Chapter 1 Water Views

Chapter Contents

Xeriscape Definition

Xeriscape is water-efficient landscaping that is appropriate to the natural environment. The term xeriscape is derived from the Greek word xeros, which means dry. The goal of xeriscaping is to create visually attractive landscapes that use water efficiently.

Key Concepts

Availability of fresh water, semi-arid environments, water rights, interest groups.

Teacher's Notes

The purpose of this introductory chapter is to set the stage for an understanding of water distribution and water rights issues in New Mexico. This background information will help students understand the importance of conserving our water resources. It will also help them understand the historic development of attitudes toward the use of water in our state.

Because this chapter serves as background material meant to provide a context within which to discuss water conservation, there is no **Xeriscape Principle, Problem to Solve** or **Project Cover Sheet** for this chapter.

Notes on the Activities

Water World – Students should realize from this lab that most of the world's water is salt water. The amount of available fresh water is very limited because most of the world's fresh water is found in ice caps and glaciers. Consequently, it is not easily accessible for use by humans. Water that is considered available for use by people is found in freshwater lakes, rivers, and groundwater. Yet even these sources are limited due to pollutants, limited access, and naturally occurring minerals such as arsenic and salt.

Teacher's Notes, continued

Use the Water World Student Worksheet to discuss the availability of water for human consumption. Note that all of the world's water could theoretically become available as technology such as desalinization is further developed. On the other hand, available water could become "unavailable" due to pollution.

Are All Habitats Identical? – This is a very open-ended activity that can be extended for as long as desired. It should help students realize that New Mexico consists of many local and regional environments, all of which are semi-arid. Rainfall is unevenly distributed (both temporally and geographically). By correlating rainfall and habitats, students should see the pivotal role that rainfall plays in determining the types of habitats that occur. In order to fabricate the model, students will need to study the habitats in detail. The New Mexico State University website at http://weather.nmsu.edu/nmcc-cooperator/index.htm provides a wealth of data that can be used for comparing many weather variables throughout the state. Students will use critical-thinking and decision-making methods to determine four categories of rainfall.

Acequias and the Community – Students will research different mechanical, political, and social aspects of the acequia system and build a model to better understand how the system works. This can be done in small groups or as individual projects. Students can determine which aspects of the system they are most interested in researching or the teacher can make assignments. The model-building activity can either be a group assignment or a class project.

Little Wet Jug – The purpose of this activity is to stimulate thought and encourage discussion. The students divide into groups to role-play six different New Mexico special interest groups. The assignment for each group is to create a water plan for the state. As current politics in New Mexico indicate, there is little consensus among existing interest groups competing for water rights. Consequently, there is not a "right" or "wrong" answer for this activity. Students should be evaluated on how well they work as a group, how thorough their research is, and the quality of their proposed water plan. Each group's plan should be creative but realistic, and it should attempt to address their water needs while also recognizing the needs of the other groups.

Background Information: Water in New Mexico

The history of water rights in New Mexico is ancient and complex. It began when prehistoric Indians constructed irrigation canals to move water to their pueblos. As early as 1582, the Acoma people saved water in marshy areas. Also during the 1500s, the early Spanish conquerors introduced acequias (community ditches) and the social rules used to manage them. One important component of these rules was the mayordomo, or ditch master, who granted the right to use the water and kept track of those who had done their share of the work to maintain the acequia. After the influx of the Spanish, the pueblos blended some of the Spanish practices with their own ancient irrigation practices.

A history of acequias and examples of by-laws are available at the Office of the State Engineer's website at http://www.seo.state.nm.us/water-info/acequias.html

As New Mexico's population grew, so did the demand for water. The late 1800s saw increased farming and mining. Dams were built and more land was irrigated. Soon, land ownership and water rights became a controversial issue. In 1851, the New Mexico Territorial Legislature established laws to deal with the expanding need for water. By 1907, the territory had its first comprehensive surface water laws. The laws were based on the early Indian-Spanish ideas of ownership of the irrigation ditches and public control of surface water. As technology improved, more underground water was tapped and more land was irrigated for crops. Oil and gas industries also entered into the picture and demanded their share of the state's water.

Current New Mexico laws state that all of New Mexico's surface and underground water belongs to the public and is subject to appropriation[1]. An appropriated water right is considered property (much like equipment or furniture), and it can be separated from the land and transferred to another location subject to legal requirements. The appropriator "owns" only the right to use the water and not the "corpus" or body of water itself. In addition, New Mexico's water is administered under the doctrine of *prior* appropriation. This means that the first person to take water and use it in a beneficial[2] way has the right to that water. Those who come later do not get to take their water until the "first to come" have gotten their share.*

The water that flows through New Mexico must be appropriated to many different entities in addition to the individuals who live here. Rivers are part of the surface water system, which by law must be shared with neighboring states according to the state compacts and court rulings. For instance, Colorado and Texas both hold rights to a certain percentage of the water in the Rio Grande. In addition, the federal government, which owns about 46 percent of the land in New Mexico, is guaranteed rights to enough water to maintain federal lands for the public. So a portion of the state's water rights belongs to the United States government to grow trees, fight fires, and maintain fishing streams, among other uses.

* For more information on water rights, see Appendix L.

Background Information: Water in New Mexico (continued)

Native Americans in the state also have significant water rights. Their reservations make up about 10 percent of the land area in the state, and they own the rights to all the water they need to use for present and future purposes on these reservations. The reservations also own similar water rights to streams that are within their boundaries.

Unfortunately, New Mexico's available water resources are very limited. The sources that supply New Mexico's water consist of:

- precipitation in the form of rain and snow,
- rivers that run through the state, and
- groundwater.

In an average year, New Mexico receives from 7 to 20 inches of precipitation across the state. Precipitation combined with river flows in the state provide about 87.7 million acre-feet of surface water[3] a year. Due to the state compacts and court rulings for shared surface water, New Mexico retains only about 1.2 million acre-feet of usable surface water a year. About seven percent of the population depends on this surface water for its domestic water needs.

Groundwater is water that moves slowly through the ground until being naturally stored in an underground aquifer. The state's underground water supply is estimated at 20 billion acre-feet. That is enough to cover the state with about 260 feet of water. However, most of this water has high levels of naturally occurring minerals such as arsenic and salt and is not suitable for human use.

Considering how little precipitation, surface water, and groundwater 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 that the cost of water development and treatment continues to escalate. Many communities are now faced with expensive water and wastewater treatment facility expansions to meet individual 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.

Current Uses of New Mexico's Water

New Mexico's water users consist of municipalities, farmers and ranchers, commercial and industrial facilities, institutions such as hospitals and schools, power generating facilities, and recreational enthusiasts. Added to this list are water used to sustain fish and wildlife and water needed to account for evaporation from reservoirs, lakes, and ponds. In addition, New Mexico must deliver certain amounts of water in its rivers to Texas to meet water demands there (just as Colorado must do for New Mexico) under interstate governmental compacts.

Background Information: Water in New Mexico (continued)

Irrigated agriculture is New Mexico's largest water user. Agricultural use accounts for approximately 75 percent of the total water used in the state. Municipalities and other domestic water users withdraw about nine percent and evaporation accounts for almost 12 percent of the state's supply. While significant water conservation opportunities exist in irrigated agriculture, the system of irrigation diversions, delivery canals, and return flows is complex, and there are some benefits to the water "waste" that occurs in agricultural irrigation – such as groundwater recharge and return flows crucial to the interstate delivery requirements. Because of this complexity, it will take a significant commitment to realize meaningful water conservation achievements in irrigated agriculture. This realization makes it even more important that other water users, such as municipalities, adopt water conservation practices to make certain that an adequate water supply is maintained.

Nationwide, approximately 47 percent of U.S. water consumption is used for residential purposes. Of that residential water use, approximately 31 percent[4] is used outdoors. Outdoor use consists mostly of landscape irrigation[5], but it also includes car washing, filling swimming pools, and cleaning driveways. In New Mexico's hot and dry summer months, up to 70 percent[6] of all residential water usage is attributed to outdoor use, primarily for irrigating landscapes. It is this 70 percent of summer outdoor water use upon which this curriculum will focus.

FINAL THOUGHT

The complexity of water rights and water usage in New Mexico is made even more complicated by the state's limited supplies of fresh water. The water that falls on New Mexico in the form of precipitation and flows through our arid state must be appropriated to many different legal entities – including the people who live here. As the state's population continues to increase, water conservation will continue to grow in importance. One obvious way to save water is to convert water-thirsty landscapes to water-thrifty xeriscapes.

FOOTNOTES (PAGES 23-25)

1 Appropriation – a taking of either surface or groundwater and applying it to beneficial use
2 The term "beneficial use of water" has been defined in the legal system very broadly. Almost any use is beneficial as long as there is not waste of the water.
3 Acre-feet of water – the amount of water needed to cover one acre of land with one foot of water, about 325,851 gallons
4 Vickers, Amy, Handbook of Water Use and Conservation (Amherst: Waterplow Press, 2001), 14-23.
5 Vickers, 14-23.
6 City of Albuquerque, *The Complete Guide to Xeriscaping* (Albuquerque: City of Albuquerque),1.

History of New Mexico Water and Water Rights

The history of water use in New Mexico is ancient and complex. It begins when the prehistoric Indians built irrigation canals to move water to their pueblos. The Acoma people came next and saved water in marshy areas as early as 1582. Also in the 1500s, the early Spanish conquerors introduced acequias (community ditches) and the social system that ruled their use. Acequias are still a very popular system for irrigation in New Mexico.

Do you think that acequias are an effective way to move water from one place to another?

As New Mexico's population grew, so did the demand for water. By the late 1800s, more land was being irrigated to grow crops, and mining for natural resources, which requires large amounts of water, had begun. Dams were built to increase water supplies in specific areas and the battles over who would get the water increased.

In 1851, the New Mexico Territorial Legislature established water laws, and by 1907 the territory had its first comprehensive laws governing surface water. The laws were based on the early Indian-Spanish ideas of ditch (acequia) ownership and public control of the water.

Public control of water means that all of New Mexico's surface and underground water belongs to the public and is subject to appropriation or private ownership of a water right. An appropriated water right[1] is like a piece of equipment or furniture. It is considered property and can be separated from the land and transferred to another location or owner subject to legal requirements.

The basis of New Mexico's water laws began with the idea of **prior appropriation**. This means that the first person to take water and use it in a beneficial[2] way has the right to use that water. Think of a long line to get into a baseball game or event. Those first in line get the best seats. Those last in line get whatever seats are left, until they are gone. However, if the people first in line do not sit in their seats (beneficial use) they will lose them, leaving room for the latecomers. To correlate that back to water rights and the history of New Mexico, this means that the state's earliest settlers, who were mainly farmers and ranchers, had the first right to use the water. If the descendents of these early settlers continue to utilize the water in a beneficial manner, they will maintain the rights to the water. The newer water users in New Mexico, such as industries and even some of the cities, get whatever water is left.

Unfortunately, water supplies do not adhere to political boundaries such as state lines. This means that the water that flows through New Mexico has to serve the people who live here as well as those who live in bordering states. For example, the Rio Grande is part of a surface water system that passes through Colorado, New Mexico, and Texas. All three states have rights to a certain percentage of the Rio Grande's water. The percentages are distributed according to court rulings called state compacts.

What do you think is a beneficial use of water? What is not a beneficial use?

[1] Water Right - a legal right to divert water to a specific beneficial use; water rights are granted in New Mexico by the Office of the State Engineer

[2] The term "beneficial use of water" has been defined in the legal system very broadly. Almost any use is beneficial as long as there is not waste of the water.

History of New Mexico Water and Water Rights (continued)

In addition, a federal law states that the federal government is entitled to enough water to maintain federal lands.

Approximately 46 percent of New Mexico is federally owned. Maintaining federal lands includes fighting fires, supplying water for recreational uses in national forests, and maintaining water for your favorite fishing stream.

The Native Americans in the state also have significant water rights. Ten percent of New Mexico is reservation land. Native Americans own the rights to enough water to use for all present and future purposes on these lands, including water rights to streams that are within their boundaries.

What's Going on Now?

With all these groups competing for water, it is easy to see how our water supply could be used up very quickly. In an average year, we receive only 7 to 20 inches of precipitation across the state. With so much need and so little water, it is important to be aware of how much water we use and to find ways to conserve it.

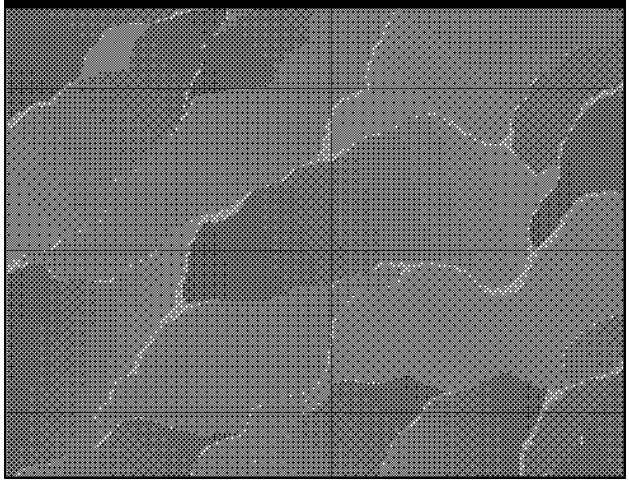
For many of us, it is difficult to understand how much water we use when we perform various necessary household tasks. Compare the water you use to the national average listed below.

Since the largest percentage of residential water use (water used in and around the home) is outdoor usage (mainly landscapes), we are going to focus our efforts on how to reduce the amount of water used outdoors.

Where do <u>you</u> use the most water?

What are some of the ways <u>you</u> can save water?

Where can <u>you</u> make the biggest difference in saving water?



Residential Water Use[3]

Outdoor use	31.0%
Toilets	18.4%
Baths	1.2%
Showers	11.6%
Faucets	10.8%
Dishwasher	1.0%
Clothes Washer	15.0%
Leaks	9.5%
Other	1.5%

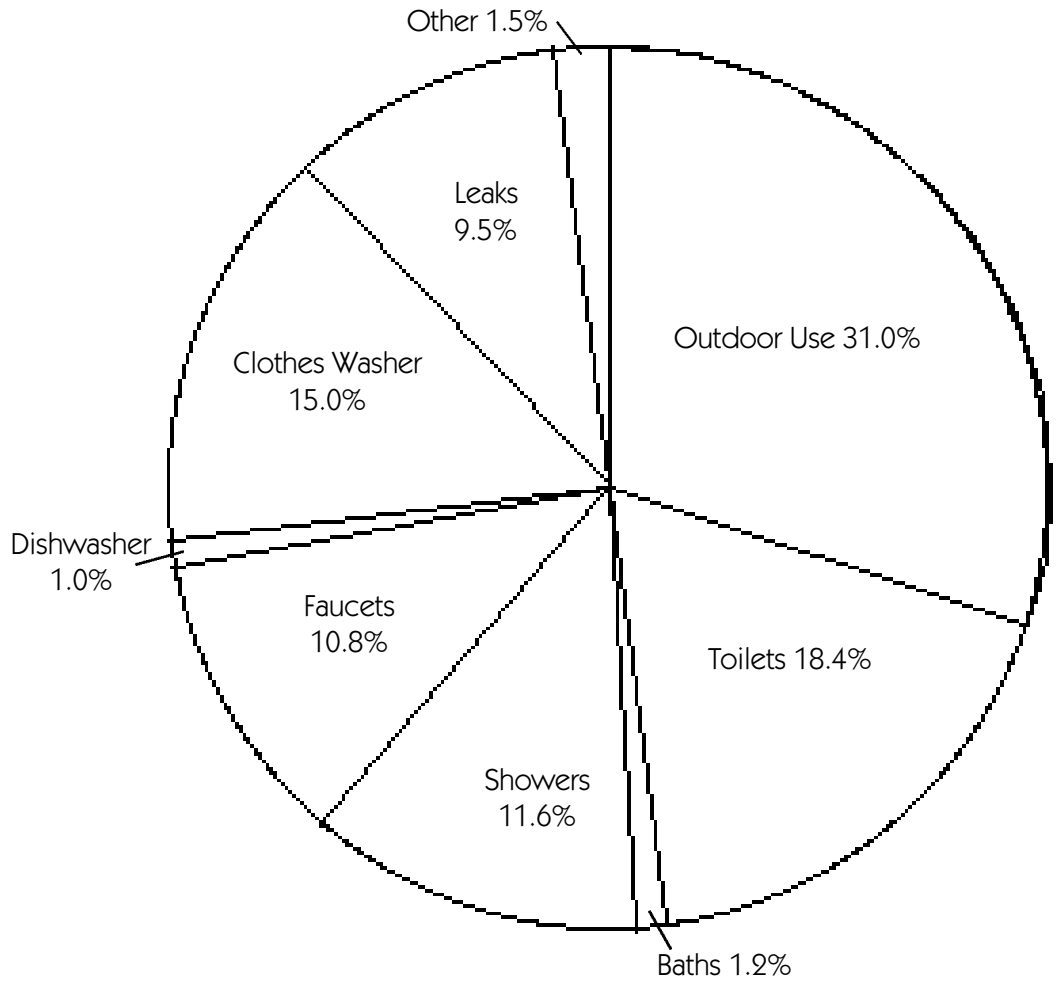
[3]Source: Vickers, 14-23

Final Thought

The water that falls on New Mexico in the form of precipitation (rain and snow) and flows through our arid state must be distributed to many different people for many different uses. As the state's population continues to increase, water conservation will continue to grow in importance. One obvious way to save water is to convert water-thirsty landscapes to water-thrifty xeriscapes.

Charts & Graphs

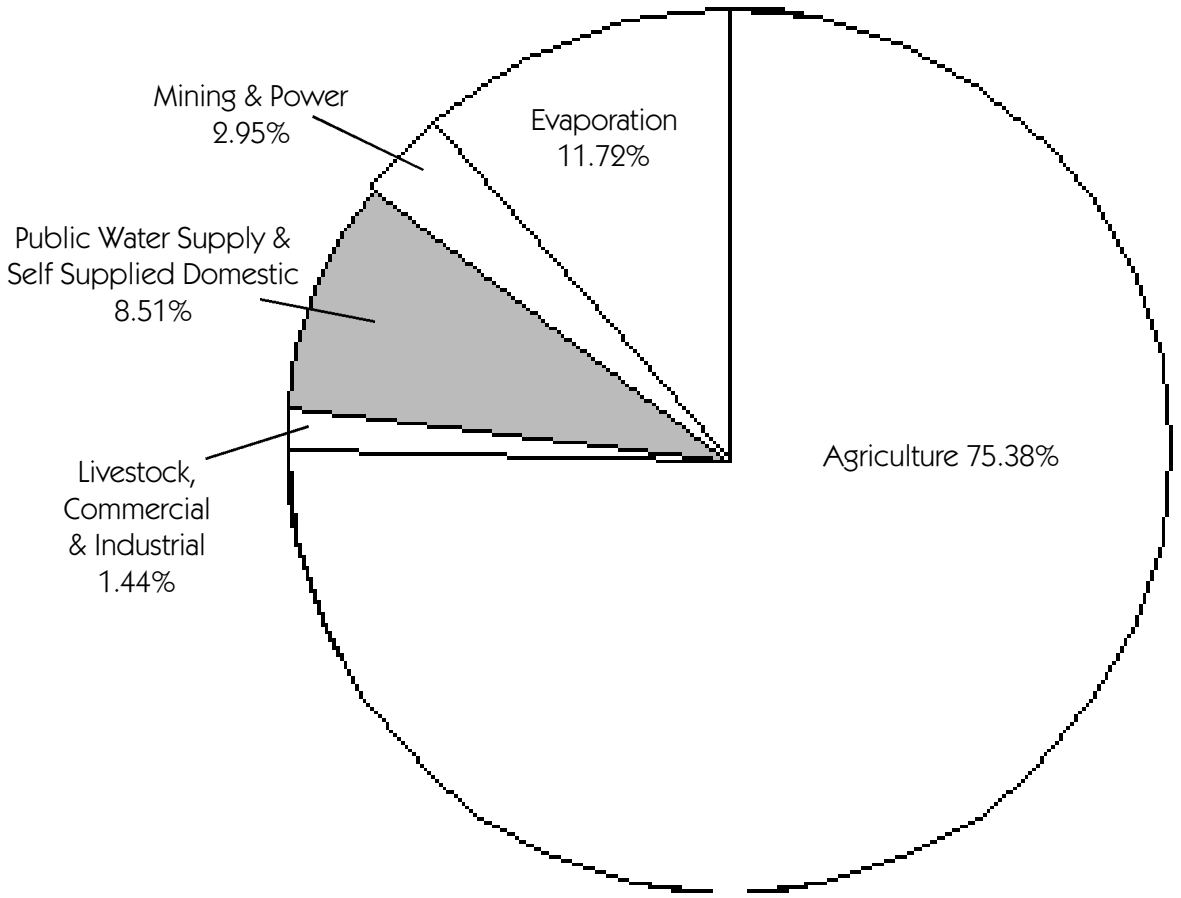
U.S. Residential Water Use[4]



[4] Adapted from Vickers, 14-23.

Charts & Graphs

New Mexico Water Use[5]



[5] Wilson, Brian and Lucero, Anthony, Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1995 (Santa Fe: New Mexico State Engineer Office, 1995), 3-4. A full size copy of both charts is provided in Appendix C.

Water World

Main Question:
How much water on the planet is available for human consumption?

Objectives:

- To visualize the distribution of water in the world
- To determine what water is available for human consumption

Subjects:
earth science, chemistry, language arts, math

Time: 1 hour

Vocabulary:
water, fresh water, salt water

Advance Preparation:

- Obtain materials.

Setting the Stage:

- Ask students why Earth is called the water planet.
- Is all water on the planet available for human use? What forms of water are available for plants and animals to use? How would a desert be defined? Is Antarctica a desert?

Water World has been adapted from A Drop in the Bucket from the *Project WET Curriculum and Activity Guide*. It is used with permission from Project WET/ The Watercourse at Montana State University.

Materials: per group

4 1000-ml beaker
4 100-ml graduated cylinder
4 10-ml graduated cylinder
4 water
4 small dish
4 eyedropper
4 food coloring (optional)

Water World

Measuring Water

1. Fill the 1,000-milliliter (ml) beaker with water to the 1,000 ml mark. This represents all of the water on the planet (100%).

2. Carefully pour 30 ml into the 100-ml graduated cylinder. The water remaining in the 1,000-ml beaker represents all of the salt water on the planet. This is approximately 97% of the earth's total water. Put three or four drops of blue food coloring into the water remaining in the 1,000 ml beaker.

3. The 30 ml of water in the 100-ml graduated cylinder represents all of the fresh water on the planet. Pour 10 ml into the 10-ml graduated cylinder. The water remaining in the 100-ml graduated cylinder represents all of the frozen water (glaciers, icecaps) on the planet. Put three to four drops of yellow food coloring into the 100-ml graduated cylinder representing frozen water. This is approximately 2% of the Earth's total.

4. The 10 ml of water in the 10-ml graduated cylinder represents all of the non-salt, unfrozen water on the planet, approximately 1%. Using the eyedropper, remove one drop and put it in the small dish.

5. Place three to four drops of red food coloring in the remaining water in the 10-ml graduated cylinder. This is the fresh, unfrozen water that is unavailable for human consumption. It includes polluted water, brackish groundwater, and water in the soil and atmosphere.

6. The small drop of water in the dish is all of the water on the planet that is actually available for human consumption.

Extension:

- Look at maps for distribution of river systems and lakes. Discuss how access to surface water has limited or encouraged population centers.

- Create a chart or overlay correlating the locations of cities or major concentrations of people with the amount of water available in each area.

- Explore groundwater maps. Is all groundwater available for human consumption? Why or why not?

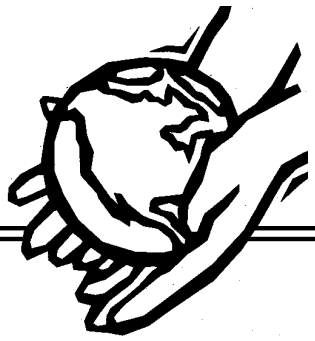
- Research desalinization. What parts of the world would benefit from a desalinization plant?

- Determine what wildlife habitats are expected in each area, based upon the amount of water that is available.

NAME

Student Worksheet

Water World



On the chart below check whether the water on earth is available or not available for human consumption. Check all that apply.

Water on Earth	Percentage of Earth's Water	4 If Available for Human Consumption	4 If Not Available for Human Consumption
Oceans	97.25%		
Icecaps/glaciers	2.05%		
Groundwater	0.68%		
Freshwater Lakes	0.01%		
Soils	0.005%		
Atmosphere	0.001%		
Rivers	0.0001%		
Other	0.0039%		
Total	100.0000%		

1. List some of the ways traditionally unavailable water might become available for human use. Be creative.

2. List some of the ways water that has traditionally been available for human use has become unavailable.

3. Write a paragraph explaining why it is important that humans use water responsibly.

Are All Habitats Identical?

Main Question:
What are the habitats in New Mexico? How do rainfall and elevation influence these habitats?

Objectives:
- To describe various habitats in New Mexico
- To examine the distribution and size of these habitats
- To recognize the characteristics of various habitats
- To correlate rainfall data, vegetation communities, and elevations

Subjects: science, geography, language arts, art

Time: 1 hour for data comparison; 10 minutes each group for presentations; 2+ hours for model building

Vocabulary: vegetation, habitat, topographic map, elevation

Advance Preparation:

- Obtain state vegetation maps, rainfall data, soil and elevation maps (whatever is available). Make an 8 1/2" x 11" base map of New Mexico for each group of students. Information on where to obtain maps is located in Appendix J.
- If there is sufficient time, have students gather the data from the Internet, state agencies, reference books, etc. The National Oceanic and Atmospheric Administration (NOAA) website at www.noaa.gov is a good resource.

Setting the Stage:

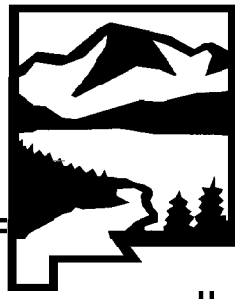
- Discuss the concept of habitats; describe different types of habitats and their water requirements.
- Ask students what habitats they have seen in New Mexico.

Materials: per group

- 4 state vegetation maps (see Appendix J)
- 4 state rainfall data (see Appendix C)
- 4 state topographic map
- 4 base map of New Mexico
- 4 blank overhead transparencies or tracing paper
- 4 transparency markers
- 4 art supplies
- 4 model-building supplies (such as gravel, dirt, pieces of weeds, toothpicks, clay, etc.)

TEACHER TIP:
Transparencies work if multiple sets of dat are to be plotted or if class overhead prese made. If only vegetat rainfall data are to be then one transparency and one base sheet are adequate.

Are All Habitats Identical?



A. Comparisons of Rainfall and Vegetation Data

1. One at a time, lay a blank transparency over the base map of New Mexico and outline the state onto three transparencies. Label them Precipitation, Vegetation, and Elevation.
2. Use the rainfall data provided in Appendix C or a precipitation map of the state to divide the state into rainfall categories. Decide how many categories are necessary.
3. Chart the data onto the Precipitation transparency.
4. Using a state vegetation map, transfer vegetation data onto the Vegetation transparency.
5. Using topographic information or a topographic map, transfer information to the Elevation transparency.
6. Overlay the Precipitation, Vegetation and Elevation transparencies and look for comparisons between the three.
7. Present the data to the class.

B. Class Model of Habitats

1. Review a map of New Mexico that includes the distribution of habitats. National Geographic has a great website that includes printable maps and descriptions of each habitat. http://www.nationalgeographic.com/wildworld/terrestrial.html
   Additional information on where to obtain maps is in Appendix J.

2. Divide the class into several groups and assign a habitat to each group. There are five habitats for New Mexico on the National Geographic website. Each group should receive a map of the state showing the assigned habitat. These can also be printed from the National Geographic site.

3. Using art supplies, each group should build a three-dimensional model of its habitat.

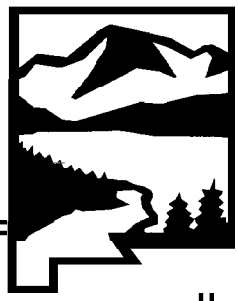
4. Have groups use pieces of weeds, gravel, glued-on dirt, toothpicks, clay, etc. to build their models.

5. Using pictures or plastic pieces, include the animals and plants that inhabit the assigned area.

6. Put all of the pieces side-by-side, as they appear on the map, to get an overview of the habitats in the state.

(continued on next page)

Are All Habitats Identical?



Extension:

- Collect historical rainfall and vegetation maps of New Mexico and make overlays to see how the distribution of habitats has changed.
- Correlate ranges of various animals with the distribution of habitats. Each student studies a different animal and examines how it uses the habitat it lives in.
- Map the distribution of habitats in the students' hometown.

Activity Tip:

Five habitat designations as presented by National Geographic:

1. Western short grasslands
   Central North America, Central United States, eastern New Mexico; Temperate Grasslands, Savannas, and Shrublands
2. Colorado Rockies forests – Central North America, Western central United States, parts of northern New Mexico; Temperate Coniferous Forests
3. Colorado Plateau shrublands – Western North America, Southwestern United States, northwest and central New Mexico; Deserts and Xeric Shrublands
4. Arizona Mountains forests – Western North America, Southwestern United States, parts of eastern New Mexico; Temperate Coniferous Forests
5. Chihuahuan desert – Southern North America, Northern Mexico into southwestern United States, southern New Mexico; Deserts and Xeric Shrublands

Acequias & the Community

Main Question:
What role do acequias play in our community?

Objectives:
- To trace the development, history and importance of the acequia system in New Mexico
- To describe acequias and how they are constructed
- To construct an acequia model
- To predict the future of the acequia system in New Mexico

Subjects:
history, art, language arts, math, geography, science

Time:
varies; average of three 45-minute class periods

Vocabulary:
acequia, conservancy district, flow rate

Advance Preparation:

- Obtain maps of irrigation systems in the community, county or the state.
- If possible, arrange for a speaker from the conservancy district, county extension service, a member of a local historical society, or a community member who has worked with the acequia system, such as a mayordomo.

Setting the Stage:

- Have the students describe and discuss acequia systems with which they may be familiar.
- Have any of the students' grandparents or parents used the system? Do any of their families have acequia-irrigated land now? How do they arrange to irrigate it?

Materials:

4 school & local library
4 9" x 14" cake pan
4 modeling clay
4 tape recorder (optional)
4 county and state maps
4 small twigs, gravel, weeds
4 jar of water
4 camera (optional)

Acequias & the Community

A. Research

1. Divide class into small working groups in order to spread out the use of reference materials. Each group should choose a topic, such as:

- How Acequias Work (mechanics)
- The History of Acequias
- Current Uses of Acequias
- How Acequias Influenced the Culture of the Community
- The Political Workings of the Acequia System (mayordomos, watering schedules, etc.)
- The Future of the Acequia System (potential improvements, water conservation, future developments, etc.)

2. Have students keep a list of the references they use. Student groups may give mini-reports to the class so that information can be shared among groups.
3. Interview officials of the local conservancy district about the history and future of the acequia system. Use a tape recorder, if possible.
4. Photograph local acequia systems and/or copy pictures from books to make a book or poster to present to the class.
5. The final presentation could be a written or oral report, a poster presentation that can be displayed in the school library, or a Microsoft PowerPoint® presentation by each group.

B. Model Building – Community

1. Spread modeling clay in the pan to construct an acequia system for a community. Be sure to slope the ditches so that water can flow downhill. The model should also show the change in ditch size from the main ditch down to the ditches in individual fields. If there is time, include fields, farmhouses and roads.
2. Fill some of the ditches with plants and debris to test the effect on water flow rate.
3. Sprinkle powdered drink mixes on the model to simulate erosion.
4. Pour water into the main ditch to test the system.

Extension:

- Students could map out the irrigation system in their community then build a model of it. Is the present system the most effective option? Are there future developments planned that could impact the present system?
- Interview relatives or local citizens who have lived in New Mexico for a long time and compile a vocal or written history of their relationships with acequias.
- Write a story about a day in the life of a farmer using an acequia for irrigation. Read the story to the class.
- Write and perform a play about the annual community clean-out of irrigation ditches.
- Math extension: using a ruler and a piece of string, measure the length of the ditches on the maps provided. If information is available from local authorities, calculate the average flow rate and the total amount of water used in a growing season.

Little Wet Jug

Main Question:
Who has the right to use New Mexico's water?

Objectives:

- To identify the points of view for various interest groups
- To practice consensus building
- To examine current and future water projections for the state

Subjects:
science, politics, history, debating

Time: 1 to 1 1/2 hours

Vocabulary: interest group, drought

Advance Preparation:

- For each student, make copies of the information on the New Mexico Office of the State Engineer's responsibilities located in Appendix L.
- To give the students a different perspective, copy the newspaper articles in Appendix D representing the interests of golf courses, municipalities, outdoor recreation groups, and ranchers. For additional research, a list of websites representing various special interest groups is located at the end of this activity.
- Invite speakers representing various interest groups (farmers and ranchers, developers, environmentalists, Native Americans, tourism, etc.) to address the students.

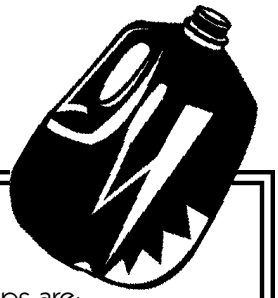
Setting the Stage:

- Have each student read the newspaper articles, highlight the important points, and list five ideas for how to deal with impending water problems.

Materials:

- 4 newspaper articles about water issues (see Appendix D)
- 4 drawing paper
- 4 markers
- 4 1 jug of water/group
- 4 6 clear cups/group
- 4 food coloring
- 4 funnel

Little Wet Jug



A. Special Interest Groups

1. Assign each group of students to represent a special interest group. Groups are:
   - Conservation/ Environmental Protection
   - Golf Courses
   - Developers
   - Farmers & Ranchers
   - Municipalities
   - Recreation Groups (fishing, boating, etc)
2. Have students get information about the viewpoints and critical issues facing their group. See Appendix D for newspaper articles.
3. Give each group of students a jug of colored water and six cups. (The cups represent each of the six special interest groups.) Make sure there isn't enough water in the jug to fill all six cups.
4. Label the cups for each of the special interest groups listed above. Pour water into each cup based upon how much the students think each special interest group should get.
5. Have the students in each group justify their program for water allocation to the class.
6. Class will evaluate programs and distribution of water in cups to come to a consensus on how to divide up the jug of water.

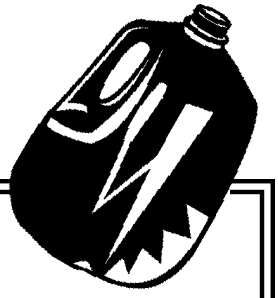
B. Legislative Plan

1. Reallocate the groups, so that the representatives from different special interest groups are now mingled into new groups.
2. Each group is now a sub-committee of the New Mexico Legislature that is required to generate an eight-point plan for how to deal with current water issues.
   Questions to ask include:
   - How to deal with continued growth versus limited supply?
   - What to do in times of drought?
   - Do current water laws fulfill the needs of the state?
   - Who has the highest priority?
   - How do we get our plan implemented?
3. Have students make a poster outlining their ideas and present it to the class (Legislature and Governor) for feedback.

Extension:

- Study the politics of water allocation between New Mexico, Texas, Colorado, and Mexico. Develop a set of guidelines for allocating water from rivers that pass through several countries.
- Repeat Section A: Special Interest Groups with simulated drought conditions in the jug. Decide how the drought would affect allocation of water in the jug.
- Write a class position paper on how New Mexico's water should be allocated. Present it at a public meeting about water issues.

Little Wet Jug



Websites for Special Interest Groups

Golf Courses
http://www.santaanagolf.com/ – The Santa Ana golf course located north of Albuquerque, along the Rio Grande

http://www.golfnewmexico.com/ – A directory of New Mexico golf courses

Environmental Groups
http://riogrande.sierraclub.org – Rio Grande Chapter of the Sierra Club

http://www.earthfirst.org/ – Earth First!

Municipalities
http://www.cabq.gov/waterconservation/index.html – City of Albuquerque Water Conservation Office

http://www.ci.santa-fe.nm.us/sfweb/ – City of Santa Fe

http://www.worldplaces.com/Las.Vegas.New.Mexico/ – City of Las Vegas

Native Americans
http://www.westgov.org/wga/initiatives/iwr/ – Western Governors Association Ad Hoc Group on Indian Water Rights

http://www.bluecloud.org/dakota.html – The American Indian Culture Research Center

Outdoor Recreation
http://www.knownworldguides.com/ – Known World Guide Service, Inc.
Professional guided white water rafting, mountain biking, fly fishing, hiking/trekking adventures in New Mexico, USA, Southern Chile and old Mexico.

http://www.rivertours.com/ – Rio Grande River Tours, just south of Taos, New Mexico

Western Living
http://www.rangemagazine.com/ – RANGE magazine representing issues of the West, its people, lifestyles, lands and wildlife

http://www.hcn.org/ – High Country News

RESOURCES:

New Mexico Water Rights, *WRRI Miscellaneous Report No. 15* provides a good introduction to the history of water rights in New Mexico. It is not overly technical and is within the capabilities of most high school students. It is available through New Mexico State University, Water Resource Research Institute for a minimal cost. Contact WRRI at 505-646-1813 for more information.

Water: A Never Ending Story teacher guide and video contain a collection of hands-on, interdisciplinary activities organized into a complete curriculum on water. It is designed to help students cultivate a water conservation attitude. The curriculum is on a middle-school level and includes sections on watersheds, water treatment and distribution, and non-point source pollution. Activities incorporate science, math, art, and language arts. The curriculum is available through the New Mexico Office of the State Engineer. See Appendix F for ordering information.

Conserve Water Educators' Guide (ISBN 1-888631-04-X) is written and published by The Watercourse, a nonprofit water education group out of Montana State University. The guide includes activities on water conservation, case studies designed to encourage critical thinking and decision making, and a separate section on how to host a water festival at your school. The curriculum is available from The Watercourse at 1-406-994-5392 or order online at http://www.montana.edu/wwwwater/

Albuquerque's Environmental Story was written by Joan and Hy Rosner and published by The Friends of Albuquerque's Environmental Story, Inc. It provides a very complete story of the interaction between man and the environment in the growth of Albuquerque. Ideas and suggestions for teachers are included at the end of each chapter. The complete curriculum is on-line at http://www.cabq.gov/aes/index.html.

The New Mexico Office of the State Engineer provides a history of acequias and ditches of New Mexico with information on the history, laws, New Mexico Acequia Commission, Acequia Rehabilitation Program and water rights information. Also includes sample by-laws for acequias.
http://www.seo.state.nm.us/water-info/acequias.html

http://www.nm.nrcs.usda.gov/drought/drought.htm – New Mexico Drought Map, indicates current drought status in an easy-to-use colored map. Provided by the Natural Resources Conservation Service of the U.S. Department of Agriculture.

http://water.usgs.gov/watuse/ – Extremely detailed data on water use in the United States, including maps from the United States Geological Survey. A detailed chart of surface and groundwater withdrawals for public water supply use in the United States is provided as part of the *Water Science for Schools* program at http://wwwga.usgs.gov/edu/tables/dlps.html.

http://www.cia.gov/cia/publications/globaltrends2015/754033.gif – A great visual of the availability of fresh water worldwide from the Central Intelligence Agency. The site includes information from 1980 and 2000 along with predictions for 2015.

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