The Water Detective!
Teacher's Guide

A Fun-Filled Water Curriculum for Elementary School Kids

New Mexico Office of the State Engineer

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Acknowledgements

Funding

New Mexico Office of the State Engineer

Albuquerque Bernalillo County Water Utility Authority

City of Rio Rancho

City of Las Cruces

City of Santa Fe Water Division

New Mexico State University:
Rio Grande Basin Intitiative/USDA/CSREES agreement #2001-45049-01149

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Design and Layout: Ken Wilson Design and Schultz Communications
Illustrations: Ken Wilson

Special thanks to all New Mexico Office of the State Engineer and Interstate Stream Commission employees who assisted with the Spanish translations of the Student Booklet, including Buck Wells, Joseph Montoya, Angie Rodriguez, Erma Romero and Estevan Lopez.

An additional thanks to New Mexico Office of the State Engineer employee Myron Armijo, Santa Ana Pueblo, for his assistance with cultural issues.

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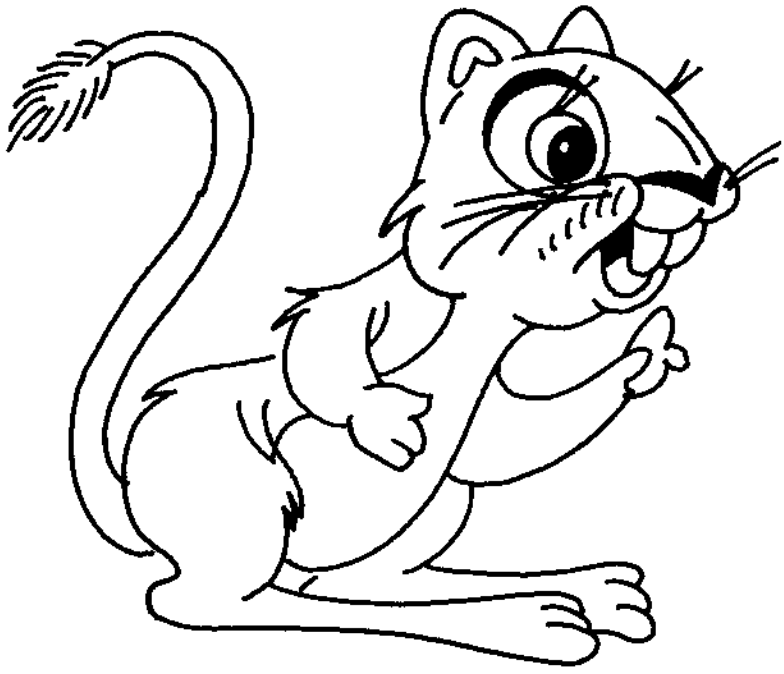


INTRODUCTION

How To Use This Guide

Welcome to ***Rio! The Water Detective.*** This curriculum is designed for students in elementary grades. Each activity or section can be modified to meet the needs and learning levels of a given classroom. In most cases suggestions for modifications or extensions are provided.

The curriculum contains two components: a **student booklet** and a **teacher's guide**. Students are encouraged to keep their student booklets and share them with their families. Student booklets are available in class sets, and they can also be re-ordered. The teacher's guide assists the teacher with the students' flow of learning, from awareness to understanding to affecting change. Each stage of learning has been given a chapter in the guide:

- **Chapter 1: Where's The Water?**
  This chapter focuses on awareness of water issues. It introduces the students to global water distribution, New Mexico's water sources and uses, and cultural issues surrounding water in New Mexico.

- **Chapter 2: Who Uses Water?**
  Moving from awareness to understanding is the second step to implementing change. This chapter focuses on understanding how people and nature use water. It covers individual actions and involves families in the learning process.

- **Chapter 3: Affecting Understanding and Change**
  The goal of this curriculum is to develop a fundamental understanding of water issues in New Mexico and to guide students to responsibly use water. In this chapter, students will recognize that their actions impact their water supply and that true water savings must include family and community.

Each chapter contains several components. The components vary in the order in which they are presented.

- ***Background Material***—provides additional information for the teacher on the concepts that are being introduced to the students.
- ***Demonstration/Visualization***—a demonstration activity or visual (i.e. map) that is led by the teacher to facilitate understanding by the students.
- ***Student Booklet Activity***—objective, materials, vocabulary and procedures for conducting an activity presented in the student booklet.
- ***Activity***—objective, materials, vocabulary and procedures for activities that complement concepts introduced in the student booklet. These activities can be used to introduce or extend the learning presented in the student booklet.
- ***Additional Activities***—a list of ideas or modifications that the teacher could develop—for those who are inspired to continue exploration of a specific area or need a modification for their classroom.

Appendices have been provided for additional information.

- **Appendix A: Glossary**—definitions, at an elementary grade level, for vocabulary words introduced in this curriculum
- **Appendix B: Spanish Translations**—Spanish equivalents of the vocabulary words, plus some additional words or phrases
- **Appendix C: Charts and Graphs**— charts and graphs that assist the teacher in demonstrating newly introduced concepts
- **Appendix D: Resources**—additional sources of information, curriculum, children's literature and websites that complement information presented in the curriculum
- **Appendix E: Aquifer Diagram**
- **Appendix F: Correlation to State of New Mexico Public Education Department Content Standards, Benchmarks and Performance Standards ***—
  (Part 1 is correlated by activity, Part 2 is correlated by content standard)

* Standards used are:
- Language Arts (Adopted on June 16, 2000)
- Mathematics (Content Standards adopted on August 1996; Performance Standards adopted November 1998)
- Science (Adopted August 28, 2003)
- Social Studies (Adopted June 22, 2001)

Introducing "Rio!," Your Tour Guide

"Rio!" the Kangaroo Rat will guide students through the curriculum. Rio will appear in the student guide whenever students are asked to complete an activity. He will reveal a little about how he utilizes water and ask the students to discover what water means to them.

The kangaroo rat is one of nature's natural water conservers. It is native to the desert Southwest and very well adapted to the desert environment. A kangaroo rat has a unique ability to convert dry seeds into water through the digestive process by producing tiny amounts of water when the food inside its system combines with the oxygen that it breathes.[1] In addition, its specialized kidneys allow disposal of waste with very little output of water, and it neither sweats nor pants to keep cool. Pouches on either side of its mouth are used to transport seeds to its burrow. Unlike a hamster, the pouches are not inside its mouth. Instead, the pouches are on the outside of its cheeks, allowing the kangaroo rat to put seeds in them without opening its mouth and losing water from its breath.[2]

Besides the special adaptations that nature has given the kangaroo rat, it has developed habits that help to conserve water. For example, it spends most of the day in underground burrows where the air is moist and humid. It comes out at night when it is cool and there is minimal evaporation. (Additional kangaroo rat resources are listed in Appendix D.)

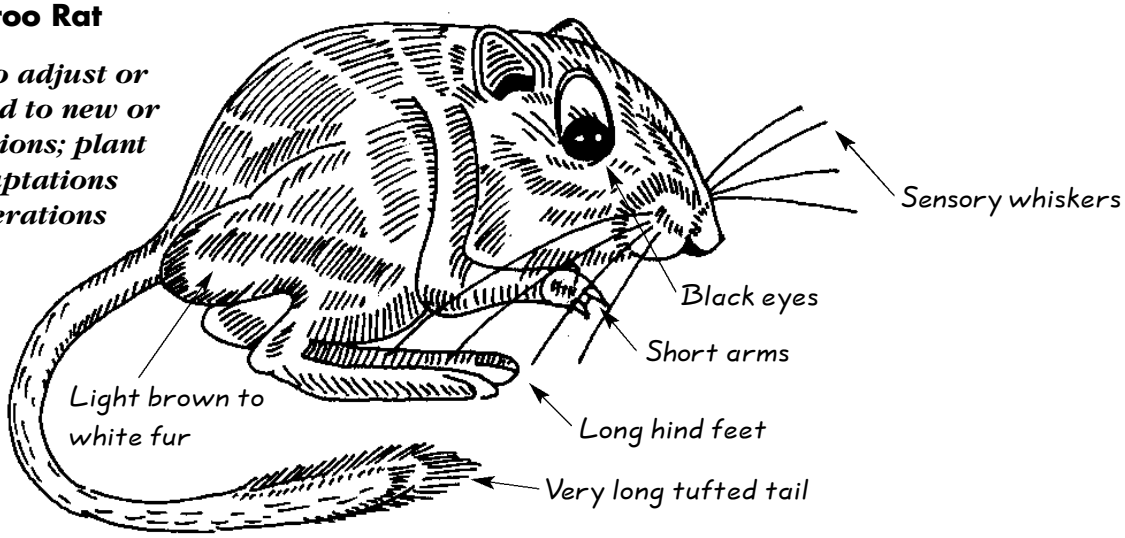
Pre-Assessment Activities

The following activities can be used as a pre-assessment for the entire curriculum. Use one or more of the following prior to beginning the curriculum, then repeat the activity at the end to assess the change in knowledge.

- Make an adaptations book (or use My Water Journal, see next page). Find three plants and three animals that are adapted to New Mexico's desert environment. Draw or paste pictures of these organisms in a notebook, one to a page. Next to each picture list the organism's adaptations.
- Ask students to find other animals or plants that conserve water. Some examples include camels, cacti, hibernating animals (brown bear, ground squirrel) and lizards.
- Have students create their own fictional animal that conserves water. What characteristics and habitats might it include?
  - ✔ Waxy skin to prevent evaporation
  - ✔ A storage hump for water
  - ✔ Sleep during the day and come out at night
- Observe the differences between an agave plant (a low-water-use plant) and a fern (a high-water-use plant). Pass the two plants around in the classroom. Let the students make both visual and physical contact. Make a list of the characteristics of each plant. Have them guess which one uses more water. Introduce the word "adaptations." Have the students make the connection to adaptations and native plants.

Kangaroo Rat

Adaptations—to adjust or become adjusted to new or different conditions; plant and animal adaptations occur over generations of survival of the fittest.



[1] http://www.stoller-eser.com/rat.htm
[2] http://www.stoller-eser.com/rat.htm

Activity: My Water Journal

Objective:
Students will express what they learn or what they feel through writing and drawing in their journal.

Materials:
"My Water Journal" (page 8 in teacher's guide)
blue stock or construction paper
white copy paper
scissors
crayons or markers
yarn, string or ribbon (option: stapler)

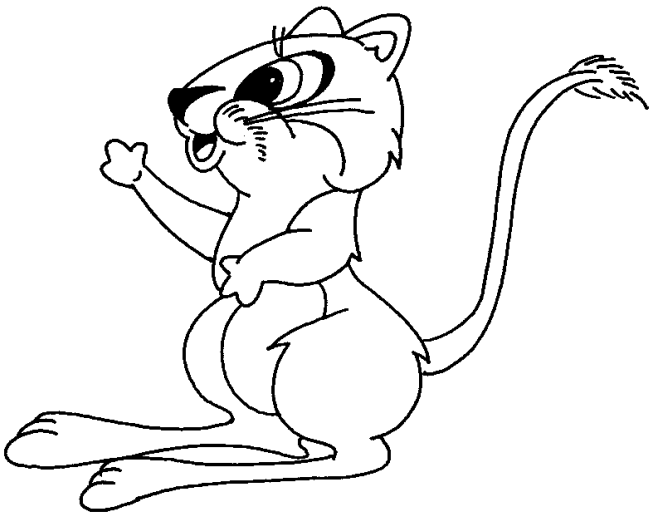
Vocabulary:
journal

Introduction:
Throughout the unit students can keep a journal of their daily actions and feelings involving water. They can include poems and songs, drawings, new words, pictures from magazines, etc.

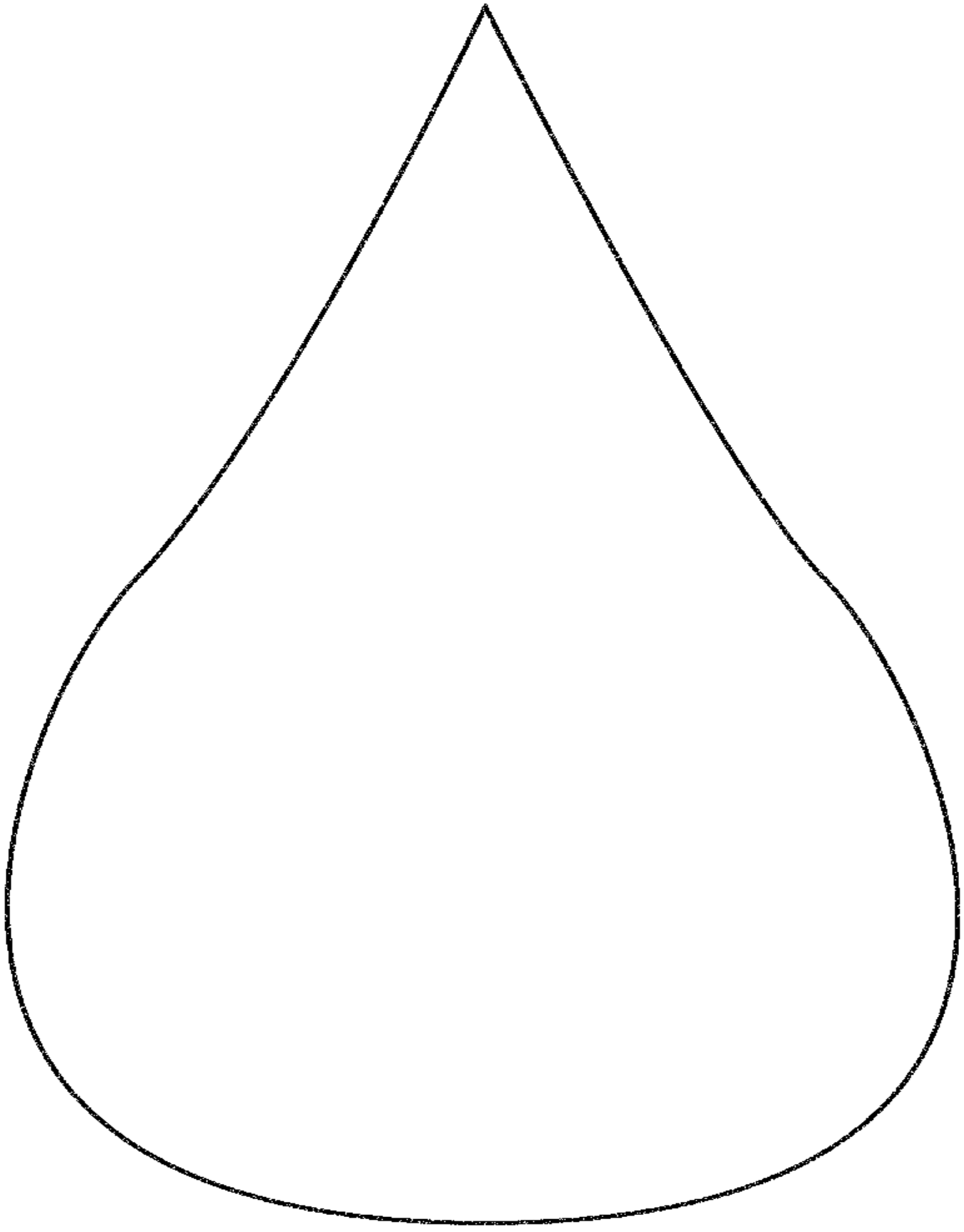
Procedure:
1. Make enough copies of the My Water Journal student page from the teacher's guide on white paper for each student to have five to 10 pages.
2. Make separate copies on blue cover stock or construction paper, enough for each student to have two pages.
3. The students should cut out the raindrop outlined on the Student Page and place the regular copies in between the two pages of construction paper that have also been cut. Students may write their names on the front cover and decorate them.
4. Place two or three small holes on the left side of each page so that the students can use yarn, string, or ribbon to tie the pieces together into a journal.
   - Options: For a more stable journal, use the whole page instead of cutting out the drop and staple pages together instead of binding with string.
   - Option to Journal: Place a large piece of paper in the shape of a water drop or with a water drop drawn onto it on the wall. Allow students to draw their water images here.

Examples for Journal:
1. Ask students to make up a rhyme about the water cycle:
   Surface water is what you see,
   Snow and rain fill lakes and seas.
   Aquifers are deep in the ground,
   Hidden from the sun with earth all around.
2. Have students list or repeat a song that they have heard that references water. For example:
   - America the Beautiful—"from sea to shining sea"
   - The Ants Go Marching—"And they all go marching down to the ground to get out of the rain, BOOM! BOOM! BOOM!"
   - The Itsy Bitsy Spider—"The itsy bitsy spider, Crawled up the water spout, Down came the rain, And washed the spider out, Out came the sun, And dried up all the rain, And the itsy bitsy spider, Crawled up the spout again."
3. Ask students to write out the new water vocabulary in both English and Spanish. For example: River = Rio.

Resources for Teaching Poetry:
1. Scholastic Teacher website: Kid's Poems—A renowned language arts teacher shares the joy of teaching young children to write—and love poetry
   www.teacher.scholastic.com/professional/teachwriting/kids_poems.htm
2. The Poetry Zone—The Teaching Zone (includes a good list of children's poetry books.)
   www.poetryzone.ndirect.co.uk/teacher.htm



(Source: The Water Sourcebook, K-2, EPA)



CHAPTER 1

Where's The Water?

Section 1: Global Awareness

Background Material

If we look at a globe or a map of the world, we will notice mostly blue. The surface of the earth is approximately 70-75% water. Most of that water is in the oceans. (For students who have never seen an ocean, a listing of ocean videos has been provided in the Resource section, Appendix D.)

The distribution and availability of the earth's water is a little surprising. Approximately 97% of the earth's water is salt water; less than 3% of the earth's water is considered fresh water. Fresh water is broken down even further: over 2% is frozen water, and the remaining less than 1% accounts for all ground water, lakes, rivers, atmospheric and soil moisture.

The following table can be found on the U.S. Geological Survey website http://ga.water.usgs.gov/edu/earthwherewater.html:

Water source	Water volume, in cubic miles	Percent of total water
Oceans	317,000,000	97.24%
Icecaps, Glaciers	7,000,000	2.14%
Ground water*	2,000,000	0.61%
Fresh-water lakes	30,000	0.009%
Inland seas	25,000	0.008%
Soil moisture	16,000	0.005%
Atmosphere	3,100	0.001%
Rivers	300	0.0001%
Total water volume	**326,000,000**	**100**

**both saline and fresh water*

Demonstration/Visualization: Globe Toss

- Ask the students if the earth's surface has more land or more water.
- Toss an inflatable globe around the room (globes also comes as balls and soft stuffed toys).
- Each time the students catch the globe, record how many of their fingers are on land and how many are on water.
- Make a chart on the board that shows the land "hits" and the water "hits."
- Seven out of 10 fingers will usually land on water, which confirms that 70% of the earth's surface is water.

Demonstration/Visualization: Earth's Water

- Place 1,000 milliliters of water into a clear glass or plastic container. This represents all of the water on the planet.
- Pour 30 milliliters into a smaller glass, drop blue food coloring into the remaining 970 milliliters. The blue water is salt water, 97% of the earth's water. The 30 milliliters, 3%, represents all freshwater.
- Pour 9 milliliters out of the 30 milliliters into an even smaller glass.
- Place yellow food coloring in the 21 milliliters – this is fresh water that is frozen in glaciers, 2.1%.
- The remaining 9 milliliters represents all the non-frozen fresh water, 0.9%.
- Take one drop out of the 9 milliliters with an eyedropper. The remaining water represents unavailable fresh water (such as water in plants, soils, atmosphere, people, polluted water and saline ground water).
- The one drop in the eyedropper represents the available freshwater in rivers and lakes. Out of the original 1,000 milliliters, just a tiny amount (0.00003%) of water is available for human consumption.

(Adapted from Drop in the Bucket, Project WET)

ACTIVITY: PLAY MONEY

Objective:
The students will be able to relate to how much of the planet's water is available for consumption.

Materials:
play money: $100, $10 and $1 bills
plus assorted change (see sheet next page)

Vocabulary:
ocean
glacier
fresh water

Introduction:
After completing the Globe Toss or Earth's Water demonstrations, ask the following questions: Can the students tell you how much of the world's water is salt water? How much is frozen water? How much is available fresh water? What do these numbers mean to your students?

Procedure:
1. Using play money, place a pile of various bills and the miscellaneous change where all of the students can see.
2. Make two piles – the first pile contains only the $100 bill, the second pile contains miscellaneous bills and change that add up to $100. Make sure the students understand that the two piles contain the same amount of money.
3. Hold up the $100 and explain that it represents all the water on the planet.
4. If $100 is all the water on the planet, have the students guess which of the bills or change represent fresh water that is available for human consumption. Have them pick from the second pile.
5. Only ninety cents ($0.90) out of the $100 represents the fresh water. This is 0.9%.
6. Less than one penny (0.00003) is available for human consumption (potable freshwater). The remaining eighty-nine cents ($0.89) is unavailable. It is in plants, animals, people, atmosphere, is too far underground or too saline (salty), or has been polluted.
7. Draw posters or allow the students to color a handmade $100 bill to remind them of what they have learned.
8. To represent the remaining categories, $97 is salt water, $2.10 is frozen fresh water (glaciers).

Additional Activities
- Use 1,000 pieces of whatever is available: counting chips, toothpicks, etc. Make piles representing salt water, frozen water and fresh water.
- Make it kinesthetic by using the students in the classroom. The majority of the students will be the ocean, one person might represent glaciers, and only one toe or finger of the last person will represent fresh water.
- Use the following rhyme to help students remember where water can be found:

  Surface water is what you see,
  Snow and rain fills lakes and seas.
  Aquifers are deep in the ground,
  Hidden from the sun with earth all around.

Copy and cut out the play money on the next page for this activity.

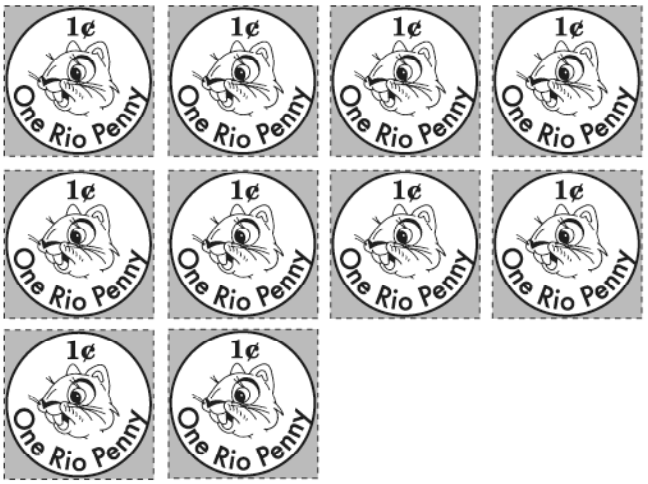

1
1
ONE
1
1
ONE RIO DOLLAR

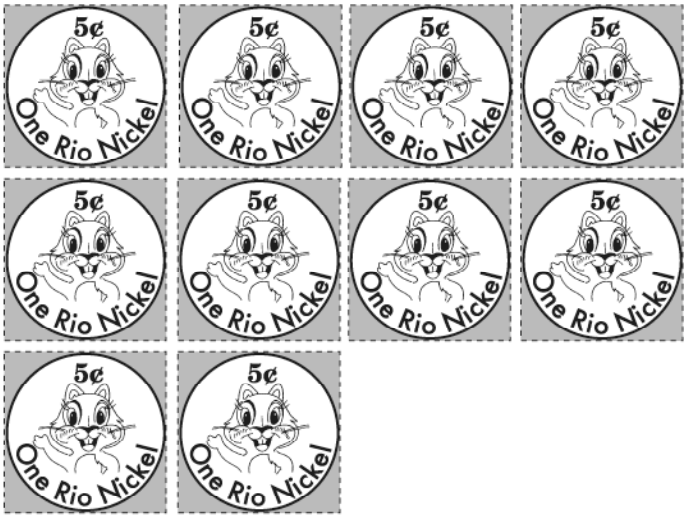

1
1
ONE
1
1
ONE RIO DOLLAR

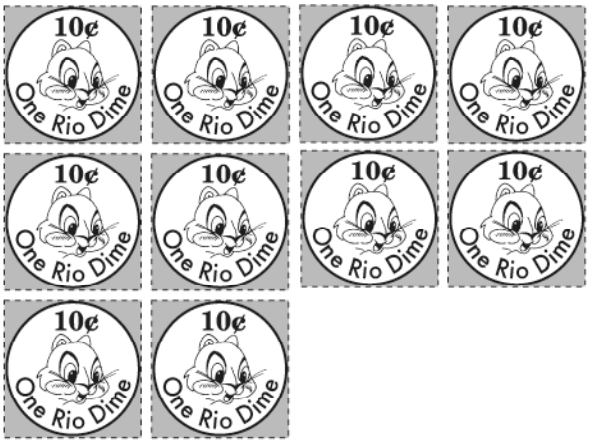

5
5
FIVE
5
5
FIVE RIO DOLLARS


10
10
TEN
10
10
TEN RIO DOLLARS


100
100
ONE
HUNDRED
100
100
ONE HUNDRED RIO DOLLARS


1¢
One Rio Penny


5¢
One Rio Nickel


10¢
One Rio Dime


25¢
One Rio Quarter

Section 2: New Mexico Awareness

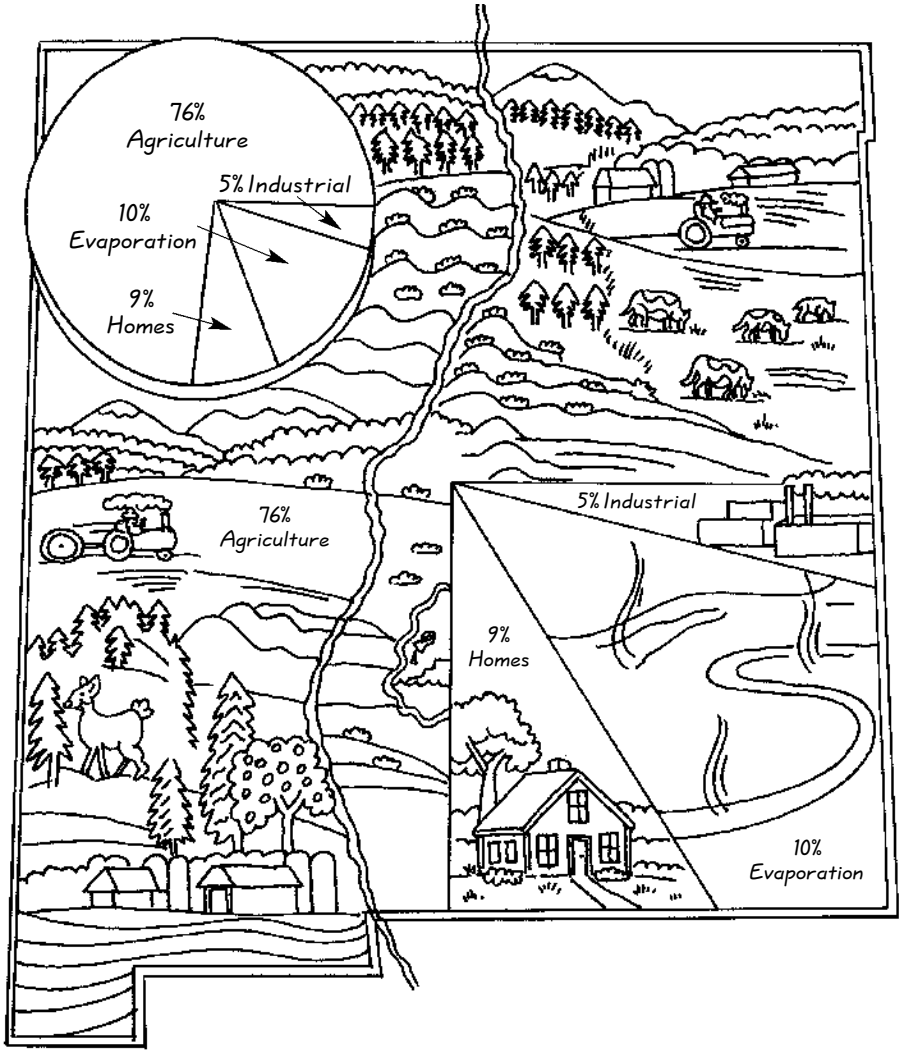
Background Material

New Mexico uses water is a variety of ways. The major categories of New Mexico's water use, in descending order, are: agricultural, evaporation, residential and commercial.

Agriculture is the largest consumer of water in the state, accounting for 76% of all water use. Agriculture is enormously important to New Mexico because it reflects the state's historical traditions and it is a $2 billion industry that employs, directly or indirectly, 100,000 people (based on 2002 statistics). New Mexico's agricultural water users range from small family-owned farms to large commercial ranches. Some of New Mexico's homegrown products include beef, chile, corn, milk, pecans, apples, lamb, sorghum, wheat and wool.

NOTE: For a complete list of the state's agricultural production, additional statistics, and student activity worksheets, go to the New Mexico Department of Agriculture's website at http://nmdaweb.nmsu.edu/. This website may help generate questions such as, "Did you know that Bernalillo County had 468 farms in 1997, while Los Alamos County had only four?" Video recommendations on agriculture are in Appendix D.

How Does New Mexico Use Its Water?



Many people are surprised to learn that evaporation accounts for a significant percentage of New Mexico's water consumption. This is due to a combination of the state's arid climates and the way in which the state stores its water supply. Annual precipitation (rainfall and melted snow), which is critical to New Mexico's water supply, is stored in above-ground reservoirs such as Elephant Butte Lake and Cochiti Lake. Unfortunately, the combination of sun and exposed water results in high evaporation rates. A full 10% of the state's water is lost to evaporation. (Look in Appendix B for rainfall amounts in New Mexican towns.)

Only 9% of New Mexico's water is used for residential purposes by municipalities, rural water suppliers and private wells. However, this percentage is expected to increase in the future. Many parts of New Mexico are experiencing rapid population growth, and in some areas this growth means homes are being built on what recently was farmland. In 2004, the population of New Mexico reached 1.9 million people — an increase of 20% from 1990.[3]

The remaining 5% of the state's water is used for mining, power, and other commercial purposes.

Surface Water

Even with reservoirs, New Mexico ranks last in the nation for the percentage of the state that is surface water, only 0.2% (USGS). Use the chart "Percentage Surface Water by State" in Appendix C to compare New Mexico to other states in the nation. Who has the largest percentage of surface water? Where do our neighboring states rank (Arizona, Colorado, Utah, Texas)? The national percentage is just 2.2%.[4]

Demonstration/Visualization: Evaporation

- On a sunny day, take the students outside with a bucket of water.
- Ask them what would happen if they placed a water handprint on the sidewalk or playground. If they guess that it will disappear/evaporate, ask them how long they think it will take.
- Have the students put their hands in the water and then place them on a flat surface such as a sidewalk or play ground, leaving a water handprint.
- Time how long it takes for the water handprint to evaporate. Try various surfaces (picnic benches, soil, concrete, etc.). Compare the evaporation rate of a water handprint when it is exposed to sun vs. shade.
- Use any remaining water to water the plants.

Or

- Place a beaker of water in a sunny location. Mark the original level of the water.
- Take readings of the water level over a couple of weeks to track evaporation.

Demonstration/Visualization: Map of New Mexico

- Show students the enclosed map of New Mexico, which is located on page 16.
- Point out the features that the students will recognize (cities, mountains, rivers, highways).
- Make a special point of showing the location of surface water and the approximate location of your school.

[3]The World Gazetteer, www.world-gazetteer.com
[4]USGS Water Science for Schools, www.ga.water.usgs.gov/edu/wetstates.html

STUDENT BOOKLET ACTIVITY: HOW DOES NEW MEXICO USE ITS WATER?

Objective:
Students will be able to identify how New Mexico uses its water. Students will recognize agriculture as the largest water user in the state.

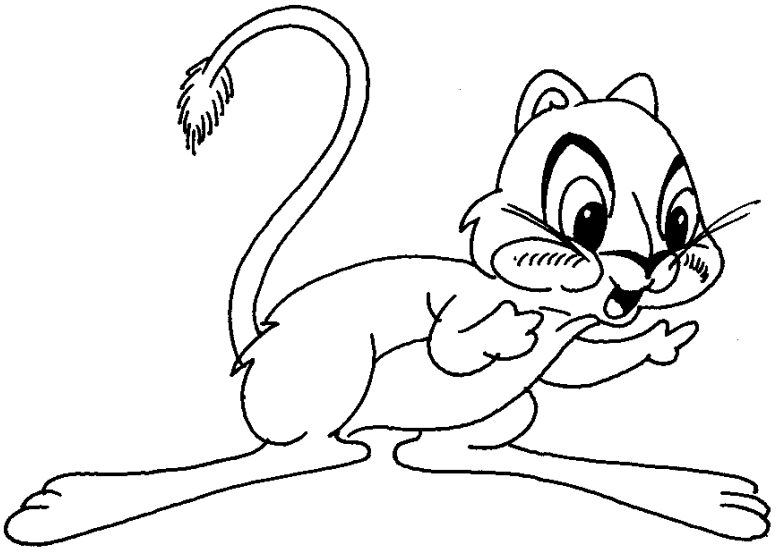
Materials:
"How Does New Mexico Use Water?" (page 2 of student booklet)

Vocabulary:
agriculture
residential
industry
evaporation

Introduction:
Agriculture accounts for 76% of New Mexico's water use. Find out how many students in the room have ties to agriculture. Whose relatives own or work on a farm—or used to own or work on a farm? Are their farms in your community? What do they grow or raise? It is likely that, even if there is no personal farm or ranch connection in the room, the students will have gone to a local farmers market, bought New Mexico-grown products, or visited the State Fair to see the produce and animals.

The remaining water use is divided as follows: evaporation at 10%; public water supply and private wells at 9%; and mining, power, and industrial uses at 5%.[5]

Procedures:
1. Identify the uses of water in New Mexico and their percentages utilizing the pictures in the student booklet.
2. Make sure the students recognize both the pie chart and the outline of New Mexico as a pie chart. Can they make pie charts in different shapes?
3. Have the students identify agriculture as the largest user of water in New Mexico.
4. See if students can list some of the products grown in New Mexico. (A partial list includes beef, chile, corn, milk, pecans, apples, lamb, sorghum, wheat, and wool. For a complete list, go to the New Mexico Department of Agriculture website at www.nmdaweb.nmsu.edu/stat.html.)
5. Help students recognize residential as "water used at home."
6. List some of the residential water uses (e.g., bathing, cooking, washing clothes, watering lawns and gardens, flushing toilets, etc.).



[5]Wilson, et al, Water Use By Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 2000. February 2003

ACTIVITY: WHERE IS NEW MEXICO'S WATER?

Objective:
Students will be able to locate the major rivers and surface water in New Mexico.

Materials:
"New Mexico Mountains and Rivers" Map (page 16 in teacher guide)
"Puzzle Map" (page 17 in teacher guide)
crayons
glue
cardboard or stiff paper

Vocabulary:
surface water
ground water
agriculture
livestock
residential
compass

Introduction:
Surface water (water sitting on the earth's surface, e.g., rivers and lakes) is scarce in New Mexico. (Refer to chart in Appendix C "Percentage of Surface Water by State.") There are only five main rivers (Rio Grande, Pecos, Canadian, San Juan and Gila) and four smaller rivers (Chaco, Chama, Rio Puerco and San Francisco). The Rio Grande is the state's main river and the third longest river in the United States. It starts in Colorado and crosses the entire state of New Mexico from north to south, runs into Texas and dumps into the Gulf of Mexico.

Show students the map of New Mexico. Point out the five main rivers. What else can they locate on the map? (cities, mountain ranges)

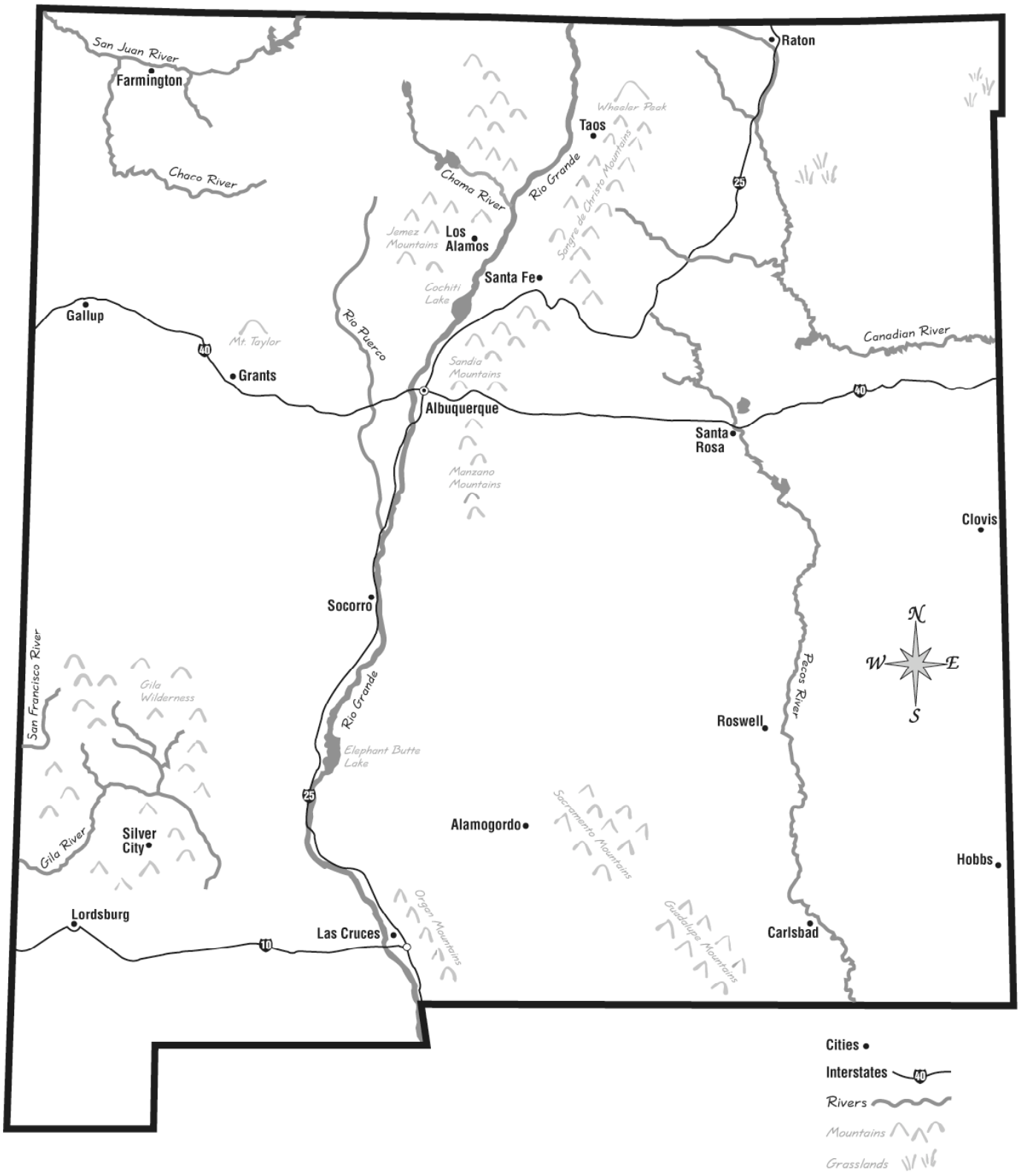
Do the students know what surface water is closest to their home? Can they find the location of their home city or town on a map of the state?

Procedure:
Part 1:
1. Make enough copies of the Puzzle Map of New Mexico for each student or student group.
2. Either precut the pieces or allow the groups to cut out their own puzzle pieces.
3. Have the students put the puzzle back together. Discuss "north," "south," "east" and "west," e.g., "Albuquerque is west of the Sandia Mountains."
4. Paste the completed map onto cardboard or stiff paper.
5. Students can then color their maps. Have them find all the surface water and color it blue. This includes rivers and lakes that will be easy to recognize on the map.
6. Have them locate their home towns on the map. Put a star on the map to represent their city or town. How close is it to a surface water supply?
7. Is the student's home north, south, east or west of the closest body of water?

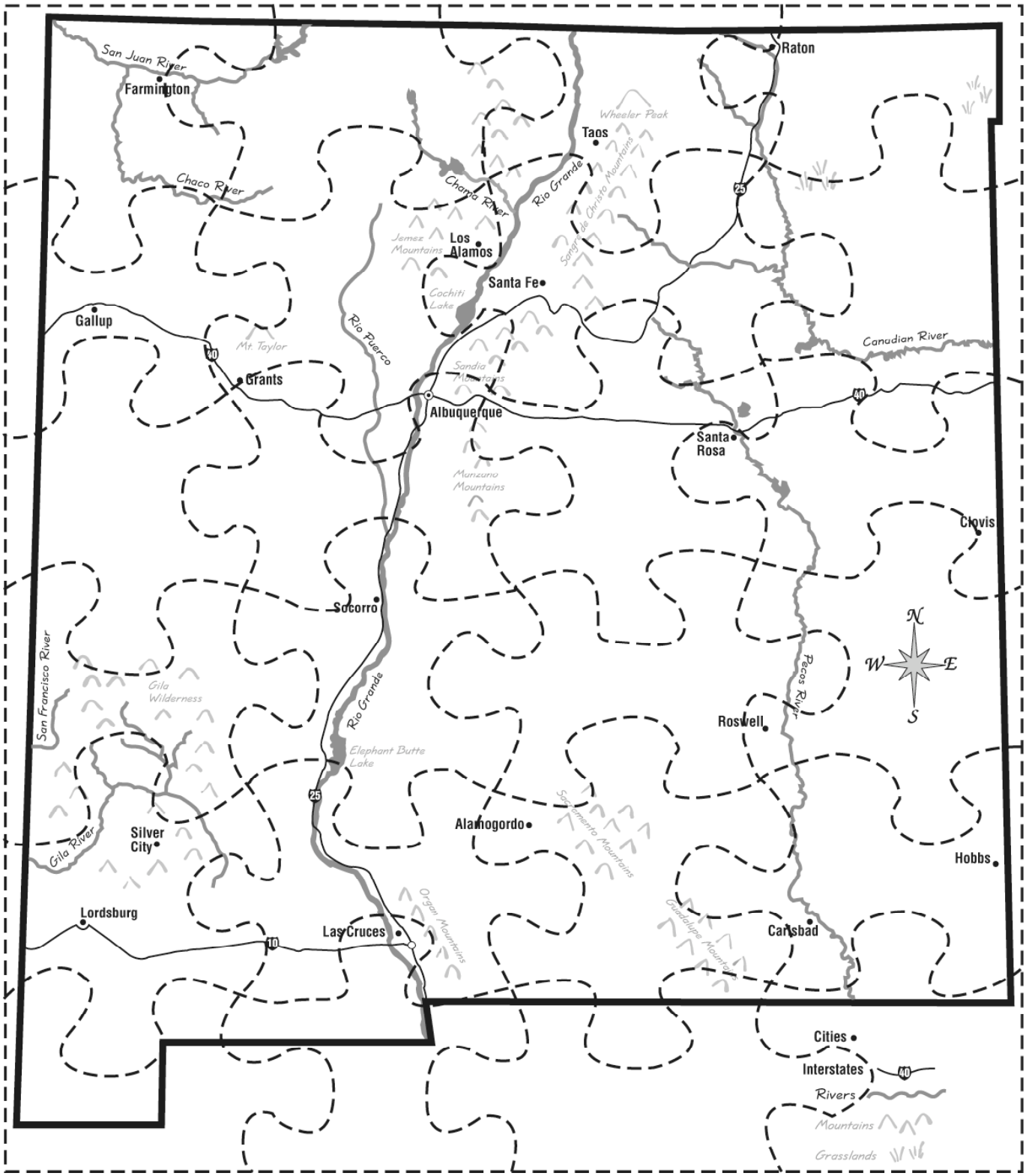
Part 2:
1. Have students research which agricultural products are produced in New Mexico.
2. Students can draw pictures of these products on to their map.

Additional Activities:
- Ask students if they know where the headwaters of rivers are located. Headwaters (where rivers begin) are usually in the mountains. Why would it be important to protect these areas from development?
- Order a free poster of the water cycle from the Natural Resources Conservation Service at www.nrcs.usda.gov/. Go to Publications and type in "water cycle."
- Find out how much of your county's commercial production is agricultural. Use the New Mexico Department of Agriculture's website for answers to this and the other questions, www.nmdaweb.nmsu.edu/stat.html.
- Find out what crops/livestock are grown in your county.
- How much of the agriculture is human food production? How much is food for livestock?

New Mexico Mountains and Rivers



New Mexico Mountains and Rivers Puzzle Map



Section 3: Cultural Awareness

Background Material

Native Americans

The earliest inhabitants in New Mexico relied heavily on nature's intermittent (interrupted or not continuous) supply of water to survive in a semiarid climate. These nomadic peoples depended on streams or springs and had little means of capturing, storing or directing water for their needs. Later, settled in one place and increasingly dependent upon agriculture, they developed ways to acquire and conserve water for drinking, other domestic uses and irrigation.

This primary period of water development occurred from 900 to 1100 A.D. The early settlers used "check dams" made of stones to slow down floodwaters in arroyos, and they also built terraces to capture rainfall running off hillside slopes. Reservoirs were used to store water for dry periods, and canals were dug to direct water to fields of corn, beans and other crops. The development of pottery capable of holding liquid made water more accessible for use in the home.

Spanish Settlers

The Spanish influence on water management and use was significant, as the Spaniards brought with them metal tools, domesticated animals, engineering skills and a political, legal and social system closely connected to land and water use. These additions to New Mexico allowed the irrigation of crops to expand through more complex water and storage and diversion systems.

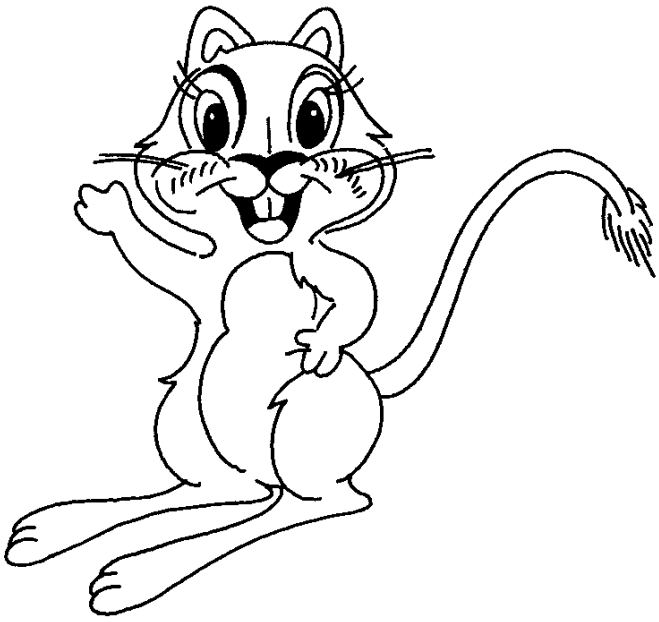
The acequia, or irrigation ditch, was so important to new settlements that it was often constructed before other village structures, such as houses and barns, were built. The first Spanish acequia was constructed near the San Juan Pueblo in 1598, and irrigation canals were built in Santa Fe when it was settled in 1610. Before long, most valleys in north central New Mexico with perennial (continuous or uninterrupted) running water had irrigation systems. These ditch irrigation systems provided an important basis for the social structure of Spanish communities, characterized by a strong attachment to land and water.

Anglo-Americans

The opening of the Santa Fe Trail in 1821 and the coming of the railroad in 1880 brought a rapid influx of Anglo-Americans to New Mexico. These settlers brought more new technology and an entrepreneurial spirit, which again significantly affected water use. The new settlers introduced commercial agriculture to the area, which required vast amounts of water. Private companies were established to begin extensive irrigation projects. New Mexico's 1828 gold rush increased the demand for water, and large ditches were built to carry water to the mines.

The 1900s brought the federal government into New Mexico's water development when major dams and reservoirs, such as Elephant Butte Dam near Las Cruces, were built. While streams and rivers produced most of the water supply, wells to tap underground water were dug and then pumped by windmills to supply more water for the state's growing needs.

Modern technology evolved as a result of the coming together of New Mexico's cultures, water-use practices, and new conservation methods. Current trends to save irrigation water include drip irrigation, ditch lining, low-impact precision application and more.



STUDENT BOOKLET ACTIVITY: WAYS WE IRRIGATE

Objective:
Students will understand how irrigation methods have changed over time. Students will be able to define irrigation and acequia.

Materials:
"Ways of Irrigating" (page 3 of student booklet)
pencil or crayon

Vocabulary:
irrigation
acequia

Procedure:
1. Open the Student Booklet to Ways We Irrigate, page 3.
2. Explain to the students that New Mexicans have been watering plants to grow food for over a thousand years. Watering plants is called irrigation.
3. One of the ways that Native Americans irrigated was to carry pots of water to the plants. (For additional Native American irrigation techniques, please read the background material for this activity.)
4. Ask the students to connect the dots on the Native American illustration. Did they find the pots used to carry water?
5. When the Spanish settlers came to New Mexico, they brought with them a new way of irrigation, called acequias or irrigation ditches. These ditches carried water from the river to the fields. This system of irrigation is still used.
6. Ask the students to connect the dots on the acequia illustration. Do they recognize the floodgate?
7. Developments in technology have advanced irrigation techniques. Many farmers are now using drip irrigation, which sends water through tubing on the ground that has tiny emitters or holes where water drips through right next to the plant. This is an efficient way of applying water.
8. Ask students to connect the dots on the drip irrigation system. Have they ever seen a drip irrigation system? They are often used in landscapes.

Additional Activities:
- Ask students to explore/research others ways that Native Americans used to irrigate (check dams, diversions, terracing).
- Using clay, build a model of an acequia in a baking dish or flat piece of Tupperware. Show how water moves through the system and onto fields using gates.
- Ask students to bring in stories of how their families have irrigated over the years.
- Invite a mayordomo (a person in charge of an acequia system) to speak to the students about the history and management of acequias.
- Ask students to explore/research additional modern conservation-oriented irrigation techniques (ditch lining, low-impact precision application, laser leveling).

ACTIVITY: MAKING POTS

Objective:
Students will identify how water was transported prior to the existence of ditch systems or water utilities.

Materials:
mud, play dough, or modeling clay
paints
paint brushes

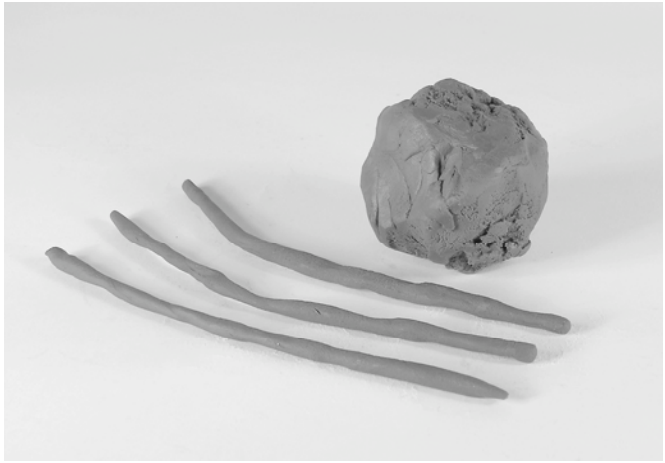
To make your own "modeling clay" use:
1 cup flour
1/2 cup salt
3/4 cup hot water
1 tablespoon salad oil
1 tablespoon alum (optional)

Mix all ingredients together. If too sticky, add more flour; air-dry, do not fire.

Vocabulary:
irrigation
utility
pottery

Introduction:
Water is currently transported to our homes using pipes and water pumps; and most farms or gardens have fancy irrigation equipment to help get the water to the plants. How did people water their plants and get water into their homes prior to the existence of water utilities? Native Americans and early settlers had to carry water from a nearby stream or river to their homes and fields. The students will build their own water pot to carry water. Please see Appendix D for additional references to Native American Pottery.

Procedure
1. Select a modeling material (clay and water mixed together, play dough, home-made modeling clay, or commercial modeling clay). Distribute material to the students.
2. Students use the material to form pots: (Pot types and directions were adapted from Navajo Pottery written by ArtWorks, The Kax Harberger Center for Children and the Arts, www.artswork.asu.edu/arts/students/navajo/lesson4.htm)
   - Coil Pots: Roll the clay into long circular "tube" shapes. For the bottom of the pot, make one continuous flat coil. Shape the remaining coils into circles or rings. Stack the rings one on top of another. As each ring is added, carefully join it to the one below it by smoothing with your thumb. The coils should become invisible as you build a smooth and uniform pot with a pleasing shape.



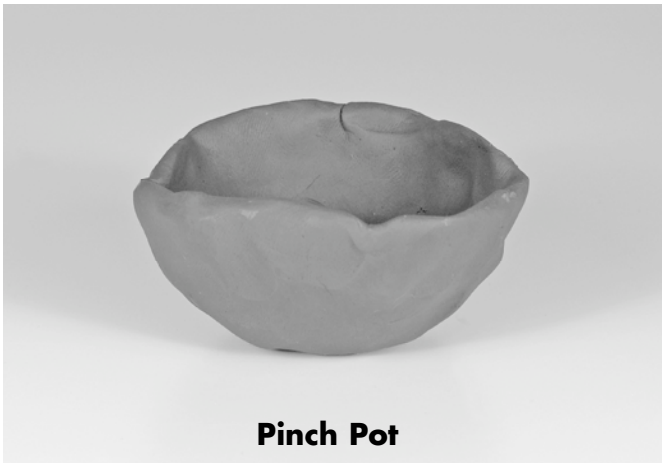
Coil Pot

- Pinch Pot: Twist off a piece the size of a baseball. Pat it into a smooth sphere. When you have a smooth ball, push your thumb into the center of the ball. Then, pinch the clay gently between your thumb and forefinger as you rotate the ball in the palm of your hand. Slowly stretch the clay into the shape of pot you desire.
- Slab Pot: Roll and stretch the clay as if it were pizza crust, a rolling pin comes in handy. The objective is to make the slab of clay a uniform thickness. From the slabs students cut out the base and sides of the pot (squares work well). Then students join the pieces with a scoring process, which requires using a paper clip or pencil to scratch hatched lines across the pieces into the edges to be joined. Smear very wet clay (the consistency of yogurt) into the scored surface, then press the edges together securely.

3. Decorate the pots with symbols from a chosen era (Native American, Early Settlers, or Modern). Symbols can be painted on, or use impressions of objects such as leaves and feathers.
4. Ask students to tell a story or re-enact how Native Americans might have used their pots.

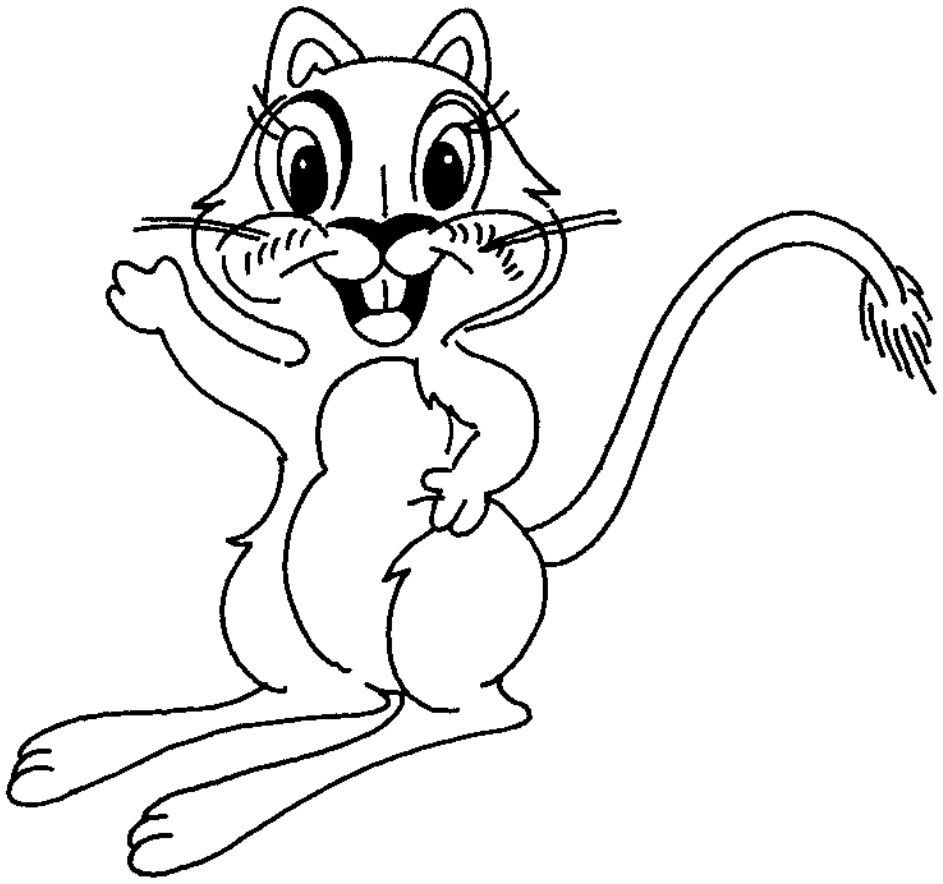
Additional Activities

- Bring in pieces of a modern drip irrigation system. Have students put together a small sample of how it would work.
- Build a model of an acequia using clay or dirt. Include three-dimensional pieces such as farm equipment and trees.
- Build a model of check dams and terraces to show how Native Americans slowed water down to irrigate their plants.
- Place different types of soil (e.g., sand, clay, compost) into funnels. Slowly pour water onto the soil. Which soil holds the water longest? Which soil does the water run straight through? What impact would this have on how we irrigate?
- Look into irrigation practices throughout the world. Build a map showing where each of these practices occurs.
- Visit the Farm and Ranch Heritage Museum in Las Cruces, the Indian Cultural Center or Petroglyph National Monument in Albuquerque, Museum of Indian Arts and Culture or the Palace of the Governors in Santa Fe, Salmon Ruins and Heritage Park in Farmington, Chaco Canyon National Historic Park, Gila Cliff Dwellings or Bandelier National Monument. Check with your local Chamber of Commerce for other Native American and early settler sites in your area.
- Call a New Mexico Soil and Water Conservation District to schedule the Rolling River – a trailer-sized working model of a watershed. The Rolling River comes with a trained presenter. Be sure to ask for the teacher guide in advance and include other classes in this unique opportunity. For information about scheduling the Rolling River, go to www.nm.nacdnet.org or call 505-785-2306.



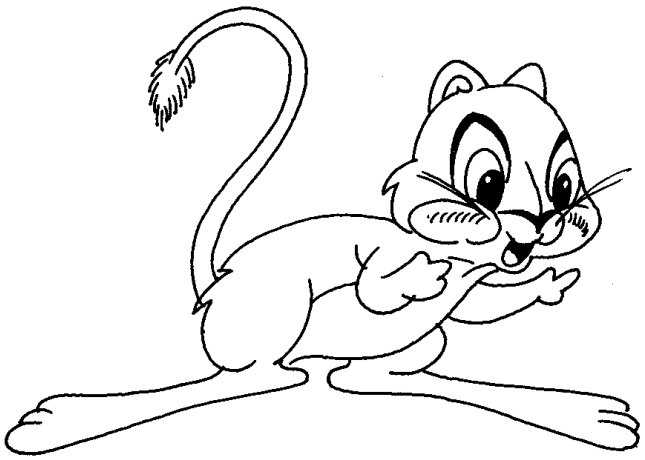
Pinch Pot

Slab Pot with Shell



CHAPTER 2

Who Uses Water?



Section 1: Home Water Use

Background Material

Considering how little precipitation, surface water, and ground water is truly available, it is no surprise that competition for the state's limited water is intensifying and the cost for options is mounting. New Mexico's population growth is increasing the demands on already scarce resources to the point that water demands in some of the state's urban areas are approaching the available supplies.

Another result of the growing water demand is the escalating cost of water development and treatment. Many communities are now faced with expensive water and wastewater treatment facility expansions to meet residential and industrial needs. Overall, demand is beginning to exceed supply, resulting in diminishing resources and expensive solutions. Fortunately, water conservation can delay, and in some cases actually eliminate, the need for costly infrastructure expenses. Conservation is almost always the least costly water supply alternative.

In the United States, approximately 26 percent of the nation's water is used for residential purposes. Residential uses include flushing toilets, washing clothes, taking baths and showers and washing dishes. A good portion of the residential water use is attributed to outdoor usage. In fact, the national average for outdoor water use is approximately 31 percent of total residential use[6]. Outdoor use includes washing cars, filling swimming pools, and cleaning driveways, but the largest category of outdoor use is landscape irrigation[7]. In New Mexico's hot, dry summer months, up to 70 percent[8] of residential usage is attributed to outdoor usage, mostly for watering landscapes.

Demonstration/Visualization: Residential Water Use

- Ask students to list ways that they use water.
- Put the list up on the board.
- See if they can guess which items in their list use the most water.
- Ask the students if they know of any special technology or water saving device in their homes. (i.e. ultra-low-flow toilet, waterwise showerhead, front loading washing machine, drip irrigation)
- Use the graph included in Appendix C, How Is Water Used In The Home? to show students the following information:

How Is Water Used In The Home?[9]

Outdoor Use (irrigation, pools)	30%	30/100
Toilets	18%	18/100
Clothes Washers	15%	15/100
Showers/Baths	13%	13/100
Faucets (washing hands, brushing teeth, drinking water)	11%	11/100
Leaks	10%	1/10 or 10/100
Other	2%	1/50 or 2/100
Dishwasher	1%	1/100

[6]Vickers, Amy, *Handbook of Water Use and Conservation* (Amherst: Waterplow Press, 2001), 14-23
[7]Vickers, 14-23
[8]City of Albuquerque, *The Complete Guide to Xeriscaping* (Albuquerque: City of Albuquerque), 1
[9]Vickers, 14-23

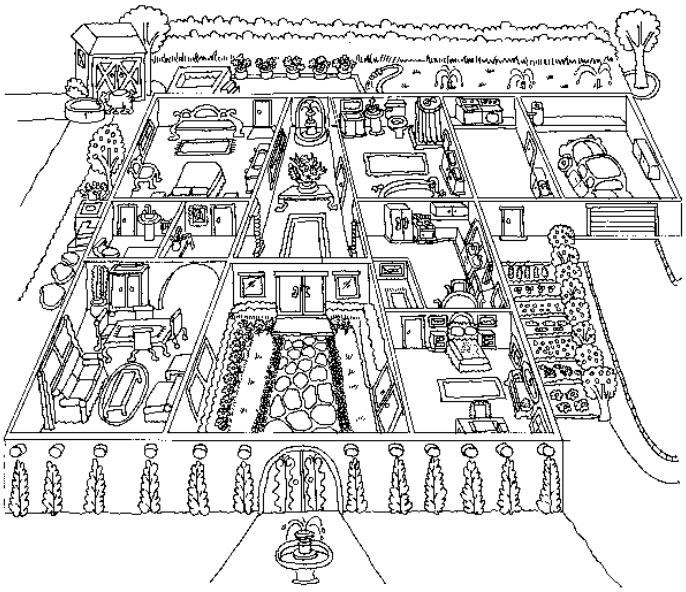
STUDENT BOOKLET ACTIVITY: HOME WATER DETECTIVE

Objective:
Using the pictures in the student booklet, students will become detectives to find the places in the home where they use water.

Materials:
"Home Water Detective" (pages 4 and 5 in the student booklet)
pen, pencil, or crayon

Vocabulary:
residential
irrigation

Procedure:
1. Open the Student Booklet to Home Water Detective, pages 4-5.
2. Ask the students to circle everything that uses water (appliances, plants and pets).
3. See how many water-using items the students can find in the picture. Some of the items they might circle include: water trough, hot tub, potted plants, garden hose, evaporative cooler, sink(s), fountain(s), washing machine, toilet, bath tub, shower, refrigerator, vegetable garden, lawn, water heater, and cat.



4. Is there anything else that uses water in homes that is not in the picture?
5. Make sure the students know that water use inside and outside the home is called "residential water use."

Additional Activities
- Expand the students' focus to the school. Have students walk around the school and identify where water is used. It might be fun to involve the custodian so the students can see some of the behind-the-scenes areas.
- Expand to the community. Have students make a list of who is using water in their community. This could be a week-long project where students look around them every day and come back with more users for the list.
- Make the school or community exploration a scavenger hunt. Walk the area (around a block) to be explored before taking the students on the walk and make a list or bingo card of things the students might find.
- Track a household's water use or the school's water use by the month. Using a monthly water bill, make a chart of gallons used per month to compare fall, winter and spring usage. Which month do the students think will be the highest? What are their predictions for the summer months?
- Roll this into "Draw a picture of how you can conserve water," page 7. Have students make a list of ways to conserve water.
- What is in the picture (Home Water Detective, pages 4 and 5 in the student booklet) that indirectly uses water? (e.g. food in the refridgerator —introduce the concept of embodied[10] energy/water).

[10]Embodied energy—all the energy required to extract, manufacture and transport a product.

Section 2: Personal Water Use

Background Material
Using the information presented in Section 1: Home Water Use, ask the students how much water they think they use. The average New Mexican uses a total of 200 gallons of water a day for indoor and outdoor uses. That is a lot of water!

The following table shows how New Mexico cities compare to other cities in the country. Per capita represents the amount of water used by one person in one day. Taking all of the gallons of water sold by a municipality and dividing it by the number of people served is how per capita use is usually calculated.

Per Capita Water Consumption[11]/
Water used by One Person in One Day

Location	Gallons per capita
Albuquerque, New Mexico	204
Boulder, Colorado	180
Denver, Colorado	205
El Paso, Texas	167
Farmington, New Mexico	260
Grand Junction, Colorado	232
Highlands Ranch, Colorado	191
Las Cruces, New Mexico	251
Las Vegas, New Mexico	146
Las Vegas, Nevada	302
Mesa, Arizona	194
Phoenix, Arizona	237
Rio Rancho, New Mexico	181
Santa Fe, New Mexico	145
Scottsdale, Arizona	366
Taylorsville, Utah	221
Tempe, Arizona	309
Truth or Consequences, New Mexico	151
Tucson, Arizona	170

[11]Out-of-state numbers provided by: Western Resource Advocates, 2004. Smart Water: A Comparative Study of Urban Water Use Efficiency Across the Southwest. New Mexico numbers provided by: Wilson, Brian C. P.E. et al, 2/2003. Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 2000, NMOSE Technical Report 51.

STUDENT BOOKLET ACTIVITY: HOW MY FAMILY AND I USE WATER

Objective:
Students will discover ways they use water in their homes.

Materials:
"How My Family and I Use Water"
(page 6 in the student booklet)
pen, pencil or crayon

Vocabulary:
gallons per capita
gallons per capita per day

Procedures:
1. Make enough copies of the How My Family and I Use Water worksheet from the teacher's guide so that each student has several. Or have the students use their own booklet.
2. Ask the students to place the worksheets around their house, wherever water might be used: in the bathrooms, kitchen, laundry room, etc. Or, post a score sheet in one central place in the house.
3. Assign a time period (a weekend, a week, one night).
4. The students will then ask their family members to make a check mark next to each task as it is completed.
5. Have the students bring the tallied sheets back to the class. Help them tally up their household numbers, then make a tally for the class. Discuss why different families might have different numbers (e.g., large or small families, going to the laundromat rather then washing clothes at home, etc.)
6. If they used a copy of the How My Family and I Use Water worksheet, have them transfer their numbers into their Student Booklet to share with their families.

Action	Gallons of Water Used[12]
Flushing toilet	5
Brushing teeth (water running)	5
Washing hands	3
Taking Shower (10 minutes)	50
Taking Bath	30
Dishwasher	15
Hand washing dishes	20
Washing Machine (large load)	50

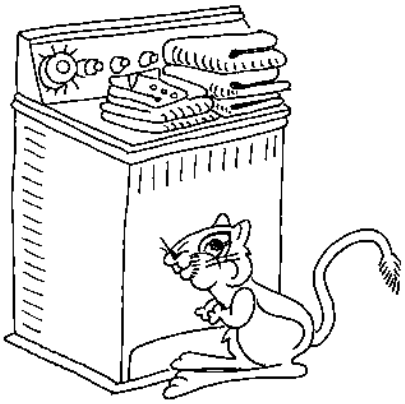
Additional Activities
- Multiply the number of times water is used (as noted on the activity sheet) by the approximate Gallons of Water Used number from the chart above.
- Have the students make a graph (bar chart) to represent their (or the class's) water use.
- Make a graph by city of the per capita water consumption chart.

[12]The Watercourse, 2000. Conserve Water Educators' Guide. Numbers reflect water usage for homes built prior to 1992 that have not been retrofitted with water-saving devices.

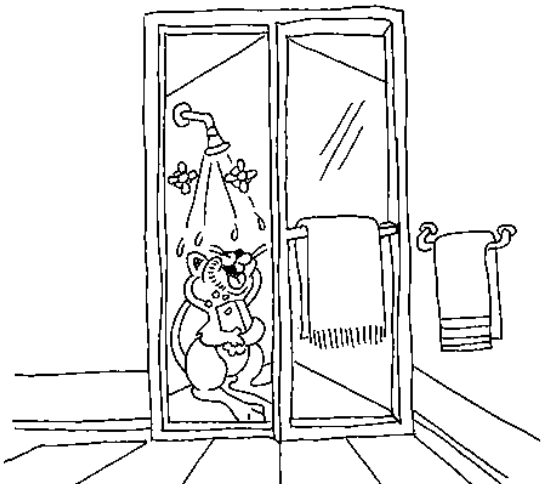
How My Family and I Use Water
Student Worksheet

Find out how much water you and your family use. Place this page somewhere in your home where everyone can see it. Ask everyone in your family to make a mark every time they complete each of the following actions.

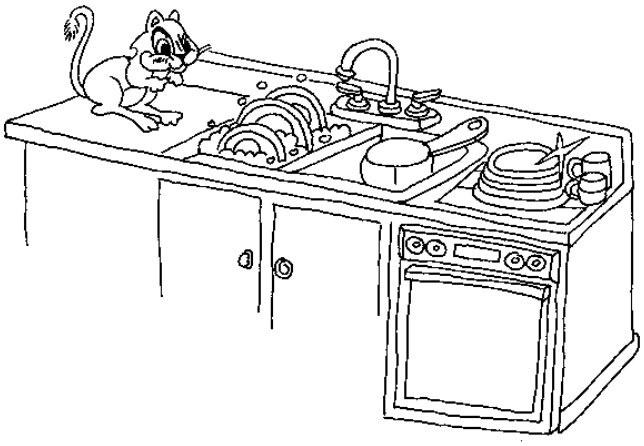
Flush the Toilet



Wash Clothes



Take a Bath or Shower



Wash the Dishes

Brush Teeth

Water the Yard

ACTIVITY: CARRY THE JUG

Objective:
Students will recognize that their actions directly affect how much water they use.

Materials:

2 large trash cans (15 to 30 gallons work well)
1 small bucket or pitcher*
1 cup*
signs "Home" and "Supply"
bathroom scale
a large open space
water (or for a less wet or indoor approach you can simulate water by using packing peanuts, confetti, or a similar filler material)

*To speed up the activity use several buckets and cups at the same time.

Vocabulary:

conservation
personal impact

Introduction:
Because students only have to turn on the tap to get water, they do not realize how much water they are using. What if they had to carry all the water that they needed? Would it influence how much water they use?

This is a team project. The students want to make the water in their supply last as long as possible. The less water a particular activity takes, the longer they will get to play the game. It is also important not to spill the water – spilled water that does not make it to the home will have to be replaced.

Procedure:

1. Photocopy the list of activities on the next page and make cards to draw out of a hat. Have the students think of additional activities to include. Write "Round 1" and the corresponding gallons used on the back of each card.
2. Make a separate set of cards for Round 2. Option: Make Round 1 and Round 2 cards different colors but place them all in the same hat. See how long it takes for the students to recognize that Round 2 cards are the low-water use activities.
3. Set up a large trashcan filled with water (or alternative) on one end of a field; mark it "supply." Set the same sized trashcan at the other end but leave it empty and mark it "home."
4. Put a gallon of water on a scale and discover how much it weighs. (A gallon of water weighs approximately 8 pounds and might be too much for the students to carry.) After the students understand how much a gallon is and weighs, introduce a smaller cup and a larger cup or pitcher for this activity. The small cup will represent one gallon and the larger cup or pitcher will represent 10 gallons.
5. Have a student draw a card from the hat.
6. Using the plastic cup or similar container, students must move the amount of water on the card from the "supply" to their "home." Keep the amounts small enough for the student to move, but large enough that they understand the difficulties associated with moving water. For the large amounts, use the "10 gallon" bucket or pitcher for the appropriate number of trips (i.e. 50 gallons to water the lawn – five trips with the 10-gallon pitcher).
7. Option for Round Two: Give students a chance to come up with ways to conserve water that are specific to the activities on their cards. For example, if they draw "brushing your teeth," they can turn off the tap to save 2 1/2 gallons, using only half a gallon.
8. A variation of this activity would set various "home" trashcans in spaces marked by room: "kitchen," "bathroom," "laundry room," etc. Then students would be able to see which areas of the home use the most water.

NOTE: When finished with the water please use it to irrigate (water) landscapes around the school.

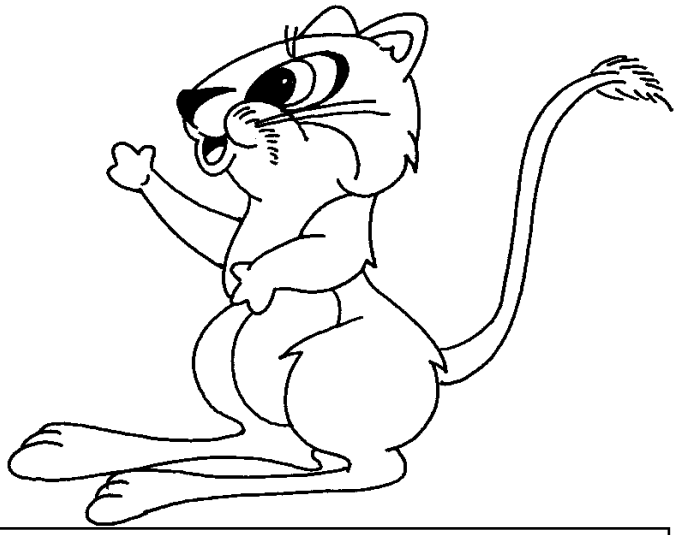
(Adapted from The Long Haul, Project WET)

Carry the Jug Activity Table
Student Worksheet

Flush the toilet	Flush the toilet
Flush the toilet	Flush the toilet
Take a shower	Flush the toilet
Wash a load of laundry	Take a shower
Brush your teeth	Brush your teeth
Wash dishes	Brush your teeth
Wash dishes	Clean sidewalk using water out of a garden hose
Wash car using water out of a garden hose	Wash hands
Water lawn	Wash hands
Water the flowers	Wash hands

For **Round One,** use the following numbers[13]

Activity	Gallons Used
Flush the toilet	5 gallons
Take a shower	10 minutes = 50 gallons
Wash a load of laundry	50 gallons per load
Brush your teeth	5 gallons
Wash dishes	15 gallons
Clean sidewalk	100 gallons
Wash car	100 gallons
Water lawn	300 gallons
Water the flowers	100 gallons
Wash hands	3 gallons



For **Round Two,** use the following numbers

Activity	Gallons Used
Flush the toilet	Install low-flow toilet, only use 1.6 gallons
Take a shower	Shorter Showers or low-flow showerhead = 15 gallons
Wash a load of laundry	Wash only full loads = 30 gallons
Brush your teeth	Turn the water off = 1/2 gallon
Wash dishes	Wash only full loads; turn water off while hand washing = 5 gallons
Clean sidewalk	Use broom instead of hose = 0 gallons
Wash car	Use a bucket of water to wash and a quick rinse with the hose = 15 gallons Install a shutoff hose nozzle instead of letting the water run = 30 gallons
Water lawn	Water at night or early morning to reduce evaporation = 100 gallons
Water the flowers	Convert to native flowering plants = 50 gallons
Wash hands	Soap up, then turn water on to rinse = 1 gallon

[13]The Watercourse, 2000. Conserve Water Educators' Guide. Numbers reflect water usage for homes built prior to1992 that have not been retrofitted with water-saving devices.

STUDENT BOOKLET ACTIVITY: SAVING WATER

Objective:
Students will discover ways they can conserve water in their homes.

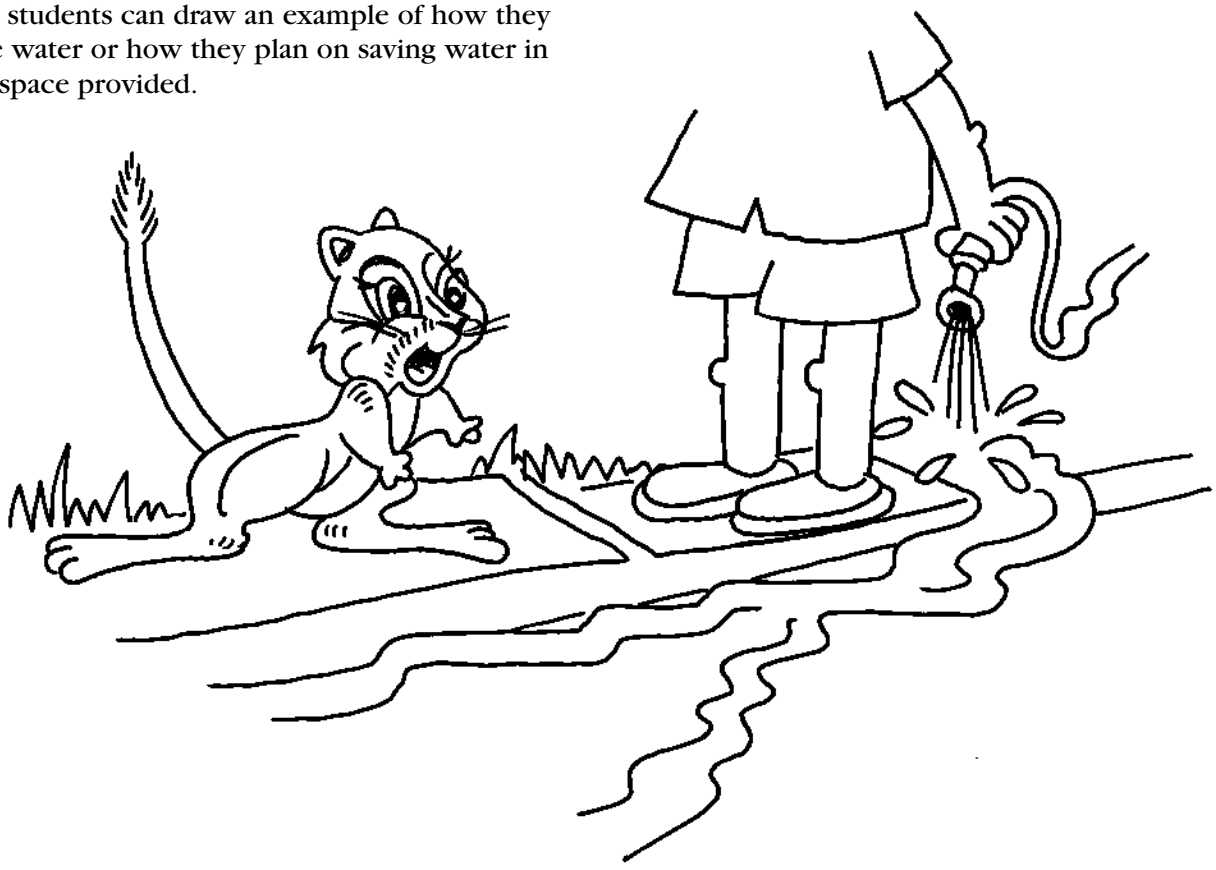
Materials:
"Saving Water" (page 7 of student booklet)
pen, pencil, or crayon

Vocabulary:
conservation

Procedures:
1. Review with the students the list of conservation tips found on Saving Water, page 7 of the Student Booklet and on this page.
2. Ask the students if they can think of any other ideas for saving water. Have the students write these ideas in the spaces provided.
3. The students can draw an example of how they save water or how they plan on saving water in the space provided.

Tips for saving water:

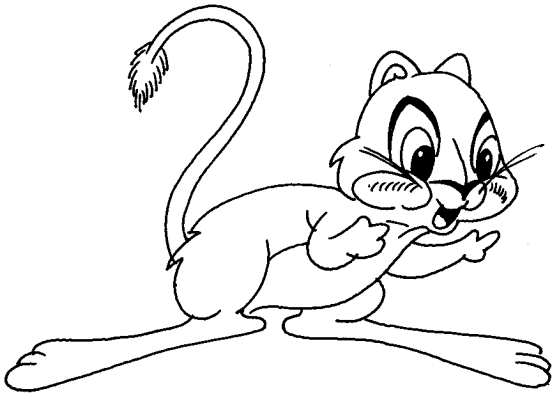
- Fix leaks in faucets, showerheads, toilets and irrigation systems.
- Wash only full loads in the dishwasher and clothes washer.
- Do not leave the water running when brushing teeth, washing hands, or washing dishes.
- Catch cold water while waiting for the hot water. The cold water can be used to water plants or for cleaning.
- Do not use the hose to clean the sidewalk or driveway, use a broom instead.
- Catch rainwater to water plants.



Section 3: Nature's Needs

Background Material

Every living thing needs water to survive. In fact, some ecosystems[14] exist only because of the presence of water. A riparian system is "relating to or living or located on the bank of a natural watercourse (as a river)."[15] In New Mexico, the cottonwood forests border our river systems and have earned a special name "the bosque." The bosque, which is Spanish for forest, is a valuable resource for the plants and animals living in the arid Southwest. It provides water, shade, food, shelter, and much more.



Demonstration/Visualization: Bosque Trip

- Take students on a field trip to the bosque.
- Have students make a list of what they see.
- Which of these things could survive without the river? How would the area look if the river were not there?
- On the way back to school, stop at an area not by the river (desert plateau, mountain forest). Compare and contrast the two areas.

Or

Virtual Bosque Trip

- If a bosque trip is not possible, bring in pictures of the bosque and pictures of the desert and have the students compare and contrast the images.
- Remind them that the plants and animals in the desert also need water. They just do not need as much water as the creatures that live right next to the river. This is because desert plants and animals have adapted to their drier surroundings.

The New Mexico rivers and their floodplains support a variety of plants and animals. The following are just a small example of what can be found.

Mammals
Coyote
Striped Skunk
Kangaroo Rat
Squirrel
Fox

Amphibians
Western Chorus Frog
Rio Grande Leopard Frog
Tiger Salamander

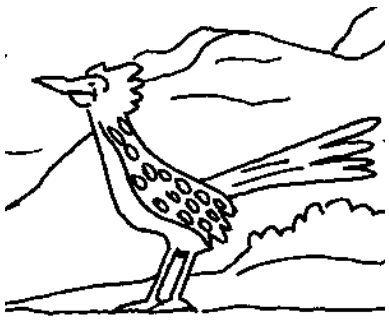
Insects
Grasshopper
Dragonfly
Mayfly
Crayfish

Birds
Blue Heron
Sandhill Crane
Bald Eagle
Roadrunner
Rufus Hummingbird

Fish
Rio Grande Cutthroat Trout
Rio Grande Silvery Minnow
Red Shiner

Plants
Cottonwoods
New Mexico Olive
Coyote Willow
Elm

Reptiles
Garter Snake
Bullsnake
Painted Turtle
New Mexico Whiptail



[14]An ecosystem can be defined as a unit of the biosphere in which the community of organisms interacts with its physical environment. Ecosystems usually have natural boundaries such as forests, rivers, or mountains; however, man-made constructions such as highways, buildings, or sidewalks can also be considered boundaries to smaller ecosystems

[15]Merriam-Webster Online, www.m-w.com/

STUDENT BOOKLET ACTIVITY: BOSQUE WATER DETECTIVE

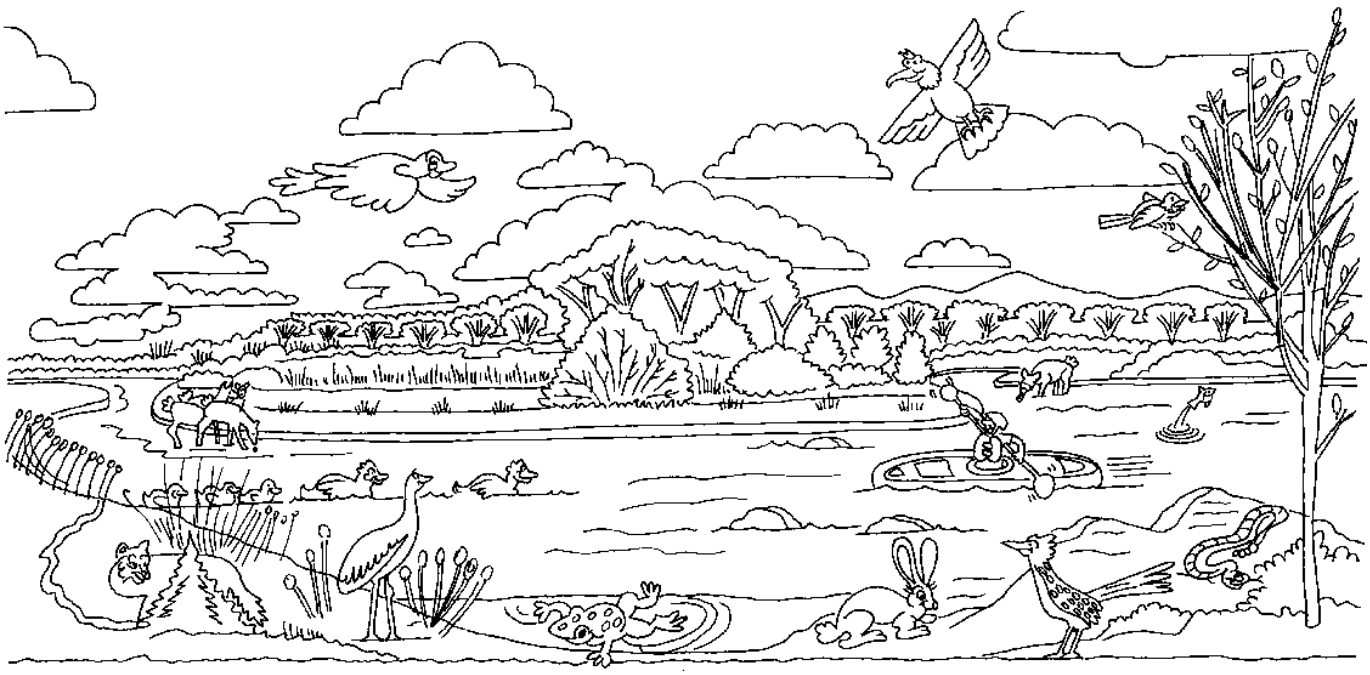
Objective:
Using the picture in the student booklet, students will become detectives to find the things in the bosque that use water.

Materials:
"Bosque Water Detective"
(pages 8-9 of the student booklet)
pen, pencil, or crayon

Vocabulary:
bosque
ecosystem

Introduction:
People need water. What else can you think of that needs water (plants and animals)? In New Mexico, the bosque is a special ecosystem that depends on the water in the river. The plants and animals that live there choose to do so because of the water in the river and the life that it provides.

Procedure:
1. Ask the students to circle images of things that use/require water in the picture of the bosque (plants, animals, and people).
2. Some of the things the students can circle include: blue heron, frog, rabbit, roadrunner, snake, fox, ducks, deer, fish, eagle, birds, person in kayak, cottonwoods, and other plants.
3. Can you think of anything not on the picture that lives in or uses the bosque? What would happen to the items that have been circled if the water disappears?



ACTIVITY: HOW MUCH WATER IS IT MADE OF?

Objective:
Students will realize that every living thing depends on water. Students will recognize a percentage as a portion of a shape.

Materials:
"How Much Water Is It Made Of?" worksheet on page 37 in this guide
crayons
dried and regular fruit (optional)

Vocabulary:
percentage
bosque

Introduction:
Every living thing is made up of water. The question is how much water? Humans are 75% water* and a coyote is 63% water. Students will have to match a proportion with a percentage; i.e., in the picture of the tomato, a dividing line will be included that shows the 94% and 6%. Students must decide which side to color.

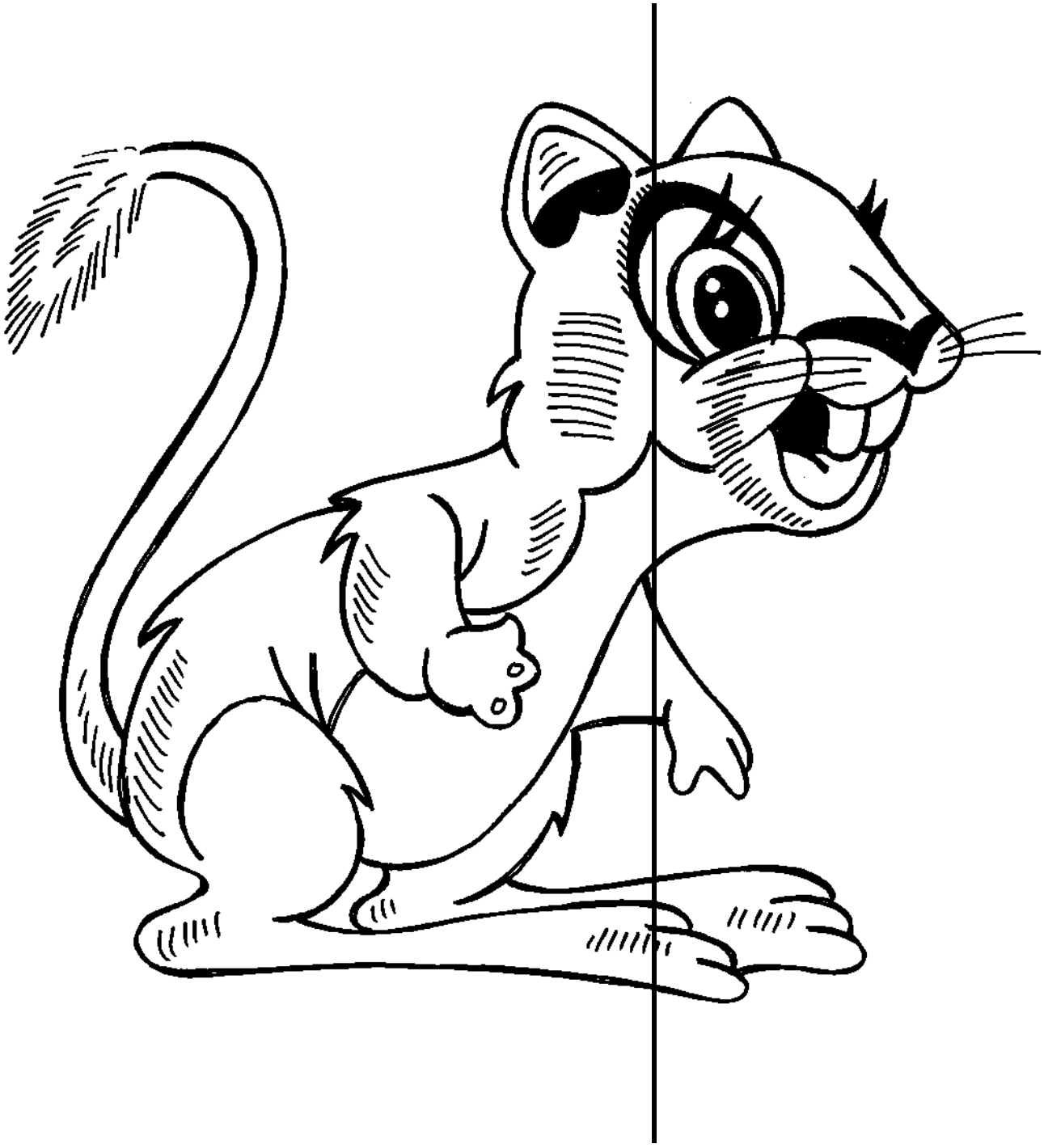
* The amount of water in a specific person can range from 70 to 75% depending upon a person's age and gender.

Item	Percentage of Water[16]
Coyote	63
Deer	64
Bananas	74
Humans	75
Oranges	87
Tomatoes	94

Procedures:
1. Complete the Student Booklet Activity: Bosque Water Detective.
2. Ask students how much water is in all the plants and animals they have circled.
3. If available, show the students a piece of fruit before and after it has been dried (a whole apple versus a dried apple). Ask them what the difference is.
4. Hand out the practice worksheet as an introduction to percentages.
5. Have the students fold the practice sheet in half, right across the tomato. On either side of the fold is 50%.
6. Ask the students whether 94 is more or less then 50.
7. If the tomato is 94% water and 94 is more then 50, which side of the line should they color?
8. Hand out Student Worksheets.
9. Ask students to color blue the side of the solid line that represents how much water that organism holds.
10. Students will have to decide which side to color.

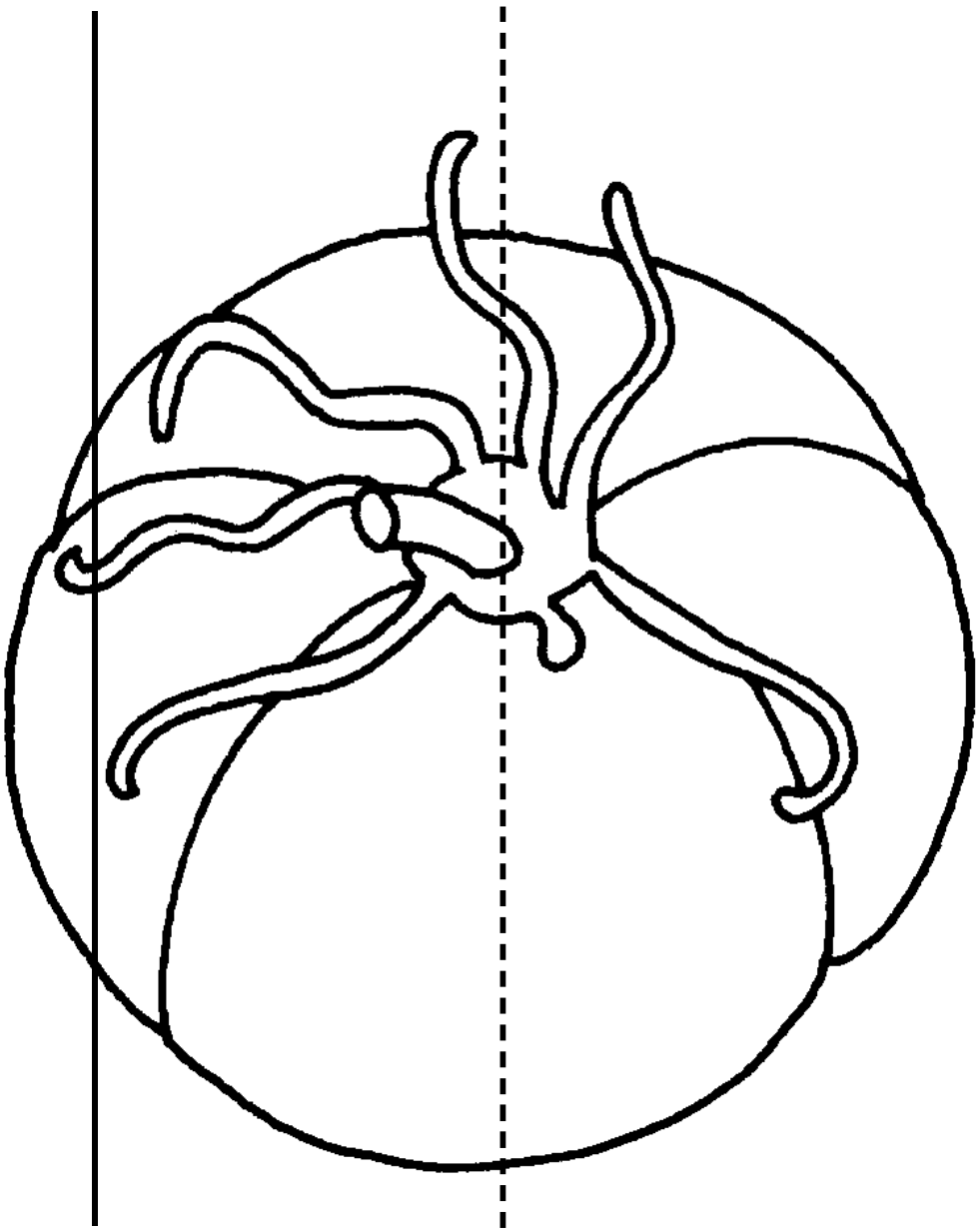
[16]Project WET

Rio! Is Approximately 65% Water.
Color on the side of the line that represents 65%.



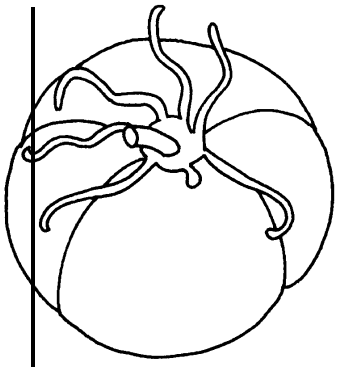
How Much Water Is It Made Of?
Practice Worksheet

Fold this page along the dotted line. (Each side of the line is 50% of the tomato.)
A tomato is 94% water. (Is 94% more than 50%?) Color everything to the right of the solid line blue. This is the 94% of the tomato that is water.

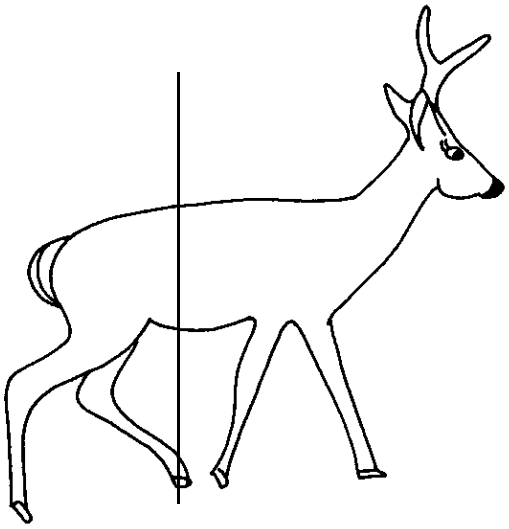


How Much Water Is It Made Of?
Student Worksheet

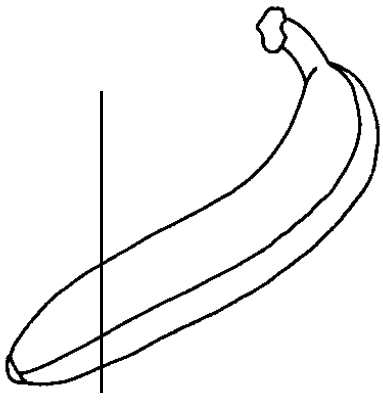
Color in the side that equals the water held in the object below.



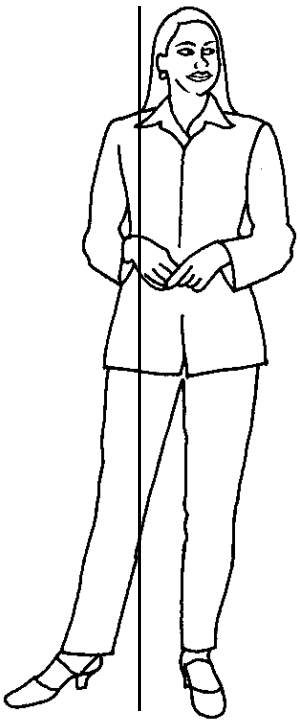
A tomato is 94% water.



A deer is 64% water.



A banana is 74% water.



A person is 75% water.

ACTIVITY: THE DOMINO EFFECT

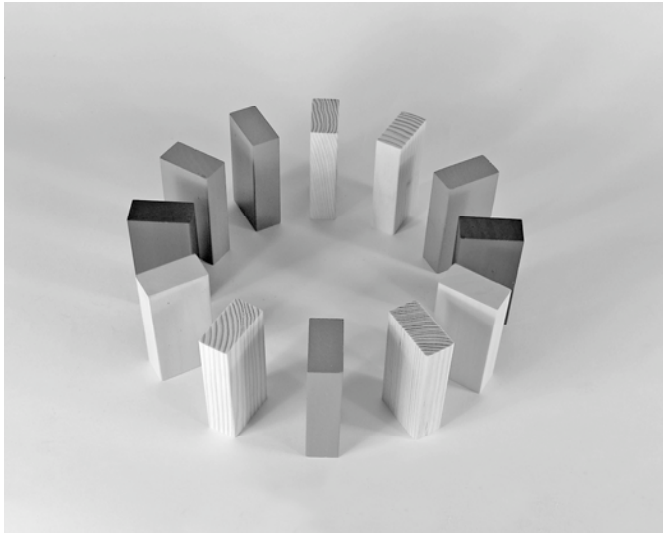
Objective:
Students will realize that every living thing depends on water.

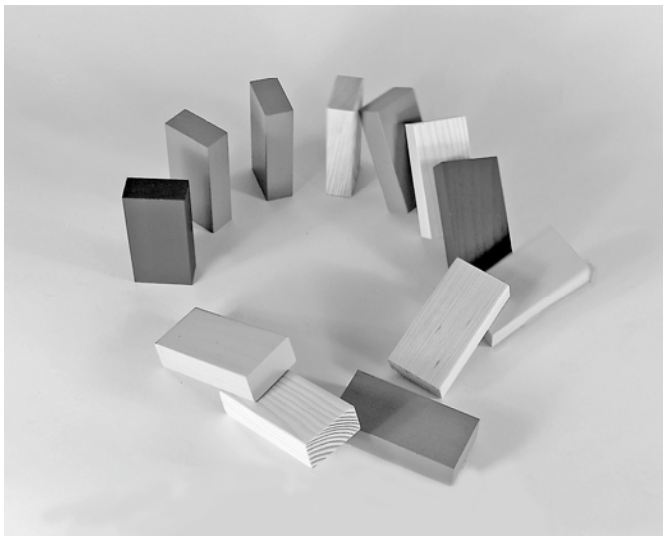
Materials:
colored blocks – 4 colors, several of each color
toy animal

Vocabulary:
habitat
shelter
space

Introduction:
All animals need water as well as food, shelter and space. Without any one of these necessities, an animal will die. Shelter is defined as a place in which to live. It could be a cave, a hole in the ground, or in the case of humans, a house, apartment, or trailer. Space is the area around the animal's home in which it gets its food and water. For the animals in New Mexico, it could be the bosque, the mountains, or the desert. For humans, it would be our community that includes schools, grocery stores, and friends.

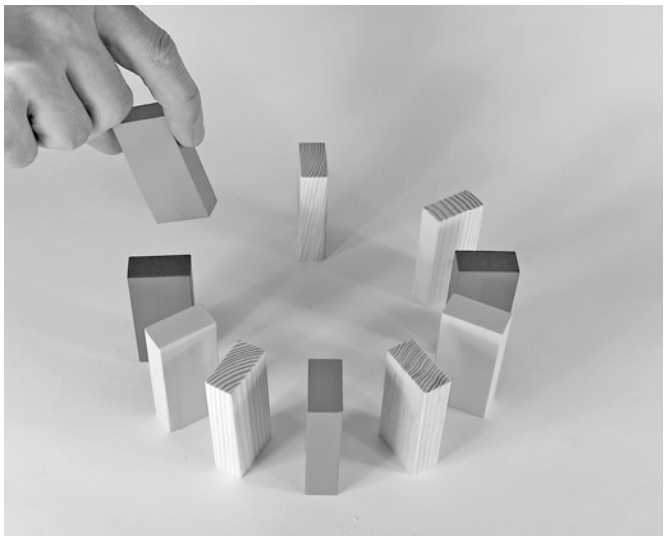
Procedures:
1. Use four different colored blocks or dominoes, several of each color. (If using blocks, make sure they are tall and thin like a domino. Square blocks will not fall over.)
2. Assign each color to represent one of the following: water, food, shelter and space. If possible, label the blocks.
3. Randomly place the colored blocks in a carefully spaced circle. The blocks need to be close enough so that when one is knocked down, it hits the adjacent block. If you have a toy animal, place it in the middle of the circle to help the students remember what it is that needs the food, water, shelter and space.
4. Give one block a slight push, so that all of the blocks 'domino' down. The falling represents a complete circle or habitat.
5. Emphasize that everything "fell" into place because all of the pieces were available for the animal.

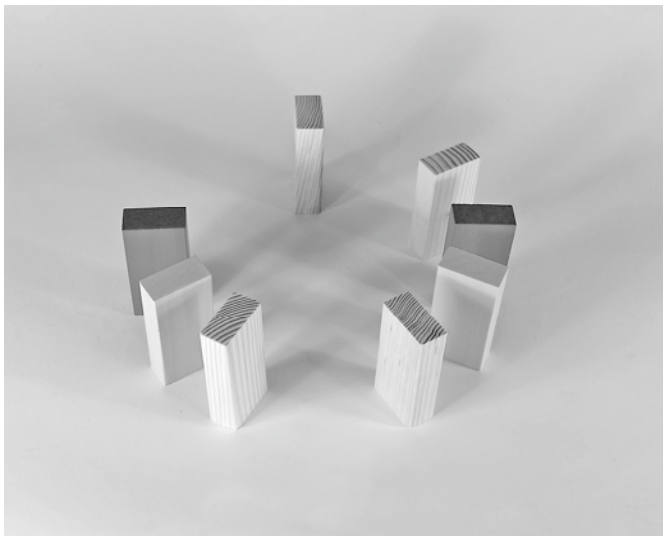


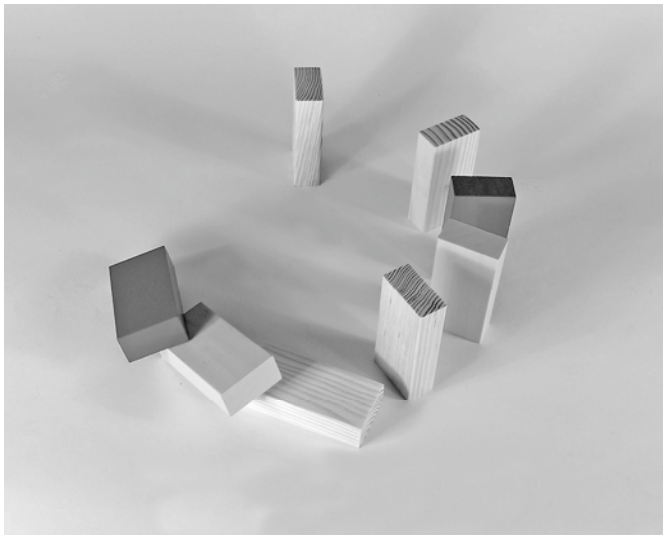


(Adapted from Project WILD activity Habitat Lap Sit)

6. Reset all of the blocks. Remember to carefully space them.
7. Ask the students what would happen if you were to remove the water blocks from your circle. Discuss.
8. Remove all of the blocks that represent water.
9. Give one of the remaining blocks a slight push.
10. What happened? Why did all of the blocks not fall? Discuss.
11. When the water blocks are removed (or any of the other components: food, shelter or space) the remaining blocks do not fall. Because they did not fall the circle is incomplete. Only when all of the components are in place will the blocks fall. Likewise, only when all of the components are in place will an animal survive.







Additional Activities

- Have each student lie down on a large piece of paper; trace the outline of each student. Have the students color in the 75% of their bodies that represents water. (From Project WET, Aqua Bodies)
- Have the students act out each animal's behavior: How would a deer react to a source of water? What would a dog do? A kangaroo rat?
- Assign each student an animal from the bosque picture. Have students research what is special about their particular animal? What would it do in a drought? A flood?
- Study desert animals and their adaptations. Start with the kangaroo rat.
- Instead of using blocks, use stepping stones or pieces of cardboard that the students can step on. Have them walk around a circle made of the four colors/categories then remove the water steps. Students will now have to jump over the missing water pieces.
- Instead of using blocks, assign the four categories to groups of students (original *Habitat Lap Sit* from Project WILD.)
  - ✔ Place all the students in a large circle, front to back, about an arms length apart. Make sure the groups (food, water, shelter and space) are mixed unevenly throughout the circle.
  - ✔ Explain that every living thing needs food, water, shelter and space.
  - ✔ Have the students slowly start to sit down until they are sitting on the knees of the person behind them. If you go slowly, this will work!
  - ✔ Have everyone stand up.
  - ✔ Remove the students in the water group and repeat without filling in the holes. The circle should collapse. The circle is incomplete without water.

Section 4: Water Distribution

Background Material

There are many different ways that drinking water reaches a home. A community or municipal water supply system is the most common delivery system. A municipal water supply contains withdrawals from surface or ground water that are sent through a treatment plant prior to being piped to individual homes and businesses. Water may be treated differently in different communities depending on the quality of the water that enters the plant and the amount of water that is being distributed.

Water treatment and distribution systems range in size from the very large to the very small. The City of Albuquerque's large system gets its water from a series of underground wells, but it will soon include surface water from the Rio Grande. Smaller systems might have only a single well and (projected for 2008) service less than 10 homes.

Another option is to get water from a private well. In rural areas where homes are far apart and building a community system would take a lot of infrastructure, residents are more likely to drill individual wells.

Farms in both rural and urban areas may use an acequia system that diverts surface water into a canal system so that it can provide irrigation. (Additional information on acequias can be found in Chapter 1.)

In some cases, a single well provides the only source of water for an entire community. The well is usually centrally located, and residents are required to carry the water in buckets from the well to their homes. This group of New Mexicans is the most likely to be conserving water. If you had to carry all the water you needed to take a bath—how many trips would you be willing to make?

Demonstration/Visualization: Leaks

(This activity is best done outside.)

- Explain to students that large amounts of water are wasted every year on leaks. Leaks can happen in the toilet, faucet, shower or anywhere in the house. Leaks also occur where they can't be seen, in the miles of underground pipes that transport water to homes.
- Have the students line up in a straight line; give everyone a plastic cup.
- At one end of the line is the community well; at the other end is a home.
- For the student closest to the community well, fill the cup with water all the way to the brim.
- Explain to students that they will be pouring water from cup to cup. Before you start, ask the students to guess how much water will be lost by the time the water reaches the final cup. Make a mark on the final cup with your guess.
- Have the first student pour the water into the next student's cup.
- Each student slowly pours the water into the next student's cup until it has reached the end of the line or the home.
- Measure the water left. How much was lost? What is that percentage?
- Repeat the process but ask the students to move a little faster.
- Water lost represents leaks in the infrastructure (pipes, meters). The leaks can also be in your home.

STUDENT BOOKLET ACTIVITY: WHERE DOES OUR WATER COME FROM?

Objective:
Students will discover where New Mexico's water comes from and how it gets to their homes.

Materials:
"Where Does Our Water Come From?"
(pages 10-11 in the student booklet)
paper or journal
pen, pencil, or crayons

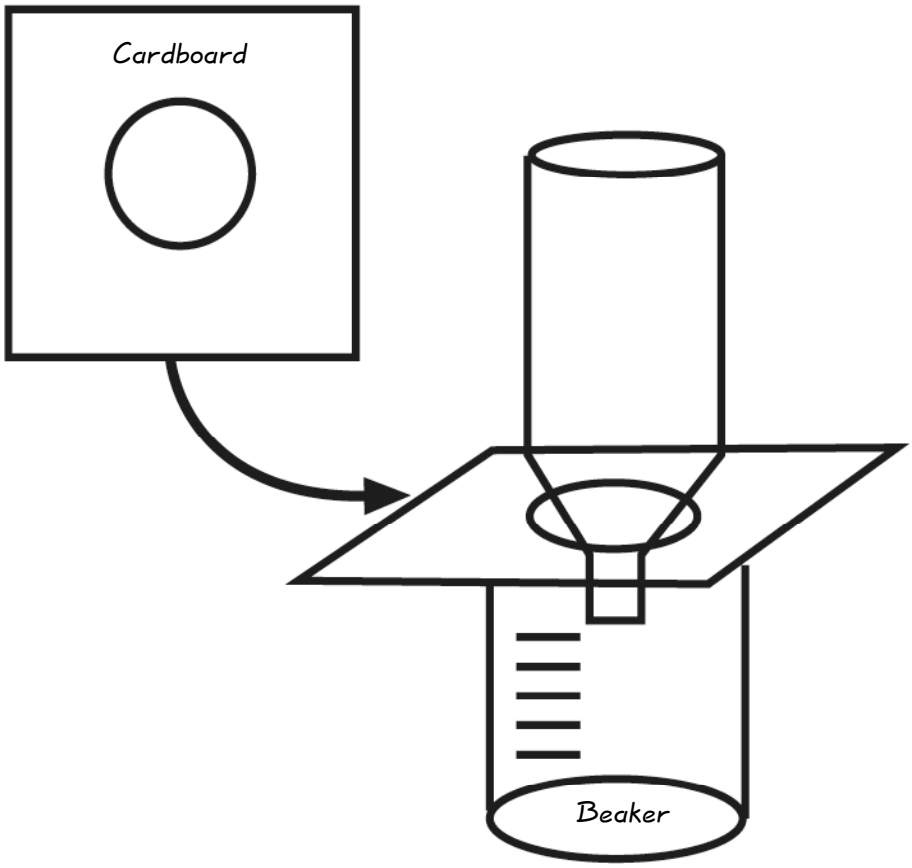
Vocabulary:
well
pump
pipes
aquifer
community well
private well

Introduction:
Do students know where their water comes from? Have students determine whether their water is coming from the aquifer (ground water) or a river or lake (surface water). Is this water going through a treatment plant, or do they have a private well with their own treatment? The teacher will have to check with the local water authority to determine which answer is correct for their community. Even then, some students may have private wells and ditch rights. Families may have multiple sources in one home. For example, a house that is on a municipal well (receives ground water from a utility) might also have a private well or ditch rights for their irrigation or livestock needs.

Procedure:
1. Examine "Where Does Our Water Come From?" (pages 10-11 in the student booklet)
2. Find the numbers on the illustration. Have the students follow the numbers from 1 to 14 and read the corresponding text at the bottom of the page.
3. Do the students recognize any of these steps? Have they seen snow on the mountains or a water storage tank?
4. Ask the students where they fit into this picture. Where does their water come from? (private well, surface water supplied by municipality, or ground water supplied by municipality)

Additional Activities
- Draw a water cycle onto a map. Show precipitation, evaporation and condensation.
- Have the students draw their own pictures and/or write a paragraph about where they get water.
- Edible Aquifer – make an aquifer out of vanilla ice cream, clear soda, different size chocolate chips, cake decoration sprinkles and sugars, drinking straws, spoons and clear cups. (A non-edible aquifer can also be built using the actual materials: sand, rock, clay and water.)
  - ✔ Fill a clear cup about one-third of the way with chocolate pieces (a less sweet option is to use ice chips, just be sure to work quickly, before they melt). This represents all of the sand, gravel, and rocks in the aquifer.
  - ✔ Pour the clear soda over the "gravel, sand, and rock layer." This is ground water. The "water" fills in the spaces around the "gravel, sand, and rock."
  - ✔ Scoop a layer of ice cream on top for the confining layer, which is usually clay or dense rock. The water is confined below this layer.
  - ✔ Add another layer of chocolate chips – "gravel and sand."
  - ✔ Finally, top with a layer of decorating sprinkles or some colored sugar for "topsoil".
  - ✔ Simulate a well by putting in a straw and drinking.
  - ✔ Simulate rain or recharge to the aquifer by adding more soda.
  - ✔ Simulate pollution by putting a drop of food color on top of the ice cream, then recharge with soda.
- Take a field trip to a treatment plant.
- Build a sand filter out of an old soda bottle to represent water treatment.
  - ✔ Cut the bottom third off an old plastic soda bottle.
  - ✔ Attach a coffee filter to the neck of the bottle with a rubber band.

- ✔ Turn the bottle upside down and pour a layer of pebbles into the neck. This layer (and all subsequent layers) should be about 2" thick. Be sure to leave room for liquids that will be poured into the top.
- ✔ Pour course sand on top of the pebbles.
- ✔ Pour fine sand on top of the course sand.
- ✔ Cut a sturdy piece of cardboard to fit on top of a beaker (see below). Cut a hole in the middle to place neck of the soda bottle. This hole will hold the bottle off the bottom of the beaker and allow you to see the water as it comes out. Try to not get the cardboard wet, as it will weaken the setup.
- ✔ Place neck of bottle in the cardboard on top of the beaker or other catchment container.
- ✔ Slowly pour clean water through the bottle to clean any debris that might be in the system.
- ✔ Dump clean water.
- ✔ Slowly pour "muddy" water through filter.
- ✔ Compare the muddy water before and after filtration.



CHAPTER 3

Affecting Understanding and Change

Section 1. Understanding Supply

Background Material

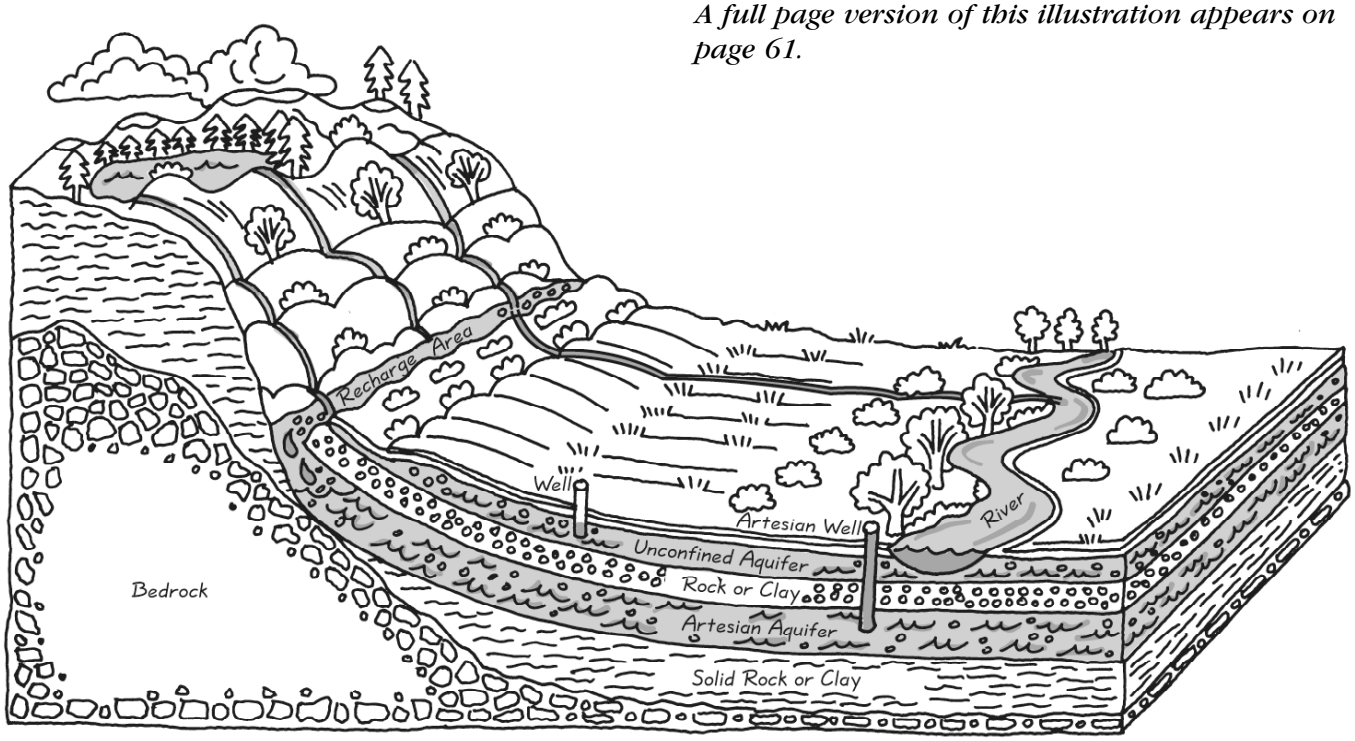
An aquifer (containing ground water) is hard concept to explain. Since an aquifer is completely underground, the only evidence that it exists is when water seeps up from underground in the form of a spring or is pumped out with a well. The actual water level or amount of water held in an aquifer can only be an educated guess. Hydrologists use a variety of instruments to determine an aquifer's boundaries and water content before they drill wells. But, even wells drilled side-by-side may produce different amounts of water due to variations in the hydrology.

An aquifer, by definition, is a water-bearing layer of permeable[17] rock, sand, or gravel. It must have an impermeable[18] layer as its base. A confined aquifer is an aquifer that has an impermeable layer both above and below it. An artesian aquifer is a confined aquifer that is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer. An unconfined aquifer has no confining layer between the water table and the ground surface above.

Aquifers recharge the same way that surface water recharges, through precipitation. However, the water must seep through the various layers of soil and rock before it hits the water table or the confined layer that holds the aquifer. As water-storage devices, aquifers have an advantage over surface water in that they do not lose moisture to evaporation.

Surface water is clearly visible, so it's easy to track how much of the water supply is being used. During a season of heavy snow, for example, spring melt fills the rivers; when irrigation season begins, water levels drop. Water levels in underground aquifers, on the other hand, aren't visible, so water consumption is much harder to track. Hydrologists can examine wells to determine water levels and estimate water withdrawals. However, the general public does not have a visual confirmation of the impact it has on the aquifer's supply of water.

A full page version of this illustration appears on page 61.



[17]Permeable – permitting passage (as of a fluid) through its substance
[18]not permitting passage (as of a fluid) through its substance

STUDENT BOOKLET ACTIVITY: THE AQUIFER GAME

Objective:
Students will recognize that their actions impact their water supply.

Materials:
"The Aquifer Game" board
(pages 12 and 13 of the student booklet)
55 poker chips, buttons, or alternative counters
one die

Vocabulary:
aquifer
conservation
water table
drought

Introduction:
The water in an aquifer is the result of hundreds, perhaps hundreds of thousands of years of precipitation. Because it is hidden underground, no one is really sure of exactly how much water any aquifer contains. The geological formation that holds an aquifer will vary in size and depth from place to place, which is why drilling a well is such an art form. Too bad we cannot take an x-ray picture of the earth!

With increasing urban populations, growing demands for irrigation and additional technological processes that require water, the demands on New Mexico's aquifers are increasing. In most aquifers, the water that is pulled out exceeds the amount of water that is being recharged, a process called "depletion" or "mining." Just as iron or coal is removed from a mine, water is being removed from the aquifer faster than nature's processes can regenerate it. By implementing conservation practices, we can help slow the withdrawal and allow time for the aquifer to recharge.

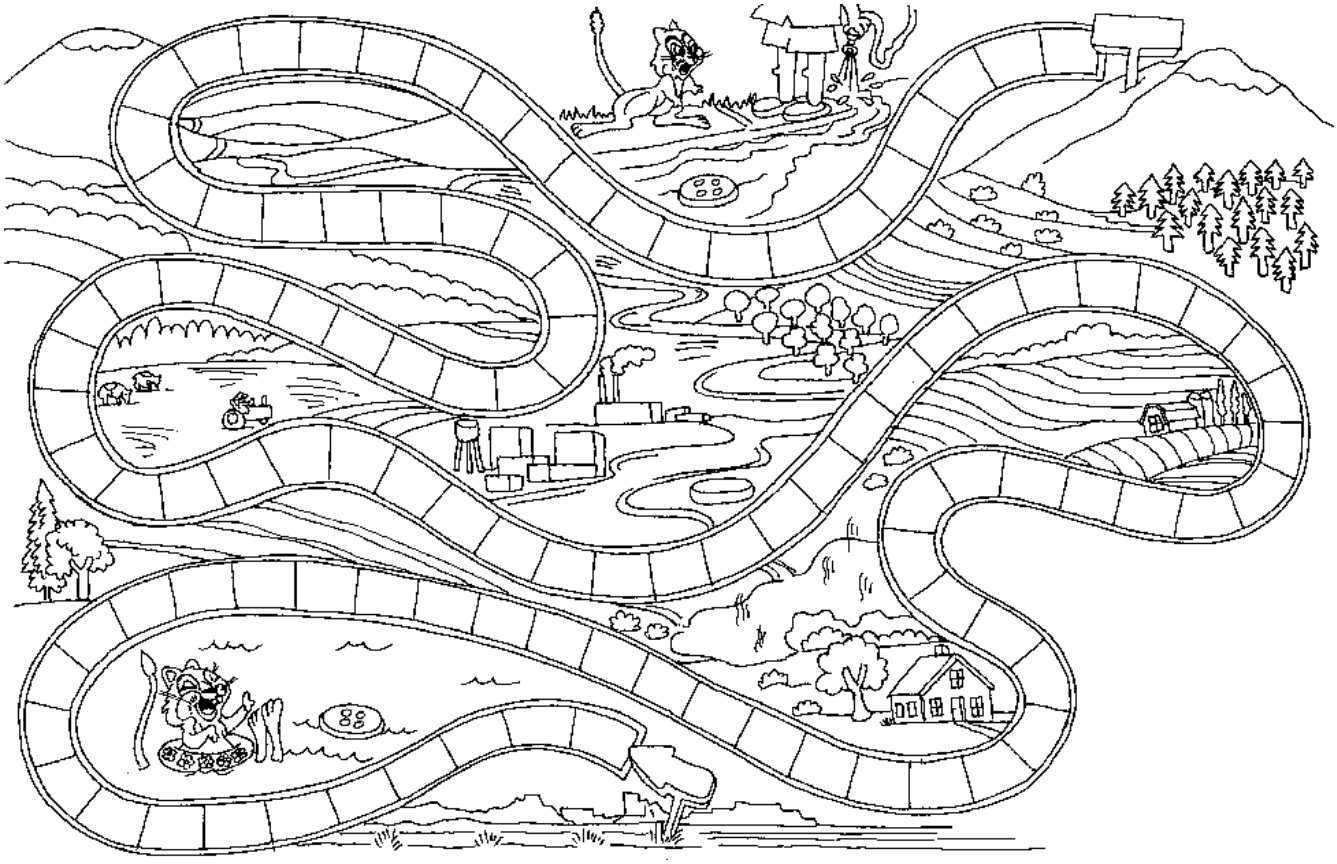
In The Aquifer Game, students work their way around a game board to either save or use water. In Level 3, they will also learn of household activities and natural events that affect supply, such as drought and rain. Students work as a team to protect their water supply.

Please make sure that the students know the difference between using water and wasting water. As they play the game, have students decide what are necessary uses of water and what is wasteful.

Procedure:
1. Place the game board where all the students can see. (Grouping option: Divide the class into groups. Supply one game board for each group.) You will need 55 counters, one die, and a game piece for each game board.
2. Place 20 counting pieces in the space marked "aquifer," which represents all of the ground water available to the group.
3. Place 20 counting pieces in the space marked "used," which represents all the water their community has used in the past. Fifteen pieces will be set aside in case of natural recharge events, like snow or rain.
4. The students represent all of the aquifer users who will be working as a community to try to save the water in the aquifer and reduce the water used. Place the game piece on the first square of the board.
5. Have one student roll the die (a task that can rotate as a responsibility).
6. Actions are taken only when students land on a blue or red drop or a square with instructions. If they land on a blank square, no action is taken.

There are several levels of play. Before starting the game, decide which level you will be playing. You can advance through the levels as the game continues.

- Level 1: If the students land on a blue drop, water has been saved and pieces are moved from "used" to "aquifer." If students land on a red drop, water has been used and pieces are moved from "aquifer" to "used." Roll one die again to see how many pieces are moved. (If this is confusing, write numbers from 1 to 6 on the drops prior to beginning the game. Students would then add or remove pieces using the number on the drop.)
- Level 2: When students land on a drop they have to state what action they might have taken to "use" or "save" water, a water use might be "take a shower," water saved might be "turn off the water when brushing teeth." As the game progresses, encourage the students to think of new uses and savings.
- Level 3: Use the game cards that are included in the teacher guide for blue and red actions. When students land on a red or blue drop, draw the corresponding card and add or remove pieces per instructions. Put the used cards on the bottom of the pile. Note: You will need 15 extra playing pieces for Level 3 (55 total).
- Level 4: Students make their own game pieces.



Save the Aquifer Game Cards—Level 3

Blue Drop	Red Drop
You turn the water off when you brush your teeth – **move 1 piece from Used to Aquifer**	You leave the water running when you brush your teeth – **move 1 piece from Aquifer to Used**
You use a broom instead of the garden hose to clean your driveway – **move 6 pieces from Used to Aquifer**	You clean the driveway using water from the garden hose instead of a broom – **move 6 pieces from Aquifer to Used**
You wash only full loads of laundry – **move 5 pieces from Used to Aquifer**	You washed half of a load of laundry instead of a full load – **move 5 pieces from Aquifer to Used**
You never water the lawn on a rainy day – **move 6 pieces from Used to Aquifer**	You watered your lawn during the heat of the day and it evaporated – **move 6 pieces from Aquifer to Used**
You watered outside plants with water that you collected in a bucket before the shower got hot – **move 2 pieces from Used to Aquifer**	You let the outside faucet run to create mud for your mud pies – **move 5 pieces from Aquifer to Used**
You never flush trash down the toilet – **move 2 pieces from Used to Aquifer**	You told your little sister to use the toilet as a trash can – **move 2 pieces from Aquifer to Used**

Save the Aquifer Game Cards—Level 3 (continued)

Blue Drop	Red Drop
You told an adult about a leaky faucet – **move 3 pieces from Used to Aquifer**	You left the water running while you washed your hands – **move 2 pieces from Aquifer to Used**
Instead of your usual 10-minute showers, you took a 5-minute shower – **move 4 pieces from Used to Aquifer**	You left the hose running while you gave the dog a bath – **move 3 pieces from Aquifer to Used**
The area receives a heavy rain – **add 6 new pieces to Aquifer**	The area is in the middle of a drought. It has not rained or snowed in 2 months. **move 6 pieces from Aquifer to Used**
The mountains received heavy snow over the winter – **add 5 new pieces to Aquifer**	The city added a new sbdivision – **move 7 pieces from Aquifer to Used**

Additional Activities

- Create different games using water as the theme, such as Concentration where the pieces are pictures and words that have to be matched. Words can be in both English and Spanish.

Section 2: Sharing With Family

Background Information

Water conservation, like an aquifer, is a very abstract thing for students. They do not see the direct results of their actions. It is our job to convince them that all of their small actions can add up to big savings.

Demonstration/Visualization:
The Sponge Soak

- Fill a bucket with water, which represents the water supply. Use a bucket with a wide opening that holds about a gallon of water.
- Place a tape mark at the water level.
- Give each student a small sponge (a half of a regular sponge works great).
- Ask each student to use a permanent marker and write or draw on one side of the sponge one example of how they used water today. (Be sure that the sponges are dry.) If you would like to reuse the sponges, have the students write on a separate piece of paper.
- On the other side of the sponge write or draw one way that they will conserve water.
- One at a time, ask students to come up to the bucket, dip their sponges in the water then pull it out without wringing it out, and state how they used water that day. Keep a list of their uses on the board.
- Place a second bucket next to the first and ask the students to wring out their sponges in the second bucket. As they are wringing, ask them to share what they plan to do to save water. Write these on the board also.
- After all of the students have gone, mark a second tape mark on your bucket to show how much water the students used.
- Dump the bucket of conserved water (where the student wrung their sponges) back into the original bucket. This is the water that they conserved. Mark the spot on the bucket.
- Discuss how each individual action can add up to huge water savings if everyone participates.
- The difference between the first marked water level and the last marked water level (after conservation has been returned) represents the water that has been consumed.

STUDENT BOOKLET ACTIVITY: THE MAYOR'S BATH

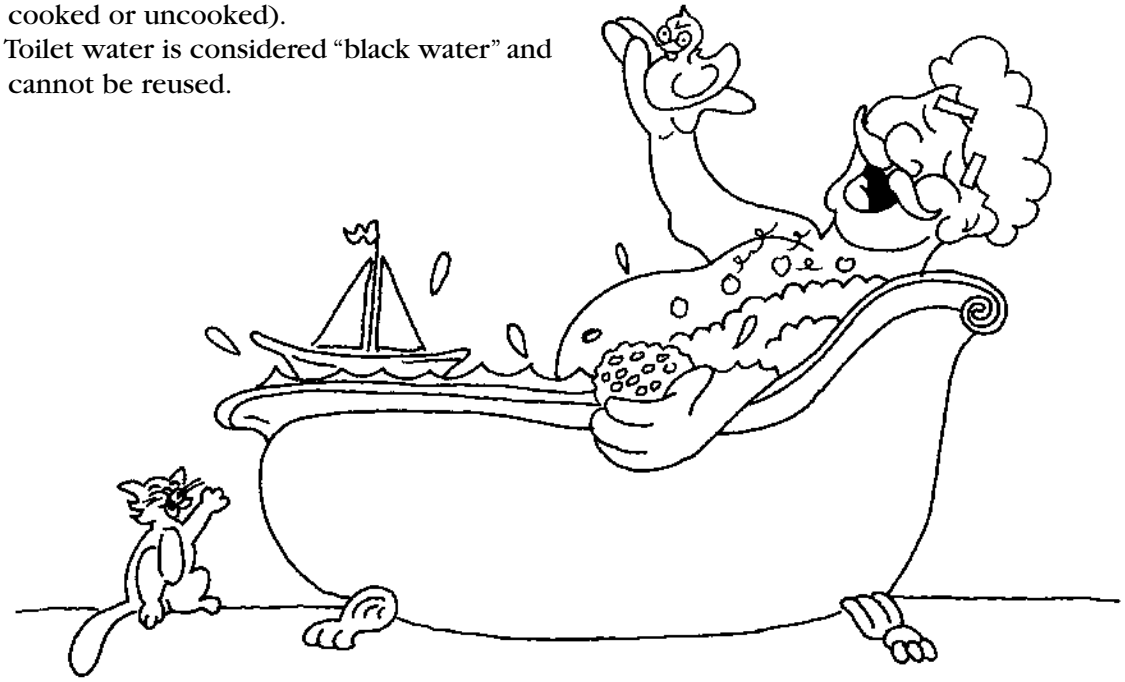
Objective:
Introduce the concept of water reuse or gray water to the students.

Materials:
"The Mayor's Bath"
(pages 14-15 in student booklet)

Vocabulary:
reuse
gray water
responsibility
conservation

Procedures:
1. Read *The Mayor's Bath* to the students.
2. Ask the students what the mayor did wrong and what he learned in the end.
3. Ask the students if they know ways that they can reuse or conserve water. Here are some tips for reusing water:
   - Do not reuse water (including dishwater) that has come in contact with meat (either cooked or uncooked).
   - Toilet water is considered "black water" and cannot be reused.
   - Clothes washers are a great source of gray water if there is not a lot of fecal matter (from diapers).
   - Do not use gray water in high traffic areas in your landscape where it is likely to come in contact with children and pets. The best way to achieve this is to bury your gray water under mulch or crusher fines so that it does not sit on the surface.
   - The best use for gray water is watering plants — both in the landscape and those growing in pots. However, gray water should not be used on root crops such as carrots or radishes.
4. Ask students to share the story of *The Mayor's Bath* with their families.

Additional Activities
- Create a list of ways to reuse water.
- Write and illustrate your own story about water reuse.
- Ask students to read the story with their families and as a family come up with three ideas on how to reuse water. They can bring the ideas back to school to share with the class.



The Mayor's Bath

Adapted from a children's book *The Sultan's Bath* by Victor G. Ambrus

Once there was a very dry city in a desert where it almost never rained. Water was always scarce. Every night the mayor of this very dry city sent his staff out to collect all the water they could find for the mayor's daily bath.

The mayor enjoyed his morning bath very, very much. He loved to float his toy boat in his bath water.

One morning the mayor jumped into his bath as usual, and he hit the bottom of the tub hard! All the water collected for the mayor's bath had been stolen overnight! The mayor flew into a rage and ordered his staff to find the thief.

The staff searched the dry city, but they could not find the thief. The bath water continued to disappear night after night. Then, one night when the moon was bright, Miguel the Gardener was spotted carrying two large watering cans full of the mayor's bath water.

Miguel carried the watering cans through a wooden door that led to a secret garden inside a courtyard. Surrounded by his friends – a roadrunner, three coyotes, some kangaroo rats, and birds of many kinds – the gardener began to water his plants.

The staff sent for the police, who dashed into the garden to arrest Miguel. The roadrunner shrieked and the kangaroo rats ran under the feet of the police. The coyotes howled and the birds noisily flapped their wings. But it was no use. Miguel was captured and thrown into jail.

The mayor was surprised to hear of the secret garden and went to see it for himself. Flowers were rare in the desert, and he was astonished to see so many beautiful flowering plants. The mayor sat down under the tall sunflowers. Sitting in the garden made him feel very happy and peaceful.

After Miguel was put in jail, no one stole the mayor's bath water. Each morning, the mayor splashed in his bath and then went to sit in the garden. But, alas, the flowers soon began to fade and the plants began to die. The roadrunners and the birds and the little kangaroo rats began to droop and hide. The Mayor grew sadder every day.

Now, while Miguel had been in prison, he had been thinking. Miguel told the mayor to have his bath as usual. Then, after the mayor's bath, Miguel would take the water to use in the garden.

Very soon everything in the garden was growing again, and even the mayor was lending a helping hand. For the rest of their lives the mayor and Miguel tended their garden—right after the mayor took his daily bath.

Section 3: Community Outreach

Background Information

True change comes from within. However, it is extremely hard to sustain change if it is not supported outside of the classroom. If we are to ask our students to change their water-use habits, we will need the support of their communities. The students can gain that support by helping to educate the community about what they have learned. As educators, it is our job to provide opportunities for the students to show off what they have learned.

Additional Activities

- Take a water conservation poster to the local hardware/grocery store.
- Perform plays or skits on the water uses in New Mexico to other groups of students.
- Allow the students time to present their water conservation ideas at parent-teacher functions, local water fairs, or other appropriate events.
- Make calendars out of the posters and drawings from this curriculum and distribute them to your school and community.
- Make Christmas/Valentine/Mother's Day/etc. gifts with a water theme.
- Next time they go into a store, building, library, or walk down the street, have your students list all of the ways they see that water is used.
- Conduct an informal water audit of the school or a local business.

APPENDICES

Appendix A

Glossary[19]

Acequia – ditches are used to move water from the river to where it is needed

Adaptation – change over time to better fit with environmental settings

Agriculture – practice of growing crops and raising livestock

Aquifer – an underground layer of rock, sand, or gravel that holds water

Community Well – a hole dug into the earth to reach underground water, pumps are used to bring the water to the surface, the water is shared by a group of people

Compass – a tool that uses magnets to determine direction (north, south, east and west)

Confined Aquifer – an aquifer where water cannot be go through the layer of rock above the water table

Conservation – a protection of a natural resource to prevent damage

Drought – a period with below normal rain or snow

Ecosystem – community of living things that interact with the environment, systems with boundaries

Evaporation – when water goes from a liquid or solid state into gas

Fresh Water – water that is not salty

Gallons Per Capita – the number of gallons of water used by a single person

Gallons Per Capita Per Day – the number of gallons of water used by a single person in one day

Glacier – a large body of ice on a land surface

Gray Water – water that has already been used for one purpose that is collected for use again

Ground Water – water in the earth that supplies wells and springs

Impermeable – not allowing liquids to move through

Industry – a business or manufacture

Irrigation – to supply water to plants

Journal – a place to write thoughts and knowledge, kept on a regular basis

Livestock – farm animals kept or raised for use or profit

Mayordomo – a person in charge of an acequia system

Ocean – the whole body of salt water that covers nearly three fourths of the surface of the earth

Personal Impact – One person's affect (on water use and/or conservation)

Permeable – allowing liquids or gases to move through

Pipes – a long tube for moving a liquid

Pottery – made out of clay, usually for containers

Private Well – a hole dug into the earth to reach underground water, pumps are used to bring the water to the surface, the water is used by one home or business

Pump – a tool that brings water from underground to the surface

Residential – having to do with a home

Reuse – to use the same water over again

Riparian – connected to the river, living on or by the river

Surface Water – fresh water on the earth's surface such as lakes, streams, and rivers

Utility – a service (electricity or water) provided by a public group

Water Table – the top level of the groundwater or aquifer

Well – a hole dug into the earth to reach underground water, pumps are used to bring the water to the surface

[19]Most definitions were adapted from Merriam-Webster Online, http://www.m-w.com/

Appendix B

Spanish Translations

(University of Chicago Spanish Dictionary 3rd Edition)

Adaptation – adaptación
Agriculture – agricultura
Aquifer – acuífero
Artesian Well – pozo artesiano
Community Well – pozo de la comunidad
Compass – compás
Conservation – conservación
Drought – sequia
Evaporation – evaporación
Fresh Water – agua dulce
Glacier – glaciar
Gray Water – agua gris
Ground Water – agua subterránea
Industry – industria
Irrigation – irrigación
Journal – diario
Livestock – ganado
Ocean – océano
Personal Impact – impacto personal
Pipes – pipa
Pottery – cerámica
Private Well – pozo privado
Pump – para sacar agua
Residential – residencial
Reuse – reutilización
River – río
Surface Water – agua superficial
Toilet – escusado
Utility – utilidad
Water – agua
Watershed – vertiene
Water Supply – abastecimiento de agua
Water Table – tabla del agua
Waterway – vía de agua
Well – pozo

Spanish Phrases

Flush the toilet - limpie el escusado con un chorro de agua
Brush teeth – cepilla los dientes
Take a bath or shower – tomar un baño
Wash clothes – lava ropa
Wash dishes – lava platos
Water the lawn and garden - riegue el patio y el jardín

Appendix C

Charts and Graphs
*Inches of Average Monthly Rainfall for NM Towns

	*INCHES OF AVERAGE MONTHLY RAINFALL FOR NM TOWNS												
**NM Towns	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	**Annual**
Abiquiu Dam	0.38	0.26	0.51	0.55	0.83	0.71	1.59	2.01	1.13	0.88	0.53	0.34	**9.71**
Alamogordo	0.73	0.52	0.46	0.32	0.50	0.83	2.13	2.13	1.68	1.05	0.54	0.81	**11.68**
Albuquerque	0.39	0.40	0.48	0.50	0.61	0.65	1.31	1.52	1.02	0.81	0.48	0.49	**8.66**
Animas	0.70	0.54	0.49	0.19	0.17	0.45	2.20	2.36	1.46	0.99	0.57	1.03	**11.15**
Belen	0.28	0.40	0.40	0.26	0.31	0.63	1.40	1.32	0.90	0.98	0.20	0.39	**7.45**
Bernalillo	0.43	0.49	0.56	0.43	0.58	0.55	1.47	1.50	0.83	0.95	0.44	0.47	**8.68**
Carlsbad	0.43	0.44	0.30	0.53	1.24	1.53	1.73	1.96	2.34	1.24	0.49	0.51	**12.72**
Clayton	0.27	0.40	0.65	1.21	2.39	1.91	2.64	2.31	1.68	1.09	0.50	0.38	**15.44**
Clines Corners	1.05	0.82	0.99	1.00	1.60	1.61	2.72	3.16	2.24	1.49	1.04	1.00	**18.71**
Clovis	0.43	0.43	0.59	1.04	2.10	2.60	2.62	2.96	2.16	1.61	0.56	0.60	**17.71**
Corrales	0.43	0.39	0.67	0.65	0.68	0.82	1.63	1.95	1.18	0.85	0.91	0.64	**10.80**
Crownpoint	0.52	0.51	0.49	0.50	0.36	0.67	2.06	1.89	0.85	0.85	0.46	0.61	**9.75**
Cuba	0.89	0.69	0.88	0.68	0.80	0.80	2.07	2.28	1.38	1.11	0.80	0.72	**13.09**
Deming	0.48	0.54	0.34	0.20	0.16	0.37	2.07	1.90	1.22	0.79	0.52	0.89	**9.50**
Española	0.47	0.43	0.59	0.58	0.89	0.75	1.50	1.94	1.00	0.90	0.57	0.50	**10.12**
Estancia	0.54	0.53	0.64	0.55	1.01	0.97	2.19	2.38	1.51	1.13	0.64	0.80	**12.87**
Farmington	0.58	0.50	0.55	0.51	0.36	0.46	0.80	1.07	0.83	1.11	0.49	0.62	**7.89**
Fort Sumner	0.39	0.40	0.44	0.59	1.16	1.47	2.42	2.81	1.80	1.37	0.55	0.49	**13.90**
Gallup	0.89	0.73	0.89	0.53	0.64	0.47	1.54	1.93	1.13	1.00	0.99	0.74	**11.50**
Grants	0.51	0.43	0.52	0.45	0.57	0.57	1.71	2.10	1.35	1.10	0.56	0.66	**10.52**
Hobbs	0.48	0.45	0.46	0.80	2.09	1.83	2.16	2.42	2.66	1.58	0.57	0.58	**16.06**
Jemez Springs	1.08	0.88	1.02	0.89	1.07	1.07	2.61	3.12	1.58	1.50	1.06	0.94	**16.83**
Las Cruces	0.52	0.33	0.23	0.21	0.33	0.66	1.46	2.27	1.31	0.82	0.46	0.76	**9.17**
Los Alamos	0.91	0.79	1.10	0.94	1.31	1.38	3.14	3.78	1.82	1.42	0.98	0.98	**18.53**
Los Lunas	0.35	0.42	0.46	0.44	0.49	0.57	1.23	1.76	1.21	1.06	0.46	0.53	**8.98**
Pecos	0.66	0.65	0.86	0.73	1.14	1.29	3.00	3.48	1.86	1.09	0.80	0.63	**16.21**
Raton	0.37	0.39	0.71	0.91	2.51	2.25	2.87	3.34	1.88	0.92	0.49	0.41	**17.07**
Roswell	0.42	0.46	0.29	0.60	1.33	1.63	2.01	2.48	2.16	1.06	0.51	0.59	**13.52**
Ruidoso	1.17	1.20	1.21	0.63	0.94	1.94	4.05	4.03	2.65	1.54	0.85	1.63	**21.85**
Sandia Park	3.10	1.24	1.44	0.93	1.14	1.12	3.00	3.00	1.83	1.40	1.31	1.20	**20.44**
Santa Fe	0.65	0.74	0.79	0.94	1.33	1.05	2.35	2.17	1.52	1.11	0.62	0.71	**13.99**
Shiprock	0.51	0.43	0.46	0.40	0.52	0.32	0.63	0.98	0.67	0.86	0.57	0.59	**6.93**
Silver City	1.25	0.85	0.84	0.55	0.21	0.58	2.78	2.48	1.91	1.21	0.49	1.07	**14.17**
Socorro	0.39	0.39	0.33	0.37	0.59	0.62	2.59	1.77	1.46	0.97	0.37	0.56	**10.40**
Taos	0.71	0.63	0.83	0.77	1.17	0.89	1.62	1.98	1.25	1.03	0.84	0.68	**12.40**
Tijeras	0.63	0.97	1.06	0.90	0.78	0.88	2.45	2.42	1.57	1.46	0.80	1.18	**15.10**
T or C	0.47	0.37	0.33	0.21	0.42	0.81	1.72	2.11	1.37	0.96	0.54	0.96	**10.26**
Tucumcari	0.26	0.47	0.39	0.87	1.49	1.78	3.30	2.40	1.46	0.94	0.50	0.27	**14.11**
Vaughn	0.44	0.44	0.35	0.51	0.92	1.60	1.99	2.56	1.41	0.87	0.41	0.38	**11.87**

Table from City of Albuquerque *Rainwater Harvesting Supply from the Sky*
*Data Obtained from the Western Regional Climate Center and the National Oceanic and Atmosphere Agency
** The average rainfall for more specific locations may vary from the averages shown here. In Albuquerque, for example, average rainfall ranges from 8.51 inches a year at the airport to 14.00 inches a year near the Sandia foothills.

Appendix C

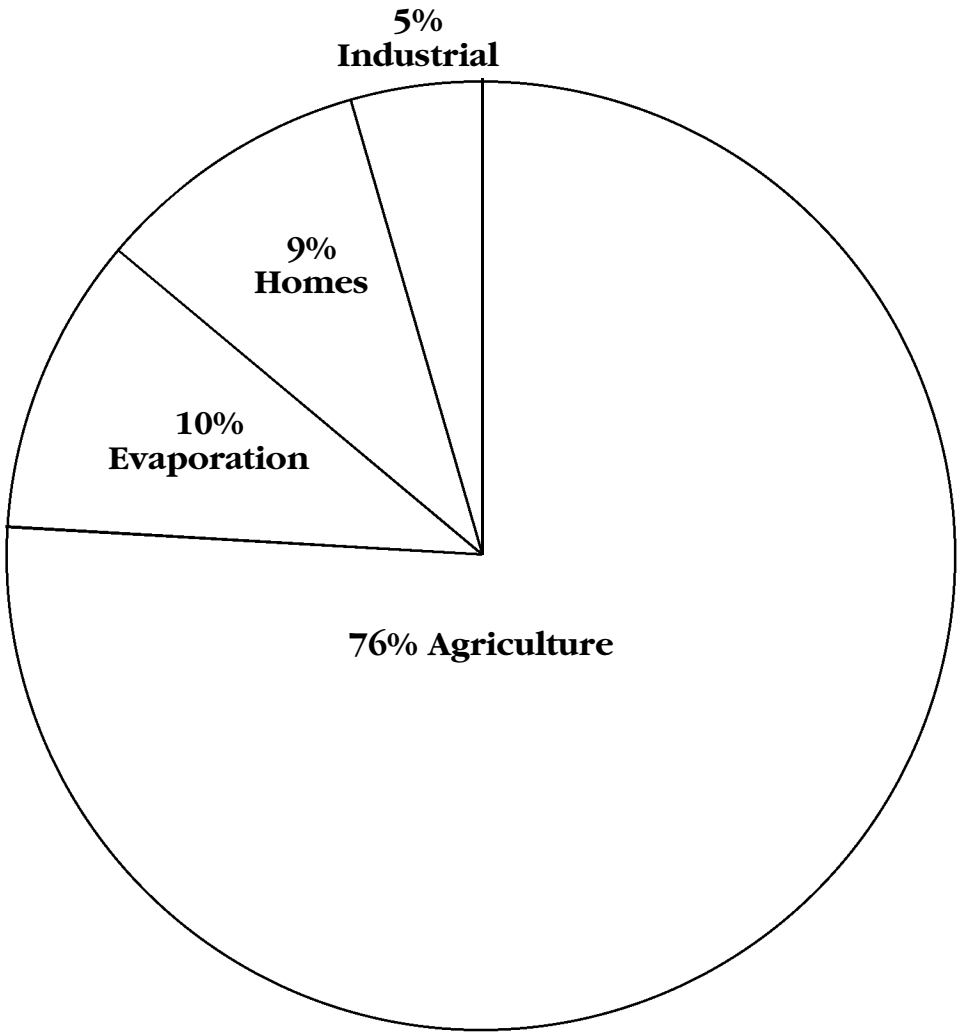
Charts and Graphs
Percentage of Surface Water by State

State	Land Area (sq. miles)	Surface Water Area (sq. miles)	Percent Surface Water	State	Land Area (sq. miles)	Surface Water Area (sq. miles)	Percent Surface Water
Rhode Island	1,212	158	13.0%	Kentucky	40,410	740	1.8%
D. C.	69	6	8.7%	Alabama	51,705	938	1.8%
Florida	58,664	4,511	7.7%	Texas	266,807	4,790	1.8%
North Carolina	52,669	3,826	7.3%	California	157,706	2,407	1.5%
Maine	33,265	2,270	6.8%	South Dakota	77,116	1,164	1.5%
Louisiana	47,752	3,230	6.8%	Georgia	58,910	854	1.4%
Maryland	10,460	623	6.0%	Idaho	83,564	1,153	1.4%
Minnesota	84,402	4,854	5.8%	Illinois	56,345	700	1.2%
Massachusetts	8,284	460	5.6%	Montana	147,046	1,658	1.1%
Delaware	2,045	112	5.5%	Missouri	69,697	752	1.1%
New Jersey	7,787	319	4.1%	Mississippi	47,689	457	1.0%
Vermont	9,614	341	3.5%	Pennsylvania	45,308	420	0.9%
New York	49,108	1,731	3.5%	Nebraska	77,355	711	0.9%
Alaska	591,004	20,171	3.4%	Oregon	97,073	889	0.9%
Utah	84,899	2,826	3.3%	Wyoming	97,809	820	0.8%
New Hampshire	9,279	286	3.1%	Ohio	41,330	325	0.8%
Wisconsin	56,153	1,727	3.1%	Hawaii	6471	46	0.7%
Connecticut	5,018	147	2.9%	Indiana	36,185	253	0.7%
South Carolina	31,113	909	2.9%	Kansas	82,277	499	0.6%
Michigan	58,527	1,573	2.7%	Nevada	110,561	667	0.6%
Virginia	40,767	1,063	2.6%	Iowa	56,275	310	0.6%
Washington	68,139	1,627	2.4%	Colorado	104,091	496	0.5%
Tennessee	42,144	989	2.3%	West Virginia	24,232	112	0.5%
Arkansas	53,187	1,109	2.1%	Arizona	114,000	492	0.4%
North Dakota	70,702	1,403	2.0%	**New Mexico**	**121,593**	**258**	**0.2%**
Oklahoma	69,956	1,301	1.9%				
				United States	**3,618,770**	**79,481**	**2.2%**

USGS Water Science for Schools http://ga.water.usgs.gov/edu/wetstates.html
These data represent only "inland" water — water that is surrounded by lands of the United States. Areas such as the Great Lakes are excluded.

Appendix C

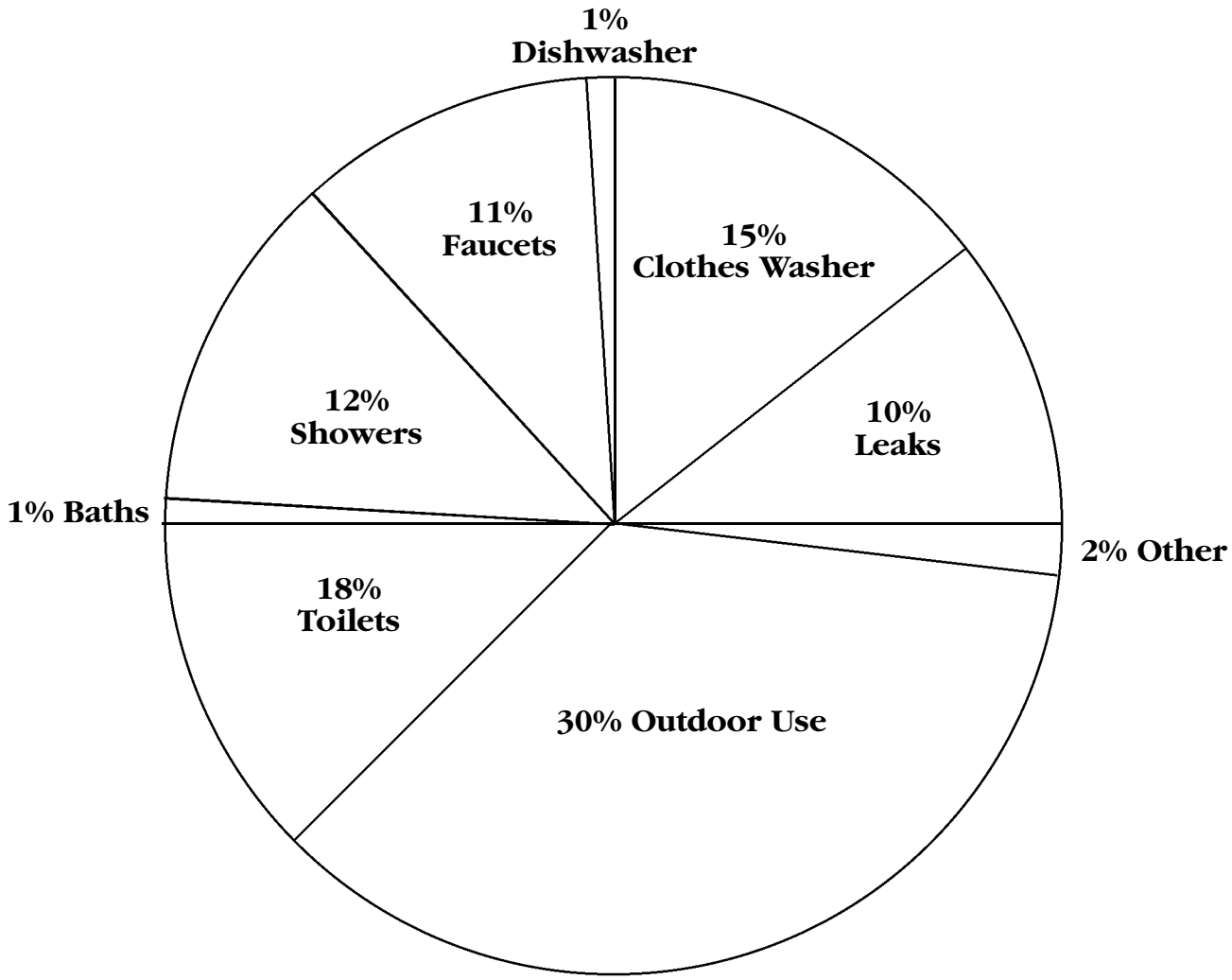
Charts and Graphs
How Does New Mexico Use Its Water?



Wilson, Brian and Lucero, Anthony, *Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 2000* (Santa Fe: New Mexico State Engineer Office, 2000), 3-4

Appendix C

Charts and Graphs
How is Water Used in the Home?



Vickers, Amy, *Handbook of Water Use an Conservation* (Amherst: Waterplow Press, 2001), 14-23.

Appendix D

Resources

Children's Books

Victor G. Ambrus, *The Sultan's Bath*
Harcourt Brace Jovanovich; 1st American edition, 1972
Out of print but used library copies still available

Frank Asch, *Water*
Voyager Books; March 2003

Michael Caputo and Joseph Bruchac, *Native American Gardening: Stories, Projects and Recipes for Families*
Fulcrum Publishing; April 1996

Karen Hesse, *Come On Rain*
Scholastic; 1st edition, March 1999

Meredith Hooper, *The Drop in My Drink, The Story of Water on Our Planet*
Viking Books; October 1998

Carolyn Meyer, *Rio Grande Stories*
Gulliver Books, June 1994
Fictional account of junior-high students telling their personal stories and accounts of growing up along the Rio Grande

Nancy Van Laan, *The Magic Bean Tree*
Houghton Miffin Co; March 1998

Walter Wick, *A Drop of Water: A Book of Science and Wonder*
Scholastic; April 1997

Curriculum

Bosque Education Guide
This curriculum is available through a teacher workshop or on-line. The primary sponsors are New Mexico Museum of Natural History and Science and the Rio Grande Nature Center State Park. To find a schedule of upcoming workshops or to download activities, go to http://www.museums.state.nm.us/nmmnh/BEG/beghome.htm or call the museum at 505-841-2800.

Conserve Water Student Booklet
The Watercourse
201 Culbertson Hall
Montana State University
Bozeman, Montana 59717
http://www.projectwet.org/watercourse/
1-866-337-5486
Fax (406) 994-1919
Email info@projectwet.org

Discover A Watershed: Rio Grande/Rio Bravo Student Booklet
The Watercourse
201 Culbertson Hall
Montana State University
Bozeman, Montana 59717
http://www.projectwet.org/watercourse/
1-866-337-5486
Fax (406) 994-1919
Email info@projectwet.org

Project WET Curriculum and Activity Guide
The Watercourse
Council for Environmental Education
Project Wet, The Watercourse
This curriculum is only available through a teacher workshop. In New Mexico, the primary sponsor is WERC/New Mexico State University. To find a schedule of upcoming workshops, call 1-800-523-5996.

Project WILD, K-12 Activity Guide
Council for Environmental Education
Western Association of Fish and Wildlife Agencies
This curriculum is only available through a teacher workshop. In New Mexico, the primary sponsor is the New Mexico Department of Game and Fish. To find a schedule of upcoming workshops, go to http://www.wildlife.state.nm.us/ or call 505-476-8119.

The Water Sourcebook
Water Environment Federation, Legacy, Inc. Partners in Education, Education Research and Inservice Center and the U.S. Environmental Protection Agency; September 1998
Available for free by downloading off the web at http://www.epa.gov/safewater/kids/wsb/

Appendix D

Kangaroo Rat Resources

Blue Planet Biomes -
http://www.blueplanetbiomes.org/kangaroo_rat.htm

Desert USA -
http://www.desertusa.com/aug96/du_krat.html

Enchanted Learning -
http://www.enchantedlearning.com/subjects/mammals/rodent/Kangarooratprintout.shtml

eNature.com® - http://www.enature.com/

Jaeger, Edmund C. "Chapter 12, The Kangaroo Rat," *Desert Wildlife*. Stanford: Stanford University Press, 1950, 1961.

McClelland, Elizabeth A. *Small Animals of North America*. Dover Pictorial Archive Series. New York: Dover Publications Inc., 1981.

Material Sources

The Groundwater Foundation
1-800-858-4844
PO Box 22558
Lincoln, NE 68542-2558
"Carries The Jug," which is an inexpensive model of an aquifer.

On-Line Resources

Indian Pueblo Cultural Center
http://www.indianpueblo.org/ipcc/

National Geographic, Wild World
http://www.nationalgeographic.com/wildworld/terrestrial.html

Natural Resources Conservation Service
http://www.nrcs.usda.gov

New Mexico Department of Agriculture
http://nmdaweb.nmsu.edu/stat.html

New Mexico Farm and Ranch Heritage Museum
http://spectre.nmsu.edu:16080/frhm/welcome.lasso

Pottery by Native American Women, Women Artists of the Southwest
http://www.sla.purdue.edu/WAAW/Peterson/

Scholastic Teacher website: Kid's Poems
http://teacher.scholastic.com/professional/teachwriting/kids_poems.htm

Southwestern United States Rock Art Gallery
http://net.indra.com/~dheyser/rockart.html

The Kax Harberger Center for Children and the Arts, http://artswork.asu.edu/arts/students/navajo/lesson4.htm

The Poetry Zone
http://www.poetryzone.ndirect.co.uk/teacher.htm

The World Gazetteer
http://www.world-gazetteer.com/

University of Massachusetts: Hollister Collection of Southwestern Native American Pottery
http://www.umass.edu/arthist/pots/main.html

USGS Water Science for Schools
http://ga.water.usgs.gov/edu/wetstates.html

Videos

Eyewitness Ocean Video - Old King Neptune gets mad, and the seas start to boil! From the ancient myths to modern science, *Eyewitness: Ocean* takes you and your family on an exciting voyage in the safety of your living room. Dorling Kindersley Studio, 1997

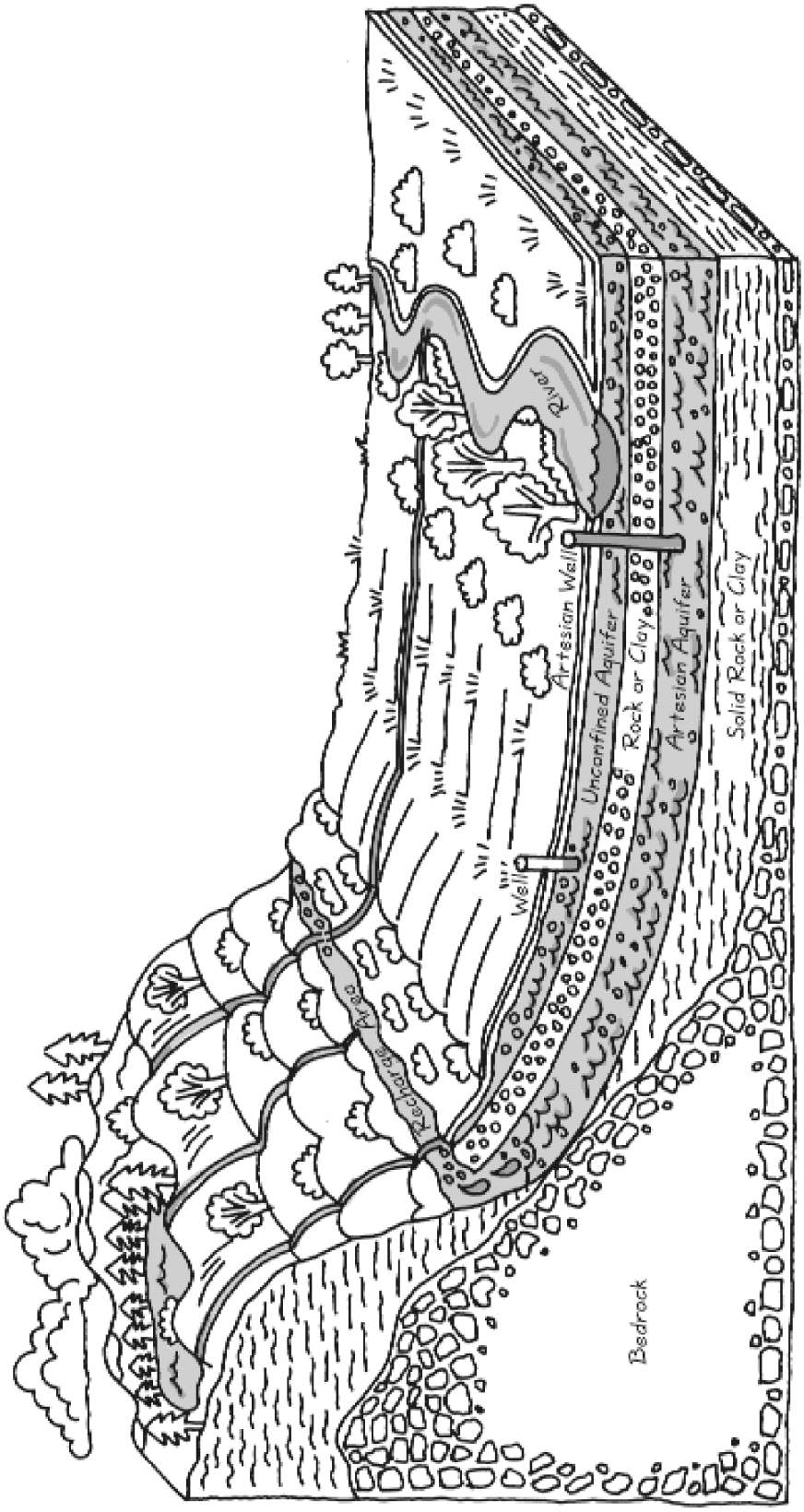
The Living Sea – IMAX format, an Academy Award-nominated documentary exploring exotic marine locales, Image Entertainment Studio, March 2000

Vrrrooommm! 1: Farming for Kids - This compelling edition is designed to help bring children closer to the American farmer and understand food production in our country. BigKidsVideo.com

Vrrroommm! 2: Dairy Farming for Kids - Using the rumble and live-action of hi-tech farm machinery, Farmer Bill gets kids' attention to deliver important messages about agriculture and U.S. farms. BigKidsVideo.com

Appendix E

Aquifer Diagram



Rio! The Water Detective
Correlation to

State of New Mexico Public Education Department
Content Standards, Benchmarks, and Performance Standards

Part 1: Correlated by Activity
Part 2: Correlated by Content Standard

Part 1: Correlated by Activity

Activity	Science	Mathematics	Social Studies	Language Arts
Chapter 1: Where's the Water?				
My Water Journal		Content Standard 2,A; Content Standard 4, D		Content Standard II, Benchmark II-B, C
Globe Toss	Strand I, Standard I, Benchmark I, III	Content Standard 4, D; Content Standard 5, C-E; Content Standard 10, A-B; Content Standard 11, B	Content Standard II-D	
Earth's Water	Strand I, Standard I, Benchmark III; Strand II, Standard III, Benchmark II	Content Standard 2, C; Content Standard 5, C, D; Content Standard 9,A, C	Content Standard II-A, D	
Play Money	Strand I, Standard I, Benchmark III; Strand II, Standard III, Benchmark II	Content Standard 1,A, D; Content Standard 5,A-D; Content Standard 7, C	Content Standard II-A, D	
Evaporation	Strand I, Standard I, Benchmark I, III; Strand II, Standard I, Benchmark I	Content Standard 1, C; Content Standard 7, D-E Content Standard 9,A, C	Content Standard II-D	
Map of New Mexico *(continued on page 63)*		Content Standard 9, B	Content Standard II-A, C, D	

Part 1: Correlated by Activity (continued)

Activity	Science	Mathematics	Social Studies	Language Arts
Chapter 1: Where's the Water? (continued)				
How Does New Mexico Use Its Water	Strand I, Standard I, Benchmark I, III	Content Standard 2, B-C; Content Standard 5, A, C D; Content Standard 6, D; Content Standard 12, B;	Content Standard II-C, F	Content Standard I, Benchmark I-C Content Standard II, Benchmark II-B, C
Where Is New Mexico's Water		Content Standard 9, B	Content Standard II-A, D	
Ways We Irrigate	Strand III, Standard I, Benchmark I		Content Standard I-A, D F; Content Standard III-B	
Making Pots	Strand III, Standard I, Benchmark I		Content Standard II-B; Content Standard III-B	Content Standard II, Benchmark II-B, C
Chapter 2: Who Uses the Water?				
Residential Water Use	Strand III, Standard I, Benchmark I	Content Standard 4, B; Content Standard 5, C-E; Content Standard 10, A-C	Content Standard II-F	Content Standard II, Benchmark II-B, C
Home Water Detective			Content Standard II-A	Content Standard I, Benchmark I-C
How My Family and I Use Water	Strand I, Standard I, Benchmark III	Content Standard 4, E; Content Standard 10, A-C	Content Standard II-C, F	Content Standard I, Benchmark I-C
Carry the Jug	Strand I, Standard I, Benchmark III	Content Standard 4, B, E; Content Standard 5, A, E; Content Standard 9, A-C	Content Standard II-C, F; Content Standard III-D; Content Standard IV-A	Content Standard I, Benchmark I-C
Saving Water		Content Standard 4, E; Content Standard 5, A, E; Content Standard 7, D	Content Standard II-C, F; Content Standard III-D; Content Standard IV-A	Content Standard I, Benchmark I-A, C
(Virtual) Bosque Trip	Strand II, Standard II, Benchmark I, II		Content Standard II-B-D, F	
(continued on page 64				

Appendix F

Part 1: Correlated by Activity (continued)

Activity	Science	Mathematics	Social Studies	Language Arts
Chapter 2: Who Uses the Water? (continued)				
Bosque Water Detective	Strand II, Standard II, Benchmark I, II		Content Standard II-C, D, F	Content Standard I, Benchmark I-C
How Much Water Is It Made Of?	Strand II, Standard II, Benchmark I, II Strand III, Standard I,	Content Standard 2, A; Content Standard 3, B, D; Content Standard 4, B; Content Standard 5, A, C-E; Content Standard 7, D-E		
Domino Effect	Strand III, Standard I, Benchmark I			Content Standard I, Benchmark I-A
Leaks	Strand I, Standard I, Benchmark I, III	Content Standard 5, A, C-E		
Where Does Our Water Come From?	Strand III, Standard I, Benchmark I		Content Standard I-A	Content Standard I, Benchmark I-A
Chapter 3: Affecting Understanding and Change				
The Aquifer Game	Strand II, Standard III, Benchmark I	Content Standard 2, C-D; Content Standard 6, A-C	Content Standard II-C, D, F; Content Standard III-D Content Standard IV-A, B	Content Standard I, Benchmark I-A, C
The Sponge Soak	Strand III, Standard I, Benchmark I	Content Standard 2, C-D; Content Standard 6, A-C;	Content Standard II-C, F; Content Standard III-D; Content Standard IV-A, B	Content Standard I, Benchmark I-A; Content Standard II, Benchmark II-A
The Mayor's Bath	Strand III, Standard I, Benchmark I		Content Standard II-C; Content Standard III-D; Content Standard IV-A, B	Content Standard I, Benchmark I-A; Content Standard II, Benchmark II-A
(continued on page 65)				

Part 2: Correlated by Content Standard

Language Arts K-4

Content Standard	**Benchmark and Activity**
Strand: Reading and Listening for Comprehension – Content Standard 1	A: Saving Water, How Much Water Is It Made Of?, How Do You Get Your Water?, The Aquifer Game, The Sponge Soak, The Mayor's Bath C: How Does NM Use Its Water?, Home Water Detective, My Family and I, Carry the Jug, Saving Water, Bosque Water Detective, The Aquifer Game
Strand: Writing and Speaking for Expression – Content Standard II	A: The Sponge Soak, The Mayor's Bath B: The Water Journal, How Does NM Use Its Water?, Making Pots, Residential Water Use C: The Water Journal, How Does NM Use Its Water?, Making Pots, Residential Water Use
Strand III: Literature and Media – Content Standard III	B: The Mayor's Bath

(continued page 66)

Appendix F

Part 2: Correlated by Content Standard (continued)
Math K-4

Content Standard	**Benchmark**
Content Standard 1: Problem Solving	A: Play Money C: Evaporation D: Play Money
Content Standard 2: Communication	A: The Water Journal, How Much Water Is It Made Of? B: How Does NM Use Its Water? C: Earth's Water, How Does NM Use Its Water?, The Aquifer Game, The Sponge Soak D: The Aquifer Game, The Sponge Soak
Content Standard 3: Reasoning	
Content Standard 4: Connections	B: Residential Water Use, Carry the Jug, How Much Water Is It Made Of? D: The Water Journal, Globe Toss, How Much Water Is It Made Of? E: My Family and I, Carry the Jug, Saving Water
Content Standard 5: Numbers and Number Relationship	A: Play Money, How Does NM Use Its Water?, Carry the Jug, Saving Water, How Much Water Is It Made Of?, Leaks B: Play Money, How Much Water Is It Made Of? C: Globe Toss, Earth's Water, Play Money, How Does NM Use Its Water?, Leaks, Residential Water Use, How Much Water Is It Made Of? D: Globe Toss, Earth's Water, Play Money, How Does NM Use Its Water?, Leaks, Residential Water Use, How Much Water Is It Made Of? E: Globe Toss, Residential Water Use, Carry the Jug, Saving Water, How Much Water Is It Made Of?, Leaks
Content Standard 6: Number Systems and Number Theories **Content Standard 7:** Computations and Estimations	A: The Aquifer Game, The Sponge Soak B: The Aquifer Game, The Sponge Soak C: Play Money, The Aquifer Game, The Sponge Soak D: How Does NM Use Its Water? D: Evaporation, Saving Water, How Much Water Is It Made Of? E: Evaporation, How Much Water Is It Made Of?
Content Standard 8: Geometric Concepts	
Content Standard 9: Understanding Use and Measurements	A: Earth's Water, Evaporation, Carry the Jug
(continued page 67)	B: Map of New Mexico, Where is NM's Water?, Carry the Jug C: Earth's Water, Evaporation, Carry the Jug

Part 2: Correlated by Content Standard (continued)
Math K-4

Content Standard	**Benchmark**
Content Standard 10: Statistics	A: Globe Toss, Residential Water Use, How My Family and I Use Water B: Globe Toss, Residential Water Use, How My Family and I Use Water C: Residential Water Use, How My Family and I Use Water
Content Standard 11: Probability	B: Globe Toss
Content Standard 12: Patterns and Functions	B: How Does NM Use Its Water?
Content Standard 13: Algebraic Concepts	

Part 2: Correlated by Content Standard (continued)
Science K-4

Strand	**Standard**	**Benchmark and Activity**
Strand I: Scientific Thinking and Practice	Standard I	I: Globe Toss, Evaporation, Leaks III: Globe Toss, Earth's Water, Play Money, Evaporation, How Does NM Use Its Water? How My Family and I Use Water, Carry the Jug, Leaks
Strand II: Content of Science	Standard I	I: Evaporation
	Standard II	I: Bosque Trip, How Much Water Is It Made Of?, Bosque Water Detective, Domino Effect II: Bosque Trip, Bosque Water Detective, How Much Water Is It Made Of?, Domino Effect
	Standard III	II: Earth's Water, Play Money, The Aquifer Game
Strand III: Science and Society	Standard I	I: Making Pots, Residential Water Use, Where Does Our Water Come From?, The Sponge Soak, The Mayor's Bath III: Ways We Irrigate

(continued page 68)

Appendix F

Part 2: Correlated by Content Standard (continued)

Social Studies K-4

Content Standard	**Benchmark and Activity**
Strand: History – Content Standard I	A: Ways We Irrigate, Where Does Our Water Come From? B: Ways We Irrigate C: Ways We Irrigate D: Ways We Irrigate F: Ways We Irrigate
Strand: Geography – Content Standard II	A: Earth's Water, Play Money, Map of New Mexico, Where is NM's Water? B: Making Pots, Bosque Trip C: Map of New Mexico, How Does NM Use Its Water?, How My Family and I Use Water, Carry the Jug, Saving Water, Bosque Trip, Bosque Water Detective, The Aquifer Game, The Sponge Soak, The Mayor's Bath D: Globe Toss, Earth's Water, Play Money, Evaporation, Map of New Mexico, Where is NM's Water?, Bosque Trip, Bosque Water Detective, The Aquifer Game F: How Does NM Use Its Water?, Residential Water Use, Home Water Detective, My Family and I, Carry the Jug, Saving Water, Bosque Trip, Bosque Water Detective, The Aquifer Game, The Sponge Soak
Strand: Civics and Government – Content Standard III	B: Ways We Irrigate, Making Pots D: Carry the Jug, Saving Water, The Aquifer Game, The Sponge Soak, The Mayor's Bath
Strand: Economics – Content Standard IV	A: Carry the Jug, Saving Water, The Aquifer Game, The Sponge Soak, The Mayor's Bath B: The Sponge Soak, The Mayor's Bath

WATER USE AND CONSERVATION BUREAU
New Mexico Office of the State Engineer

City of Las Cruces
PEOPLE HELPING PEOPLE

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Water Division

City of Rio Rancho
Water Conservation Office
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Rio Grande Basin Initiative

NMSU–Rio Grande Basin Initiative/
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