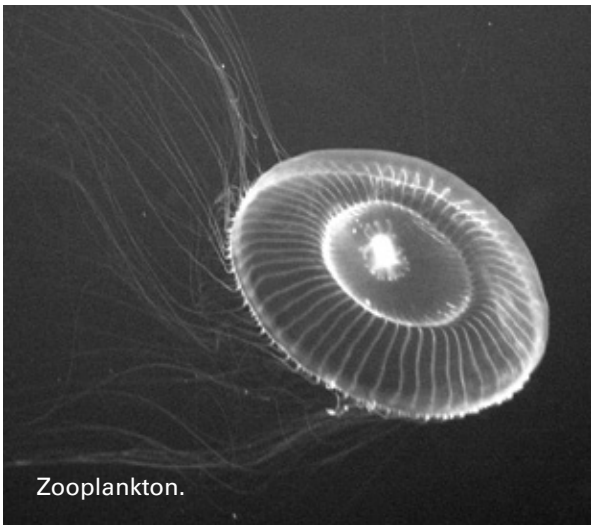
Have students listen to classical works that focus on water such as Smetana's "The Moldau," Debussy's "La Mer," and Handel's "Water Music." Have them use one of these works, separately or in a group, in a medium of their choice (dance, rap, poetry, etc.) to create an artistic representation of water.

Multimedia

Sea songs and shanties that focus on water as a theme are a tradition found across many cultures. Have students research this type of music and, if they are musicians, have them perform and record examples. These can be posted by the students on *YouTube* or a website. A particularly helpful website for this activity is Songs of the Sea *(http://www.contemplator.com/sea/index.html).*

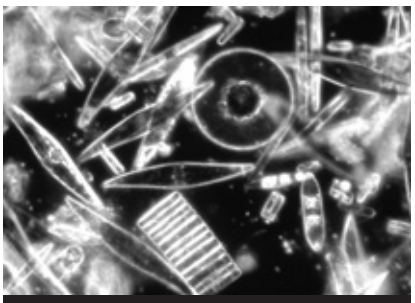
9 Life in a Drop of Water

Florida Sunshine State Standards Benchmark	
SC.A. 2.2.1	Materials may be made of parts too small to be seen without magnification.
SC.F. 1.2.3	Living things are different but share similar structures.
SC.G. 1.2.7	Variations in light, water, temperature, and soil content are largely responsible for the existence of different kinds of organisms and populations.


Zooplankton.

Microscopic Aquatic Life

You know that many organisms live in the water – fish, dolphins, whales, seaweed, or manatees might come to mind. Most of the organisms that live in the water, however, are too small to see with the naked eye, and we generally do not think about them. Plankton are microscopic, single-celled aquatic organisms with limited swimming abilities. They are classified into two groups: phytoplankton (plants) and zooplankton (animals). Phytoplankton are very important to other larger aquatic organisms as well as to people. They are the basis of nearly all aquatic food chains and also produce about 80% of the oxygen we breathe. Phytoplankton, like all plants, make their own food through photosynthesis.


Phytoplankton.

Phytoplankton occur in many shapes, including disks, rods, chains, and spines. There are three major types of phytoplankton: diatoms, dinoflagellates, and coccolithophores. Diatoms float and usually live where the waves and currents push them around. Dinoflagellates are plankton with two tails (flagella) that beat to push the organism around. Coccolithophores are spherical and covered with chalky discs that shed off the organism and sink to the ocean floor.

Zooplankton are floating or weakly swimming animals that rely on water currents to move. They are usually larger than phytoplankton, ranging from microscopic creatures like rotifers to easily visible jellyfish. Zooplankton are also an important part of aquatic food chains. Some zooplankton are primary consumers, eating phytoplankton, and others are secondary consumers, feeding on other zooplankton. Zooplankton are the favorite food of many marine animals such as fish and baleen whales.

Is it possible for you to see phytoplankton or zooplankton? In the following activity, you will use your naked eye, a magnifying glass, and a microscope to find out.

Activity: What's in a Drop of Water?

Find out what organisms you can see in a sample of water

Materials Needed

- three water sample jars
- samples of fresh and salt water
- a permanent marker
- magnifying glass or hand lens
- microscope
- petri dishes, baby food jars, or other small clear or white colored glass containers
- microscope slides and cover slips
- copy of Life in a Drop of Water Activity Worksheet on page 57

Follow these steps:

1. Choose a location or locations to collect your samples. Ideally, collect a fresh water sample from a stream, another from a pond or lake, and a saltwater sample from the ocean.

   Note: It may be necessary for the teacher to collect samples in advance of this activity or ask students to bring water samples from the surrounding area.

2. Collect 1-liter samples from each water location. When collecting, dip your container into the water at the water's edge making sure to get any algae or plant life present. Quickly remove the container to ensure that most of your organisms do not escape.

3. Use a permanent marker to write the location and date for each sample on each "water sample" container.

4. Bring samples back to the classroom for observation.

5. With your naked eye, observe, sketch, describe and count the type and number of visible organisms found in each sample. Record your data in the naked eye column of the worksheet. The samples can be transferred to a petri dish, baby food jar, or other shallow clear or white container. Containers can also be placed on a white sheet of paper for easier viewing.

6. Next, observe the water samples using a magnifying glass or hand lens. Again, sketch, describe, and count the type and number of visible organisms found in each sample, recording your data in the magnifying glass column of the worksheet.

7. Finally, observe the water samples using the microscope. Again, sketch, describe, and count the type and number of visible organisms found in each sample, recording your data in the microscope column of the worksheet.

8. Discuss your observations in groups and as a class.

9. Create a graph to compare and analyze your collected data.

Have students review the following summary questions:

1. What types of animals did you find in the pond water?
2. Did the type of water sample change the number and kinds of organisms found? Why or why not?
3. Would you expect to find the same organisms in each sample all year round? How could you test your prediction experimentally?

Exploring *One Water*

Look at the following clip of mosquitoes spreading the malaria infection to humans.

Video Clip: Mosquito Larvae
http://knowater.org/videos/

Consider the Quote

"Eventually, all things merge into one, and a river runs through it. The river was cut by the world's great flood and runs over rocks from the basement of time. On some of the rocks are timeless raindrops. Under the rocks are the words, and some of the words are theirs. I am haunted by waters."

—Norman Maclean, A River Runs Through It, 1989

Extension Activities

Elementary School Students

Some of the most beautiful scientific drawings ever created are the work of the German scientist Ernst Haeckel (1834-1919). Many of them are of microscopic animals found in seawater such as Radiolarians. Have students go online and collect a portfolio of his work, finding out who Haeckel was and what were the subjects of his illustrations.

Multimedia

Have students create a slide show using Power Point™ or a bulletin board display of Ernst Haeckel's drawings of microscopic sea life.

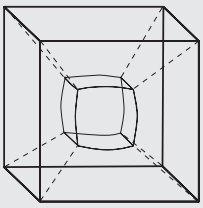
Extension Activities

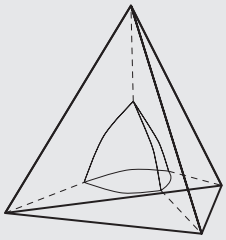
Middle School Students

Microscopic sea animals such as Radiolarians and various other planktons have the same shapes and structures as soap bubbles made with soap bubble frames. Have students construct a square soap bubble frame using pipe cleaners or light-weight wire. When dipped in a soap solution, the bubble formed assumes the same shape as certain types of Radiolarians. Why does this happen? A soap bubble is a minimal surface. It takes the most physically efficient form possible—free standing, this is a sphere. When stretched on a square frame this shape is a trapezoid bubble with a square bubble in the center. A triangular frame gives a triangular trapezoid.

Video

A video recording with instructions for completing this activity can be referenced at the *One Water* curriculum website.





Have students compare these shapes with the following drawings of Radiolarians made by Ernst Haeckel. Have them try to conclude why these shapes are the same. (The Radiolarian's skeleton takes the most energy efficient shape possible, the same as a soap bubble).

Multimedia

Have students create a slide show on Power Point™ of Radiolarians as compared to soap bubble frames.

Secondary School Students

The architect Peter Stevens in his book *Patterns in Nature* has shown that the stress lines found in rocks, dried mud, and even the cracked surface of an ancient Chinese vase follow the most efficient and stable lines of stress possible. In general, when most elastic substances are placed under stress, they will fracture into hexagonal shapes, meeting one another at angles of approximately 120 degrees. Individual snowflakes and the cells of plants and animals assume this basic hexagonal form. The cells in the eye of a common housefly take on these hexagonal shapes. Even the shells of tortoises have hexagonal configurations that repeat the shapes and forms that soap bubbles can take. As discussed above, the skeletons of the tiny sea creatures, Radiolarians, are remarkably similar in form to soap bubbles formed with differently shaped wire frames. Have students go online to research and write a 3 to 4 page double-spaced paper outlining how patterns are found in nature, even among the smallest animals and plants found in fresh water ponds or the ocean.

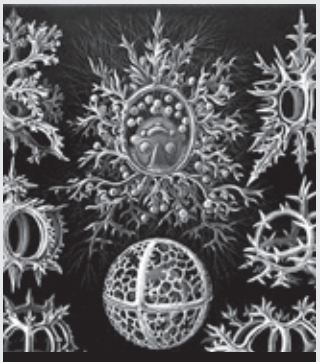


Plate 71 from Ernst Haeckel's *Kunstformen der Natur* (1904), showing Radiolarians of the order Stephoidea.

Multimedia

Have students create a Point Point™ presentation, a website or short film on patterns found in nature. Keywords that will help them on Internet searches include Darcy Wentworth Thompson, *On Growth and Form*, and Fibonaccian sequences.

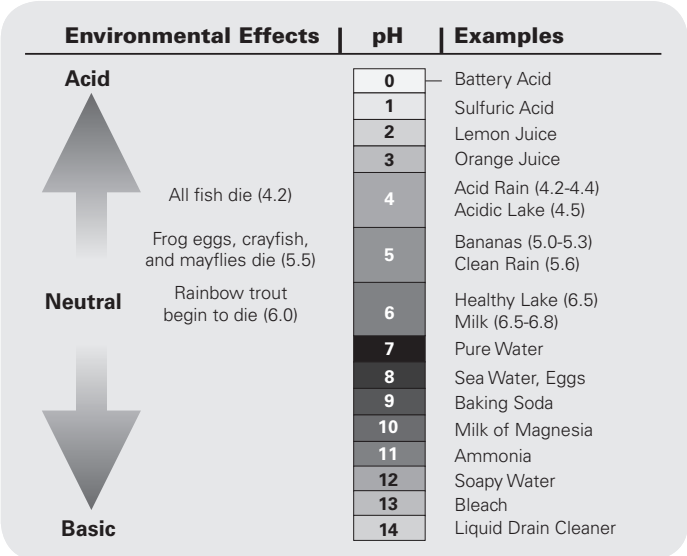
10 Acid Rain

Florida Sunshine State Standards Benchmark	
SC.A. 1.2.1	The properties of materials (in this pH) can be compared and measured.
SC.A. 1.2.5	Materials made by chemically combining two or more substances may have properties that differ from the original materials.
SC.G. 2.2.3	Changes in the habitat of an organism may be beneficial or harmful.

Acid Rain & pH

Water pollution comes in many forms. Some are obvious and highly visible, like an oil spill or trash floating in a lake. Other forms of water pollution can be difficult to detect. Acid rain is not obviously pollution, but can cause great damage to water ecosystems by lowering the pH of the water. Acid rain is rain that has been made acidic by certain pollutants in the air. An acid is a substance that has a very low pH. The scale for measuring pH runs from zero (the most acidic) to 14 (the most basic or least acidic). A substance that has a pH of 7 is neither basic nor acidic and is called "neutral."

Human activities are the main cause of acid rain. Cars, power plants, and factories release many different chemicals into the air that change the mix of gases in the atmosphere. These pollutants cause acid rain. Acid rain can be extremely harmful to forests. Acid rain that seeps into the ground dissolves nutrients that trees need to be healthy and also make it difficult for tree roots to absorb water. These trees become weaker and more prone to damage from infections, insects, and cold weather. Acid rain is also very harmful to lakes and streams. Most lakes and streams have a natural pH level between 6 and 7.



Acid rain, however, has caused many lakes and streams to have much lower pH levels. This increase in acidity can be deadly to aquatic wildlife, including fish, insects, frogs, plankton, and aquatic plants. The chart shows the pH scale, examples of common liquids with different pH levels, and the effect of lowering pH on aquatic life.

Activity: The Effect of Acid Rain on Radish Plants

In the following activity you will test the effects of simulated acid rain on growing plants.

Materials Needed

- a pack of radish seeds
- bag of potting soil
- three small pots
- permanent markers
- tap water
- vinegar
- graduated cylinder
- ruler
- two clean cups
- pH test strips
- copy of Acid Rain Activity Worksheet on page 57

To test the effects of acid rain on radish plants, follow the steps below:

1. Fill one clean cup with tap water and the other cup with vinegar.

2. Using the pH strips, measure the pH of each liquid and record on the acid rain data sheet.

3. Label the three pots A, B, and C with the marker.

4. Fill each pot with potting soil and poke several small holes in the bottom for drainage.

5. With your finger, make a hole 4 cm deep in the soil in each cup.

6. Place five radish seeds in each hole and carefully cover the seeds with soil.

7. In Pots A and B, use the graduated cylinder to water the seeds with 50 ml of water.

8. In Pot C, water the seeds with 50 ml of vinegar.

9. Place all three pots in the same growing area.

10. Check the plants each day, using the ruler to measure and record their growth on the data sheet.

11. Add 20 ml of water every other day to Pots A and B. Add 20 ml of vinegar to Pot C every other day.

12. After one week, continue to water Pot A with 20 ml of water every other day. Water Pots B and C with 20 ml of vinegar every other day. (Note that Pot B has now switched from water to vinegar).

13. Continue measuring and recording plant growth each day for a three-week period.

14. After plants have grown for three weeks, create a bar graph from your data to compare the growth of the plants in the three pots.

Have students review the following summary questions:

1. What can you conclude based on your data?

2. What effect did changing Pot B to a vinegar mixture have on the growth of the radish plant?

3. What effect does acid rain have on plant growth?

Exploring *One Water*

Look at the following clip to see how pollution affects the local environment in Louisiana.

Video Clip: Pollution in Louisiana
http://knowater.org/videos/

Consider the Quote

"There is nothing softer and weaker than water,
And yet there is nothing better for attacking hard and strong things.
For this reason there is no substitute for it."
—Lao-Tzu circa B.C. 550

Extension Activities

Elementary School Students

Review with students the ways fresh water can become polluted. Talk with them about ways they can help prevent certain water pollution. List them on the board.

Multimedia

Have students draw pictures of the causes of water pollution in their community.

Middle School Students

Review with students the ways fresh water can become polluted. Talk with them about the places where they think water pollution might be going on in their community or in other parts of the country. Have them compile a descriptive list of water pollution sites (local and national).

Multimedia

Use the local community list generated by students to go out and document with photographs the sources of water pollution that they can find in their communities. Have them create a bulletin board exhibit or website with their photographs.

Secondary School Students

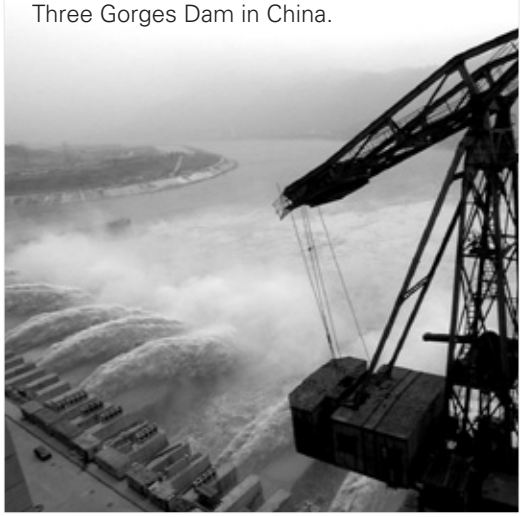
Have students research in their community to find out if there is a site that has serious water pollution. Have them try to discover who is responsible and what can be done about the problem. This activity can culminate in the writing of an action letter to a local government official or representative, or to the newspaper.

Multimedia

Have students create a film showing a water pollution problem in their local community. In the film, have them suggest actions that can be taken to solve the problem. Post the film to a website such as *YouTube*.

11 The Effects of Damming Rivers

Florida Sunshine State Standards Benchmark	
SC.B. 1.3.51	The student uses various geographic representations, tools, and technologies to acquire, process, and report geographic information.
SS.B. 1.3.4	The student understands how factors like culture and technology influence the perception of places and regions.
SC.B. 2.3.6	The student understands the environmental consequences of people changing the physical environment in various world locations.



Three Gorges Dam in China.

Damming Rivers

A dam is any structure that is built across a flowing body of water to control or alter the water's flow. People have been building dams for millennia. Eight thousand years ago, the Sumerians built dams along the Tigris and Euphrates rivers in present-day Iraq. The purpose of dams is to improve quality of life by providing drinking water and supporting economic growth by diverting water for power, flood control, and agricultural irrigation. Today, most of the world's large rivers are dammed. It has been estimated that there are currently more than 40,000 large dams (over 15 meters high) and 800,000 small dams around the world.

Aerial view of Hoover Dam on the border of Arizona and Nevada.

In many ways, these dams have been successful. Irrigation of the Western United States, for example, has allowed large-scale farming to flourish in arid conditions. India's irrigation systems have enabled that country to become a self-sufficient producer of food for over one billion people. Dams have helped in reducing the life-threatening problems of famine as a result of drought, devastation from floods, and disease.

Despite these benefits, the widespread damming of rivers has come under increasing criticism due to a wide range of unintended negative consequences. The adverse effects of dams include the disruption of ecosystems, the decline of fish stocks, the forced resettlements

of communities, and, in some cases, increases in disease. New damming projects face increased opposition. Despite this, the world's largest dam is nearing completion in China.

China's Yangtze River is the world's third largest river. It stretches for 3,700 miles across China and provides life-sustaining water for millions of people who live in the Chinese countryside. It irrigates the majority of the crops that feed the rest of country. The Yangtze's life-giving waters can also cause devastation and death. Throughout thousands of years of Chinese history, the Yangtze has flooded on an average of about once every ten years. These floods have caused great losses of life and infrastructure. As more and more businesses and factories sprung up along the river, there were increased calls to dam the Yangtze. After decades of debate, construction of the Three Gorges Dam was begun by the Chinese government in 1994. Originally scheduled for completion in 2007, delays have pushed the completion date back to 2011.

Critics of the Three Gorges Dam continue to warn that when the project is completed, it will destroy the delicate ecosystem of the river, killing many of the fish and dramatically increasing pollution of the Yangtze as it becomes increasingly stagnant. Further, the flooding of the area behind by the dam will bury archaeologically valuable temples and burial grounds, as well as causing the forced displacement of between four and five million people.

Activity: The Three Gorges Dam

In the following activity, you will prepare for a debate on the whether the Chinese government should complete the construction of the Three Gorges Dam.

1. Find information about the area that would be affected by the dam.
   Start with the following website: *http://www.pbs.org/newshour/bb/asia/july-dec97/gorges_10-8.html*

   From there, conduct additional on-line searches to gather more information about the Three Gorges Dam project.

2. From the information you gather, fill in both the benefits and the costs columns of the Three Gorges Dam Activity Worksheet on page 58.

3. Make a decision about whether you are in favor or against the Three Gorges Dam.

4. Your teacher will assign you to "pro" and "con" teams to have a debate on the statement: The Three Gorges Dam is a benefit to the Chinese people.

5. Remember that when you have a debate, the goal is to present facts and evidence and not just to argue with the other team.

After the debate, consider the following summary questions:

1. Did any of your opinions about dams change as a result of the debate? Why or why not?

2. If your city was planning to build a new dam, what advice would you give the mayor?

3. Do you think the importance of dams is different in developed and developing countries? Why or why not?

Exploring *One Water*

Look at the following clip of the Three Gorges Damn in China.

Video Clip: Three Gorges Dam in China
http://knowater.org/videos/

Consider the Quote

"The creation of huge reservoirs allows some control over the flow of the river itself...But the [river] is not just a machine. It is an organic machine...For no matter how much we have created many of its spaces and altered its behavior, it is still tied to larger organic cycles beyond our control."

— Richard White, The Organic Machine, commenting on the Hoover Dam

Extension Activities

Elementary School Students

Google Earth is an online mapping software, as well as a tool for viewing, creating, and sharing site/location-specific information. Download Google Earth to your computer or library classroom and take a tour with your students of your local community. Have them note where bodies of water such as rivers and streams are located. Create a poster-size hand-drawn map with the assistance of your students.

Multimedia

Copy the map you have created with your students to a web page or create a Power Point™ page. Have students collect together photographs of different bodies of water in their community and have them insert them into the map.

Middle School Students

Have students visit the "Rising Sea Level Animation," created by Zoltán Büki, available on Google Earth. Have them create a list of ten major cities from around the world that will be flooded if sea levels continue to rise because of global warming.

Multimedia

Use the local community list generated by students to go out and document with photographs the sources of water pollution that they can find in their communities. Have them create a bulletin board exhibit or website with their photographs.

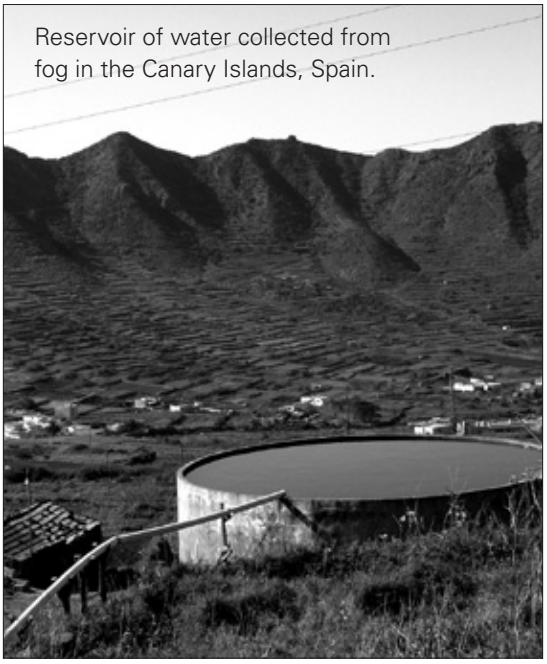
Secondary School Students

Who owns the water in a river? Is it the people at the headwaters or the beginning of its flow, or is it everyone over whose land the river flows? If a river is totally blocked by a dam, is it just "tough luck" for the people below the dam? Have students explore online the history of the Colorado River. Ask them to write a brief history (two pages double-spaced) of how the water rights for the seven states the river runs through have been dealt with by politicians and the government.

Multimedia

Have students create a multimedia history using Power Point™ of Water Rights Issues and the Colorado River.

12 Quotes About Water



Reservoir of water collected from fog in the Canary Islands, Spain.

Florida Sunshine State Standards Benchmark	
SC.A. 1.2.2	75 percent of the surface of the Earth is covered by water.
SC.B. 2.2.2	Reducing, reusing, and recycling natural resources improves and protects the quality of life.
SC.D. 1.2.5	Changes in the habitat of an organism may be beneficial or harmful.
SC.H. 2.2.1	The student understands the environmental consequences of people changing the physical environment in various world locations.

Thinking About Water

The following quotations about water are taken from a wide range of authors and historical time periods. What they all hold in common is the importance of water to human life. Use the quotes as points of discussion with your students. You may wish to post them on a board on a daily or weekly basis, or have students use them as the basis for a journal entry, an essay, a report or a multimedia presentation.

"Water and air, the two essential fluids on which all life depends, have become global garbage cans."

—Jacques Cousteau (1910-1997)

"Water is fundamental for life and health. The human right to water is indispensable for leading a healthy life in human dignity. It is a pre-requisite to the realization of all other human rights."

—The United Nations Committee on Economic, Cultural and Social Rights, Environment News Service, November 27, 2002

"Water, like religion and ideology, has the power to move millions of people. Since the very birth of human civilization, people have moved to settle close to it. People move when there is too little of it. People move when there is too much of it. People journey down it. People write, sing and dance about it. People fight over it. And all people, everywhere and every day, need it."

—Mikhail Gorbachev, President of Green Cross International
quoted in Peter Swanson's *Water: The Drop of Life*, 2001

"Multinational companies now run water systems for 7 percent of the world's population, and analysts say that figure could grow to 17 percent by 2015. Private water management is estimated to be a $200 billion business, and the World Bank, which has encouraged governments to sell off their utilities to reduce public debt, projects it could be worth $1 trillion by 2021. The potential for profits is staggering: in May 2000 Fortune magazine predicted that water is about to become 'one of the world's great business opportunities', and that 'it promises to be to the 21st century what oil was to the 20th'."

—John Louma, "Water Thieves," The Ecologist, March 2004

"No one has the right to use America's rivers and America's Waterways that belong to all the people as a sewer. The banks of a river may belong to one man or one industry or one State, but the waters which flow between the banks should belong to all the people."

—Lyndon B. Johnson (1908-1973), 36th U.S. President,
signing the 1965 Clean Water Act

"We used to think that energy and water would be the critical issues for the next century. Now we think water will be the critical issue."

—Mostafa Tolba of Egypt, former head of the United Nations
Environment Program

"You don't miss your water until your well runs dry."

—Old country proverb

13 Worksheets: Extension Activities

Water Cycle Simulation

Extension Activities worksheet for Page 8 & 9

Rain in a Pot Simulation – Record your observations in words or pictures.

Rain in a Plastic Cup Simulation – Record your observations in words or pictures.

Recording Rain Fall

Extension Activities Worksheet for Page 11

1	
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Global Warming Activity

Extension Activities Worksheet for Page 14

Cups of water added	Depth of water in box	% of island flooded	Description of flooding
1			
2			
3			
4			
5			
6			

Water Taste Sample Activity

Extension Activities Worksheet for Page 20

Water Sample #	Taste Ranking	Description of Taste
1		
2		
3		
4		
5		

Fill in the Word (Cloze Sentence Activity)

Extension Activities Worksheet for Page 21

EARTH SALT WATER FRESH WATER STREAMS RIVERS POLLUTED WATER DRINKING WATER

Use the words listed above to complete the following sentences. Some can be used more than once.

1. _____ and _____ have running water.
2. There is much more _____ than fresh water in the world.
3. _____ is bad for the environment.
4. _____ can be drunk.
5. _____ is found in the oceans.
6. The _____ is known as the "Water Planet."
7. _____ is bad for fish.
8. _____ must be kept clean.
9. _____ cannot be drunk.
10. I like to drink _____.

Answers: 1. streams or rivers; 2. salt water; 3. polluted water; 4. fresh water or drinking water; 5. salt waters; 6. Earth; 7. polluted water; 8. streams or rivers; 9. salt water or polluted water; 10. fresh water or drinking water.

Life in Drop of Water Activity

Extension Activities Worksheet for Page 40

Water Sample	Naked Eye	Magnifying Glass	Microscope

Acid Rain Data Sheet

Extension Activities Worksheet for Page 44

Days	Pot A (Water)	Pot B (Water, Vinegar)	Pot C (Vinegar)
1			
3			
5			
7			
9			
11			
13			
15			
17			
19			
21			

Three Gorges Dam Activity

Extension Activities Worksheet for Page 48

Benefits of the Three Gorges Dam	Costs of the Three Gorges Dam

Knowater Notes

Knowater Notes

Atatürk Dam, Turkey.

Adventurer Marco Cruz holds a 30-year-old picture of Mount Chimbarazo when the ice cap was much larger.

Iceberg near Laguna San Rafael in Chile.

Waterfall in Ecuador.

One Water Motion Picture Credits

Note: The short non-verbal 1H20 film and the television version of "One Water" have separate credits not all of which are reflected here. The television version of "One Water" is narrated by Martin Sheen.

PRODUCER, WRITER AND DIRECTOR
SANJEEV CHATTERJEE

EDITOR AND DIRECTOR
ALI HABASHI

ORIGINAL MUSIC COMPOSED ORCHESTRATED AND CONDUCTED BY
THOMAS M. SLEEPER

PERFORMED BY
THE RUSSIAN NATIONAL ORCHESTRA
AT THE GREAT HALL OF MOSCOW
P.I.TCHAIKOVSKY CONSERVATORY

DIRECTOR OF PHOTOGRAPHY
ED TALAVERA

NARRATED BY
DONNA E. SHALALA

EXECUTIVE PRODUCED BY
SAM L GROGG
HARRY CLEIN

EXECUTIVE PRODUCERS
LUIS GLASER
JAMES WILLIAM HIPP
EDWARD J. PFISTER
M. LEWIS TEMARES
SHELTON G. BERG
THOMAS LE BLANC

SUPERVISING SOUND EDITOR AND RECORDING MIXER
JEFFREY H. STERN

SOUND EDITOR
KATELYN NYE

ASSISTANT SOUND EDITORS
RICARDO AGURRE PADILLA
EVA DYER
ERIC SCHWARTZ

RECORDING ENGINEER
OLEG IVANOV

RECORDING SUPERVISOR
TATIANA VINVITSKAYA

MUSIC EDITED AND MIXED BY
PAUL GRIFFITH

PIANO SOLO
MARINA RADIUSHINA

ADDITIONAL MUSIC ALSO BY
THOMAS SLEEPER
ADAGIO FROM SYMPHONY NO. 1
LULLABY FOR CHELSEA ROSE
HANNA'S DAY OUT
HEMINGWAY SONG CYCLE
THE JUNGLE HARP
STRING QUARTET NO. 2
LEYLIE'S WALTZ
USED BY PERMISSION OF UROBOROS MUSIC

"RAME KHUDAYA KUAN, BAODI" SONG PERFORMED BY
BIRJU BHOPA
KAMALA DEVI BHOPA

"DUNABE, DUNABE" SONG PERFORMED BY
PETI, KOVACS ISTVAN SR., PETI, KOVACS ISTVAN JR.,
PETI, KOVACS TIBOR AND PETI, KOVACS GABOR

UNDERWATER AND SPECIAL EFFECTS CAMERA
PETER ZUCCARINI

CAMERA ASSISTANT
TIM CALVER

SECOND UNIT CAMERAS
NAOKI NODA - JAPAN
SUN MANG - CHINA
ART NOBO – MIAMI
ADDITIONAL MEXICO FOTTAGE
KENT ROMNEY
BRIAN HARDIN

COLORIST AND GRAPHICS
JAIME MARTINEZ, CINFINITY

POST–PRODUCTION COORDINATOR
CHAD TINGLE, CINFINITY

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VUJITY TVRTKO

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WANG XINLI
LIU SHUN'AN
OUYANG WEI
TUO SHANGHAI
WANG JING

ECUADOR
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EVA JARA
GERARDO YAGUAL
XIMENA CRUZ

HUNGARY
TV2
SZÉCHENYI FÜRDŐ

INDIA
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RAMESH PANWAR
LAXMINARAYAN SHARMA
KAILASH PANWAR
MOHAN LAL
DR. KOMAL KOTHARI
BUNKER ROY
ROOPA RAM
SAURYA CHATTERJEE

TECHNICAL TEAM
BOLLYWOOD HELPERS
MOTI LAL SENY
KEDAR PRASHAD SHARMA
SHANKAR LAL SHARMA
RAJESH SHARMA
RAM GOPAL SHARMA

SPECIAL THANKS
ECUADOR
MARCO CRUZ
BALTAZAR USHCA

INDIA
THE PEOPLE OF HAMIRA,
ASDEY KI DHANI, RINGI, TILONIA,
DAYAPUR, HABRA AND KOLKATA
PREMA DEVI AND MAMTA.
JYOTIRMOY MONDOL
PRONOTI JANA
THE WOMEN OF DAYAPUR, WEST BENGAL
THE THOUSANDS WHO BATHE DAILY IN THE GANGES

JAPAN
CHRISTOPHER JEANSONNE
RIYOJI MOGI

KENYA
KENNETH MURIUKI

PERU
PETER ZUCCARINI

SPAIN
DR. VIKI MARZOL JAEN

SOUTH AFRICA
ASHWIN DESAI
DESMOND D'SA
NTOZONKE BHENGU
FSARI NGEOBO
AYANDA DUBE
JOANNE DEALL

RUSSIA
MARINA RADIUSHINA

UNITED STATES
MIAMI
NEHA JAIN
LAUREN JANETOS
AUGIE RHO

NEVADA
ELIZABETH YOUNG, DEPARTMENT OF RECLAMATION
TOM SCHAUSS, HELICOPTER PILOT
THE HUALAPAI TRIBE OF INDIANS
SCOTT ALBOUM
JEFF HENDLER

ACCOUNTS
THE LATE JACKIE GONZALEZ
VALORY GREENMAN
LAUREN JANETOS
AKEMI WITKOWSKY

SPECIAL THANKS
HOLLY ACKERMAN
JOHN ASHE
JAWED ASHRAF
MIMI BANERJEE
RUKMINI BANERJEE
DR. JOHN BEIER
AGNES BIHAQRI
KENNY BROAD
MATTHEW BYRNES
REBECCA BYRON
ROCIO CALVO
RAUL CARDONA
DIPANKAR CHAKRABORTI
SUMITA CHATTERJEE
ANILLA CHERIAN
GEORGE CHESROW
CHHIME CHHOYKYAPA
FRANCISCO CHIMBO
MARY DOYLE
BRUCE GARRISON
JOHN GITHURE
KIM GRINFEDER
JUDY HOOD
FR. ODONDI JOHN
DR. TUSHAR KANJILAL
LOUP LANGTON
ERNIE LEON
LHAKDOR
MARGARET MARSHALL
MAKOTO MURASE
REVEREND NICK OYARE
GREG RABE
PAUL RICHARDSON
LELEN BOURGOIGNIE-ROBERT
MICHEL ROBERT
LUIS RODRIGUEZ
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JIM THEBAUT
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RUBEN VALENCIA
THE LATE BOB WEAVER
MYRA WEAVER
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EXPEDICIONES ANDINAS, RIOBAMBA
KENYA MEDICAL RESEARCH INSTITUTE, KISUMU
PRESERVATION ASSOCIATION OF SUNEORI AMAGOI FESTIVAL AND ITS MEMBERS
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one water

Many of the images in this booklet are taken from the motion picture *One Water*, or were taken by Sanjeev Chatterjee and Ali Habashi. The DP for *One Water* is Ed Talavera.