

WATERWAYS

TEACHER GUIDE

2006



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A Little About the Metropolitan Water District...

The Metropolitan Water District of Southern California is a public agency established in 1928 to build an aqueduct bringing water from the Colorado River. Today, it is one of the nation's largest suppliers of treated drinking water, providing about half the water used by 18 million people.

Metropolitan is governed by a 37-member board of directors representing 26 cities and water agencies in a six-county service area that encompasses 5,200 square miles in Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties.

Metropolitan draws water supplies from two sources—the Colorado River Aqueduct, which it owns and operates, and the State Water Project. The Colorado River Aqueduct moves water from the east, 242 miles across deserts and mountains. The State Water Project brings water supplies from Northern California through the Sacramento-San Joaquin Delta, 444 miles across the central part of the state, over the Tehachapi Mountains and into the Southern California coastal plain.

Metropolitan maintains and operates a regional distribution system that includes hundreds of miles of pipeline, five filtration plants, nine reservoirs, and fifteen hydroelectric plants.

Even with its extensive distribution and storage system, Metropolitan's imported supplies can vary due to precipitation levels and water allocations by federal and state agencies. Currently, Metropolitan works with its member agencies to create a reliable water supply by investing in indoor and outdoor conservation programs, water transfers and exchanges, water recycling, groundwater cleanup and recharging, additional storage and other local water-saving programs.

Metropolitan's and Southern California's basic belief is that **every drop of water saved today can be stored for tomorrow.**

For more information, please go to Metropolitan's Web site at www.mwdh2o.com

Metropolitan's Member Agencies



714 765-5137



310 285-2462



818 238-3550



Central Basin
Municipal Water District

310 217-2222



310 605-5595



818 790-4036



714 738-6890



818 548-2107



909 357-0241



Long Beach Water Department

562 570-2300



213 367-4211



626 744-4409



818 898-1213



626 289-7821



714 647-5400



310 458-8224



San Diego County
Water Authority

858 522-6600



909 621-5568



310 618-6216



West Basin
Municipal Water District

310 217-2411



951 789-5000



805 526-9323



951 928-3777



818 251-2100



714 963-3058



626 443-2297

WATER WAYS

THE PEOPLE BEFORE COLUMBUS



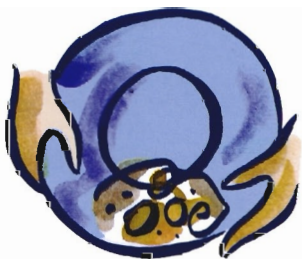
Explore early Native American attitudes towards water, how they used it, and how they saved it. Enjoy Native American legends, rain chants and art.

SETTLING THE COLONIES



Discover how colonists used water for trade and travel and to begin their settlements. Build a water wheel, learn about the first public utility and play some colonial games.

MOVING WESTWARD



Share Mark Twain's life on the Mississippi River, join Powell's exploration of the Colorado River, sing about The Erie Canal and build your own example of locks used on the Canal. Learn how using water effectively opened up new territories to explore and settle.



**METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA**

The mission of the Metropolitan Water District of Southern California is to provide its service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way.

WATERWAYS

TEACHER GUIDE



A SUPPLEMENTAL WATER EDUCATION PROGRAM FOR FIFTH-GRADE STUDENTS

Water Ways

is a fifth-grade unit prepared by The Metropolitan Water District of Southern California (MWD). It was created as a supplement to the fifth-grade social studies program and is divided into three sections. The materials are intended to be used during studies about Native Americans before Columbus' arrival, settling the colonies and the westward movement. Each section emphasizes the use of water, attitudes toward water, geographic concepts and water problems of that particular period.

The three sections were reviewed and field tested by curriculum specialists and teachers throughout MWD's service area.

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NOTES

TO THE TEACHER

Before you begin to teach each part of *Water Ways*, it might help you to begin collecting materials in advance. Below are some items you will need. Your students may be able to bring some of these items, also.

Pre-Columbian Native American Use of Water

U.S. Map
globe
cardboard tubes: gift wrap, mailing tubes or paper towel tubes (enough for each student)
toothpicks
glue
seeds, pebbles, rice, beads or dried beans (for use in making rainsticks)
paint

Settling the Colonies

California map
tall paper or plastic cup (1 per group of students or 1 to be used for demonstration)
sand
broom handle
rags from light-colored cloth
stones (fist size)
detergent
Popsicle™ sticks (about 30 per group)
styrofoam plates (2 per group)
water pitcher (1 liter or larger)
basins or tubs to catch water
sponges (1 per student or per group)
pasta: different types such as macaroni, spaghetti, manicotti
poster board
markers

Moving Westward

dishpans (for 2 - 4 students)
paper cups: 3 oz., 5 oz. and 9 oz.
(Enough for groups of students)
toothpicks
rubber bands
lead pebbles
soil
sand
pie plates (1 per 2 students)

Water Ways Correlation with History-Social Science Content Standards for California Public Schools

COURSEWORK

WATER WAYS ARTICLES

<p>5.1 The Land and People Before Columbus</p> <p>5.11 Examine major Pre-Columbian settlements</p> <p>5.11.1 Cliff dwellers and pueblo people of the desert Southwest</p> <p>5.11.2 American Indians of the Pacific Northwest</p> <p>5.11.3 Nomadic tribes of the Great Plains</p> <p>5.11.4 Woodland peoples east of the Mississippi</p>	<p>Gathering Water May Be Harder Than You Think</p> <p>Water Baskets</p> <p>Water in the Desert. Making Every Drop Count</p> <p>Farming and Irrigation Practices Helped Native Americans With Food Supply</p>
<p>5.12 Discuss how people adjusted to their natural environment</p>	<p>The Greatest River of All</p> <p>Gathering Water May Be Harder Than You Think</p> <p>Water in the Desert. Making Every Drop Count</p> <p>Water, Climate and Land Shaped the Life-Style of Pre-Columbian Native Americans</p> <p>Taking Care of the Environment</p>
<p>5.13 Explore how people developed an economy and a system of government and expressed their culture in art, music and dance</p>	<p>Artifacts Tell Stories of Ancient Ways</p> <p>People Everywhere Communicate Through Art</p> <p>The Greatest River of All</p> <p>Dances and Songs Brought Life-Giving Rain</p>
<p>5.14 Introduce the rich mythology and literature of American Indian cultures</p>	<p>Legend of "Raven-Who-Sets-Things-Right"</p> <p>Dances and Songs Brought Life-Giving Rain</p> <p>The Swallower of Clouds and the Hero Twins</p> <p>Koluscap and the Water Monster</p>
<p>5.3 Settling the Colonies</p> <p>5.33 Explore life in New England</p> <p>5.33.7 Political, religious, economic and social life of the New England colonies</p>	<p>Estuaries Shared by Many Early Settlements and Colonial Cities</p> <p>Contrasting Lifestyles. Is Water Good or Bad for You?</p> <p>The Water Wheel</p> <p>Fire!</p> <p>The First Public Water Utility</p> <p>A Colonial Sing-Along</p> <p>Some Colonial School Games</p>
<p>5.34 Survey the Middle Colonies</p> <p>5.34.2 Geographic factors enabling the middle colonies to thrive and contribute to the development of New York and Philadelphia as busy seaports</p>	<p>Water in the New Colonies</p> <p>The Water Well</p> <p>Roads, Ferries and Bridges</p> <p>Outgrowing the East Coast</p> <p>The Erie Canal</p> <p>Locks. Going Uphill on Level Water</p>
<p>5.34.3 Literature of period</p>	<p>The Wit and Wisdom of Poor Richard</p> <p>Benjamin Franklin's <i>Poor Richard's Almanac</i></p>
<p>5.4 Settling the Trans-Appalachian West</p> <p>5.45 Read biographies, tall tales and legends; sing songs of frontier period</p>	<p>The Cumberland Gap</p> <p>A Tall Tale. Pecos Bill</p>
<p>5.6 Life in the Young Republic</p> <p>5.62 Describe the waves of immigrants who arrived from Europe and their advance into the fertile Ohio and Mississippi Valleys</p>	<p>The Things You Carry</p> <p>Trade and Travel Along the Mississippi</p>
<p>5.63 Highlight the songs and literature of the era</p>	<p>Mark Twain's Mississippi</p> <p>Erie Canal</p> <p>Water Inspires Art</p>
<p>5.64 Highlight the Louisiana Purchase and chronicle the expeditions of Lewis and Clark and of John C. Fremont</p>	<p>Lewis and Clark Follow the Waters to the Pacific Ocean</p> <p>A Moment in Time: John Wesley Powell Explores the Last Unknown</p> <p>The Diary of Major Powell: Exploration of the Colorado River</p>
<p>5.7 The New Nation's Western Expansion</p> <p>5.71 Examine the advance of pioneer settlements beyond the Mississippi</p> <p>5.71.4 Farmers moving to Oregon's fertile valleys</p>	<p>Home on the Range</p>
<p>5.71.5 Forty-Niners bound for the Mother Lode of California</p>	<p>Gold Fever</p> <p>Mining and the Environment. Not a Good Mix</p>

WATER WAYS

TEACHER GUIDE

THE PEOPLE BEFORE COLUMBUS

Introduction

Purpose of Pre-Columbian emphasis

We prepared this issue of Water Ways to provide a water-related supplement to the “Land and People Before Columbus” unit of the California fifth-grade social studies curriculum: *U.S. History and Geography: Making A New Nation*. It is the first part of a water-related supplement for use in Southern California’s fifth-grade classrooms.

Objectives

1. Students will read about how Pre-Columbian Native Americans adjusted to their environment.
2. Students will gain knowledge and understanding of how Pre-Columbian Native Americans used water in their lives.
3. Students will review geographic regions and major river systems that relate to North America.
4. Students will use critical thinking skills to compare and contrast water use among Pre-Columbian Native Americans with present day water practices in California.
5. Students will recognize the effects of literature and art in early society through the study of stories, illustrations and petroglyphs.

Background Information

Prehistoric, Pre-Columbian

The people who lived on this continent before the Europeans arrived had no system of writing. As a result, we have no written record of their history and culture. We call this time when there was no written history “prehistory.”

On this continent, the prehistoric period ended with the arrival of Christopher Columbus, so we also call it Pre-Columbian. Despite their lack of written language, Pre-Columbian people were very aware of the history of their tribe, and they very carefully related their history to each generation through stories, legends and myths. These stories conveyed not only their tribal history, but also their religious beliefs and value systems. This wonderful tradition of spoken history is still carried on today.

“People” and “Native Americans”

Knowing what to call the original inhabitants of this country is difficult. “Indians” is a misnomer applied by Europeans who did not know where they had landed. Some groups object to this label and prefer to be called “Native Americans.” The Pre-Columbian people did not have one word for themselves. Individual tribes often referred to themselves by words that meant “The People” in their native tongues. They often called other tribes by names that described their habits, such as “Generous with Food” or “The Desert People.” In this issue, we use the terms Native Americans, Pre-Columbian Native Americans and People to embrace all the original inhabitants of the Pre-Columbian era.

LESSON PLAN PAGE 2

ARTIFACTS TELL THE STORIES OF ANCIENT WAYS

1. Introduce vocabulary words (see the glossary at the end of this section of the teacher guide): **archaeologist, gourd, artifacts, Pre-Columbian Native Americans.**
2. Have students read the short article and discuss it.
3. **Activity—Join the Dig.** Please find this reproducible page in your teacher

guide, page 18. Introduce this activity by asking students if they have ever seen artifacts of civilizations other than their own. Have the students give some examples. Ask the students what kinds of artifacts they think represent their particular generation best. Why? Have the students work individually or in groups for this activity. Explain that it is their task to choose five items that represent something about how we use water, such as a bathtub, a faucet, a fire hydrant, a toothbrush, etc. Explain that these items will be buried, only to be unearthed 2000 years from now. They should draw a picture of each item selected and tell why they selected the particular item and what the item represents about the culture. Have the students present their individual or group choices to their classmates. We’ve drawn in a few examples to start them off. Discuss their choices with them.

LESSON PLAN PAGE 2

PEOPLE EVERYWHERE COMMUNICATE THROUGH ART

1. Introduce new vocabulary words: **pictographs, petroglyphs.**
2. Have students read the article. Ask if they have ever seen a pictograph or a petroglyph. Have them describe a few. (Examples—international road signs, some billboards, computer icons, etc.)
3. Ask them to look at the petroglyph on page 2. What do they think it means? (*A person is searching for water but cannot find it.*)
4. **Activity—One Picture is Worth a 1000 Words.** In the space provided, have the students create their own simple pictograph using water as the subject. Under the drawing, write one sentence to explain it.

LESSON PLAN PAGE 3

THE LEGEND OF “RAVEN-WHO SETS-THINGS-RIGHT”

Background Information: Most collections of Native American stories include stories about tricksters, mischievous supernatural beings who sometimes help people. Their escapades help explain how the natural world got many of its features. The story was entitled “Raven Brings Fresh Water to the People,” and it was adapted from a story retold by Fran Martin in *From Sea to Shining Sea: A Treasure of American Folklore and Folk Song*, compiled by Amy L. Cohn (1993).

Las Virgenes Municipal Water

District 818 / 251-2100
www.lvmwd.com

(Agoura, Agoura Hills, Calabasas, Chatsworth, Hidden Hills, Lake Manor, Malibu Lake, Monte Nido, Topanga, West Lake Village)

Municipal Water District 714 / 963-3058
of Orange County
www.mwdoc.com

(Aliso Viejo, Brea, Buena Park, Capistrano Beach, Corona del Mar, Costa Mesa, Coto de Caza, Cypress, Dana Point, El Toro, Fountain Valley, Garden Grove, Huntington Beach, Irvine, Laguna Beach, Laguna Hills, Laguna Niguel, La Habra, Lake Forest, La Palma, Leisure World, Los Alamitos, Mission Viejo, Newport Beach, Orange, Placentia, Rancho Santa Margarita, Rossmoor, San Clemente, San Juan Capistrano, Seal Beach, Stanton, Tustin, Tustin Foothills, Villa Park, Westminster, Yorba Linda)

San Diego County Water Authority 858 / 522-6600
www.sdcwa.org

(Alpine, Bonita, Bonsall, Camp Pendleton, Cardiff-By-The-Sea, Carlsbad, Casa De Oro, Castle Park, Chula Vista, Crest, Del Mar, De Luz, El Cajon, Encinitas, Escondido, Fallbrook, Jamul, Lakeside, La Mesa, Lemon Grove, Leucadia, Mount Helix, National City, Oceanside, Otay, Pauma Valley, Poway, Rainbow, Ramona, Rancho Sante Fe, San Diego, San Marcos, Santee, San Ysidro, Solana Beach, Spring Valley, Valley Center, Vista)

Three Valleys Municipal 909 / 621-5568
Water District
www.threevalleys.com

(Azusa, Charter Oak, Claremont, Covina, Covina Knolls, Diamond Bar, Glendora, Industry, Irwindale, La Puente, La Verne, Pomona, Rowland Heights, San Dimas, South San Jose Hills, Walnut, West Covina)

Upper San Gabriel Valley 626 / 443-2297
Municipal Water District
www.usgvmwd.org

(Arcadia, Baldwin Park, Bassett, Bradbury, Covina, Duarte, El Monte, Glendora, Hacienda Heights, Industry, Irwindale, La Puente, Monrovia, Montebello, Pasadena, Rosemead, San Gabriel, South El Monte, South Pasadena, South San Gabriel, Temple City, Valinda, West Covina, Whittier)

West Basin Municipal 310 / 217-2411
Water District
www.westbasin.org

(Alondra Park, Angeles Mesa, Carson, Culver City, Del Aire, El Nido-Clifton, El Porto, El Segundo, Gardena, Hawthorne, Hermosa Beach, Howard, Inglewood, Ladera Heights, Lawndale, Lennox, Lomita, Malibu, Manhattan Beach, Marina Del Rey, Miraleste, Morningside, Palos Verdes Estates, Point Dume, Portuguese Bend, Rancho Dominguez, Rancho Palos Verdes, Redondo Beach, Rolling Hills, Ross-Sexton, Topanga Canyon, Parts of Topanga Park, Victor, View Park, West Athens, West Carson, West Hollywood, Westmont, Windsor Hills, Wiseburn)

Western Municipal Water District 951 / 789-5000
<http://www.wmwd.com>

(Bedford Heights, Canyon Lakes, Corona, Eagle Valley, El Sobrante, Green River, Lake Elsinore, Lake Mathews, March Air Force Base, Norco, Orangecrest, Rancho California, Riverside, Temecula, Temescal, Woodcrest)

ADDITIONAL WATER EDUCATION RESOURCES

Metropolitan Water District Web Sites:

www.mwdh2o.com
www.bewaterwise.com

Water Education Organizations

Water Education Foundation

717 K Street, Suite 517
 Sacramento, CA 95814
 916 / 444-6240
www.water-ed.org

California Department of Water Resources

P.O. Box 942836
 Sacramento, CA 94236
 916 / 653-9892
www.dwr.water.ca.gov

American Water Works Association

6666 W. Quincy Ave.
 Denver, CO 80235
 303 / 794-7711
www.awwa.org

CREEC

California Regional Environmental Education Community
www.creec.org

MEMBER AGENCIES

For more information on local water issues and materials, contact the appropriate agency listed below:

City of Anaheim	714 / 765-5137
www.anaheim.net/utilities	
City of Beverly Hills	310 / 285-2462
www.beverlyhills.org	
City of Burbank	818 / 238-3550
www.ci.burbank.ca.us	
City of Compton	310 / 605-5595
www.comptoncity.org	
City of Fullerton	714 / 738-6890
www.ci.fullerton.ca.us	
City of Glendale	818 / 548-2107
www.ci.glendale.ca.us	
City of Long Beach	562 / 570-2300
www.lbwater.org	
City of Los Angeles	213 / 367-4211
www.ladwp.com	

City of Pasadena	626 / 744-4409
www.ci.pasadena.ca.us	
City of San Fernando	818 / 898-1213
www.ci.san-fernando.ca.us	
City of San Marino	626 / 289-7821
www.ci.san-marino.ca.us	
City of Santa Ana	714 / 647-5400
www.ci.santa-ana.ca.us	
City of Santa Monica	310 / 458-8224
pen.ci.santa-monica.ca.us	
City of Torrance	310 / 618-6216
www.ci.torrance.ca.us	

Calleguas Municipal Water District 805 / 526-9323 www.calleguas.com

(Bell Canyon, Camarillo, Channel Islands Beach, Lake Sherwood, Las Posas Estates, Moorpark, Oak Park, Oxnard, Pleasant Valley Heights, Point Mugu, Port Hueneme, Simi Valley, Santa Rosa Valley, Somis, Thousand Oaks)

Central Basin Municipal Water District 310 / 217-2222 www.centralbasin.com

(Artesia, Bell, Bellflower, Bell Gardens, Cerritos, Commerce, Cudahy, Downey, East Compton, East La Mirada, East Los Angeles, Florence, Graham, Hawaiian Gardens, Hollydale, Huntington Park, La Habra Heights, Lakewood, La Mirada, Los Nietos, Lynwood, Maywood, Montebello, Norwalk, Paramount, Pico Rivera, Santa Fe Springs, Signal Hill, South Gate, South Whittier, Vernon, Walnut Park, West Compton, West Whittier, Whittier, Willowbrook)

Inland Empire Utilities Agency 909 / 357-0241 www.ieua.org

(Chino, Chino Hills, Fontana, Montclair, Ontario, Rancho Cucamonga, Upland)

Eastern Municipal Water District 951 / 928-3777 www.emwd.org

(Canyon Lake, Good Hope, Hemet, Homeland, Juniper Flats, Lakeview-Nuevo, Mead Valley, Moreno Valley, Murrieta, Murrieta Hot Springs, Perris, Quail Valley, Romoland, San Jacinto, Sun City, Temecula, Valle Vista, Winchester)

Foothill Municipal Water District 818 / 790-4036 www.fmwd.com

(Altadena, La Canada Flintridge, La Crescenta, Montrose)

1. Introduce new vocabulary: *legend, myth, Chinook* (Shuh nook'), *devised*.

2. Have your students read the story. Discuss it with them. You might want to include a question about ownership of water, such as: Do you think it is right for one person or group to "own" water in the same way that Ganook felt entitled to keep water for himself? (*The question of water rights will surface later when students read about Kuluscap and the Water Monster. You may want to compare the two stories at that time.*)

3. Activity—Map Study. Explain that the Pacific Northwest region is often defined as the states of Oregon and Washington, as well as a small part of California. Students should know, throughout this unit, that while states have surveyed boundaries, regions do not, so talking about a region is not an exact area. Point out the Pacific Northwest on a map. Have the students find it on their individual maps provided in the unit. What major rivers exist in that area? Have them look at a more detailed map in an atlas to see the abundance of rivers and lakes in the Northwest. Ask them why they think it was important to the people living in this region to explain the origin of these rivers and lakes. (It is important to note that throughout all of the map study, not all rivers in all areas will be recognized. We will be introducing major rivers and tributaries of regions. You may want to add rivers to the selection we have provided.)

4. Activity—Write a Legend About Water. Help your students select a body of water that they know something about. Encourage them to think in non-traditional terms about its origin. Was it put there on purpose? Was it a gift from a mythical being to an animal or human? Was it an accident? How can they explain any special features such as its color, surrounding rock formations, seasonal changes, etc.? You may want to hold a class brainstorming session to help them get started. Ask students to develop their ideas into a story and pretend they must pass on this story to others so future generations can understand its importance in their lives.

5. Activity—Story Circle. After the students are finished writing their legends, select a few that you believe are well-written. Invite the students to sit in a "story circle" and have the students who wrote those few legends read or

tell their stories to the whole class. They might even want to act them out in some manner.

LESSON PLAN

PAGE 2

THE GREATEST RIVER OF ALL

Background Information: The Mississippi River runs for approximately 2,500 miles, spanning almost the entire north-south distance across what is now the United States. It is the only long river in the western hemisphere that is in a temperate zone, meaning that it has a mild climate and ample rainfall. The Mississippi is part of a vast river "system" including the Ohio River and the Missouri River. It has a great expanse of fertile river valleys where people could settle. It has many tributaries that allow people to travel, trade and exchange ideas. These factors made the Mississippi River area the most populated region in North America before Columbus.

The other great North American rivers are the Colorado River and the Columbia River, but they were not as hospitable as the Mississippi. The Colorado River and its tributaries went through rugged, almost inaccessible canyons and high altitude deserts. The surrounding land was dry and not very fertile, and the river's rapids made river travel and trade almost impossible. The Colorado supported life and culture, but not trade like the Mississippi River system. The Columbia River Valley had plenty of rainfall, but it also had rapids that made long-range river travel impossible. The land routes went through rugged mountain terrain, so cultural exchanges from the Northwest were also difficult. In addition, the river lies so far north that the summer growing season is very short. The Native Americans of the Pacific Northwest could not depend as much on agriculture as the people in the Mississippi Valley.

The Mississippi River system, on the other hand, remains temperate, fertile and wet between all of the tributaries. The Mississippi River Valley was blessed with plentiful rain and a long frost-free season. It had a legendary abundance of fish, animals and plant life. Thus, the whole region comfortably supported an interconnected culture. The culture was marked by large villages, agriculture and a highly developed ceremonial structure.

The Mississippi's tributaries carried aspects of this advanced culture to tribes throughout the region. When the first Europeans arrived, they never saw the large,

bustling villages that lined the Mississippi River Valley because they arrived on the coastlines hundreds of miles from there. More than a century passed before explorers and settlers arrived at the Mississippi, by which time these villages were mostly depopulated. Several theories exist as to why these mound cultures died out. Perhaps European diseases were brought to them by intertribal trade in advance of the later explorers. Perhaps malaria began infecting the river valley. Or perhaps the balance of power among tribal regions was so disrupted by the arrival of the Europeans that the once powerful culture was overshadowed and defeated by tribes with superior weapons. By the time Europeans explored the Mississippi Valley, the mound culture was gone. When the explorers asked the Natchez, who still lived in the area, what the mounds meant, they could not explain. They only knew that the mounds had been used by the people who came before them.

1. Introduce the new vocabulary: *Winnebago, fertile, silt, tributary, Lake Superior, Ohio River, "Messi Sippi"* (Mississippi River)

2. Have the students read the article.

3. Make certain that your students realize that the Winnebago words "Messi Sippi" became our "Mississippi." They might also be interested in knowing that "Missouri" is a Native American word meaning "Big Muddy" and realize that "Ohio" means "Beautiful River." Point out that the names the Native Americans gave rivers often described the physical appearance of the rivers.

4. Ask why the Messi Sippi was so important to Pre-Columbian Native Americans. (*The river system provided trading routes, and the land throughout the Mississippi River system was fertile, warm and received ample rainfall; thus, it supported many people and villages.*)

5. Ask why the people who lived near the river did not need to trade for food. (*All Native Americans were self-sufficient and could rely entirely on the local food sources of their region. They were interested in trading for items they could not make or that were not available, such as jewelry and other aesthetic items.*)

6. Activity—Map Study. Locate the following places on a map: Mississippi River, Lake Superior, Gulf of Mexico. Ask students to find tributaries of the Mississippi River on a map, specifically the Ohio River and Missouri River. Have the students locate and label these on



You may want to use the panoramic art at the top of pages 2-3 as a discussion starter. Here are some possible ideas to discuss.

Some Southwestern Native Americans lived in villages on the sides of cliffs.

The animals that were sources of food and clothing for Native Americans would move around according to water availability.

The plains people lived in tipis that were easy to fold up and move around.

their own maps. Have them measure the distances that goods were traded during the mound culture period. For instance, if copper from Lake Superior were found in Georgia, how far did it travel? If shells from the Gulf of Mexico were found in North Dakota, how far did they travel? Point out that one of the cultural centers of the mound culture, named Choaka, was right across the river from St. Louis. Locate St. Louis on map. Why might the people of the mound culture have chosen this location? Why did St. Louis become an important city?

7. Activity—Discussion. To Trade or Not to Trade: Ask students to imagine life before there was money. People traded one prized object for another. What could you make or gather for trade if you lived on the seashore? In the mountains? On the prairie? What might you want to trade your items for? How would you get your items back and forth before there were cars, trains and airplanes? Is trading still in practice today? Ask students for examples.

8. Activity—Writing a Cinquain. After the students have finished reading about the Mississippi River, have them write a cinquain about the Mississippi or about a river, in general. There are 5 lines to a cinquain.

Line 1: 1 word = title (noun)
 Line 2: 2 words = adjectives describing the title
 Line 3: 3 words = ing verbs or participles
 Line 4: verb phrase
 Line 5: 1 word = synonym for the title
Example: Hawk
 Graceful, free
 Sailing, soaring, swooping
 Watching from the sky
 Warrior

LESSON PLAN PAGE 3

GATHERING WATER MAY BE HARDER THAN YOU THINK/WATER BASKETS

Background Information: The Anasazi and Hohokam cultures thrived in the Southwest until about the 15th century. The Anasazi lived in what is now called the Four Corners area of New Mexico, Arizona, Utah and Colorado. Archaeologists and anthropologists generally believe that the Pueblo (who live in villages the Spaniards called pueblos) are descended from the Anasazi and that they continue many of the traditions of that ancient tribe. The Pueblo tribes include the Hopi and Zuni. Farther to the south, the Papago probably descended from the earlier Hohokam.

Across the continent, people typically built their villages near rivers, streams, freshwater springs or places where there was a reliable water supply. Where per-

manent water supplies were scarce, the people were often nomadic, like the people of the Great Basin, or they learned to manage water ingeniously, like the village-dwelling inhabitants of the Southwest.

1. Introduce new vocabulary: *Anasazi, invisible, Massachusetts, Narragansett* (Nar rah gan' set), *Wampanoag* (Wom' puh noag), *Paiute* (Pie' yute).

2. Activity—Map Study. Using a map of the United States, point out the Southwest region, (generally southern Nevada, New Mexico, Arizona) the Northeast area (states around the Great Lakes east and north to Maine) and the Great Basin area (those states that lie between the Sierras and Rockies south to the Southwest region). Have students find and point to these on the map provided. Using a relief map, have the students discuss the possible geographic differences of the three areas (mountain ranges, desert areas, water sources, weather patterns, etc.).

3. Have your students read the two short articles. Ask students which group of Native Americans probably had the easiest time securing water for their use in their homes. (*It was people of the Northeast or eastern woodlands because there were so many more streams and rivers there than in the rest of the*

The Erie Canal

Musical score for "The Erie Canal" in 4/4 time, starting with a mezzo-forte (*mf*) dynamic. The score consists of ten staves of music with lyrics underneath. Chord symbols are placed above the notes. The lyrics are: "I've got a mule, her name is Sal, Fifteen miles on the Erie Canal. She's a good ol' work-er and a good ol' pal, Fifteen miles on the Erie Canal. We've hauled some bar-ges in our day, Filled with lumber, coal and hay, And we know ev-'ry inch of the way From Albany to Bu-ffa-lo. Low bridge, ev-'ry-bo-dy down! Low bridge, for we're con-in' to a town! And you'll al-ways know your neigh-bor, You'll al-ways know your pal, If you've ev-er nav-i-ga-ted on the E-rie Ca-nal."

Cumberland Gap

G Em
 Me an' my wife an' my wife's pap, We

G G
 all live down in Cum-ber-land Gap.

Chorus

 G Em
 Cum-ber-land Gap. Cum-ber-land Gap.

G D7 G
 *Mmm 'way down yon-der in Cum-ber-land Gap.

The Bluegrass Songbook. Dennis Cyporyn. McMillian Co. 1972

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Native Americans often built dams to trap soil carried by water. When enough soil built up, they planted crops in it.

In dry areas, Native Americans depended on songs and dances to bring rain.

Native Americans would locate their villages near water sources because they provided food, transportation and recreation opportunities.

continent.) Ask if they think having to carry water in jugs back to their home would affect the way they use water. (It would probably make them more aware of water conservation practices.) Discuss.

4. Activity—Water Carriers. Using any natural material that is waterproof, have the students try to make a simple vessel that will hold water. (This will be a difficult activity, but give it a try!)

LESSON PLAN PAGE 3 DANCES AND SONGS BROUGHT LIFE-SAVING RAIN

Background Information: The stories and poems on this page stem from the region of the Southwest where water is very scarce and all ceremonies involve prayers for rain.

While people worshipped water, they also felt that it held dangerous powers. For example, the Paiutes of the Great Basin believed that the scarce bodies of water that never dried up held spirits called water babies, and they called on the water babies to bring rain. On the other hand, they also thought the water babies could be evil and would eat children or trick people into drowning.

1. Introduce new vocabulary: *yucca, guardian, cumulus, germinate.*

2. Have students read the introductory paragraph and the Zuni rain chant.

3. Ask the following questions for review:

- What is the meaning of the word "sacred" and why do you think Pre-Columbian people would consider water sacred? (When something is sacred, it deserves "reverence;" it should be "revered." Water is essential to life. The scarcer it is the more sacred it becomes, because without it, there cannot be life. Pre-Columbian people knew this, just as we know it today.)
- What are some of the ways early Native Americans used water in sacred ways? (The Paiutes used water to get rid of bad spirits and take away bad thoughts. The Zuni and Hopi used water mixed with yucca cactus to make a purifying shampoo.)

4. Discuss the meaning of the Zuni rain chant with your students. Why do you think the "rain priest's" head was feathered with cumulus clouds in the first verse and mist in the second verse? What happened in the third verse? (In the first verse, the rain priest brought clouds; in the second, he brought rain. In the third verse, the young corn plants began to grow.)

5. Activity—Language Arts: Writing a Poem. Write a poem that celebrates

the importance of water in supporting life. You may want to review particular types of poetry with your class prior to beginning this.

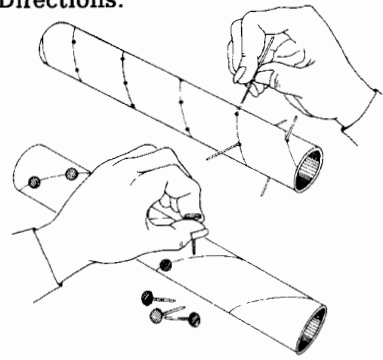
6. Activity—Research Assignment: Cloud Seeding. Explain that in California today, people sometimes practice "cloud seeding" which may seem like a modern day "dance" to bring rain. This technique helps clouds drop their rain before they normally would. Have your students look up "cloud seeding" in a reference book and write five facts about it.

7. Activity—Art: Making Your Own Rainstick. Copy page 17 for your students to use.

Materials needed:

- cardboard tubes (from paper towels, gift wrap or mailing tubes)
- a tool to punch holes
- small hammer
- toothpicks or flat head nails (for 1" diameter tube, use a 7/8" nail)
- glue
- masking tape
- wire cutters or sturdy scissors
- "fill" (seeds, pebbles, rice, dried beans, shells, beads)
- materials to decorate the outside (paint, crayons, glitter, sand)

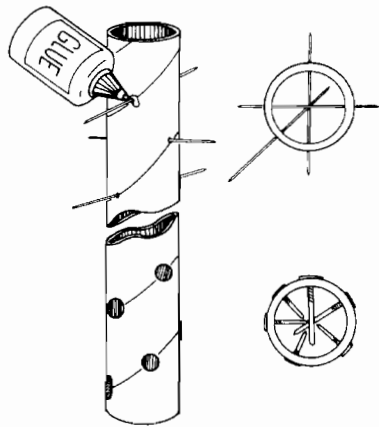
Directions:



a. Drill or poke holes in the cardboard tube. Be careful not to collapse the tube by pressing too hard. Creating a spiral staircase pattern, place the holes about one inch apart. Drill the holes through one side only or all the way through both sides of the tube. If you are using nails, it is not necessary to drill holes.

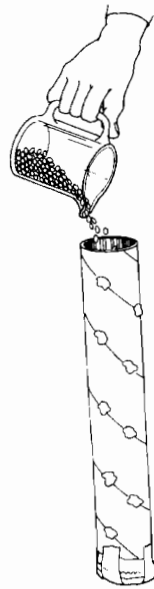
b. If you use toothpicks, push toothpicks through the holes. Leave a little bit of the toothpick remaining outside the tube. If holes were drilled straight through the cylinder, push the toothpick all the way through the tube. Inserting the toothpicks to different lengths will produce a variety of sounds.

If you are using nails, insert nails that are slightly shorter than the diameter of the tube in a spiral pattern. A small hammer may be useful.



c. Apply glue to the little bit of toothpick that is sticking outside and allow the glue to dry. Cut off the ends if they stick out more than 1/4" from the tube. Or, seal the nail heads with glue or wrap the entire tube with masking tape.

d. Seal one end of the tube with masking tape. Pour in the fill. Cover the open end of the tube with your hand and invert it. Close your eyes and listen. Add more fill or take some away to create a sound that is pleasing to you. Cover the other end of the tube with masking tape.



The instructions for building your own rainstick have been reprinted with permission from *The Rainstick: A Fable* (copyright, 1994 Project WET, Water Education for Teachers, Bozeman, MT and Falcon Press, Helena, MT)

e. You may wish to decorate your rainstick by coating it with glue and rolling it in sand. This is messy, but it provides a wonderful texture for the surface of your instrument. After it dries, you may paint and decorate your rainstick with natural objects from your own part of the world. Be creative! When you slowly turn your rainstick end to end, listen for the sound of the rain. What stories do you hear?

8. Activity—Music: "I Bring the Rain." Make copies of the song found on page 19 of this guide. It is about a Zuni boy who can bring the rain.

LESSON PLAN PAGE 4

WATER IN THE DESERT: MAKING EVERY DROP COUNT

Background Information: Your students may be shocked to read that the Papago considered using water for bathing and dish washing to be a waste of a precious resource. To clean themselves, the Papago did what people did around the continent: they took sweat baths. Sweat baths were a favorite custom of many peoples, even those who had plenty of water for bathing. They were not only a form of bathing, they were a form of spiritual cleansing and medical healing.

As for dishes, many people cleaned the few utensils they used with a stick brush, sand or ash from the fire. Even the Pilgrims used these methods, since soap from England was very rare and expensive. For the Pre-Columbian people, this method was perfectly sufficient. They had so few communicable diseases that there was little danger of passing deadly germs from person to person on their dishes.

1. Have your students read the story of the Papago girl. Explain to them that this account is adapted from an account by Ruth Underhill, an anthropologist who lived with an elderly Papago woman in the early part of this century to learn the history of her early life

before the days of American influence.

2. Have your students describe the area in which the Papago girl lived. Ask them to point to the general location on a U.S. map. (*Their clue is that it was a hot desert and it is south of the Anasazi cliff dwellings.*)

3. How did the Papago girl get her water? How does this compare with the way we get our water in Southern California today? (*She ran each morning from her home in the desert to the mountains, where she filled water vessels and carried them home on her back. Although families in Southern California can turn on a faucet to get their water, that water must still come from far away. About two-thirds of the water used in Southern California comes via aqueducts from the State Water Project to the north, the Colorado River to the east, and [for the city of Los Angeles] the Owens Valley to the northeast.*)

4. How did the Papago conserve water? How does this compare to the way you conserve water? (*They did not bathe in water, and they scraped their dishes with a stick instead of washing them in water. Accept any reasonable comparisons to their own conservation habits.*)

5. Why did the Papago girl have to be so careful with water? Why do Southern Californians have to be careful with water today? (*It was so scarce and required so much effort to collect. Exactly the same conditions hold true today.*)

6. Activity—Could You Use Less Water? Discuss the situation presented in the activity on the accompanying worksheet on page 16 in this guide. Have the students list eight ways they use water. Next, ask them to circle the ways they use water that they could not do without. As a class, go over the water uses and how much water is used for each activity. (Use MWD's slide chart on conservation tips to assist you. You may want to have them listed on the board for easy reference.) Have students add up the water needed for all their circled items. If their use of water exceeds the five gallons presented to them, have them write two ways they know they could conserve more water. How might this lifestyle compare to that of the Papago girl? The goal is for the students to become aware of how comfortable life is today because of our water supply and delivery system.

LOTS AND LOTS OF LOCKS

Here is a way for you to see how locks work. Have fun doing this!

What you'll need:

- a dishpan
- one 3-ounce paper cup
- one 5-ounce paper cup
- two 9-ounce paper cups
- water to fill the cups
- scissors
- two rubber bands (large enough to fit snugly, but not tightly, around the tops of the 5-ounce and 9-ounce cups)
- a small piece of toothpick to serve as a "boat"

The steps:

- 1.** Fill the 3-ounce and 5-ounce paper cups with water. Float the toothpick "boat" in the 3-ounce cup. Your job is to float the toothpick into the larger cup. How can it be done? That is the task of a canal's lock.
- 2.** Empty the cups into one of the 9-ounce cups. Then line up the three different sized empty cups side-by-side. Mark the height of the 3-ounce cup on the side of the 5-ounce cup, and mark the height of the 5-ounce cup on the side of the 9-ounce cup.
- 3.** Using scissors, on the lip of the cup, cut a flap about 1.5" wide and only as deep as the line that you drew at the height of the next smallest cup. Fold the flap down carefully. (Be careful because you will need to fold it back up and hold it in place with the rubber band.)

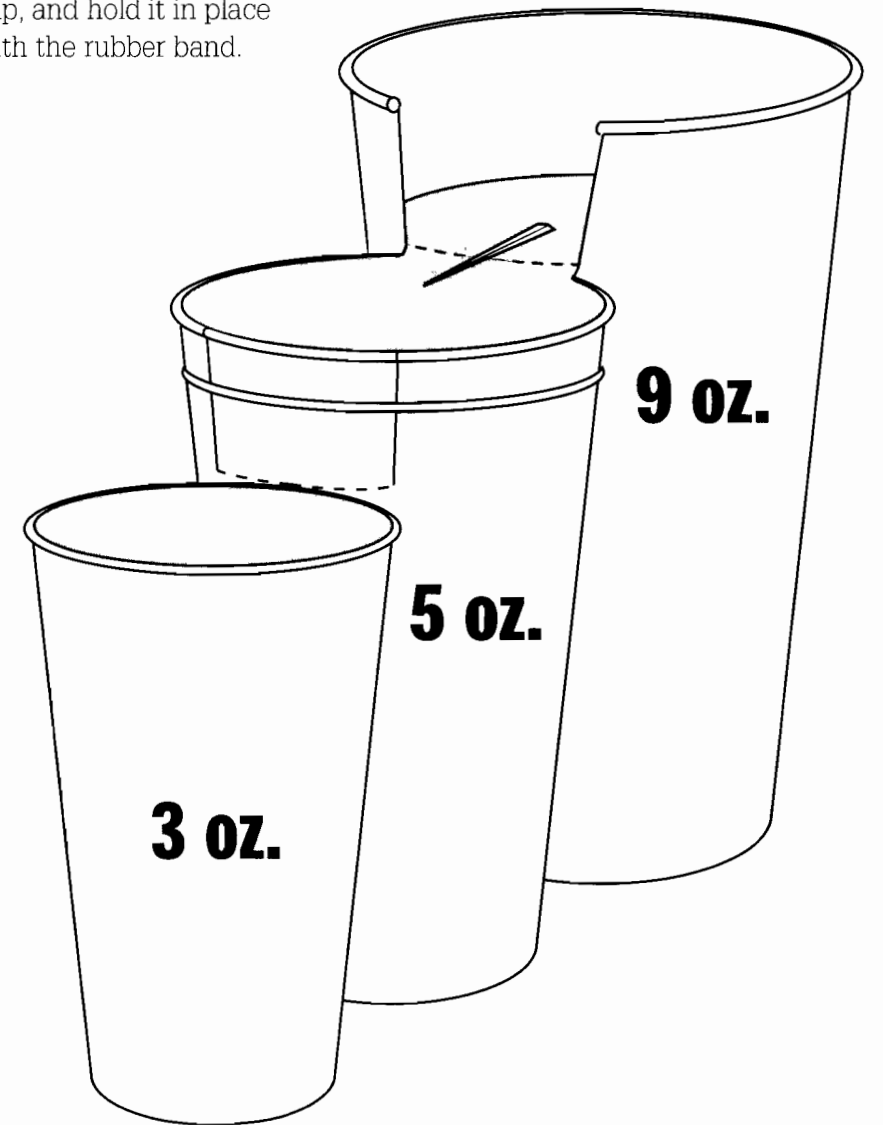
4. Put the rubber bands around the necks of the 5-ounce and 9-ounce cups. Fold down the flaps under the rubber bands.

5. Use the water in the other 9-ounce cup to fill each cup to the level of the folded flap (which is as full as possible). You will need additional water as well.

6. Float the "boat" in the 3-ounce cup, and "sail" it (push it) into the 5-ounce cup. With the surface tension it should sail in easily. Fold up the flap on the 5-ounce cup, and hold it in place with the rubber band.

7. Fill the 5-ounce cup to the surface, and this time float the boat into the 9-ounce cup. Fold up the flap on the 9-ounce cup, seal it with a rubber band, and fill the cup to the surface. You have now built a model lock to raise the level of your boat without touching it.

Having successfully completed your model lock, just imagine how difficult it was to build the Erie Canal with its 83 locks in 1825 with such limited tools!



GLOSSARY

aquifer: a place where water collects underground. It is often between underground rock ledges or places of gravel and sand

blaze: To mark a trail for others to follow

canal: a human made “river.” Most canals were built to carry boat traffic to and from places that are not naturally connected by navigable water.

capsize: to turn over

cascade: waterfall

chimbleys: Mark Twain’s word for “chimneys”

Continental Divide: the imaginary line that runs north-south through the Rocky Mountains. The line follows the natural position that determines which direction water will follow—westward towards the Pacific Ocean or eastward towards the Mississippi River or Gulf of Mexico.

(river) **course:** the path a river takes

development: the building of houses, farms, towns or mines

elevation: the distance above sea level

engineers: people trained to build certain machines, structures, buildings, etc.

erosion: the washing away of soil from a river bank, mountain or field

expedition: a party of explorers that has been assigned a specific mission

frontier: the edge of settlement

Great American Desert: the Great Plains

Great Barrier: the Appalachian Mountain range, including the Allegheny Plateau, which prevented people from crossing to the west

Great Plains: the large section of the country between the Mississippi River and the Rocky Mountains

headwaters: the very beginning of a river or stream

homesteading: acquiring land from the U.S. by filing a record and living on it and cultivating it. This was common practice in the West so that settlers would come and stay.

Humboldt and Carson: western rivers that are small and seasonal as they flow through Nevada. For example, they might not be anything but dry creekbeds in summer.

hydraulic mining: the use of large amounts of rushing water to separate valuable minerals from gravel and soil

insignificance: not worth considering, lack of importance

inspire: to fill with feeling or with the desire to do something

interior: the “inside” section of the United States that is not near a coast

kilowatt: a unit of energy; 1000 watts

lock: a structure in a canal that allows boats to be raised or lowered. Locks have a gate that closes and “locks” water in. A boat enters the lock and the gate closes. To be lowered from a higher portion of a canal to a lower section, water is pumped out of a lock and the water level drops. When the water level in the lock drops to the canal level, the gate opens and the boat travels on. To raise a boat, water is pumped into the lock to raise the water level.

Louisiana Purchase: the agreement struck between Thomas Jefferson, the United States’ third president and Napoleon of France. The United States bought the “Louisiana Territory” from France in 1803. It included land that spanned from the Mississippi River to the Rocky Mountains.

mine: a site where valuable ores, metals or gems are taken from the earth

navigable rivers: rivers deep enough and wide enough to afford passage of ships

obstructing: blocking or stopping

Ogalala Aquifer: a large aquifer running through Nebraska, Kansas, Oklahoma and Texas. About 30% of all groundwater used in agriculture in the United States comes from this aquifer.

Old Oolitic Silurian Period: Mark Twain’s made-up geologic era

panning: a low-technology method for separating gold from sand, using a shallow pan near a river’s edge. The hopeful miner scoops up some sand from the river bottom and allows the flowing water to wash away the lighter sand particles. Since gold is heavier than the minerals in sand, only gold flakes are left in the bottom of the pan.

pinnacles: highest point or a lofty peak

plateau: a high, flat plain

prairie: the grasslands of the Great Plains

quest: to search for, or the search itself

rapids: places in rivers where the river drops dramatically and the water rushes wildly, often over large rocks

rifle: a deep groove on the bottom of a sluice that prevented the gold from washing out

seaport: a city with a harbor on the ocean

scene: a location or setting

sluice: a human-made channel for water that was used with a series of open-ended boxes with riffles in them to mine gold

steamboat: a boat powered by steam. River steamboats burned wood or coal to make steam. The engine turned large paddle wheels to propel the boat.

steamboat pilot: the person who guides the steamboat and gives orders to the engine crew

surveying: measuring the elevation of landforms, as well as the distance of one feature from another

tributaries: rivers that feed into a larger river

trough: a long shallow container or channel for water

wilderness: a natural setting far away from towns and farms, where humans have not made any changes to nature

LESSON PLAN PAGE 4

THE SWALLOWER OF CLOUDS AND THE HERO TWINS

1. Have the students read this Zuni story about drought.
2. Ask the following questions:
 - a. What happened to the earth when the “Swallower of the Clouds” drank all of the clouds? (*The water disappeared and the people began to suffer and die.*)
 - b. Why were the Zuni people thankful when they saw red stones? (*The “Swallower of the Clouds” turned into a red stone when the Hero Twins threw him over the cliffs. Perhaps the Zuni believed that as long as there were red stones, the swallower of the clouds couldn’t drink the rain.*)
3. **Activity—Producing a Play.** This story might be a good one for your students to act out while a narrator tells it. Perhaps it could even be staged as a puppet show with props, etc., and then presented to those in the younger grades, complete with their own explanation.

LESSON PLAN PAGE 5

KOLUSCAP AND THE WATER MONSTER

Background Information: This story raises the issue of water rights. Although water rights is a complex issue, it might be very interesting for your students to discuss water rights in a simplified manner. In California, we have a mixture of principles. One principle holds that the people who use the water first have the right to continue using it. This idea is often called an “appropriative right” or “first in time, first in right.” Another principle holds that whoever owns land or lives along a body of water has the right to use the water; that right is a “riparian” right. A third principle holds that water must be used for the common good; even if a person has an appropriative or riparian right to water, they cannot withhold its benefit from a large number of people. The Pre-Columbian North Americans did not conceive of land or water as property; thus they did not think in terms of water rights. They did however, believe that natural resources were to be shared for the common good, as the Koluscap story demonstrates.

1. Have your students read “Koluscap and the Water Monster.”
2. **Activity—Group Work.** Divide the class into groups. Have each group select a recorder and a spokesperson

who will present their view to the class. Have them discuss and try to reach consensus on the following questions:

- a. A stream runs alongside your home. Should you be entitled to use the water from that stream?
- b. Should you be allowed to use so much that there is not enough for the people farther downstream?
- c. How would you feel if someone upstream from you built a dam or polluted the water in the river so it was unusable when it reached your home?
- d. The story demonstrates a basic Native American belief about water. What do you think this belief is? *Water is not owned by anyone and all of us have the right to use it.*

Give the students approximately 10-15 minutes to discuss and record their answers. Then have the groups report their answers and any interesting discussion they had as you review each question.

3. Briefly mention the concepts of “riparian rights,” “appropriative rights” and “beneficial use,” using the background information supplied above. Ask the students how these concepts seem to compare to concepts of water rights held by Native Americans. (*Native Americans generally believed that water existed for the common good. Thus, the concept of “beneficial use” is closest to a Native American conception of water.*)

LESSON PLAN PAGE 4

WATER, CLIMATE AND LAND SHAPED THE LIFESTYLE OF PRE-COLUMBIAN NATIVE AMERICANS

Background Information: Across the continent, people typically built their villages near rivers, streams, freshwater springs or places where there was a reliable water supply. Where permanent water supplies were scarce, the people were often nomadic, like the people of the Great Basin, or they learned to manage water ingeniously, like the village-dwelling inhabitants of the Southwest. People who lived along the coast often lived where they could catch salmon when the fish ran upriver to spawn in the spring, or where they could gather tidal fish. Villages controlled both sides of a riverbank, so the people thought of the surrounding “watershed” as its natural territory. That way, the people had access to the bears, geese and other wildlife that used the river’s watershed.

1. Introduce the new vocabulary: **Gabrielino** (Gah bree el lean’ yo), **tipis** (tee’ peas), **estuary**, **basin**.

2. Activity—Map Study. Find the following areas on their map: Southern California area, the Great Basin area, the Great Plains (*This area is most of the central part of the U.S., with the Rocky Mountains on the west and the Mississippi River on the east.*) Ask the students to look at maps showing the varying climates of the United States. Have them think about how the climate influenced life for early peoples. How does the amount of rainfall in a region influence life for us today?

3. Read the article. Ask the following questions:
 - a. Which of the Pre-Columbian Native Americans lived near water sources year-round? (*The Gabrielinos of Southern California*)
 - b. In which region did the Native Americans move about to find water? (*Great Basin Native Americans—Ute, Paiute and Shoshone*)
 - c. How does this compare or contrast to the way modern-day people live throughout North America? (*In modern-day North America, people have built elaborate water delivery systems to bring water to population centers. As a result, large populations live in areas that do not have adequate water supplies. Southern California is a prime example. In California, two-thirds of the population lives in the dry south, while two-thirds of the water resources are in the north.*)

4. Activity—Map Study. Ask students if they can find a salty body of water in the Great Basin? Find it and label it on your map. (*The Great Salt Lake*)

5. **Activity—Research Project: Compare and Contrast.** Work with students to help them complete the chart included in the teacher guide on page 15. Much of the information can be found in the reading they have done so far. Start them off on their research article by working on the Southern California area together. For example, ask them to name all the geographic terms that are used to describe the Southern California area and list them on the board while they fill in the information on their charts. No climate has been mentioned in the article for the Great Plains, so the students would have to research on their own to find this.

Some of the Answers to the Research Project: Compare and Contrast

Area	Southern California	Great Basin	Great Plains
Geographic Terms	streams, marshes, estuaries, ocean, mountains, forest	canyons, deserts, lake, mountains	fields, prairie, streams, rivers
Native Americans living in area	Gabrieliño	Ute, Paiute, Shoshone	Sioux, Pawnee, Crow, Blackfoot
Lifestyle	village	nomadic	nomadic villages
Food	grasses, nuts, fish, acorns, ducks, shellfish, deer, birds, rabbits, game	seeds, nuts, roots, cactus, fruit, animals	buffalo meat, seeds, nuts, fruits
Climate	mild	hot summers; dry, cold winters	hot summers; wet, cold winters
Water Availability	limited streams	limited	watering holes

Other geographic areas and Native American groups have been added to this exercise, including the Pacific Northwest, the Southeast, the Northeast woodlands, the Mississippi Valley and the Southwest desert since earlier articles have mentioned these. This might be a good group project. Look above for sample answers.

6. Activity—Group Work: Designing the Ideal Pre-Columbian Native American Home. Break the students into small groups of 3-4. Tell the students they have to choose a place to live in an unsettled land. They must design the “perfect” settling place, draw plans or create a diorama to show it, and write a few paragraphs explaining their design. Before breaking into groups, hold a class discussion about which of these factors (temperature, food, water, shelter, safety) your students think are more important in choosing a place to live in Pre-Columbian times. Help them realize how interrelated the factors are: for example, shortage of fresh water is more critical when temperatures are very high because the body needs more water in hot climates. Have the groups present their projects to the other members of the class. Do any of their ideal sites resemble any modern place they know? In what way?

LESSON PLAN PAGE 4

FARMING AND IRRIGATION PRACTICES HELPED NATIVE AMERICANS WITH FOOD SUPPLY

Background Information: Many of the people of the arid Southwest practice some irrigation, but the Anasazi brought it to a high art. In the cultural center of the

late Anasazi period—Chaco Canyon, New Mexico—there were 1,000 acres of irrigated farmland! One dam was 120 feet long, 20 feet thick and 7 feet high. During a typical thunderstorm, this one dam could have captured 540,000 gallons of water, which was enough water to irrigate 24 acres. The Anasazi at Mesa Verde also had extensive irrigation, as well as what some archaeologists believe was a reservoir. Historians are puzzled why the descendants of the Anasazi did not continue irrigation. One theory is that there was a disintegration of the social structure that might have been required to plan and maintain the irrigation ditches. Another theory is that the irrigation ruined the land as the salts from the alkaline water built up, so the practice died out.

The Paiutes: The valley settled and irrigated by the Paiutes is today’s Owens Valley. It was the most densely populated of the sparsely populated area in the Great Basin. The Owens Valley continued as a fertile farming valley even after being settled by Europeans. It is still a water source for the city of Los Angeles today.

The Paiutes of Owens Valley were among the few groups in California to independently develop irrigation. Many of the other tribes that practiced irrigation borrowed the technology from tribes along the Colorado River plateau who in turn had borrowed it from Mexico. The Paiutes are unique in history because they developed irrigation without developing agriculture. In most cultures, the people cultivated crops for hundreds or thousands of years before developing irrigation. The Paiutes never cultivated their wild grasses—that is, purposefully planting seeds in prepared grounds for a harvest—although they may

have cared for their grasses by weeding around them.

You might want to point out that the practice of alternating grass fields for irrigation from year to year is a precursor to the agricultural practice of letting the land lie fallow or rotating crops to prolong the fertility of the soil. The Paiutes (as well as most tribes that practiced agriculture) understood the necessity and the methods of revitalizing the soil’s fertility.

1. Introduce new vocabulary: **cultivate, irrigate, dry farming, earthen dams, canal, reservoirs, divert.**
2. Have students read the article.
3. Ask the following questions:
 - a. What were the “three sisters?” (*The three primary food crops of the early Native Americans were beans, corn and squash.*)
 - b. How big were some of the Anasazi villages? (*Some villages were as large as 1,000 people. Have your students think of examples of places where they may have seen 1,000 people in one place. One thousand people in one place is an unusual event: the idea of supporting that many people in a desert village in prehistoric times is remarkable.*)
 - c. Discuss the ways the Zuni and Hopi, the Anasazi and the Paiutes irrigated their crops. (*Zuni and Hopi: small, dry farming gardens to catch the rainfall and dams of stone to slow the flow of water and trap the soil. Anasazi: built low earthen dams to channel rain water into stone-lined canals. Gates were used to run the water onto fields that needed it. Some of their villages even had reservoirs. Owens*

traveling and living in places that few other Europeans had reached. Some focused on the wilderness (Moran and Bierstadt), others on the way of life of the American Indian (Caitlin) and the cowboy (Remington). These painters felt they were in the presence of a wholly different kind of life, and their paintings captivated the attention of people both on the East Coast and in Europe. The paintings of the American wilderness had a profound effect on the attitude of this country toward nature. They placed an intrinsic value in nature—apart from its use to humans—and this attitude started a movement to preserve certain wilderness sites from development. A painting by Moran of the Yellowstone River led to the creation of the first national park.

1. Introduce new vocabulary: **inspire, development, scene, wilderness.**
2. Have your students read the article entitled “Water Inspires Art.”
3. Discuss these questions:
 - a. What effect did the painting by Albert Bierstadt and the sketch of Powell’s journey down the Colorado River done during this period of time have on people? (*People saw the need to protect the natural wonders from being harmed by development of the land.*)
 - b. Did the painting by Albert Bierstadt and the sketch of Powell’s journey down the Colorado River in this section present a different idea to you about the American West than you had imagined?
 - c. Compare the paintings presented in Water Ways with other artists’ paintings of the same events. How are they similar? How are they different? Do you prefer one painter’s style over another’s? Why?
4. **Activity—Art.** Have students illustrate in some manner their own version of something that they read about in this third section of Water Ways. Have them sign it, date it, give it a title and put a caption underneath to explain it. Have them try to use a style of a particular artist of this time period.
5. **Activity—Art: Culminating the Three Sections.** Divide the class into three groups—The People Before Columbus, Settling the Colonies and Westward Movement. Have the students, in their groups, settle on the three most interesting things they learned in their section. Plan out an illustration and

paint it as a mural. Put the three sections together in one large mural that will reflect a time frame of these studies.

6. **Extender—Art Appreciation.** Check out books on American art from your library, or borrow slides from an art teacher. Look for collections of **Bierstadt, Bingham, Moran, Remington** and **Caitlin**. Have your class look at the paintings and help them appreciate the role that water played for the artists. (Note: A good discussion of water in American art is contained in **American Views: Essays on American Art**, by John Wilmerding, Princeton University Press, Princeton, NJ, 1991.)
7. **Activity—Language Arts: A Nose for News.** Pick key characters from each time period, i.e. a Native American, Ben Franklin and Mark Twain. Have them represented by students. Have the rest of the class be newspaper reporters well-prepared to ask questions about water in their respective eras of time. Interview them about water. With the students, list similarities and differences on water use and attitudes in history. Emphasize the importance of water in history.

RESOURCES

Books (fiction)

Huckleberry Finn by Mark Twain
Streams to the River, River to the Sea by Scott O’Dell. Based on the Lewis and Clark expedition as told through the eyes of Sacagewea. See also **Thunder Rolling in the Mountains** by Scott O’Dell. Based on the story of Chief Joseph and the expulsion of the Nez Percé from their river valley by the American army.
The Sodbuster Venture by Charlene Joy Talbot. About a girl on the Kansas prairie.
Sweetgrass by Jan Hudson. Blackfoot girl, Plains Indian life and a smallpox plague.
Timmy O’Dowd and the Big Ditch: A Story of the Glory Days on the Old Erie Canal by Len Hilts.

Books (non-fiction)

American Heritage Junior Library
 Books on the Oregon Trail, Mississippi Steamboats, Daniel Boone and the Cumberland Gap, and the Lewis and Clark Expedition.
Americans on the Move Series
 by Tim McNeese, illustrated by Chris Duke, Crestwood House, New York, MacMillan Publishing Co. 1993.
Growing Up in the Little House
 by Laura Ingalls Wilder.
High, Wide and Lonesome
 by Hal Borland, J.B. Lippincott Company, Philadelphia and New York. 1956.
The Oregon Trail by Frances Parkman, Library of America. 1991.
By Wagon and Flatboat by Enid La Monte Meadowcroft. Story of pioneers.
The Story of Mississippi Steamboats
 by Conrad Stein, Children’s Press, Chicago. 1987
Whistles Round the Bend: Travel on America’s Waterways by Phillip Ault, Dodd, Mead and Co., New York. 1982.
Growing Up in the Old West
 by Judy Alter.
The Great American Gold Rush
 by Rhoda Blumberg.
The Incredible Journey of Lewis and Clark by Rhoda Blumberg.
Exploring the American West
 by James Collins.
Children of the Wild West
 by Freedman Russell.
Daniel Boone by Laurie Lawlor.

PECOS BILL

1. Discuss what your students think a “tall tale” is. Ask if they have ever read about Pecos Bill or Paul Bunyan or other characters of American mythology.
2. Read the tall tale aloud to your class while they follow along. (A strong southern accent may help.)
3. **Activity—Language Arts.** Tell your students that “Nobody ever learned Pecos Bill how to talk gentlemanly!” Have them work with a friend to rewrite this story in “proper” English. You might also want to do this as a class. It is a good review of grammar and mechanics.
4. **Activity—Language Arts (Creative Writing).** Have your students write a tall tale, like the story about Pecos Bill and the Grand Canyon, to explain how a body of water “came to be” in California. You might want to “brainstorm” to get them started.

GOLD FEVER

Background Information: Compared to the East Coast, settlement came late to the Pacific Coast. The Spanish established their first permanent settlement, a mission at San Diego, in 1769. After the Mexican Revolution, California still belonged to Mexico. These Californians had a festive culture that revolved around horses, cattle and fiestas. Their main connection with the United States was with the trading ships, many of which came to trade hides for shipment to the New England shoe factories. Except for a few fur trappers and ranchers, most Americans had no interest in going to California.

One American who did go there was John Sutter, a Scottish emigrant and an American citizen. He set up a ranch and sawmill along the American River. On January 24, 1848, his employee, James Marshall, found nuggets of gold near the sawmill. Gold seekers flooded into California and in 1850, California became the 31st state in the Union.

The arrival of the gold miners caused a revolution in water use in the state. Until then, Californians had adopted the Spanish concept of water rights: water is scarce and necessary for life; thus it belongs to the community and not private individuals. Individuals can use it but cannot prevent others from using it. When conflicts over water arose, the common good always

won out over private use.

The gold miners needed water to operate their mines, and they felt that the first mining operation to use the water had the first right to that water. Some mines diverted the entire flow of water from streams, or clogged downstream rivers with mud. People downstream had no legal recourse. After the practice of some hydraulic mining operations caused tremendous damage downstream and interfered with navigation on rivers, the U.S. Supreme Court intervened. Since then, California has developed a complicated set of water laws that tries to balance the rights of private water users with the common good.

1. Introduce new vocabulary: **erosion, mine, panning, riffle, sluice.**
2. Have your students read the article entitled “Gold Fever.”
3. Discuss these questions:
 - a. Why was California so sparsely populated before 1848? (*It was very difficult to reach California by land from the East because of the desert and the Sierra Nevada Mountains. Sailing there required a trip around the tip of South America.*)
 - b. How did miners use water to separate gold from the other rocks and minerals? (*They used it to wash away the lighter rocks and minerals, leaving only the heavy gold metal behind.*)
 - c. What kind of mining methods did miners use? (*Panning and sluicing.*)

4. Activity—Panning for Gold.**Materials needed:**

- lead pebbles (such as small fishing sinkers or the lead rolls used by plumbers) If you have the time, you may even want to paint these lead pebbles gold.
- sand and soil from around home or school
- pie plates (one per two students)
- water

Preparation:

- a. Mix the lead pebbles with sand and soil from around your home or school.
- b. Conduct this activity outside so students do not need to worry about spilling water.

Directions:

- a. Have each team of two students put a small handful of the dirt mixture into their pie plate. Then have them fill the pie plate with water.
- b. Have them gently swirl the dirt out of the plate (adding water as necessary) until they can easily pick out

the pieces of lead.

NOTE: Lead, like gold, is a very heavy metal, so it will sink to the bottom of the pan while the other minerals swirl out.

MINING AND THE ENVIRONMENT: NOT A GOOD MIX

1. Introduce new vocabulary: **hydraulic mining, navigable rivers.**
2. Have students read the article entitled “Mining and the Environment: Not a Good Mix.”
3. Discuss the following questions:
 - a. What is hydraulic mining? (*The use of large amounts of water in mining.*)
 - b. What kind of damage did hydraulic mining cause? (*It washed away hillsides and mountains, flooded farms and clogged rivers. It also harmed fish and kept steamboats from traveling because mud clogged the paddle wheels.*)
 - c. Discuss the Supreme Court decision regarding hydraulic mining. Include a discussion of people’s property rights.
 - d. Brainstorm environmental problems caused today in California that affect water. (You may want to encourage students to discuss problems with the Sacramento-San Joaquin Delta needing more water flow to enhance fish spawning, landfills leaking that cause groundwater problems, agricultural draining affecting surface water and groundwater, etc.) Discuss how any court decisions have affected these problems.

WATER INSPIRES ART

Background Information: Paintings of nature have always used water symbolically, and a new breed of American artists used the many forms of water in the American West to express their wonder and worship of nature and life.

American artists had always followed the lead of European painters, focusing on portraits or historical, religious or mythological events. When they painted landscapes, they showed nature as a setting for people, or as a rural, tamed environment that was always familiar and accessible to people.

The westward expansion in America inspired a whole new kind of painting, and many painters devoted their lives to

Valley Paiutes: dug irrigation ditches and brought the water to places that needed it. Only harvested half an irrigated area each year to keep the soil fertile.)

- d. Research question: How was this early irrigation system similar to irrigation in modern-day California? (*It was very similar. Most of California’s farmland, including the Central and Imperial valleys, is heavily irrigated. Much of the irrigation water is held in reservoirs and released to the fields—often via irrigation ditches—when it is needed.*)
- e. Critical Thinking: What changes might take place in a culture when people start growing food crops to feed themselves? (*When cultures develop agriculture, they depend less on hunting and gathering. As a result, they can stay most of the year in one settlement, and they can support a larger population. While agriculture is not really less work than hunting and gathering, it allows people to specialize, and this may lead to other cultural developments like pottery, tool making, art, music and ceremonies. Agriculture also leads to engineering developments, especially irrigation. When people irrigate, they channel water from a river or stream onto their fields. Irrigation helps produce more food, and it protects people from starving during dry periods.*)
- f. Critical Thinking: What would Southern California be like today without agriculture and irrigation? (*Agriculture once made Southern California the fastest growing region of the state, and it was irrigation that made that agriculture possible. Before irrigation, today’s Imperial Valley was considered a deadly wasteland, even by Pre-Columbian people. After irrigation, it bloomed into a garden in the desert and immediately attracted a new population.*)

4. Activity—Art: Creating a Mandala.

Reproduce page 14 of this Teacher Guide. Explain to students that they have studied much about how the Pre-Columbian Native American used water and valued it. Using this information, they are going to create a mandala. Explain to students that a mandala is a symbolic design that is used by Asian cultures and some Native American cultures to represent the universe. They will be using water as the center of the

universe for this particular mandala. The mandala is usually divided into sections and in halves. For our purposes, we will only be dividing the circle into four sections. All representations on the mandala should be drawings; the students should not be writing. In the center section, have the students draw what they think of when they think of the word “water.” In the second circle, have them draw scenes from their favorite legends or myths that they read in this unit. In the third circle, have students represent Pre-Columbian Native American values of water and how they used water. In the final circle, students should draw how we use water today in our society. Allow students to share their ideas with the class before beginning. Put some of the key words and ideas they say on the board to remind them. When finished, have some of the students explain their mandala.

TAKING CARE OF THE ENVIRONMENT

1. Introduce new vocabulary: **cascades, herring.**
2. Have the students read the article and discuss how the Shasta tribe protected their food source. This issue is very current today with the protection of the fish in the Sacramento-San Joaquin Delta, the protection of salmon in the Northwest and protection of fish in the Owens River. You may want to explore these issues with your students in more detail.
3. **Activity—Map Study.** Have the students locate the Northwest area on their own maps. Ask them if they remember the other group of Northwest Native Americans they learned about at the beginning of the unit. (Chinook) Keep the maps the students are working on for the next part of this unit.

RESOURCES**Brother Eagle, Sister Sky:**

A Message from Chief Seattle
adapted by Susan Seffers,
Dial Books, 1991.

From Sea to Shining Sea:

A Treasure of American Folklore and Folk Song
compiled by Amy L. Cohn, 1993.

American Indians Sing

by Charles Hoffman,
John Day Co., NY, 1967

Papago Woman

by Ruth Underhill,
Holt, Rinehart and Winston, 1979.

Keepers of the Earth: Native American Stories and Environmental**Activities for Children**

by Michael J. Caduto and
Joseph Bruchac.

Native Americans Before 1492:**The Moundbuilding Centers of the Eastern Woodlands**

by Lynda Norene Shaffer,
M.E. Sharpe, NY, 1992.

The Great Thirst:**Californians and Water**

by Norris Hundley, Jr.,
Univ. of California Press, Berkeley,
1992.

The People of Chaco:**A Canyon and Its Culture**

by Kendrick Frazier, W.W.
Norton and Co., NY, 1986.

RECOMMENDED READING**Cadillac Desert: The American West and Its Disappearing Water**

by Mark Reisner,
Penguin Books, 1986.

The Early American Wilderness as the Explorers Saw It

by Bill Lawrence,
Paragon House, NY, 1991

The First Americans series published by Facts on File, Benford Books, Inc., Oxford, NY, 1992.

Handbook of the American Indians, Smithsonian Institute. Indians in

America Before the Mayflower
by Howard S. Russell,
University Press of New England,
Hanover, NH, 1980.

New World Beginnings: Indian Cultures in the Americas

by Olivia Vlahos,
Viking Press, NY, 1970.

GLOSSARY

Anasazi: Native Americans who lived in the Southwest desert. Means “Ancient Ones”

archaeologist: a person who studies material remains, such as fossil relics, artifacts and monuments, of past human life and activities

artifacts: an object of a past civilization

basin: the entire tract of country drained by a river and its tributaries

canal: an artificial waterway for navigation or for draining or irrigating land

cascade: a steep, usually small fall of water

Chinook: Native American tribe that lived in the Pacific Northwest

cultivate: to prepare and use land for the raising of crops

cumulus: a mass cloud form having a floating base and rounded outlines often piled up like a mountain

devise: to form or invent

divert: to change from one course or use to another

dry farming: farming done on land with little rainfall that relies on drought-resistant crops and ways of cultivating that conserve moisture

earthen dams: dams built using packed dirt instead of concrete

estuary: a water passage where the sea meets a river

fertile: capable of producing a lot of growth. Fertile soil is very rich soil that makes possible good plant growth.

germinate: to begin to grow

gourd: a hard fruit often used as an ornament or as a vessel and utensil for food. A melon, squash or pumpkin are good examples of gourds.

guardian: one that protects or has the care of another person or property

herring: a fish found in temperate and colder parts of the North Atlantic that is prepared in the adult state by smoking or salting and in the young state by canning as sardines. It was a good source of protein for Native Americans.

invisible: incapable of being seen

irrigate: to supply with water by artificial means

Lake Superior: the largest of the Great Lakes. It is the most northern and western of the lakes.

legend: a story handed down from the past, especially one that seems historical although not necessarily true

Massachusetts: a state in northeastern United States

Mississippi River: a river in the U.S. that flows from Minnesota to the Gulf of Mexico

myth: a story that seems to explain an event in nature or a people or belief

Narragansett: Native Americans who lived in the northeastern United States

Ohio River: a river flowing from western Pennsylvania into the Mississippi River

Paiutes: Native Americans who lived in the Great Basin

petroglyph: pictures carved into stone. The petroglyphs often marked important places of the tribes

pictograph: pictures painted on stone

Pre-Columbian Native Americans: Native Americans who lived on this continent before Christopher Columbus discovered America in 1492

reservoir: an artificial lake where water is collected and kept in quantity for use

silt: mud

tipi: same as “tepee.” A cone-shaped tent consisting of skins used especially by the Plains people

tributary: a stream feeding a larger stream or lake

Wampanoag: Native Americans who lived in the northeastern United States

Winnebago: Native Americans who lived near the Mississippi River

yucca: a plant on a woody base with long leaves that often has large white blossoms

times. Perhaps some pen pal letters to students in that section of the country would be a good activity. They could “swap” water information about their areas.

Research aquifers in general. Contact a local water agency. Ask them where there might be aquifers in their area? What kinds of problems are they having with them, if any? What are the largest aquifers in the U.S. and where are they located? Where are aquifers in California? Are they important to our water supply in this state? How and when are aquifers “recharged?” What happens when overdraft of an aquifer occurs in a dry area such as the Great Plains? In a coastal area?

5. Activity—Wet/Dry Years: Graphing: Does “Rain Follow Plow”?

Reproduce the graph and questions worksheet on pages 44 and 45 of this teacher guide. This graph shows the annual (yearly) rainfall in the Los Angeles area for the 116-year period between 1878 and 1993. Use it to answer the following questions:

a. In what year did the greatest amount of rain fall? How much rain fell that year? (*1884 at 40.29 inches*)

b. In what year did the least amount of rain fall? How much fell that year? (*1953 at 4.08 inches*)

c. What was the average amount of rainfall over 123 years? (*15.00 inches*)

d. In what year was the rainfall closest to “average?” (*1977*)

e. Suppose you moved to California in 1930 and lived there for 10 years. How would you describe the climate? Do you think it would be “typical” for the region? Would you believe the theory that “rain follows plow?” (*Average rainfall in the L.A. area is 15.00 inches per year. Since the average for that period was approximately 17 inches, the climate would be substantially wetter than usual. The rainfall would lead you to believe “rain follows plow,” because you moved there and the rainfall increased.*)

f. Suppose you moved to California in 1923 and lived there for 10 years. How would you describe the climate? Do you think it would be “typical” for the region? Would you believe the theory “rain follows plow?” (*Average rainfall in the L.A. area is 15.00 inches. The average during that 10-year*

period was approximately 12 inches. The climate would be drier than usual. The rainfall would lead you to believe the opposite of “rain follows plow” because you moved there and the climate stayed dry.)

g. Do you think a 10-year period is long enough to give you an idea of what the climate of a region is really like? (*Not really. Some 10-year periods are close to average; others vary widely from average. In every 10-year period there is a lot of variation in annual rainfall.*)

h. Can you use this graph to predict what the average annual rainfall will be for the years 2005 to 2010? (*No, climate graphs cannot help predict weather in specific years.*)

6. Activity—Language Arts: Come and Get It. Have students create an ad for moving west based on availability of water. If they perform skits, videotape them and compare.

7. Extender. If you live outside the L.A. area, locate your rainfall statistics and compare averages to L.A. You also might want to change the activity in #5 to reflect your community instead of L.A.

LESSON PLAN PAGE 14

A MOMENT IN TIME: JOHN WESLEY POWELL EXPLORES THE LAST UNKNOWN

Background Information: After the Civil War, it was clear that Colorado, Nevada, Utah, New Mexico and Arizona would soon become states, so having accurate maps of these territories was important. President Grant sent John Wesley Powell to explore the last great unknown section of the country, the canyon country near the region we now call the “Four Corners” area. His record of his expedition down the Green and Grand (now the Colorado) Rivers and through the Grand Canyon is a fascinating account of courage, curiosity about the geology of this unique region, ingenious technology for tracking elevation and poetic appreciation of the beauty of nature. He returned for more expeditions and then became Secretary of the Interior. He was very concerned about water issues in the arid Southwest, and made some provocative and insightful recommendations about water policy that were ultimately not heeded. One of his suggestions was to establish state boundaries based on natural river basins rather than to carve them

up into straight lines. He felt using natural boundaries would minimize the political struggle over water among the states. It is ironic that the very region he was concerned about is the only place in the country with four states joining at right angles! These four states, as well as California, Wyoming and Nevada, are embroiled in a century-long struggle for water rights. That struggle might never have happened if Powell’s recommendations had been heeded.

1. Introduce new vocabulary: **elevation, surveying, kilowatt, insignificance, pinnacles, quest, obstructing, trough, capsiz.**
2. Have your students read the article entitled “A Moment in Time: John Wesley Powell Explores the Last Unknown.”
3. Discuss these questions:
 - a. Why was this southwestern area not explored until Powell’s expedition? (*The land was mostly desert and steep canyons.*)
 - b. Why was Powell’s exploration of the Colorado River so important? (*He made it possible for settlers to begin to understand the river and its possible benefits. Also, mapmakers were able to use his information to fill in that territory on maps.*)

4. Tell students that the best method we have to learn about the past is from a primary source. Explain that the next few paragraphs are excerpts from Major Powell’s diary, which is considered a primary source of information. Ask them to read the selections to find out what Powell was thinking about during his trip down the Colorado River. Discuss the passages with your students.

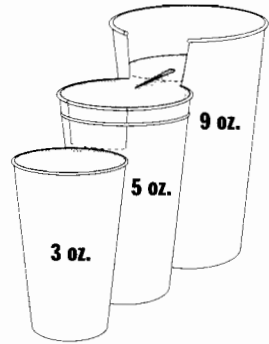
5. Activity—Recording History. Write a diary entry that details your first memory of an encounter with water—in a river, a pool, the ocean, lake, etc., that you would want people to know about many years later. Write a diary entry that describes your day. As an art project, wet paper and crinkle it. Let it dry. Transfer the diary entry to that paper. Students should also add a sketch if desired.

Materials needed (per each team of two-four students) :

- a dishpan
- water to fill the cups
- one 3-oz. paper cup
- one 5-oz. paper cup
- two 9-oz. paper cups
- two rubber bands, large enough to fit snugly but not tightly around the tops of the 5-oz. and 9-oz. cups
- a small piece of toothpick to serve as a "boat"
- scissors

Directions:

- Fill the 3-ounce and 5-ounce paper cups with water. Float the toothpick "boat" in the 3-ounce cup. Your job is to float the toothpick into the larger cup.
- Empty the cups into one of the 9-ounce cups. Then line up the three different sized empty cups side-by-side. Mark the height of the 3-ounce cup on the side of the 5-ounce cup, and mark the height of the 5-ounce cup on the side of the 9-ounce cup.



- Using the scissors, on the lip of the cup cut a flap about 1.5" wide and only as deep as the line that you drew at the height of the next smallest cup. Fold the flap down carefully. (Be careful because you will need to fold it back up and hold it in place with the rubber band.)
- Put the rubber band around the necks of the 5-ounce and 9-ounce cups. Fold down the flap under the rubber band.
- Use the water in the other 9-ounce cup to fill each cup to the level of the folded flap (which is as full as possible.) You will need additional water as well.
- Float the "boat" in the 3-ounce cup, and "sail" it (push it) into the 5-ounce cup. With the surface tension, it should sail in easily. Fold up the flap on the 5-ounce cup, and hold it in place with the rubber band.

g. Fill the 5-ounce cup to the surface, and this time float the boat into the 9-ounce cup. Fold up the flap on the 9-ounce cup, seal it with a rubber band, and fill the cup to the surface. You have now built a model lock to raise the level of your boat without touching it.

8. Extender. For the students who are really excited about this, they may want to design a more sophisticated model with different materials. (Great for Open House!)

LESSON PLAN PAGE 14
HOME ON THE RANGE

Background Information: In the early 1800s, maps of the United States labeled the section we now call the Great Plains the "Great American Desert." The great expanse of prairie was unlike anything European descendants had ever seen before. They thought that because it did not have trees, it was barren. They did not realize that prairies have rich ecosystems that supported a wealth of plant and animal life. People soon realized that the soil that supported the grasses was very fertile and that crops would grow better there than in the soils of the East Coast and Europe. It was also easier to till the soil because it had no rocks.

The American government was so eager to settle the Great Plains that they advertised its virtues throughout the East Coast and Europe. A temporary change in the climate gave them a good advertising gimmick to explain how the Great American Desert could have turned into the land of milk and honey. During one decade in the late 1800s, the rainfall in the eastern region of the Great Plains increased dramatically. This increase in rainfall coincided with an increase in settlement. Many people thought the increase in settlements caused the increased rainfall. They then concluded that if more people settled further west, they would bring increased rainfall to the arid West as well! They coined the slogan "rain follows plow" to entice more people west. People came in droves, but the rain did not. After a few years, the climate returned to normal, and people found farming and ranching more difficult than they had expected.

To survive on the prairie, people needed to dig deep wells. The surface water (rivers and ponds) was not very dependable for year-round residents. Sometimes it flooded, and sometimes it dried up. In addition,

it was usually muddy. Well water was dependable and pure, but it came from the an aquifer that was deep underground. That aquifer, the Ogallala Aquifer, is one of the largest on the continent. It has become one of the major water supplies for the farms and cities of today's "Bread Basket."

1. Introduce new vocabulary: **aquifer, Ogallala Aquifer, Great American Desert, Great Plains, plateau, prairie, homesteading.**

2. Have your students read the article entitled "Home on the Range."

3. Discuss the following questions:

- Why did the United States once consider the Great Plains a "desert?" (Some people thought that because the prairie did not have trees, it was bare and full of nothingness. They did not realize that prairies have rich ecosystems that supported a lot of plant and animal life.)
- Why did the name "Great American Desert" change when people started settling there? (People began to realize that the soil that supported the high prairie grasses was very fertile and that crops would grow better there than in the soils of the East Coast and Europe.)
- What might the saying "rain follows plow" mean? (As soon as people started settling in the "Great American Desert," the rainfall increased for a period of about 10 years. In their excitement about their new home, they rationalized that if they settled there and started to farm, they would be blessed with ample rainfall. There was no scientific reason for this phenomenon, but people tried hard to think of one! One group thought that farmers released moisture when they tilled the damp soil that condensed and made rain. Today we know that the climate can vary and there can be unusually wet or dry years.)
- Why did the settlers of the Great Plains have to dig deep wells? (Their well water came from the Ogallala Aquifer, which is very deep in some places. Wells as deep as 400 feet were not uncommon.)

4. Activity—Map and Research: **Ogallala Aquifer.** Search maps to find where this aquifer is located (It runs through the states of Nebraska, Kansas, Oklahoma and Texas). Point it out on the map. Have the students try to find out about the Ogallala Aquifer in present

CHIEF SEATTLE SAYS...

This type of puzzle is called a double crostic. Fill in the clues, then transfer the numbered letters to the bottom. The answer is a quote from Chief Seattle.

CLUES

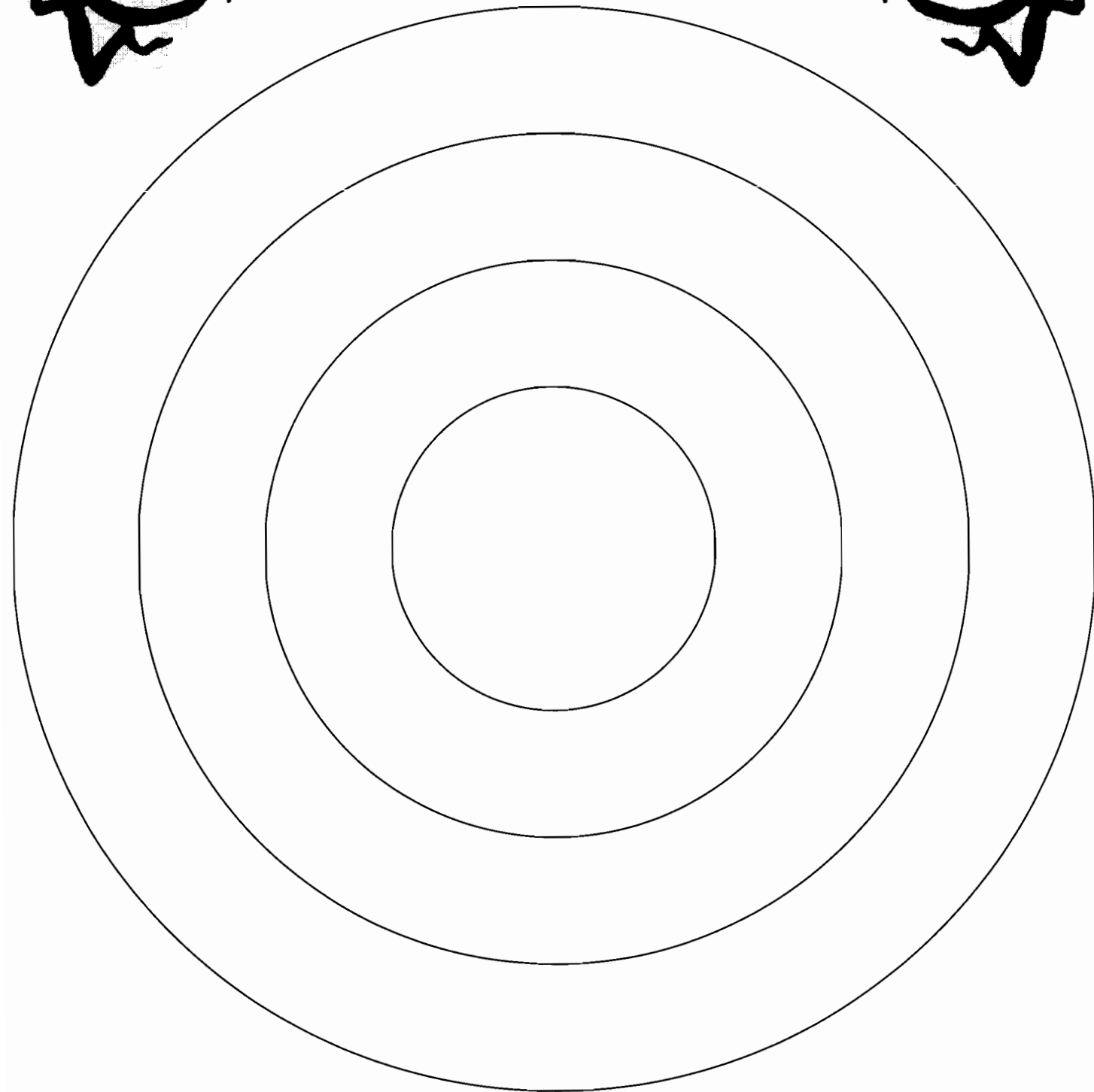
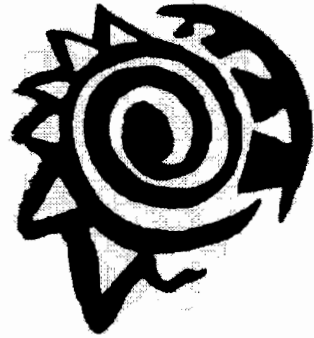
1. "Trickster" figure from the tribes of the Northwest
2. Northwest river
3. Northwest picture
4. Northwest area
5. Northwest area
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ANSWER

Y O U M U S T G I V E T H E R I V E R S K I N D N E S S

CREATE A WATER MANDALA

Instructions: In the center section, draw what you think of when you think of the word "water." Draw scenes from your favorite legend or myth in the second circle. In the third circle, show how Native Americans valued and used their water. In the outside circle, draw how we use water today.



Tom Sawyer and Huck Finn enjoyed life on the Mississippi

Steamboats later became an important way to travel on the river

Canals with locks helped move boats more easily down the waterways in order to increase trade

The workers on the Erie Canal were mainly Irish immigrants. There are no records of how many workers were hired or how many died in accidents or from malaria in the mosquito-infested swamps.

The canal was conceived as a water route for trade, and it was tremendously successful. It also had another overwhelming impact on the country. It became a heavily used water route for immigration. The first barge to leave New York harbor for Lake Erie was loaded with Scandinavians fresh from Europe. They were the first of millions of people who came to the interior states directly from Europe.

1. Introduce new vocabulary: **canal, engineers, interior, lock, seaport.**

2. Have your students read the article entitled "The Erie Canal."

3. Discuss these questions

a. Why did the canal planners decide to connect Lake Erie to the Mohawk River? (They wanted to connect Lake Erie to an ocean harbor. Once the canal reached the Mohawk River, boats could travel down the Mohawk River to the Hudson River to the New York City harbor. The Mohawk is one of the few rivers that flows through the Appalachian Mountains.)

b. Why was it important to have access

to a seaport? (Access to a seaport allowed cities to trade goods with other cities and with Europe.)

c. What challenges did the canal engineers meet? (They had to figure out how to build the banks, locks and bridges, and how to blast through rocks, pull up stumps of huge trees and drain swamps.)

d. In California, we have the Coachella Canal and the All-American Canal. How are they different from the Erie Canal? (They are similar in that they are both human-made waterways. They are different in that the Erie Canal was built for barge traffic and commerce. The Coachella and All-American Canals, on the other hand, were built for carrying irrigation water to farms. Also, the Coachella and All-American Canals have no locks.)

4. Activity—Map Study. Have students locate the Mohawk River on their maps and label it. Have them find and label the route of the Erie Canal on their map. (Check their social studies books for this.) Where did it follow natural waterways and where did it have to cut its own route? (It followed natural waterways along the Mohawk River but then had to cut across land to Buffalo. It followed along south of Lake Ontario.)

Also have them find some of the major cities along the canal and find out when they were founded. Was it close in time to the building of the canal?

6. Activity—Music: The Erie Canal.

Teach the song to the students. Reproduce the music found on page 43 of this Teacher Guide. Ask the students what they think the lyrics in the song "Low bridge, Everybody Down!" mean. (Bridges cross the Erie Canal along its entire length. To save money and speed the construction, the builders decided to build "low" bridges, which are bridges only four or five feet above the water level. When a barge reached a low bridge, the pilot would yell "Low bridge, everybody down!" and everyone on the barge would know to duck. Some barge workers who did not duck were actually killed when their heads struck a low bridge.)

7. Have students read the article "Locks Going Uphill on Level Water." Ask why locks were needed. (Canal barges had to be raised and lowered over the mountains. Locks allow that to happen.)

8. Activity—Lots and Lots of Locks!

Copy page 41 for your students. Try this activity using teams of "canal engineers." The objective is to show how locks raise and lower boats in a canal.



You may want to use the panoramic art at the top of pages 12-13 as a discussion starter. Here are some possible ideas to discuss.

Powell and his men tackled the mighty Colorado River. Often they stopped to try to survey the next part of the journey.

Gold seekers brought a rush of people to the West.

5. Activity—Math: And the Winner Is...

This activity is in the student material and it is a good activity to do together, since it may be difficult. Ask your students: How can Mark Twain claim the R.E. Lee's trip was slower than the Eclipse's?

To figure out which boat traveled faster, use a calculator and follow these steps:

- a. Calculate how many hours each boat traveled.

Eclipse	R.E. Lee
3 days, 3 hrs, 20 min	3 days 1 hr
3 days = 3 x 24 = 72 hrs	3 days = 3 x 24 = 72 hrs
3 hours = 3 hours	1 hour = 1 hour
20 min = .33 hrs	

Total Time = 75.33 hrs **Total Time = 73 hours**

- b. Next, divide the total number of miles traveled by each boat by the total travel time of each to get the miles per hour.

Eclipse	R.E. Lee
1,080/75.33 = 14.34 mph	1,030/73 = 14.11 mph

- c. Which boat traveled faster? (*The Eclipse at 14.34 mph.*)
- d. How much faster did the boat travel? ($14.34 - 14.11 = .23$ or *approximately 1/4 mph faster.*)

6. Have your students read the passage from Mark Twain's *Roughing It*.

- a. Discuss his humor.
- b. Discuss the rivers in Nevada. The difference in water resources in the

eastern U.S. and western U.S. is profound, and this passage summarizes the difference. Discuss your students' perceptions of those differences. (*The West is dry and arid; the East is wet and has plenty of water. In the West, the rivers are so small that people can jump over them during certain times of the year, and they look small enough that it almost seems a person could just drink them dry.*) What very important western river might have impressed Mr. Twain had he seen it? (*The Colorado*)

7. Activity—Language Arts: Journey Down the River. Have your students give themselves a pen name, such as Mark Twain's. Then have them pick (or make up) a river and write about an imaginary trip down it. Suggest that they write it in a conversational dialect similar to Twain's.

8. Extender—Language Arts. Read chapters of *Huckleberry Finn*, *Life on the Mississippi* or *Roughing It* out loud to your class. Throughout the school year, notice and discuss the way water is treated in other works of literature and songs. Perhaps by providing incentives to students when they point this out will increase student interest and awareness.

LESSON PLAN **PAGE 13**

THE ERIE CANAL

Background Information: As the American settlements expanded west towards the Ohio, Illinois and Mississippi River valleys, a greater portion of the nation's economy shifted towards the Mississippi River and the cities of St. Louis and New Orleans. The major shipping and trading cities of the East Coast were cut off from this trade because it was too difficult, slow and expensive to transport western goods through the forests and over the mountains. Governor De Witt Clinton of New York had a creative solution to this transportation barrier—the Erie Canal—but no one took him seriously. Even Thomas Jefferson, who was known as a “can do” president, told him it couldn't be done. At that time, New York harbor was a second class harbor compared to Boston and Philadelphia. The Erie Canal would change all that.

Building the Erie Canal was a true test of American ingenuity. A canal of this length that scaled mountains had never been attempted elsewhere. Clinton sent an engineer to England to walk along the English canals and draw pictures of the way the banks were formed and how locks and aqueducts were built. The engineers had to improvise solutions to many of the geographical challenges of the Erie Canal.

LEARNING MORE ABOUT NATIVE AMERICAN LIFE

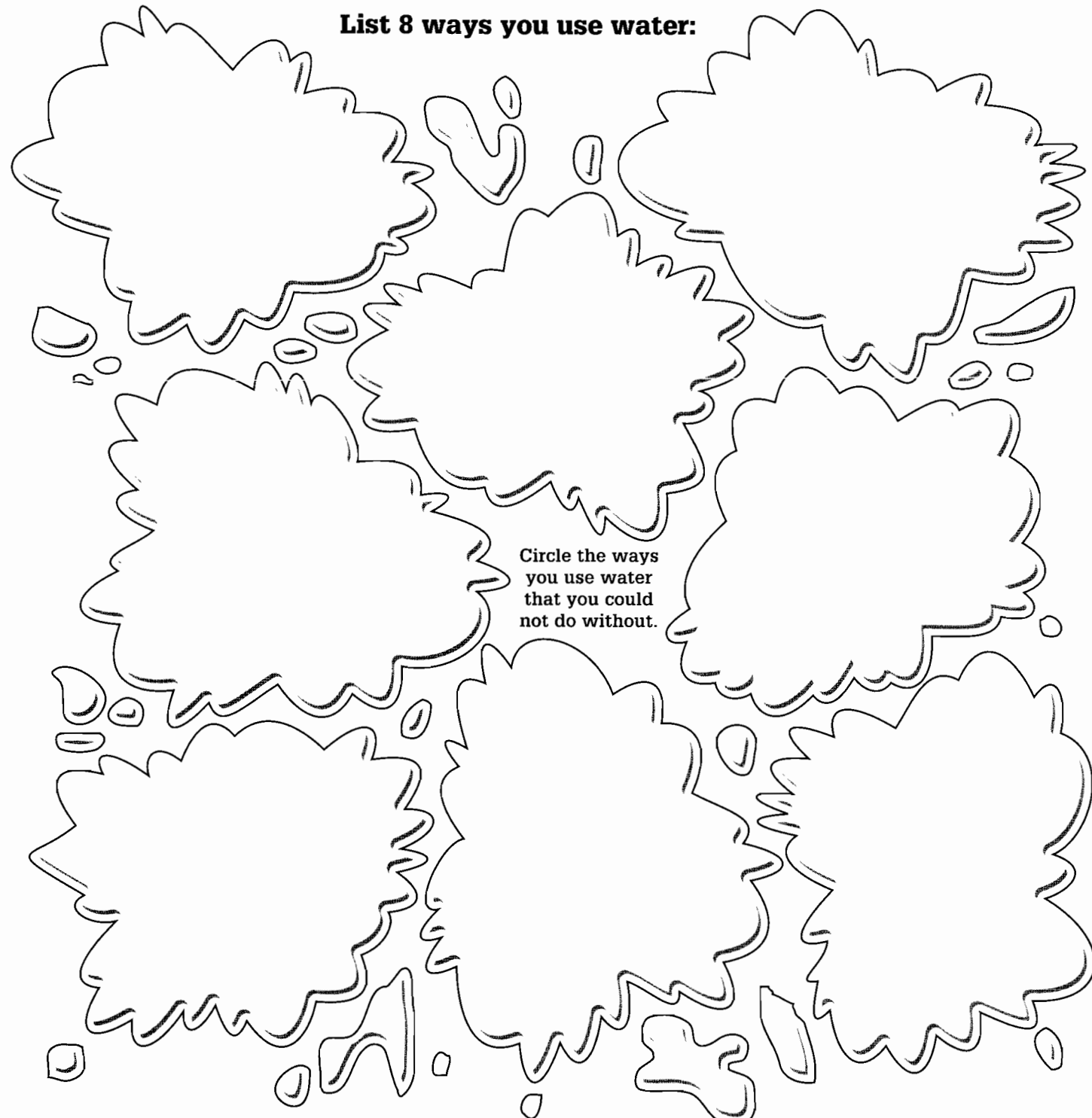
Instructions: Use your “Water Ways” articles and the library to help you learn more about Native American lifestyle



	Pacific Northwest	Southern California	Southwest	Great Basin	Great Plains	Mississippi Valley	Northeast	Southeast
Geographic Terms								
Native Americans Living in Area								
Lifestyle								
Food								
Climate								
Water Availability								

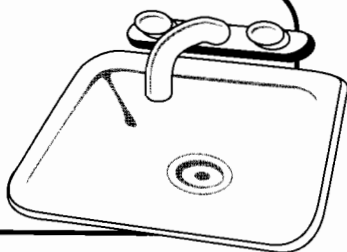
COULD YOU USE LESS WATER?

List 8 ways you use water:



Circle the ways you use water that you could not do without.

What is the total amount that you use for all of those activities each day?



If it's more than five gallons, write two ways you know you could conserve water:

fur trapper and a Native American woman in their expedition; however, the land west of the Continental Divide was unknown even to these two.

President Thomas Jefferson had many motives for funding the Lewis and Clark expedition. He was personally curious to learn more about the Native Americans and the flora and fauna of the country. He was professionally interested in learning more about the land his nation had just acquired. He wanted to know which areas would make good settlements. He was eager to establish settlements as widely as possible because they would help establish the U.S.'s rather feeble, vague claim to "all of the land connected by the tributaries of the Mississippi." He also wanted the expedition to reach Oregon Territory to stake a U.S. claim to that as yet unclaimed region. And, of course, he hoped to find the elusive northwest passage.

1. Introduce new vocabulary: *cascade, Continental Divide, expedition, headwaters, Louisiana Purchase, rapids, tributaries.*

2. Have your students read the article.

3. Discuss these questions:

a. Why did Jefferson send Lewis and Clark on the expedition? (*He wanted to learn about the land he had bought "sight unseen" and to learn which areas would be good for settlement.*)

a. What difficulties did the expedition have to overcome? (*It was hard to get the boats upstream. They had to hunt for food and needed to get across the mountains before winter.*)

4. Activity—Map Study: Louisiana Territory. The Louisiana Territory included all the land from the Mississippi River to the Rocky Mountains. Explain that this was a vague definition—no one knew exactly how much land it was or where the boundaries were. Have your students find the Louisiana Territory on the Water Ways map. Which section of the country is generally within that boundary? (*The Great Plains*)

5. Activity—Map Study: Lewis and Clark Expedition. Have your students trace the route of the Lewis and Clark Expedition on the Water Ways map. On their own map, label the Snake River, the Columbia River and the Rocky Mountains. Have them label each of the modern states through which the expedition passed. (*Missouri, Kansas, Iowa, Nebraska, South Dakota, North Dakota, Montana, Idaho, Oregon, Washington*) Have

students look at a map and name some of the important cities along these rivers.

LESSON PLAN PAGE 12

TRADE AND TRAVEL ALONG THE MISSISSIPPI RIVER

Background Information: Knowing how important the Mississippi River has become to this country's economy, it seems strange that for their first 300 years on this continent Europeans and their descendants did not pay much attention to this large, long river. Explorers were eager to find a river passage west, but did not see much value for a river that ran from north to south. (Remind your students of what they learned about the river during the time of the Pre-Columbian Native Americans. You may want to compare and contrast attitudes, uses of, etc.)

The first Europeans to use the river for trade were the fur trappers in the Great Lakes regions who used it to bring their pelts to trading centers that later became major cities like St. Louis and New Orleans. As frontiersmen arrived, lumberjacks floated their logs down, and soon farmers on the prairie sent their goods to market in flatboats and keelboats. The first steamboat arrived on the Mississippi in 1811. The Mississippi River soon became America's main street.

1. Introduce new vocabulary: *steamboat.*

2. Have your students read the article entitled "Trade and Travel Along the Mississippi River."

3. Discuss these questions:

a. Why did people need to take their goods down river to sell? (*They wanted to get their goods to the markets in the major cities.*)

b. Why did they travel by water rather than over land? (*There were few, if any, roads leading to major cities. Taking a wagon-load of goods to the East Coast was almost impossible.*)

c. How did steamboats help the towns? (*They connected the river towns to one another. Because of this, towns along the rivers began to grow and become wealthier.*)

4. Activity—Language Arts: Art: Word Pictures. With your students, brainstorm all the words that make you think about steamboats and the Mississippi River. (You might want to read the next few articles before doing this!) Use as many words as you can from the articles. List them on the board

so the students can see them. Using these words as "the lines" of the drawing, "draw" a steamboat scene on the Mississippi River.

LESSON PLAN PAGE 13

MARK TWAIN'S MISSISSIPPI

Background Information: The importance of the Mississippi River to our nation goes beyond commerce and travel. It also inspired one of America's finest authors, Mark Twain.

1. Introduce new vocabulary: (*river course, steamboat pilot.*)

Also introduce some of the silly "Mark Twainisms:" *chimblyes, Humboldt and Carson, Old Oolitic Silurian Period.*

2. Have your students read the first three paragraphs from the article entitled "Mark Twain's Mississippi." It includes a passage from *Huckleberry Finn*. Ask a student to read the passage aloud or have students follow along as you read it. Explain that many authors and artists have used rivers as a symbol for the promise for a better future or a pathway to a new freedom. The stillness of water often represents a quiet, reflective mirror of the soul, while storm water can represent an inner struggle or turmoil. In *Huckleberry Finn*, the Mississippi River serves all these functions for Huck and Jim. What feeling do your students get from listening to this passage?

3. Read the next two paragraphs about "the length of the Mississippi River"—a passage from Twain's book, *Life on the Mississippi*. Mark Twain liked to show the absurdity of certain kinds of reasoning. His discussion of the conclusions that can be drawn about the Mississippi's (then) recent changes in course are a case in point. Ask your students these questions:

a. Do you think this was a "serious" passage or "playful?" What clues do you have to support your answer?

b. From the description, what might the course of the river have looked like several thousand years ago? (*It may have meandered more.*)

c. What might it look like in another thousand years? (*It may be straighter.*)

4. Next, ask the students to read the passage from Twain's *Life on the Mississippi* about the time of the steamboat trip between New Orleans and Cairo.

WATER WAYS

TEACHER GUIDE

MOVING WESTWARD

Introduction

We prepared this issue of Water Ways, Moving Westward, to provide a water-related supplement to the "New Nation's Westward Expansion" unit of the California fifth-grade social studies curriculum: *U.S. History and Geography: Making a New Nation*. It is the third part of three.

Objectives

1. Students will read about how water influenced the westward expansion, including trade, lifestyle and health
2. Students will read about the importance of water during this period of American history.
3. Students will be exposed to the music, art and literature of the period.
4. Students will complete learning activities on each main topic, including hands-on, critical thinking, compare and contrast and creative writing.

LESSON PLAN PAGE 12 WESTWARD HO!

Background Information: To the early colonists, the new continent seemed vast, but by the time of the American Revolution many people were feeling cramped in the area of the 13 original colonies. There were several reasons for this. Rugged individualism was already an American tradition, and these folks wanted lots of space with few neighbors. Many farmers overplanted and did not maintain the fertility of the land, and so wanted to start new farms on the land that seemed theirs for the taking beyond the frontier. The colonial leaders encouraged settlers to push the frontier, because they wanted to drive the Native American tribes who had been assisting their enemies (Britain)

west of the Mississippi River. After the United States became a nation, the notion of "Manifest Destiny" began to take hold and the government was in a hurry to claim the rest of the continent before the English, Spanish, French or Russians did. In this start-up activity, students will put themselves in the position of the first settlers to push beyond the frontiers of the 13 colonies.

1. Introduce new vocabulary: **blaze, canal, frontier, Great Barrier, plateau.**
2. Have your students read the article entitled "Westward Ho!"
3. Ask the following questions:
 - a. What was the Great Barrier and why was it so named? (*The Great Barrier was the Appalachian Mountain chain, which includes the Allegheny Plateau. It was so named because the mountains were steep and heavily wooded, and there are no navigable rivers that cross the mountains from east to west. Thus, they acted as a great barrier to the rest of the continent.*)
 - b. Why was it difficult for settlers to travel westward? (*Land trails across the mountains were too narrow for wagons, and there were no rivers to travel. Travel across the mountains was very slow and dangerous.*)
4. **Activity—Music: Cumberland Gap.** Teach your students the song "The Cumberland Gap." The music and words can be found on page 42 of this teacher guide. First have them read through the words then ask:
 - a. Why was the Cumberland Gap important? (*It opened the first land route across the Appalachian Mountains and was the start of the Wilderness Trail.*)
 - b. In the song, what do you think is meant by the line "Three kinds of

water to wash your face?" (*Accept any reasonable answer. Perhaps it meant that there are springs, rivers and lakes along the trail.*)

5. **Activity—The Things You Carry.** page 12, student materials. Imagine you lived in the early 1800s and you and your family are leaving your farm in Virginia to start a new life in western Kentucky. You will travel on the Wilderness Trail and can only take one pack horse. You must carry the rest of your belongings on your back. What will you take with you? Below is a list of possible items you might take on your trip west. Circle the items you would take. Put an X through items you think you would not need. Draw in and label additional items you would want. Below, explain why you need each of the items (how it will help you, etc.).

Items that appear in students' list:

Ax, rifle and ammunition, a plate and cooking pot, change of clothes, bedding, knife, staples (flour, salt, coffee), spare shoes, needles, iron nails.

- a. Discuss the items that they circled or put an X through. Let the students share their reasoning behind each item.
 - b. Repeat this for items they have added.
 - c. Discuss survival needs with students. What other needs might they have? Where will they get their food and water needs?
6. **Activity—Map: Through the Cumberland Gap on the Wilderness Trail.**
 - a. Have your students find and label the Allegheny Plateau and the Appalachian Mountains on their map.
 - b. Then find and trace the Wilderness Trail and locate the Cumberland Gap on the map in Water Ways.
 - c. Ask if there are barriers that keep them from traveling. Are they the same kinds of barriers the pioneers had? Or are they different? How?

LESSON PLAN PAGE 12 LEWIS AND CLARK FOLLOW THE WATERS TO THE PACIFIC OCEAN

Background Information: When the United States bought the Louisiana Territory in 1803, the Mississippi River was used by trappers, and the southern part of the river had a few budding cities like St. Louis. Only fur trappers and natives knew much about the land at the headwaters of the western tributaries. Lewis and Clark were wise to include a French Canadian

BUILD YOUR OWN RAINSTICK

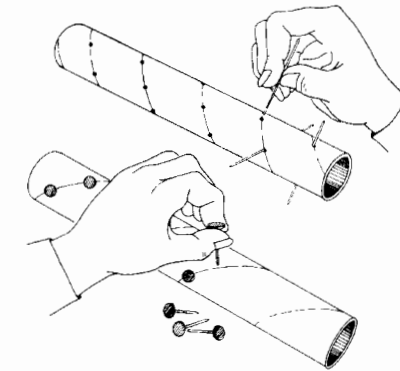
As people build rainsticks from materials found in the environments in which they live, you too can create your own rainstick with things within your home.

What you'll need:

- Cardboard tubes from paper towels or gift wrapping, mailing tubes
- A tool to punch holes in the tube, such as a drill or awl
- Small hammer
- Toothpicks or flat head nails (for 1" diameter tube, use a 3/8" nail)
- Glue
- Masking tape
- Wire cutters or sturdy scissors
- "Fill"—seeds, pebbles, rice, dried beans, shells, beads and so forth
- Materials to decorate the outside of the tube: paint, crayons, sparkles, sand, etc.

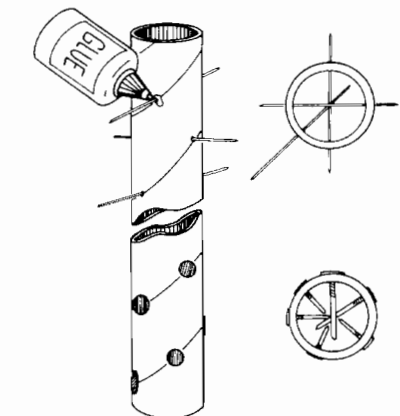
The steps:

1. Drill or poke holes in the cardboard tube. Be careful not to collapse the tube by pressing too hard. Creating a spiral staircase pattern, place the holes about one inch apart. Drill the holes through one side only or all the way through both sides of the tube. If you are using nails, it is not necessary to drill holes.

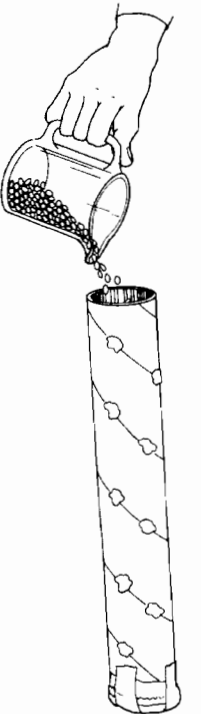


2. If you use toothpicks, push the toothpicks through the holes. Leave a little bit of the toothpick (a nub) remaining outside the tube. If holes were drilled straight through the cylinder, push the toothpick all the way through the tube. Inserting the toothpicks to different lengths will produce a variety of sounds. If you are using nails, insert nails that are slightly shorter than the diameter of the tube in a spiral pattern. A small hammer may be useful.

3. Apply glue to the nubs and allow to dry. Cut off the nubs if they stick out more than 1/4" from the tube. Or, seal the nail heads with glue or wrap the entire tube with masking tape.



4. Seal one end of the tube with masking tape. Pour in the fill. Cover the open end of the tube with your hand and invert it. Close your eyes and listen. Add more fill or take some away to create a sound that is pleasing to you. Cover the other end of the tube with masking tape.



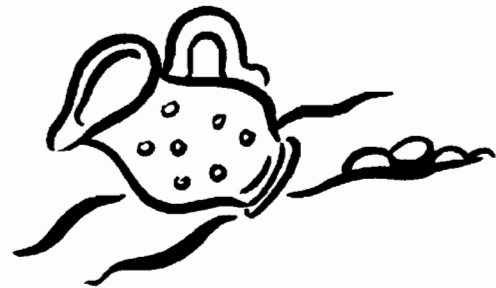
5. You may wish to decorate your rainstick by coating it with glue and rolling it in sand. (Messy, but it provides a wonderful texture for the surface of your instrument.) After it dries, you may paint and decorate it with natural objects from your own part of the world. Be creative!

When you slowly turn your rainstick end to end, listen for the sound of the rain. What stories do you hear?

The instructions for Building Your Own Rainstick have been republished with permission from The Rainstick. A Fable © 1994 Project Wet, Water Education for Teachers pgs 36-37 Bozeman, MT and Falcon Press Helena MT

JOIN THE DIG

Imagine that archaeologists 2,000 years from now want to learn about how people lived in the year 2000. They dig, and find the remains of a 2,000-year-old neighborhood in what we now call Orange County. Think of 5 items that represent water use in your time and draw them into the dig site below. We've already drawn a couple to get you started.



Describe what these objects might tell you about that society and its use of water: _____

A Conservation Activity

JOSÉ wants to see how much water he can save by cutting his 10-minute showers down to five minutes. He needs your help!

1. Here's how José measures the flow rate (or amount of water coming out) of his shower: He takes a gallon milk jug and cuts the top off (so the hole is larger). He turns on the water as if he were taking a shower. He holds up the milk jug so the water fills it without spilling. He times how long it takes to completely fill the jug with one gallon of water.

It takes **10 seconds**.

HELP!...If José needs ten seconds to fill a jug with one gallon of water, how much water would he have if he collected it for one minute?

(The answer to that question is the flow rate of the shower in "gallons per minute," or **gpm**.)

2. Multiply the number of **gpm** by the length of José's shower to find out how many gallons he would use for each shower:

A N S W E R

10 minute shower = gpm x 10 =

5 minute shower = gpm x 5 =

3. How much water would José save by cutting a 10-minute shower to five minutes?

A N S W E R

4. Assuming José takes one five-minute shower each day instead of a 10-minute shower, how much water would he save each year?

A N S W E R

5. Imagine that José was taking a shower in colonial days. Suppose a colonial water bucket held three gallons of water. How many buckets would he have to carry to fill a tank with enough water for a 10-minute shower?

A N S W E R

- Think about how heavy that bucket would be. (Each gallon of water weighs **7.5 pounds!**)
- Imagine having to carry that many buckets just to bathe!
- Imagine having to chop and carry the firewood to heat the water.
- Now think about how long would it take you to get ready to bathe. **Do you think it would be worthwhile for José to limit his showers to five minutes or less?**

BUILDING A WATER WHEEL

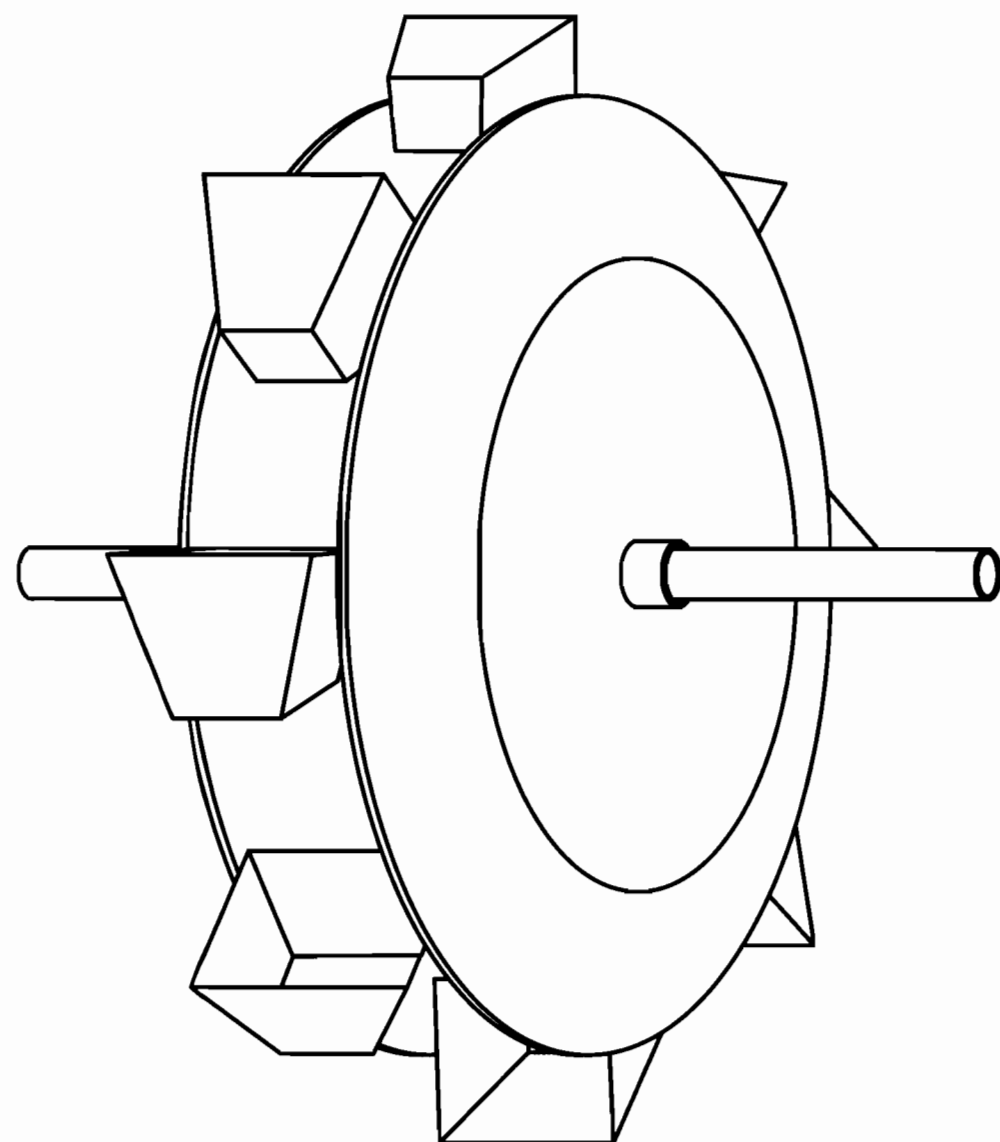
The American colonists used water wheels to power their labor saving machinery. You can build a working model of a water wheel.

What you'll need:

- Eight 1¼ oz paper soufflé cups (8 per water wheel)
- Styrofoam plates (2 per water wheel)
- two straws of different diameters (one should slide freely inside the other)
- scissors for cutting the straws
- stapler
- water
- straight edge and sharpened pencil
- water pitcher (about a liter)
- a basin for catching the water

The steps:

1. Staple eight paper soufflé cups between two styrofoam plates. They should all point in the same direction. The cup at either 3:00 or 9:00 should face upside down, while the one at the opposite side of the circle should face right side up. Cups should be placed roughly equidistant around the plates (45° apart).
2. Draw two lines across the diameter of a plate to find the center point of the circle and poke a hole through the plates with the sharpened pencil.
3. Cut the straw with the larger diameter to a length of about 3", and leave the other straw full length.
4. Slide the short straw through the hole in the styrofoam



plates, then slide the long straw through the short straw. (The short straw is a bushing, allowing the wheel to turn freely on the long straw.)

5. Hold the long straw so the water wheel can spin freely. Hold the wheel over the catch basin so the water won't spill.
6. Have someone pour water

from a pitcher slowly into the cups so the water wheel turns. The pitcher represents the trough that delivers water to a water wheel.

7. Discuss how this water wheel works. In a mill, the power of the water wheel turned gears, which in turn, did some sort of work such as grinding grain or sawing lumber.

I Bring the Rain

Here I sit and with my power,
 I bring the South wind t'ward me,
 After the wind, I bring the clouds,
 After the clouds, I bring the rain,
 That makes the flowers grow,
 That makes the home grounds beautiful.

WATER WAYS

TEACHER GUIDE

SETTLING THE COLONIES

Introduction

We prepared this issue of Water Ways, Settling the Colonies, to provide a water-related supplement to the "Settling the Colonies" unit of the California fifth-grade social studies curriculum: *U.S. History and Geography: Making a New Nation*. It is the second part of three.

Objectives

1. Students will read about how water influenced settlement, travel, trade and health in colonial America.
2. Students will read about the importance of water in early America.
3. Students will complete a variety of learning activities that accompany each lesson, including hands-on activities, critical thinking, compare-and-contrast and creative writing.
4. Students will be exposed to the customs, commerce and daily living habits of the time.

clear, clean streams and ponds, wide open fields, and deep, dark forests."

4. Have your students work in pairs to discuss the following four questions:
 - a. What is the first thing you would need to do?
 - b. How would you take care of these necessities: shelter, food and drink, clothing and bathing?
 - c. What five things would you want to bring with you from your old home?
 - d. What would you miss most about your old lifestyle?
5. Quickly review their responses by having each group report their answers. Note and discuss similarities and differences in their responses.
6. From the article, "Water in the New Colonies," have your students list as many areas as they can where water played an important role in the lives of early colonists. (*farming, drinking, travel, energy, trading, fire fighting, cleaning, industry.*)

LESSON PLAN

PAGE 6

LESSON PLAN PAGE 6 WATER IN THE NEW COLONIES

Background Information: The early European settlers left their homes and comforts behind to come to a world they knew nothing about. In this start-up activity, students put themselves into that position and reflect on the items of true importance in their lives.

1. Introduce new vocabulary: **harbor, malaria, pollution, water resources.**
2. Have your students read the article.
3. Set the stage in the following way: "Imagine that you have moved to a completely new location. Your new home has none of the things you are used to: running water, toilets, electricity, stores, buildings, roads (or schools!). There are

resources. Likewise, most of the early American cities grew up in estuaries.

Early settlers, however, were slow to adapt to the new conditions on this continent in spite of it being the land of plenty. They wanted to reproduce a European lifestyle, maintain their old customs and grow their old crops (rather than native plants that grew well in these conditions). As traditional stories have related many times, they probably would have died without the help of the local Native Americans, who gave them food and showed them how to grow native crops, as well as to fish and hunt.

The tidewater estuary of Jamestown was an ideal place to begin a new colony. The Pilgrims intended to go to the Jamestown colony, but a storm blew them off course to Cape Cod. Making the best of a bad situation, they chose a location near the now famous Plymouth Rock, partly because the land was already cleared for farming. Here, like in many other new settlements, the Europeans arrived to find empty Indian villages. This occurred because the 16th century explorers brought European diseases with them, especially smallpox, and by the time the settlers arrived in the 17th century, many Native Americans had died. Squanto, who helped the Pilgrims learn how to live in the new world and taught them to grow corn, was the only survivor of his village.

1. Introduce new vocabulary: **brackish water, estuary, tides.**

2. Have your students read the article entitled "Estuaries: Shared by Many Early Settlements and Colonial Cities."

3. Discuss these questions:
 - a. What is an estuary? (*The area where a freshwater river empties into the ocean, and freshwater and saltwater mix. Estuaries are rich habitats and very important to the overall balance of nature.*)
 - b. What is brackish water? (*Water that is saltier than freshwater but not as salty as seawater. It is usually too salty to drink or use on crops, but it provides an excellent home for many marine species.*)
 - c. What did the settlers in Jamestown find? (*They found incredible natural bounty, including wild game, fruits and food from the sea.*)

4. **Activity—Map Study**

- a. Find a map in your textbook that shows the original northern, middle and southern colonies. Have your students find the major cities and



Yankee Doodle Dandy

Yankee Doodle went to town A - rid - in' on a po - ny; He
 stuck a feath - er in his cap And called it mac - a - ro - ni.
 Yan - kee Doo-dle, keep it up, Yan - kee Doodle dan - dy,
 Mind the mu - sic and the step, And with the girls be hand - y.



Yankee Doodle Dandy

Yankee Doodle went to town A - rid - in' on a po - ny; He
 stuck a feath - er in his cap And called it mac - a - ro - ni.
 Yan - kee Doo-dle, keep it up, Yan - kee Doodle dan - dy,
 Mind the mu - sic and the step, And with the girls be hand - y.

GLOSSARY

aquifer: an underground source of water. Aquifers consist of saturated porous stone, sand, dirt or clay. Holes dug into aquifers—wells—fill with fresh water.

brackish water: water that is a mix of fresh water and salt water. It is usually too salty to drink or use on crops, but it is less salty than seawater.

bucket brigade: a line of people stretching from a water source, such as a pump, a river or a pond, to a fire. People pass full buckets in one direction and empty buckets in the other.

drought: an extended rainless period

ecosystem: the natural system and balance of nature, starting with the lowest end of the food chain and extending up to the largest plants and animals

estuary: the area where a river empties into the ocean, and fresh water and salt water mix. Estuaries are rich habitats and very important to the overall balance of nature.

ferry: a special boat used to cross a body of water. Many early ferries were pulled across rivers by ropes.

fieldstone: a smooth, natural stone that is used as a common building material even today

ford: crossing a shallow portion of a river or stream by wading or riding through it

harbor: a protected inlet from the ocean where ships may safely anchor and the passengers may go ashore

malaria: a deadly disease carried by mosquitoes

mill pond: a small pond alongside a mill. Millers often dammed streams and allowed the water to fill a small pond, then they diverted water from the pond to turn their water wheel.

mill race: a trough of water running from the mill pond to the water wheel. The weight of the water—rather than its speed—turned the wheel and powered the mill.

pewter: a soft metal alloy, often consisting of tin and lead. Many colonial plates and bowls were made from pewter.

pollution: destruction of the natural environment caused by human activities

reservoir: an artificial lake where water is collected and kept for later use

springs: all across the earth, there is water in the ground. If you dig down

a few feet into the soil in most places, you will feel that the soil is moist. If the water bubbles to the surface naturally—because of pressure or gravity—that is called a spring. Water that resides in the ground is called groundwater, and concentrations of groundwater are called aquifers.

tides: the daily rising and falling of the oceans caused by the effects of the moon’s gravity on earth. Two high tides and two low tides occur along sea-coasts each day throughout the world.

tributary: a river or stream that feeds water into a larger river or stream. The Missouri River, for example, is a tributary of the Mississippi.

trusses: cross supports that give a bridge its strength

untreated waste: the raw byproducts of life that can cause disease or pollution, such as fecal matter from humans and wild animals

water resources: the total available water in a region. It may be used for fishing, farming, transportation, drinking and bathing, or it may not be used by people at all.

well: a hole dug into an aquifer from which fresh water may be drawn

well sweep: a long, counterbalanced arm that enabled colonists to lift water from their wells without the difficult work of cranking a heavy bucket up

identify the rivers/estuaries they are built around:

Boston (*Charles River*)**

New York (*Hudson River*)

Philadelphia (*Delaware River*)

Wilmington (*Delaware River*)

Washington, D.C. (*Potomac River*)

Jamestown (*James River*)

Norfolk (*James River*)

Charleston (*Cooper River*)**

Savannah (*Savannah River*)

b. Label these cities and rivers on their maps. **The Charles River and the Cooper River are too small to appear on the map. Explain to the students that, although the rivers are not shown, Boston and Charleston are situated on the rivers listed above.

c. Ask your students what these cities have in common. (*They are on natural estuaries.*)

5. Activity—Map Study: Have your students locate estuaries in Southern California (*Los Angeles River, Santa Ana River, San Diego River*) and identify the cities that are sited there. Which city grew up at the estuary of the Mississippi River? (*New Orleans.*)

6. Extender—Xeriscape gardening. The Indians had to teach the settlers which plants to grow in their new land and how to grow them. European crops did not grow as they did in Europe; only native crops really grew well on this continent. Have your students learn about xeriscape gardening, which is a modern gardening technique that uses only native plants. Plant one or two native plants in your classroom and one or two common flowering houseplants. Record the amount of water the two types of plants require to stay healthy.

LESSON PLAN PAGE 6 WHO MAKES UP A TOWN?

Background Information: Every village and town had certain artisans, craftspeople and merchants: the butchers, the bakers, the millers, the coopers, the sawyers, the tailors, the smiths. Many of the family names, or surnames, we encounter today grew from the professions of our ancestors, and that holds true for every language and culture. “Schumacher,” for example, means shoemaker in German. Other people have taken names from their home’s location, such as “Waters,” “Hillman” or “Rivers.”

1. Have your students read the short article.
2. Discuss, or have students research in a dictionary or other source, the meanings

of the profession with which they are not familiar.

- Smith: metal worker
- Tailor: clothes maker
- Cooper: barrel maker
- Tinker: a maker or mender of utensils
- Tanner: leather worker
- Woods
- Butcher
- Teacher
- Mason: stone worker

3. Activity: Names in Your Class. Ask if any of the surnames in your classroom indicate a person’s (or ancestor’s) trade or profession...either in English or another language. What are they?

4. What name would best fit a water engineer? Ask students to think up a last name.

LESSON PLAN PAGE 6

CONTRASTING LIFESTYLES: IS WATER GOOD OR BAD FOR YOU?

Background Information: The many differences in lifestyle between the settlers and natives often led to misunderstandings. One of these differences was the way the settlers and natives used natural resources. Concerning drinking and bathing habits, the Europeans settlers were not used to having clean water. They lived in crowded cities, with no sewage or sanitary water supply. Many diseases, such as cholera, were carried by contaminated water. As a result, the Europeans did not drink water, and they did not bathe very much, because in Europe drinking water and bathing made people sick. In contrast, the Native Americans lived in uncrowded conditions, and they did not have the many devastating and contagious diseases of the Europeans. They also considered it their sacred duty to keep water supplies pure and unspoiled.

1. Introduce new vocabulary: *untreated waste, tides.*

2. Have your students read this article. Ask students to note the differences between the Native Americans’ attitudes toward drinking water and the early colonists’ attitudes. (*Colonists distrusted water because in Europe it often made them sick. Native Americans thought water was very pure.*)

3. Locate a news article on death and disease in the world caused by water-borne disease, and discuss today’s emphasis on public health and clean water. These instances are incredibly common, even today with our advanced technology.

4. Discuss the importance of protecting our drinking water supply. Ask your students if they know of any countries in the world that have had major disease outbreaks recently because of bad drinking water? (*Peru, Ruwanda*)

5. Activity—Poetry. Have your students make a up a diamonte about water and illustrate it.

Diamonte (Diamond) form consists of seven lines in a diamond-shaped form that expresses one idea and takes it to the opposite of that idea.

1st line = 1 word noun
2nd line = 2 adjectives that describe the noun
3rd line = 3 verbs ending in ed/ing which are related to the first noun
4th line = 4 nouns—2 related to line 1, and 2 suggesting a change to line 7
5th line = 3 verbs ending in ed/ing related to line 7
6th line = 2 adjectives describing line 7
7th line = 1 word noun that is opposite of line 1
example of a diamonte
day
bright, cheerful
shining, warming, blazing
daybreak, sun, shadows, sunsets,
cooling, darkening, nearing
mysterious, dark
night

LESSON PLAN PAGE 7

THE WIT AND WISDOM OF POOR RICHARD

Background Information: The 25 years of *Poor Richard’s Almanack* fits comfortably into a single volume. It is filled with aphorisms and witticisms that provide a delightful window into Colonial life.

1. Read the few aphorisms from the almanac contained in the text, and discuss the meaning of each.

2. Check out a copy of the almanac from the library and have your students find three items they find interesting. Have students share them with the class and explain either their humor or their meaning or relevance to their lives. Observe the differences in the language, such as the use of capitalization within a sentence.

3. Activity—Language Arts. Have your students make up their own Poor Richard’s aphorism about items related to water. You might want to “publish” these in a class book format.



You may want to use the panoramic art at the top of pages 6-7 as a discussion starter. Here are some possible ideas to discuss.

A mill race carried water along a nearly level course until it reached the water wheel.

In later years, water towers held the town's supply of water.

Well sweeps were used to help raise water from the well.

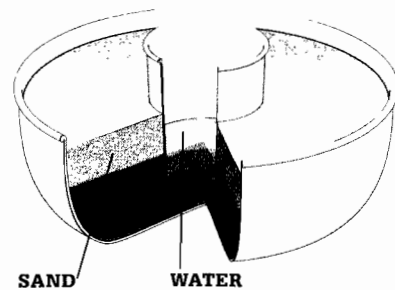
LESSON PLAN **PAGE 7**
THE WATER WELL

Background Information: People have been drawing groundwater from wells since pre-Biblical days. In Southern California, about one-third of all the water consumed comes from groundwater aquifers. Those aquifers serve as water storage basins, just like surface water reservoirs. Throughout the year, water is pumped from the aquifers through wells. During wet periods, excess water is directed to recharging fields and allowed to percolate through the soil and back to the aquifers. When more water is pumped from a well than is replaced, the groundwater level drops, and eventually the well dries up.

1. Introduce new vocabulary: **aquifer**, **well**, **well sweep**.
2. Have your students read this article.
3. Discuss the article by asking the following questions:
 - a. What is an aquifer?
 - b. Why did the settlers not have to dig deep for water? (*The water table [or water level] in the colonies was high, or close to the surface. As the shallow aquifers have become depleted, people have to dig deeper and deeper for water.*)
- c. Discuss with your students the mix of water coming into Southern California.

(About two-thirds of the water used in Southern California is imported from the State Water Project, the northern and eastern Sierra and the Colorado River. The remaining water comes primarily from local groundwater sources and is pumped from wells.)

4. Ask the class if anyone has ever seen a well.
5. Have your students try to lift a heavy object (such as two or three dictionaries) off the ground. Then have them try to lift the same weight using a long lever, such as a long broom handle. This demonstration will help them see how well "sweeps" eased the task of pulling water up a well.
6. **Activity—Make a Well.** (You may want to have the class work in small groups to make these.)
 - a. Cut out the bottom of a tall paper or plastic cup, and discard the bottom.



- b. Line the bottom of a basin (such as a dish basin or a 12" x 12" plastic container) with about 1" of sand.
- c. Place the cylinder (the cup without the bottom) on the sand, with the open sides vertical.
- d. Fill the rest of the container with sand up to about 1/8" - 1" below the lip of the cup.
- e. Pour two cups of water onto the sand (not in the cup). Look in the cup. What happens?
- f. Keep pouring water onto the soil two cups at a time until your well fills.
- g. Does the water in your well appear clear or cloudy? Let it sit for a couple of days, then look again. Is the water clear?
- h. Explain that the water in the sand around the cup is an aquifer. The cup acts like a well, filling with water up to the level of the water table.

LESSON PLAN **PAGE 7**
A BATH EVERY SATURDAY...

1. Introduce new vocabulary: **pewter**, **fieldstone**.
2. Have your students read this article.
3. Discuss this topic: Do you consider clean, running water, indoor plumbing, and flush toilets necessities or luxuries? What might happen in our populated society if we did not have these conveniences?

SOME COLONIAL SCHOOL GAMES

1. Activity—Unscrambled Words.

Have your students unscramble the listed words.

- verri (river)
- reamst (stream)
- mirglip (Pilgrim)
- trewa (water)
- leiw (well)
- retaw elehw (water wheel)
- donsuh rvrie (Hudson River)
- wontjames (Jamestown)
- ryfer (ferry)
- kubcet gradebi (bucket brigade)

2. After unscrambling the words, have your students use them in sentences that describe what they have learned.

3. Activity—Charades: Oral Language.

Have your students read the section on charades. Charades was a favorite game of colonial school children.

- a. Have your class make up their own water-related sayings and act them out in the game.
- b. Suggestions for charade topics:
 - Water conservation tips, such as "Don't waste water" and "Fix leaky faucets."
 - Water concepts such as bucket brigade, fetching water from a well, water wheel, bathing with a basin of water, estuary, clearing land, doing laundry the old fashioned way.

RESOURCES

Books

Changes in the Land
by William Cronon.

Everyday Life in Early America
by David Freeman Hawke,
Harper and Row. New York, 1988.

Everyday Things in American Life 1607-1776 by William Chauncy Langdon.
Charles Scribner's Sons, New York, 1965.

Home Life in the Colonial Days
by Alice Morse Earle.
Macmillan Co., New York, 1926.

Like It Was: Bicentennial Games 'n Fun Handbook by Adah P. Strobell.
Acropolis Books, Ltd., 1975.

The Reshaping of Everyday Life: 1790-1840 by Jack Larkin,
Harper and Row. NY 1988.

Paintings

The Oxbow (View from Mt. Holyoke, North Hampton, MA after a Thunderstorm) by Thomas Cole.

The painter was disturbed by the destruction of the landscape brought by technology, so he painted an idyllic scene of how life had been before.

Lake George by John W. Casilear (1860). Shows the domestication of nature, with cows, canoe's wake and a person on shore. Nature yields to the needs of man.

New England Scenery

by Frederick E. Church. Shows covered wagon, wooden bridge, sawmill and cows. Portrait of a "perfect" place that shows the painter's ideal of harmony among human industry, rural life and nature.

Niagara by Frederick E. Church. Niagara Falls impressed all who saw it, and challenged painters to portray the untamed wilderness of America.

Natural Bridge of Virginia by an Officer of the British Royal Navy. The human being is dwarfed by the huge rock tunnel, reflecting people's sense of being overwhelmed by the enormity of the American wilderness.

reseed forests. At some point in time, people started to observe changes in the land, the decline of fertility of the soil, the loss of some plant species, and the decline in fish, beaver, deer, birds, ducks and other animal populations.

Could they relate these changes to their wasteful, polluting habits? If so, they did not seem to feel the need to change their habits. For one reason, it seemed to them that there was an endless supply of resources in this vast land. If they used up the land in one area, there was always more land for the taking further west.

In fact, the huge size of the American wilderness made nature seem more like an enemy than a thing of beauty. Forging a European-style life in this country was hard work, and vast, uncut forests seemed like a threat to civilization. It was so much work to clear land for a house and a farm that it was cleared land, not land in its natural state, that seemed beautiful. The colonists did not think about clearing forests as deforestation, as many people do today, but as progress.

1. Introduce new vocabulary: **pollution**.

2. Have your students read this brief article.

3. What were the colonists' attitudes toward natural resources? (*They felt the natural resources were in abundant supply; they could use as much as possible.*)

4. Name at least two different types of pollution (*air pollution and water pollution*) and name at least two examples of each. (*You may want to point out situations involving water pollution, such as groundwater contamination in the San Gabriel Basin.*)

5. Create the following checklist on the board:

- Polluting activity
- Type of pollution
- Is the pollution continuing? If yes, why?

Have the class think of as many types of pollution as they can, particularly types of water pollution. Do they pollute water, air and/or something else? Is the polluting activity still continuing? If the answer is yes, discuss why. For example, we are still causing air pollution from automobiles and electric generating stations. We are doing it because we still need to travel by automobiles and to generate electricity, and we do not have other competitively priced options.

FUR TRAPPERS LEARN ABOUT THE INTERIOR WILDERNESS

Background Information: All throughout the years of colonization and the settling of the eastern U.S., a hearty group of French and English individualists covered the interior. They hunted and trapped, though, never really settling down to create permanent homes.

The permanent homes that did result from their efforts were trading centers, places where they could trade their furs for supplies. The two most important trading centers were St. Louis and New Orleans. Even today, both cities have interesting commonalities.

1. Have your students read the article.

2. On the map inside Water Ways, point out the "interior" of the U.S. It covers the entire Mississippi River system, from the Great Lakes to the north, the western slope of the Appalachian Mountains and Allegheny Plateaus to the east, and the eastern slope of the Rocky Mountains to the west. The Mississippi River system provided an ideal transportation and trade network for these traders.

3. **Activity—Map Study.** Locate St. Louis and New Orleans on the map and label them. What do those two cities have in common? What features of the river mark both of them? (*They are both along the Mississippi River. St. Louis lies at the convergence of the two of the Mississippi's largest tributaries—the Missouri River from the west, and the Illinois River from the northeast. New Orleans lies at the mouth of the Mississippi River, so it became a major shipping port, linking the Mississippi Valley with the east coast cities and the rest of the world.*)

4. Discuss various ways we move goods today. (*There is still a tremendous amount of barge traffic along the rivers of the Mississippi River system. In addition, we use railroads, trucks and airplanes, none of which existed in the colonial days.*)

OUTGROWING THE EAST COAST

Background Information: European settlers in the eastern U.S. began a tradition of altering the land to suit their needs that has continued for almost 400 years. In the last half of this century, as we have stretched many of our natural resources to their limits, including water, research has shown that we must change our practices to achieve "sustainability," the ability to use only as much as we need and to replenish that which we can.

For centuries, for example, "civilization" has promoted the draining and filling of swamps and wetlands to acquire more land for farming or building. Only recently have we started to realize the immense natural value of wetlands. They are an essential component of a healthy ecosystem, and they support a tremendous amount of life. In addition, they help to balance the swings of nature, holding water in the spring to prevent flooding, and releasing that water slowly through the summer to buffer the effects of heat and drought.

In the past decade or two, as scientific knowledge of wetlands has changed, federal and state laws no longer allow development to destroy wetlands. Many developers are required to replace wetlands that had been destroyed in the past. The need for these dramatic efforts have their roots in the attitudes of colonial Americans who faced a continent so big and so generous that it seemed genuinely limitless. The colonists simply kept pushing west until they had no place to go. When they backed up to the Appalachian Mountains and the Allegheny Mountains, their choice was to stay where they were or try to find a way across. These natural barriers were major obstacles to the westward expansion.

1. Introduce new vocabulary: **ecosystem**.

2. Have your students read the article entitled "Outgrowing the East Coast."

3. **Activity—Map Study.** As a class, examine the map of the U.S., then locate and label on their individual maps, the Appalachian Mountains and the Allegheny Plateau. Why did the colonial people consider these natural features barriers to settling the interior of the country?



Mechanized farming meant more land could be planted by farmers, and hence increased the demand for water.

Doing laundry in colonial days was hard work. Women used rocks and sticks to try to clean their clothing.

Estuaries were good sites for colonial settlements because they provided fresh water, ample food and land and good drainage.

LAUNDRY DAY

Background Information: In virtually every society, division of labor has been essential for survival, and labor was usually divided according to gender. In the culture of the colonies, for example, the men did the field work and hunting, while the women did the domestic work, including the laundry.

1. Have your students read this brief article.

2. Discuss how washing has changed since colonial times.

3. **Activity—Washing Clothes Like the Settlers.** For this activity you will need some rags made from light-colored cloth, such as a white sheet. You will also need some stones, some basins of water and detergent.

- a. Rub the rags in dirt so they are all equally soiled.
- b. Take one rag home with you and wash it in your washer. That rag will become your "control" to see how clean they can possibly get the rag.
- c. Divide the class into small groups (of 2 or 3 students each) and give each student a rag to get clean. Each group should have access to a basin of clean water, detergent and some rocks.
- d. Have each group get their rag as clean as possible in 5 or 10 minutes.

4. Math Activity—Conservation.

Complete the worksheet on page 31 of this guide with your students to learn more about water conservation.

Answer key

- a. *The flow rate of the shower is 60 seconds per minute ÷ 10 seconds = 6 x 1 gallon or six gallons per minute (gpm).*
- b. *10 minute shower: 6 x 10 = 60 gallons
5 minute shower: 6 x 5 = 30 gallons*
- c. *60 gallons - 30 gallons = 30 gallons saved each shower.*
- d. *60 gallons per day x 365 = 21,900 gallons used per year for 10-minute shower.
30 gallons per day x 365 = 10,950 gallons used per year for 5-minute shower.
21,900 - 10,950 = 10,950 gallons saved each year.*
- e. *10 minute shower = 60 gallons.
60 gallons 3 gal./bucket = 20 buckets.*

Try measuring the flow rate of your own shower at home using the same method José used. How much time do you spend in each shower? Bring your answers to class with you tomorrow.

- e. Compare which group's rag got cleanest, and compare the rags with the rag you washed in your washer.
- f. Discuss how our lives have changed with mechanization and electricity.

ROADS, FERRIES AND BRIDGES

Background Information: Early roads connected farms and towns with rivers or the coast rather than with one another. Most of the hauling of goods was by flat-boats or rafts down the river. Most goods were traded downstream only, and the rafts that carried the goods were often sold as firewood.

Later, trails that ran along rivers were widened to accommodate wagon traffic. Still, many inland villages remained unconnected to one another by roads. Although a farm may have been close to a village by the way the crow flies, it could take many hours over a circuitous route to get from one place to the other. This pattern of travel explains the old New England tradition of giving directions to strangers, "Well, you can't get there from here."

Bridges that spanned wide rivers, supporting their own weight (and more) without any support from below, required quite advanced engineering. See if your

students can do better than the early colonists.

1. Introduce new vocabulary: **ferry, ford, trusses.**
2. Have your students read this brief article.
3. **Activity—Make a Bridge.**

Materials needed:

- 15-30 Popsicle™ sticks per group of students (more sticks may result in sturdier bridge)
- one container of white glue per group
- weights, such as stacking plastic containers filled with water

Directions:

- a. Check out several picture books from your library on bridges.
- b. Divide your class into groups of three or four students each.
- c. Have each group study the bridge pictures, and ask them to pay particular attention to the trusses and supports.
- d. Have each group draw a simple bridge design that they think would be structurally secure (or hold a lot of weight).
- e. Give each group an equal number of Popsicle sticks plus white glue, and give them two days to build their bridges. (They will need two days so the glue has ample time to set.) Tell them they may use only the number of Popsicle sticks provided, but no more than that.

Each bridge must be at least:

- one Popsicle stick high
- two Popsicle sticks long (without a center support)
- wide enough for a toy car (1.5" or so) to cross

Test the weight bearing capacity of each bridge by placing weights on them until they break. (Small, stacking plastic containers filled with sand or water make good weights. You may need a lot of them!) Which team's bridge carried the most weight? Why did some designs work better than others?

4. **Activity—Art.** Give your students one week to observe and sketch the various bridges they find in their area, and have a class discussion on the different designs they find.
5. **Activity—Careers.** Invite a civil engineer to speak to your class and discuss his/her career and talk about building roads and bridges.

THE WATER WHEEL

1. Introduce new vocabulary: **mill pond, mill race.**
2. Have your students read this brief article and ask the class if anyone has ever seen a water wheel.
3. Check out some books in the library that show various types of water wheels, and examine the work they did. Make particular note of those water wheels powered by rushing water and those powered by a mill race. Ask your students to think about the difference in the two. (*Wheels powered by moving water could only be built by fast moving streams and rivers. Wheels powered by mill races could be built almost anywhere there was water and a slight grade. They might have turned more slowly, but the speed could be changed by using gears.*)

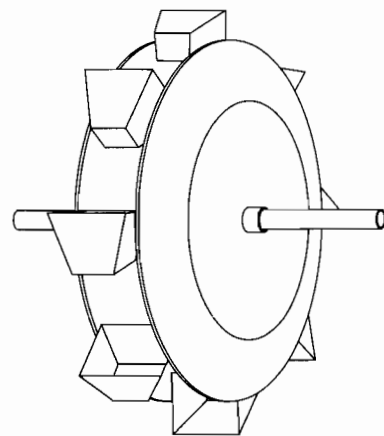
4. Activity—Building a Water Wheel. Materials needed:

Copy page 30 of this guide.

- Eight 1¼ oz paper soufflé cups (8 per water wheel)
- Styrofoam plates (2 per water wheel)
- two straws of different diameters (one should slide freely inside the other)
- scissors for cutting the straws
- stapler
- water
- straight edge and sharpened pencil
- water pitcher (approximately 1 liter)
- a basin for catching the water

Directions:

- a. Staple eight cups between two styrofoam plates. They should all point in the same direction. The cup at either 3:00 or 9:00 should face upside down, while the one at the opposite side of the circle should face right side up. Cups should be placed roughly equidistant around the plates (45° apart).
- b. Draw two lines across the diameter of a plate to find the center point of the circle and poke a hole through the plates with the sharpened pencil.
- c. Cut the straw with the larger diameter to a length of about 3", and leave the other straw full length.
- d. Slide the short straw through the hole in the styrofoam plates, then slide the long straw through the short straw. (The



short straw is a bushing, allowing the wheel to turn freely on the long straw.)

e. Have one student hold the long straw so the water wheel can spin freely. Hold the wheel over the catch basin so the water won't spill.

f. Have a second student pour water slowly into the cups so the water wheel turns. Explain to the students that the pitcher represents the trough that delivers water to a water wheel.

g. Discuss how this water wheel works (*Water fills the cups, which adds weight to one side to make the wheel spin. As it turns, the water constantly fills the cups at the side and spills from the cups at the bottom, so as long as water flows, the wheel continues to turn. The power of the wheel will depend on the size of the cups [the weight of the water], not the velocity of the water.*) In a mill, the power of the water wheel turned gears, which in turn, did some sort of work such as grinding grain or sawing lumber.

A COLONIAL SING ALONG

Background Information: Your students may already be familiar with many songs from this period—such as “Yankee Doodle,” “Froggie Went a Courtin,” and “The Riddle Song.” There are many books on songs of this period, and your students may enjoy singing them.

1. Have your students read the article, including the section on instruments.
2. Sing “Yankee Doodle” as a class. The music is on page 29. Discuss rhyme and meter with the students.
3. **Activity—Music.** Divide the class into cooperative learning groups and have each group make up a song about water to the tune of “Yankee Doodle.” Make certain they understand rhyming, timing and amounts of syllables needed.

4. **Activity—Music.** Allow your students to build instruments (either the ones described or instruments of their own design), and have them accompany themselves as they perform their song to the class. Allow enough time for your students to practice.

5. You may want to videotape the class performance.

FIRE!

Background Information: In Bethlehem, PA, as in Boston, Philadelphia and other cities with early public water supplies, the driving force behind developing the public supply was fire fighting, not drinking water. Even in cities, most people had wells either in their houses or in their yards. Bethlehem had the first public water supply in 1754. By 1795, Boston had followed in the footsteps of Bethlehem. The Jamaica Pond Aqueduct Company had built a water supply system, the main purpose of which was fire fighting. The water was transported to the homes of the area through wooden mains. Whenever a fire broke out, the firefighters used a special tool to bore a hole directly into the wooden main so there was a water supply right at the site of the fire. Once the fire was out, the firefighters capped the hole with a special stopper called a “fire plug,” and the name has stuck!

1. Introduce new vocabulary: **bucket brigade.**

2. Have your students read the short article.

3. Have your students discuss the difficulties of fighting fires in colonial America.

4. **Activity—A Classroom Bucket Brigade.** This activity allows you to recreate and illustrate the difficulties of fighting fires before water distribution systems and high-pressure pumping.

Materials needed:

- one sponge per student
- 4 water basins: two filled with equal amounts of water and two empty

Directions:

- a. Divide your class in half.
- b. Instead of buckets of water, you will transfer the water in sponges, so you will need one sponge per person. (If you buy them, make them all the same size. If you have students bring them in, make sure the sponges of each team have roughly equal holding capacity.)
- c. Have each group of students line up between the full water basin and the empty water basin. The object of the

race will be to transfer as much water as possible in exactly one minute (or whatever length of time you want). Pile up all the sponges next to the basin full of water. The students next to the full bucket of water should dip a sponge into the bucket, let it soak up water, wring out enough so that the sponge doesn't drip but still holds water, and pass the sponge to the next student, who passes it down the line. The first student repeats this procedure with all the sponges. When a sponge reaches the last student (next to the empty basin), that student wrings out the sponge into the basin.

- d. At the end of the race, the winner is the group that got the most water into the empty basin.
- e. Use the water in the basin to water plants and trees around your school.
- f. Discuss the problems inherent in fighting fires by bucket brigade, such as waste, spillage and speed.

5. **Activity—Research.** Have a student call the fire department in your city or town and learn about the fire water delivery system. Is it different from the drinking water supply? How much water pressure does it operate under? What sorts of problems have they encountered in the past? How do they fight fires during periods of severe drought? After conducting this research, have the student present his or her findings to the rest of the class.

THE FIRST PUBLIC UTILITY

Background Information: Until the late 18th century, almost all Americans had to draw water from a well or river and carry it to their homes. In the late 1700s, however, waterworks started coming into common usage. In its simplest form, a waterworks pumps water to a high point (such as a water tower or water tank above the town), and then gravity feeds the water to the homes. For the system to work, the town must have a complicated water supply system of mains and feed lines.

1. Have your students read this article and ask if they can name their water utility (or water agency).
2. Why did the people of Bethlehem think it was necessary to build a water utility? (*It was too difficult to carry water from the spring to the town because water had to be carried a long way uphill.*)
3. How do you think your water utility differs from the water utility in colonial

Bethlehem? (You might want to ask your local water utility to come speak to your class about the city's water distribution system.)

4. **Activity—Building a Water Delivery System.** The town of Bethlehem made a water supply system that fed water to holding tanks or cisterns in all parts of town, and eventually supplied water to every building through underground pipes. In this activity, your students can design and build a small community's waterworks using poster paper and different sizes of pasta.

Materials needed:

- poster paper and markers
- several packages of different types of pasta, such as ziti, macaroni, spaghetti, manicotti shells (for cisterns)

Directions:

a. Divide your class into groups of three or four students each and give each group a piece of poster paper and a marker.

b. Have them draw a town that includes homes, community buildings, stores, and a water supply that is close to (but not in) the community. They may include cisterns (storage tanks) to provide water to different sections of town.

c. Using the different types of pasta, have the students design a simple water delivery system that can move water from the supply to all of the users.

d. Once the students have built a simple system, ask them to try to design a system that takes supply reliability into account: How can they prevent houses from losing water if a water main breaks someplace “upstream” from them? (They will have to create loop systems and ways to isolate small sections.)

EARLY AMERICAN WATER POLLUTION

Background Information: The Europeans were aghast at the rate at which the colonialists used wood, both at the sawmills and in home fireplaces. Timber resources in Colonial America were so plentiful that minimizing waste must have seemed completely irrelevant. Getting rid of the sawdust waste must also have seemed trivial: just throw it into the swamps, marshes and streams. This habit reflected the general attitude towards natural resources: they could be used for human's needs and did not need to be conserved or protected. Farmers did not rotate crops or let fields lie fallow; loggers did not