Developing a second, third, and fourth grade environmental unit on water education

Denise M. Price
California State University
San Bernardino

DEVELOPING A SECOND, THIRD, AND FOURTH
GRADE ENVIRONMENTAL UNIT ON
WATER EDUCATION

A Project Submitted to
The Faculty of the School of Education
In Partial Fulfillment of the Requirements of the
Degree of

Master of Arts
in
Education: Environmental Education Option

By
Denise M. Price
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Abstract

This project kit centers around a video called "Wanda the Water Drop." The video is the story of Wanda's trip down the California State Water Project. It is designed to teach second, third, and fourth graders how some water is acquired for local use. Accompanying the video is a coloring book which reviews Wanda's trip. In the coloring book is a place for the students to write sentences about each picture.

Included in the kit is a teacher's guide with the procedures for ten lessons on water education. The lessons include a pretest, posttest, and review lesson. There are also lessons on map skills, the water cycle, water uses, water treatment, conservation, and reservoirs. The lessons are multicurricular with lessons in science, social studies, reading, math, art, performing arts, and writing. Also included are blackline masters so teachers can reproduce the pretest, posttest, maps, and other exercises.
Acknowledgements

This unit was prepared with assistance from the San Bernardino Valley Municipal Water District and the Environmental Education Resource Center, California State University, San Bernardino.

Special thanks to:

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Dr. Iris Riggs for being my second reader.

Jeff Espinosa for doing the voice of "Wally" on the video.

Kevin Kurtz for his computer assistance in making the coloring book.
Dedication

To my wonderful husband, Hank, without whose encouragement, faith, support, love, and typing this project would never have been completed.
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Introduction

Very little research has been done in the area of water education. Since water is one of the world’s most precious resources, however, it is a subject worthy of study. The amount of water on the earth has not changed over time, but as the population of the world increases, the percent of water that is usable is becoming more important.

The San Bernardino area, like many other areas in the world, must import part of its water supply from other areas. This is a costly process and can sometimes be threatened by drought or some other natural disaster.

Since water is such an important commodity and we cannot live without it, we must use the water we have as wisely as possible. That is where water education comes in. Every individual’s actions have the potential to affect the world. This is especially true in the area of water usage. If each citizen wastes a gallon of water here or two gallons of water there, it really starts to add up.

Through education, children can come to appreciate water and realize that there is more to water than just turning on the faucet. Educating children is the first step in changing public attitudes, and changing public attitudes is the first step in assuring that the Earth of the future will still be a place where we will want to live.
Water may be the most precious resource the Earth gives to humankind (Riviere, 1989). Without water life, would cease to exist. It is the one substance that seems to separate our planet from the rest of the Universe. Less than one percent of the world's water is available for human use. That is about 9,000 cubic kilometers. This is enough water to sustain 20 billion people (Riviere, 1989). Presently, there are over 5 billion people in the world.

It would seem that there is more than enough water for everyone. But the trouble is not the amount of available water but the distribution of that water. Rain forests are drenched with water while deserts such as those in the Southwestern United States receive less than ten inches of rainfall a year (Chiras, 1991).

The uneven distribution of water has led to the building of huge water delivery systems such as the California State Water Project. Students in Southern California should know that part of their water comes from this source. In California, 75 percent of the available water originates north of Sacramento while 75 percent of the water is used south of Sacramento. The California water distribution systems move 60 percent of the state's total water requirements (Water Education Foundation, 1989). This makes water available to Californians where and when it is needed. But this will not always be the case.

Agriculture uses 85 percent of California's water (Griffone, 1991). Worldwide,
85 percent of the water is used for livestock and to grow crops. The amount of irrigated land worldwide will double between 1975 and the year 2000 (Chiras, 1991). This will further increase the percentage of water used to grow crops. Water demands are expected to exceed available water by the year 2000. Half of the United States will be affected by this deficit.

The affects of water deficits have recently hit home for many Southern Californians as mandatory water-use reductions have gone into effect. As California’s population continues to increase, mandatory reductions may become common place even after the drought ends.

Through water education, students can be taught to use water more wisely. Students must be made to understand that everyone has to do their part. All people must conserve water. Life on earth will be more precarious in the year 2000 unless world trends are altered (Barney, 1980). Through environmental education programs, children’s knowledge can be expanded while at the same time their awareness is increased and their attitudes about the environment are changed. It is imperative that a new world attitude or ethic be initiated. This can be done through more conservation education (Leopold, 1966).

Children are the key to the future. When their attitudes are changed, this affects the attitudes of their families and their future children. Thus, water education is not a choice, it is an unavoidable necessity.
Goals and Objectives

The goal of this project was to produce a usable water education program for second, third, and fourth grade students. It was intended to be multicurricular with a variety of activities to maintain the students’ interest. The program goal was to increase childrens’ knowledge of water, where it comes from, how it is treated, its different forms and phases, and how to use it wisely.

Another goal of this project was to produce a video and coloring book which would show children how water is brought to Southern California via the California State Water Project. These materials would be used in conjunction with the water lessons to give students a good basic knowledge of water.
This project evolved from a flannel board story I wrote. The flannel board story was presented to the San Bernardino Valley Municipal Water District Board. The Water District became interested in using the story as part of their local water education. Its use was not practical, however, since two people were required to perform the flannel board story. To remedy this, I changed some of the pictures and recolored all of the drawings. Then, with the help of the Audio/Visual Department at California State University, San Bernardino, the story was made into a video.

To reinforce the information on the video, I designed a coloring and writing book. The coloring and writing book has sixteen pages of drawings. Each page has a drawing, a title at the top, and a box at the bottom in which the student can write a sentence about the picture.

To accompany the video and coloring book, I wrote a water education program for second, third, and fourth grades. The program consisted of ten lessons. In Lesson One, the students take a pretest to determine what they already know about water. Then they watch and discuss the video "Wanda the Water Drop."

In Lesson Two, the students begin by reviewing information from Lesson One. They also learn more facts about the source of their local water. The students then do a map activity where they label the different parts of the California State Water Project. Lastly, the students do a vocabulary word search. Included in the kit is a
California map blackline master to make a transparency, a vocabulary word search, and the California map work sheet for teachers to duplicate.

In Lesson Three, the students listen to a guided imagery story, then discuss the story. Next, they illustrate the different parts of the story in a circle drawn on construction paper. When the pictures are finished, the teacher tells the students that they have just drawn a picture of the water cycle. The teacher explains what evaporation, condensation, and precipitation are and has the students label their pictures.

In Lesson Four, the students first review the water cycle by doing a water cycle work sheet. Next, they discuss the three phases of water. Then, in small groups, the students brainstorm water uses. These are listed on the board. To finish up this lesson, the students in small groups make murals of water uses. Included in this lesson is a water cycle work sheet the teacher can duplicate.

In Lesson Five, the students learn about power plants and pumping plants. They do a work sheet on pumping plants and power plants. To demonstrate how the water wheels in a pumping plant and power plant work, the students make pinwheels. Included in the kit is a pattern of a pinwheel, and the power plant and pumping plant work sheet.

In Lesson Six, the students learn about water treatment. First, they discuss why water is treated. Then, the students do the water treatment exercise. Lastly, the students write stories about the life of a water drop. Included in the kit is a copy of
the water treatment blackline master to make a transparency, the water treatment exercise, and the water drop writing paper for teachers to duplicate.

In Lesson Seven, the students learn about water conservation. The students first review the five steps in water treatment. The students next discuss the importance of water conservation. To help practice water conservation, the students then make posters with water conservation slogans to take home. The students end this lesson by taking home the "Water Use Survey" and the "Ways to Save Water" handout. Included in the kit are copies of the "Water Use Survey" and the "Ways to Save Water" handouts for teachers to duplicate.

In Lesson Eight, the students learn about reservoirs. First, they do a worksheet of math word problems. Then, they discuss the different uses of reservoirs. Next, the teacher tells the students some of the history of Silverwood Lake. Lastly, the students illustrate pictures of people using Silverwood Lake and paste them to a large map of the lake. Included are the math exercise for teachers to duplicate and a copy of a map of Silverwood Lake which teachers enlarge for the art activity.

In Lesson Nine, the students review everything they have learned. They then do a vocabulary crossword puzzle. The crossword puzzle is included for teachers to duplicate.

In Lesson Ten, the students take the posttest. The students will finish the program by writing water poems.

Each lesson includes a list of the materials needed, a list of things that should
be done in advance of the lesson, a vocabulary list with definitions, and the procedure for each lesson.

Also included in the program are a list of student learning objectives, a correlation of the program with the *California Science Framework (1990)* and *California History-Social Science Framework (1988)*, and a list of children’s books that will reinforce the concepts taught in this program. In addition, related activities from *Project WILD*, *Project WILD Aquatic*, and *Project Learning Tree* are listed.
Water, Our Most Precious Resource
An Environmental Education Curriculum Guide
(Grades Two, Three, and Four)

Teacher Guide Introduction

With the population of the world increasing daily, the amount of usable water available to each person is decreasing. Thus, we must use the water we have as wisely as possible. Through education, children can be taught to conserve their natural resources. This will help to insure that the Earth of the future will still be a place where we would want to live.

This program is for second, third, and fourth grade students. It is designed to give students a general knowledge of water and to teach them that water is a valuable resource that must be used wisely.

The program consists of an eleven-minute video and the procedures and exercises for ten multicurricular lessons on water. Also included is a coloring and writing book, for optional use, to reinforce the concepts presented in the video.
Program Learning Objectives

- Students will map where their local water comes from.
- Students will describe the many uses of reservoirs.
- Students will describe how their local water is transported down the California State Water Project.
- Students will describe the different phases in the water cycle.
- Students will list ideas on why it is important to conserve water.
- Students will identify ways to conserve water.
- Students will initiate water saving practices at home.
- Students will identify places in their school where water is wasted.
- Students will educate fellow students about water conservation practices.
- Students will determine how their drinking water is purified before it reaches their homes.
- Students will describe the different forms in which water can be found.
- Student will describe the differences between power plants and pumping plants.
## Correlation of Program with the California Science Framework (1990)

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Section</th>
<th>Question (Themes)</th>
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<tbody>
<tr>
<td>Physical Science</td>
<td>B. Reactions &amp;</td>
<td>2. What controls how substances change? (Patterns of Change, Energy)</td>
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<tr>
<td></td>
<td>Interactions</td>
<td></td>
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<tr>
<td></td>
<td>C. Force &amp; Motion</td>
<td>1. What is motion? What are some basic kinds of motion? How is motion described?</td>
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<tr>
<td></td>
<td></td>
<td>(Patterns of Change, Systems &amp; Interactions)</td>
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<tr>
<td></td>
<td></td>
<td>2. What is force? What are the characteristics of forces?</td>
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<td></td>
<td></td>
<td>What is the relationship of force to motion?</td>
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<tr>
<td></td>
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<td>(Systems &amp; Interactions)</td>
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<tr>
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<th>Section</th>
<th>Question (Themes)</th>
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<tbody>
<tr>
<td>Physical Science</td>
<td>D. Energy: Sources &amp; Transforms</td>
<td>1. What is energy and what are its characteristics?</td>
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<td></td>
<td></td>
<td>(Energy, Systems &amp; Interactions, Patterns of Change)</td>
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<tr>
<td></td>
<td></td>
<td>2. What do we do with energy? What changes occur as we use it?</td>
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<td></td>
<td></td>
<td>(Energy, Systems &amp; Interactions)</td>
</tr>
<tr>
<td></td>
<td>F. Energy: Electricity &amp; Magnetism</td>
<td>1. What are they like, &amp; what are their basic properties?</td>
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<td></td>
<td></td>
<td>How do they interact?</td>
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<td>Earth Sciences</td>
<td>B. Geology &amp; Natural Resources</td>
<td>4. What are the responsibilities of humans toward natural resources? (Energy, Systems &amp; Interactions)</td>
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<tr>
<td></td>
<td></td>
<td>1. What is the water cycle? How does the water cycle affect the climate, weather, and life on the earth? How does water affect surface features of the land and the ocean floor? (Systems &amp; Interactions, Patterns of Change)</td>
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<td><strong>D. Meteorology</strong></td>
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<td>1. What are the physical bases of the earth’s climate and weather?</td>
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<tr>
<td></td>
<td></td>
<td>(Patterns of Change, Systems of Interaction)</td>
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<tr>
<td><strong>Life Sciences</strong></td>
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<td>4. How do humans interact with living things?</td>
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<tr>
<td></td>
<td></td>
<td>(Systems &amp; Interactions)</td>
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<tr>
<td><strong>C. Ecosystems</strong></td>
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<td>1. What are ecosystems, and how do organisms interact in ecosystems?</td>
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<td></td>
<td>(Scale &amp; Structure, Systems &amp; Interactions, Patterns of Change)</td>
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<tr>
<td></td>
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<td>4. What are the responsibilities of humans toward ecosystems?</td>
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## Correlation of Program with the California History-Social Science Framework (1988)

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<td></td>
<td>3. Understand human &amp; environmental interaction.</td>
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<td>1. Develop personal skills.</td>
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<td>Participation</td>
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<tr>
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<td></td>
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<td>3. Organize &amp; express ideas clearly in writing &amp; in speech.</td>
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Lesson 1: The California State Water Project

Materials:

- Pretest
- Video "Wanda the Water Drop"
- Video player

Advanced Preparation:

- Make a copy of the pretest for each child.
- Preview the video.
- Set up the video player.

Vocabulary:

- **aqueduct**: a large canal or channel used to transport great amounts of water.
- **chlorination**: when small amounts of chlorine gas or liquid are added to water to kill any bacteria or microorganisms.
- **dam**: any wall or framework used to obstruct a current of water.
- **distribution system**: the system of pipelines in which water is distributed to houses and buildings.
- **earth**: soil, areas of land.
- **electricity**: energy produced by a generator, which can produce light, heat, and make machines run.

- **energy**: the ability to work or usable power.

- **filtration**: the process by which impurities are removed from water when it is passed through sand, gravel, and charcoal.

- **groundwater**: water that is found underground in porous rock.

- **hydroelectric**: having to do with the production of electricity through the use of water power.

- **lake**: an inland body of fresh water surrounded by land and formed by the drainage of a river or stream.

- **organism**: any living thing.

- **pipeline**: a line of pipes with pumps and control devices used to take water from one place to another.

- **power plant**: a building containing all the equipment needed for generating power, especially electric power.

- **pumping plant**: a facility where water is pushed from a lower elevation to a higher elevation with the use of an electrically powered water wheel.

- **reservoir**: a human-made lake where water is collected and stored for later use.

- **river**: a natural stream of water, larger than a creek, which empties into a lake or ocean.
• **spreading pond**: a large earthen pool that is filled with water; the water is then allowed to filter into the ground to add to the underground water supply.

• **turbine**: an engine or motor fitted with scoопlike buckets that are driven around by the pressure of water or steam.

• **watermaster**: a person or a group of people appointed by the court to monitor the use of water in a determined geographic area. They insure that court approved water agreements are followed.

• **well**: a hole made in the earth to reach underground water.

**Procedures:**

A. **Administer the pretest**

• Tell students that over the next two weeks they will be learning all about water. They will be studying how water gets to their homes, the water cycle, and ways to conserve water.

• Explain to the students that before they start the lessons that they will be taking a pretest to determine what they already know about water. Tell the students that it is all right if they do not know some of the answers because they will be learning them later in the program.
• Distribute the pretest to each student.

• Read the directions together. Then read each question allowing the students plenty of time to circle their answers.

• Collect the pretests. Correct them later using the answer key. Retain them for comparison with the student's posttests.

B. Introduce and show the "Wanda the Water Drop" video

• Tell the students that they will be seeing a video about "Wanda the Water Drop." In the video Wanda will be taking a trip down the California State Water Project.

• Ask the students what they think the California State Water Project is. (The California State Water Project is a series of aqueducts that bring water from Northern California down to Southern California. Included in the project are reservoirs which are used to store water, power plants, and pumping plants.)
Tell the students to watch the video to see what happens to Wanda on her trip down from Northern California.

Show the video.

C. Discuss the video

1. What happens to Wanda first? (She falls into Lake Oroville.)

2. What is it called when rain or snow fall to earth? (This is called precipitation.)

3. What human-made structure is used to form some lakes? (This is called a dam.)

4. Once Wanda leaves Lake Oroville where does she go? (She flows into the Feather River.)

5. What is a delta? (It is a triangular shaped tract of land at the mouth of a river.)
6. When Wanda lets go of the bird what does she fall into? (She falls into the aqueduct.)

7. What are the buildings along the aqueduct called that move the water uphill? (These buildings are called pumping plants.)

8. As Wanda flows across the desert, what happens to some of her water drop friends? (They evaporate and turn into water vapor.)

9. What happens to Wanda when she leaves Silverwood Lake? (She goes down the San Bernardino Tunnel and through the Devil Canyon Power Plant.)

10. What does the water do inside the power plant? (The water spins the turbine to generate electricity.)

11. What happens to Wanda in the Linden Spreading Pond? (The water that pours into the pond above her pushes her right down into the ground.)

12. How was Wanda cleaned after her long trip? (As she filters into the ground she is cleaned.)
13. How is Wally cleaned? (He goes through a water treatment plant. First, he is squeezed through filtering material. Then chlorine is added to kill any remaining organisms. Note: In reality it is chlorine gas that is added to water in most cases, not liquid chlorine.)

14. Where does Wanda go next? (She goes into a waterpipe that takes her to the Watermaster’s house.)

15. What is the last thing that happens to Wanda? (The Watermaster’s son drinks her.)
Lesson 1: Pretest Answer Key

Directions: Circle "Yes" or "No" to answer each question.

1. Is it all right to waste water?  
   Yes  No

2. Can water be cleaned when it filters through the ground?  
   Yes  No

3. Could the water you had to drink this morning have come from far, far away?  
   Yes  No

4. Could the water you used today to take a shower have once been used by a dinosaur to take a bath?  
   Yes  No

5. Is it true that someday we may not have enough water for all our needs?  
   Yes  No

6. Are chemicals like chlorine added to water to kill bacteria and disease germs?  
   Yes  No
7. Can people build very long canals to bring water to places that do not have enough water?  Yes  No

8. Do all living things need water?  Yes  No

9. Can water sometimes have things in it that are so small that we cannot see them?  Yes  No

10. Can the form of water be changed from a liquid to a solid or a gas?  Yes  No
Lesson 2: Mapping Wanda's Trip

Materials:

- "California State Water Project Map: Transparency A" blackline master
- "California State Water Project Map: Transparency B" blackline master
- "California State Water Project Map" for each student
- Two transparencies
- Overhead projector
- Vocabulary Word Search exercise

Advanced Preparation:

- Set up the overhead projector.
- Make copies of the "California State Water Project Map" for each student.
- Make copies of the "Vocabulary Word Search" exercise for each student.
- Using the blackline masters make "Transparency A" and "Transparency B."

Vocabulary:

- **aqueduct**: a large canal or channel used to transport great amounts of water.
- **lake**: an inland body of fresh water surrounded by land and formed by the drainage of a river.
- **power plant**: a building containing all the equipment needed for generating power, especially electric power.
- **pumping plant**: a facility where water is pushed from a lower elevation to a higher elevation with the use of an electrically powered water wheel.
- **reservoir**: a human-made lake where water is collected and stored for later use.
- **river**: a natural stream of water, larger than a creek, which empties into a lake or ocean.

**Procedures:**

**A. Discuss where local water comes from**

- Remind the students that in the video, "Wanda the Water Drop," they learned one way water is brought from Northern California to Southern California. In the video Wanda traveled down the California State Water Project.

- Tell the students that of all the water that is available to Californians, 75% comes from above Sacramento. But 75% of all the water used by Californians is used below Sacramento. So the California State Water Project was built to bring the water to where it was needed. The California
State Water Project delivers more than four million acre feet of water each year. An acre foot is equal to 326,000 gallons of water. An acre foot of water would cover a football field with water one foot deep. (optional) Multiply four million by 326,000 on the board to show the students how many gallons of water are in one acre foot.

- In the San Bernardino area about 10% of the water supply comes from the state water project.

- The other 90% of the water used locally comes from wells that pump groundwater up to the surface. Like Wanda, the water is then piped to people's houses.

B. Conduct map activity

- Explain to the students that they will now be doing a map activity in which they will be mapping the California State Water Project.

- Distribute the student maps.

- Show the "California State Water Project Map: Transparency A."
- Point out Lake Oroville, the Feather River, the Sacramento River, the Sacramento-San Joaquin Delta, the Tehachapi Mountains, and Silverwood Lake.

- Have the students label each of these things on their maps as they are pointed out.

- Put on Transparency B. Point out Sacramento, the California Aqueduct, the Pearblossom Pumping Plant, and the Devil Canyon Power Plant.

- Again, have the students label each item as it is pointed out.

- Have students note that the circles stand for pumping plants. Ask the students why the pumping plants are located so close to the Tehachapi Mountains. (A lot of energy is required to move the water up large elevation gains. There is a very large elevation gain in this area.)

- Point out to the students that the water from Lake Oroville travels about three quarters of the length of California.
• Explain to the students that the biggest reason 75% of the available water in California is used below Sacramento is because that is where the farms are located. About 40% of the water in the State Water Project goes to agriculture.

• Have students keep their maps to refer to later.

C. Conduct the "Vocabulary Word Search" exercise

• Distribute a copy of the "Vocabulary Word Search" exercise to each student.

• Have students complete the word search.
Lesson 2: California State Water Project Map Key

Map Key
- Mountains
- Pumpint Plant
- Power Plant
Lesson 2: Vocabulary Word Search

Name: ______________________

Find the following words in Wanda the Water Drop:
- Afterbay
- Aqueduct
- California
- Dam
- Delta
- Earth
- Electricity
- Filtering
- Groundwater
- Hyroelectric
- Pipeline
- Tehachapi
- Watermaster
Lesson 3: The Water Cycle

Materials:

• Taped water sounds (optional)
• Tape recorder (optional)
• A copy of the guided imagery story
• A 12 x 18 sheet of white construction paper for each child

Advanced Preparation:

• Prepare a tape of water sounds. (optional)
• Set up the tape recorder. (optional)
• Read the guided imagery story.
• On the 12 x 18 papers, draw a circle the size of the page. (optional)

Vocabulary:

• condensation: water that has changed from a vapor back to a liquid.
• earth: soil, areas of land.
• evaporation: the process by which water that is heated changes from a liquid to a gas.
• groundwater: water that is found underground in porous rock.
- **lake**: an inland body of fresh water surrounded by land and formed by the drainage of a river.
- **precipitation**: water that falls to the earth as hail, mist, sleet, snow or rain.
- **ocean**: a great body of salt water.
- **river**: a natural stream of water, larger than a creek, which empties into a lake or ocean.
- **water**: a colorless liquid found in rivers, lakes, and oceans; it can also be found naturally as a solid (ice) and a gas (water vapor).
- **water cycle**: the natural cycle water goes through: evaporation from lakes and oceans, condensation into clouds, precipitation as rain or snow, and falling back to the earth to eventually flow back to the ocean.
- **water drop**: a very small amount of water.

**Procedures:**

**A. Prepare students for the guided imagery lesson**

- Have students take everything off their desks.
- Tell them to sit in a comfortable position.
• Tell the students that you will be reading a guided imagery lesson. During the story they should sit with their eyes closed and try to visualize what is being said.

• Have the students try to imagine how things would feel and smell. What color would they be? What sounds would they hear?

B. Read the guided imagery story

• Read the guided imagery story slowly to allow the students time to visualize the different parts of the story.

• Read the story aloud.

• When the story is finished, have the children continue sitting with their eyes closed for one or two minutes. During this time the students should review what they imagined.

• Have the students quietly open their eyes.
C. Discuss the experience by asking the following questions

- Were you able to imagine the places in the story?

- Which place was your favorite?

- Were you able to imagine sounds and smells?

- What happened to the water drop first?

- What happened next to the water drop?

- What happened after the water drop became part of the cloud?

- Where did the water drop end up?
D. Do the art project

- Distribute the white construction paper.

- If it is not already done, have the students draw their circles. The circles must be as big as possible.

- Have the students divide their paper into four quarters using a crayon.

- Have the students number the sections from one to four.

- In section one have the students draw what happened first. (The water drop turned into water vapor.)

- In section two have the students draw the second thing that happened (The water drop became part of the cloud.)

- In section three have the students draw the next thing that happened (The water drop falls back to earth.)
• In the last section have the students draw what happens to the water drop once it gets back on earth. (It runs off and becomes part of a stream and then a river.)

E. Label the pictures

• When the students are finished, explain to them that what they have just drawn is a picture of the water cycle.

• Explain to the students that when water changes from a liquid (a water drop) to a gas (water vapor) this process is called evaporation. Explain that water can evaporate from anywhere. But the majority of it evaporates from the oceans because they hold the greatest amount of water. Have the students label the first picture evaporation.

• Explain to the students that when water changes from a gas back to a liquid the process is called condensation. This occurs when the air cools and can no longer hold the water as water vapor. Have the students label the second picture condensation.
• Explain to the students that when water drops back to the earth as snow, hail, sleet, or rain, this is called precipitation. When the water drops get too heavy for the air to hold them they fall back to the earth. Have the students label the third picture precipitation.

• Explain to the students that after the rain falls back to earth it eventually flows back to the ocean. In its trip back to the ocean it might get drunk by an animal, be absorbed by a tree, or filter into the ground and become part of the groundwater. But it always seems to find its way back to the ocean to become part of the water cycle again.

• Explain to the students that we have the same amount of water on the earth now as we did millions of years ago. The same water just keeps getting used over and over again.
Imagine you are a water drop... It is a very warm day... You are on the surface of the ocean under a wide blue sky... There is a cool breeze, but you can still feel the heat of the sun beating down on you... You can hear the gentle lapping of the water as it is stirred by the breeze. There is a gull crying as it circles overhead... Suddenly, you notice that you are feeling different. You no longer feel the other water drops brushing against you... You feel yourself go floating into the air. You are no longer a water drop. You are now water vapor... Higher and higher you float into the air... You feel so light... As you climb higher and higher you feel as if you're soaring to the sun... You notice as you look down that you are no longer above the ocean... The gentle breeze has pushed you over the land... You can just make out a forest of pine trees far, far below... You continue to sail higher into the sky but you notice that the earth below seems to be getting closer instead of farther away... You realize that the wind is pushing you over a mountain... As you go higher and higher you notice that the air around you is getting cooler... You look up and see some puffy white clouds... You seem to be floating right toward them... As you get closer to the clouds you feel the air continue to get cooler and cooler... Then just as you feel you could reach out and touch the clouds, you feel yourself changing again and you realize that you have changed back into a water droplet... You are now part of one of those fluffy white clouds... But, as time passes you notice that the clouds

Lesson 3: Guided Imagery Story
have changed to a dark grey... Everywhere you look there are more water drops just like yourself... You feel yourself getting fatter as more water drops join you... The air is so crowded with water drops that you are sure not one more water drop would fit... Then, just when it seems like the air can no longer hold you, you feel yourself falling. You fall so fast that everything is a blur. Down, down you go... Just when you think that you'll never stop falling, you splash onto some pine needles on the forest floor... You try to look up to see where you are but you're still moving... You have joined other water drops and you are flowing together down a small hill... As you go down the incline you are joined by more and more water drops... Very soon there are so many water drops flowing together that you have formed a small stream... As you flow along you notice your stream is being joined by other little streams of water... You no longer seem to be going down a hill but you are still moving down... As the ground flattens out and you are joined by still more water, you seem to slow down... You have now slowed down enough to see the trees hanging over you and ever so often a timid animal coming to the edge of the river to drink... Every once in awhile you can feel a fish slip by you... As the river grows in size it just seems to kind of crawl along... You go under big bridges and even sometimes see buildings in the distance... Finally, after what seems like a very long journey you pour back into the sea to begin your journey again.
Lesson 4: Water Phases and Water Uses

Materials:

- "The Water Cycle" exercise
- Old magazines with pictures of water being used or where water use can be inferred (i.e., plants, making food, manufacturing)
- Writing paper
- A piece of tag board for every three students in your class (i.e., ten pieces for thirty students)
- Scissors
- Glue

Advanced Preparation:

- Make one copy of the "The Water Cycle" exercise for each student.

Vocabulary:

- condensation: water that has changed from a gas back to a liquid.
- evaporation: the process by which water that is heated changes from a liquid to a gas.
- groundwater: water that is found underground in porous rock.
- ice: the solid phase of water.
• liquid: fluid or capable of flowing; not solid or fixed.
• precipitation: water that falls to the earth as hail, mist, sleet, snow, or rain.
• water vapor: the gas phase of water.

Procedures:

A. Review the water cycle

• Ask the students what the different parts of the water cycle are.

• Remind the students that when water changes from a liquid to a gas this is called evaporation. This happens when the water is heated up by something like the sun. When water cools and turns back to a liquid, this is called condensation. As air rises it cools and that is when the water vapor turns back to water drops. When water returns to earth in the form of rain, snow, sleet, or hail this is called precipitation.

• Remind the students that in the video Wanda filtered into the ground and for awhile she became part of the groundwater.
• Explain that the groundwater is part of the water cycle. It is a way that the earth stores water. The water can be pulled out of the ground through a well or by plants absorbing it through their roots.

B. Do the exercise "The Water Cycle"

• Distribute a copy of "The Water Cycle" exercise to each student.

• Write the words condensation, evaporation, precipitation, and groundwater on the board.

• Have students label each part of the water cycle.

• Walk around and help students as necessary.

• Also, have the students label the groundwater.

• Correct the exercise with the class.
C. Discuss Water Phases

- Tell the children that in the guided imagery story, the water had three forms.

- Have the students name the forms. (solid, liquid, gas).

- Explain to the students that water is the only substance on earth that is found naturally in all three forms.

- Ask the students to give you examples of each form of water in nature. (solid- glaciers, snow; liquid - lakes, streams, rain, and oceans; gas - water vapor is in the air all around us).

- Tell the students that these different forms of water are called the phases of water.

- Explain to the students that they will now be discussing how water is used.

- Remind them that we use all the different phases of water.
D. Conduct the water use activity

• Break the students into groups of three or four.

• Distribute a piece of writing paper to each group.

• Have each group of students write down all the ways they can think of that water is used. Give them five minutes.

• Have a spokesperson from each group read off their list. Write the ideas on the board as they are read.

• When all the students have had a turn, go back over the list together. Discuss each item. Eliminate those that are not appropriate. Add important items that they have missed.

E. Conduct the art activity

• Distribute a piece of tag board, several magazines, glue, and scissors to each group.
• Tell the students to search the magazines for pictures that show water uses. The students can include pictures where water use can be inferred.

• Explain that they should cut the pictures out and glue them to the tag board to form a mural. (Note: If it is not possible to get magazines, have students draw pictures of the different ways water is used, cut these out, and glue them to the tag board.)

• Have a student from each group share the group’s mural with the rest of the class.

• Display the murals.
Lesson 4: The Water Cycle

Condensation

Precipitation

Evaporation

Groundwater
Lesson 5: Power Plants and Pumping Stations

Materials:
- 18 inch piece of dowel for each student (1/4 inch in diameter)
- One tack or small nail for each student
- One pinwheel pattern for each student duplicated onto white construction paper
- Squirt guns (optional)
- Laminated 9 x 12 piece of tag board
- Tub of water
- "How Power and Pumping Plants Work" exercise for each student
- One duplicating master

Advanced Preparation:
- Make a duplicating master from the pinwheel pattern.
- Duplicate the pinwheel pattern onto 9 x 12 pieces of construction paper.
- Make a pinwheel from laminated tag board.
- Make copies of the "How Power and Pumping Plants Work" exercise for each student.
Vocabulary:

- electricity: energy produced by a generator, which can produce light, heat, and make machines run.
- energy: the ability to work or usable power.
- generator: a device for converting mechanical energy into electrical energy.
- hydroelectric: having to do with the production of electricity through the use of water power.
- penstock: an above ground pipe that goes up hill from a pumping station or down hill to a power plant.
- pipeline: a line of pipes with pumps and control devices used to take water from one place to another.
- power plant: a building containing all the equipment needed for generating power, especially electric power.
- pumping plant: a facility where water is pushed from a lower elevation to a higher elevation with the use of an electrically powered water wheel.
- turbine: an engine or motor fitted with scooplike buckets that are driven around by the pressure of water or steam.
Procedures:

A. Discuss Pumping Plants

- Explain to the students that because water can not flow uphill naturally the California State Water Project must have a way to move water from a lower elevation to a higher elevation.

- Have the students imagine that they are on their bicycles at the top of a hill. Ask them if they will have to pedal to get to the bottom of the hill. (No, the pull of gravity will bring the bike to the bottom of the hill without being pedalled.) Now have them imagine that they are at the bottom of the hill. Ask them if they will need to pedal to get back up the hill. (Yes.) Tell them that the steeper the hill is, the harder they will have to pedal to get back to the top. To get back to the top, they will have to put in energy.

- Explain that water works in the same way. To get it from a low place (elevation) to a higher place, energy must be used. This is where the pumping plants come in. Energy in the form of electricity is used to push the water up the hills.
B. Conduct the "How Do Power and Pumping Plants Work" exercise

- Distribute a copy of the "How Do Power and Pumping Plants Work" exercise to each student.

- Have a student volunteer read the paragraph about hydroelectric power plants.

- Tell the students to look at the picture of the power plant.

- Discuss the picture. Emphasize that the water pushes against the turbine which spins the generator and this produces electricity.

- Now have a student volunteer to read the paragraph about pumping plants.

- Discuss the pumping plant picture. Emphasize that now the water is being pushed by the water wheel instead of pushing on the water wheel.

- Have the students answer the questions at the bottom of the page.

- Correct the questions together.
C. Discuss more about power plants and pumping plants

- Tell students that it costs about 120 dollars to pump one acre foot (326,000 gallons) of water from Northern California to San Bernardino. (Have students refer to the maps they made to see how far this is.) Before 1983 the cost was only 15 dollars.

- Tell them that this is one of the reasons for the power plants that are included along the California State Water Project. By producing electricity they can get back some of the energy that is used to bring the water south.

D. Conduct the "Pinwheel" art lesson

- Distribute the pinwheel patterns.

- Have the students color their pinwheel pattern. (Note: They need to color the back of the pattern because this is the part that will show.)

- If the squirt guns are going to be used, the pinwheel patterns should be laminated before they are cut out.
• Have the students cut along the solid lines.

• Insert the tack through each of the points marked with X’s. The tack should then be pushed through the middle of the pinwheel and into the end of the dowel.

• If squirt guns are being used have the students practice squirting the pinwheel and making it turn.

• Explain that this is similar to how the turbine in a hydroelectric power plant is turned. The water pressure of the water being pushed from the squirt gun makes the pinwheel turn just as the water pressure in a hydroelectric power plant turns the turbine.

• Partially submerge a pinwheel (this pinwheel should be made from laminated tag board) in a tub of water.

• Rotate the pinwheel with your finger.

• Have the students take turns putting their hand in the water in front of the pinwheel to feel the water pushing against their hand.
• When everyone has had a turn, ask the students what they felt.

• Tell the students that in this case the pinwheel is acting like the water wheel in a pumping plant, it is increasing the pressure on the water and causing it to move.
Lesson 5: How Power and Pumping Plants Work Key

Hydroelectric Power Plants

Hydroelectric power plants convert water pressure to electric energy. Water is brought down hill to the power plant through an above ground pipe called a penstock. The weight of the water high in the pipe presses on the water below it increasing the pressure. The water then enters the power plant and is piped to the turbine. A turbine is a water wheel which spins when the high pressure water pushes against its scooplike buckets. The turbine is connected to a generator. The rotation of the turbine spins the generator and produces electricity. The power that is produced is called hydroelectric power.

Hydroelectric Power Plant

Pumping Plant
Lesson 5: How Power and Pumping Plants Work (Continued)

Pumping Plants

Pumping plants work in the opposite way of hydroelectric power plants. In a pumping plant electricity is used to power an electric motor which spins a water wheel. The rotation of the water wheel increases the water pressure and pushes the water up hill. A large amount of energy is required to move water up hill.

Answer the following questions:

1. What is electricity produced by water called? _hydroelectric energy_

2. Why are power plants and pumping plants opposites? _They are opposites_ because _power plants produce energy and pumping plants use energy_.

3. What is the water wheel in a power plant called? _It is called a turbine._

4. What part of a hydroelectric power plant produces electricity? _the generator_
Lesson 6: Water Treatment

Materials:

- Pencils or crayons
- Copies of the "Water Treatment" exercise
- The "Water Treatment" blackline master key
- An overhead projector
- Copies of the "Water Drop Writing Paper"

Advanced Preparation:

- Make copies of the "Water Treatment" exercise for each student.
- Make a transparency from the "Water Treatment" blackline master key.
- Set up the overhead projector.
- Make a copy of the "Water Drop Writing Paper" for each student.

Vocabulary:

- **aeration**: water is sprayed into the air to release any trapped gases and to absorb additional oxygen.
- **aqueduct**: a large canal or channel used to transport great amounts of water.
- **coagulation**: in water treatment alum is dissolved in the water; the alum attaches to dirt particles; these become heavy and sink.
• **chlorination**: when small amounts of chlorine gas are added to water to kill any bacteria or microorganisms.

• **contaminated**: to be made unclean or impure.

• **filtration**: the process by which impurities are removed from water when it is passed through sand, gravel, and charcoal.

• **floc**: heavy particles of alum combined with dirt.

• **groundwater**: water that is found underground in porous rock.

• **impurities**: things such as dirt, plant matter, and germs that make water unclean.

• **molecules**: the smallest part of a substance that still retains the characteristics of the substance.

• **polluted**: water which is made unclean or contaminated.

• **sedimentation**: in water treatment, when the heavy particles sink so the clear water above can be skimmed off.

• **well**: a hole made in the earth to reach underground water.

**Procedures:**

**A. Discuss why water is treated**

- Remind the students that in lesson 3 they learned that the earth has the same amount of water now as it has had for millions of years. This means
that we use the same water that dinosaurs used and the same water George Washington used. The water we bathed in this morning might have once been part of an ice pack in Antarctica, a pool in Australia, or once been absorbed by a redwood tree in Northern California. The possibilities of the many things that could have happened to any glass of water are endless.

- Ask the students how they think it is possible to use the same water over and over again. (Answers will vary.)

- If the students do not respond with the correct answer explain that the reason that water can be used over and over again is because it can be cleaned.

- Tell the students that as they learned in the "Wanda the Water Drop" video, water can be cleaned in two ways. First, it can be cleaned naturally. This happens when water filters down into the ground. As water filters into the ground, the impurities such as dirt, dust, plant matter, and germs are caught between particles of gravel and sand. Then when it is pumped back out of the ground through a well it can be sent right to consumers (people who use the water). Sometimes water is contaminated by things like oil that were once dumped on the earth and that over time have seeped down into the
groundwater. This water must be cleaned in another way. This is also true of water that is taken from rivers, streams, lakes, and aqueducts. Water that is polluted or that has been taken from a surface source such as a river or lake must be taken to a water treatment plant.

B. Conduct the "Water Treatment" exercise

- Distribute a copy of the "Water Treatment" exercise to each student.

- Show the "Water Treatment" transparency. (Cover everything but the term aeration and the picture that accompanies it.)

- Read and discuss the term aeration. Give the students time to draw an aeration picture on their work sheet.

- Continue the same procedure for each of the remaining terms. Always allow enough time for the students to make their own drawings.
C. Conduct the "Mini Water Treatment Simulation" exercise (optional)

- This exercise is on pages 55-57 in the 1988 edition of *Water Precious Water*. This is an activity book that was put out by Project Aims. In this lesson the students can actually do the different steps in the water treatment process.

- If it is not possible to do the above exercise, let the students brain storm ways to clean water. If it is feasible let them try out some of their ideas.

D. Conduct the "Water Writing" exercise

- Distribute a copy of the "Water Drop Writing Paper" to each student.

- Tell the students that they will be writing a story about the life of a water drop. They should include in the story all the different places the water drop can visit. Remind the students that the water has to be cleaned in a treatment plant or be filtered into the ground before it can be used again.

- When everyone is finished have the students share their stories with the rest of the class.
Lesson 6: Water Treatment Exercise Key

Directions: Draw the pictures of the different steps in water treatment.

Aeration - In this step water is sprayed into the air. This helps to release trapped gases and it allows the water to absorb more oxygen.

Coagulation - The water then moves to the mixing basin where coagulating chemicals such as powdered alum are added to the water. These coagulating chemicals make sticky clumps which attach to particles such as dirt making them very heavy. These heavy clumps are called floc.

Sedimentation - In the settling basin the floc sinks to the bottom of the basin and clear water is taken off the top.
Lesson 6: Water Treatment Exercise (Continued)

Filtration: In this step the water is passed through layers of gravel, sand, and coal to remove any impurities that are still in the water.

Chlorination: After the water leaves the filter a disinfecting chemical such as chlorine gas is added to the water to destroy any remaining bacteria or disease germs.
Lesson 6: Water Drop
Writing Paper

Name: __________________
Lesson 8: Silverwood Lake Pattern
Lesson 7: Water Conservation

Materials:

- Construction paper
- Writing paper
- Pencils and crayons
- "Home Water Survey" for each student
- "Ways to Save Water" handout for each student

Advanced Preparation:

- Make copies of the "Home Water Survey" and the "Ways to Save Water" handout for each student.

Vocabulary:

- conservation: the act of preserving and guarding; when something is used wisely and not wasted.
Procedures:

A. Review the five steps in water treatment

- Ask students the following questions:
  1. What are the five steps in water treatment? (aeration, coagulation, sedimentation, filtration, chlorination)
  2. What happens during each of these steps? (see Lesson 6)
  3. What water has to be run through water treatment plants? (All surface water such as water from aqueducts, lakes, streams, and rivers must be treated. Contaminated groundwater must also be treated.)

- List student answers on the board for review.

B. Discuss water conservation

- Remind the students that they have learned that the earth has the same amount of water on it now that it did one million years ago.

- Give students the following facts. Ninety-seven percent of the earth’s water is salty. Two percent of the earth’s water is found in glaciers and polar
icecaps. That leaves less than one percent of the water on earth that can actually be used.

- Ask the students if the amount of people on the earth is the same as it was even 100 years ago? (No!)

- Ask students the following question. How will there be enough water to meet everyone's needs if the world population is increasing and the amount of water on the earth is staying the same? (Answers will vary.)

- Tell students that the best way to insure that we all have enough water for our needs is for everyone to conserve water. What does it mean to conserve water? (When we conserve water, we use only what we need and we do not waste it.)

- List the following water uses on the board:
  1. showering/bathing
  2. watering the lawn
  3. washing dishes
  4. washing clothes
  5. brushing teeth
6. washing the dog
7. cooking
8. washing the car
9. drinking

- Have students brainstorm how water could be saved during each of the above activities.

- List the students' ideas on the board.

C. Conduct the "Water Poster" activity

- Distribute two pieces of construction paper to each student.

- Have the students make two posters with water conservation slogans that they can hang up at home to remind them to conserve water.
D. Look for wasteful water practices at school (optional)

- Have students survey the school for ways that water is being wasted (i.e., look for broken sprinklers, leaky faucets, and other ways water is being wasted).

- Have the students write letters to the principal or superintendent asking to have broken items fixed.

- Have students collect water from a dripping faucet for one day. From this have the students determine how much water is wasted in a week and in a month.

- Have students make posters to be hung around campus that tell other students how to save water.
E. Have students take home the "Home Water Use Survey" and the "Ways to Save Water" handout.

- Have students return the survey the next day.

- Have the students tell you what they learned.
Directions: Circle "Yes" or "No" to answer the following questions.

1. Does your house have leaky faucets, hoses, or toilets? Yes No

2. Do you let the water run when you brush your teeth or shave? Yes No

3. Do you rinse off your driveway instead of using a broom? Yes No

4. Do you have water saving shower heads? Yes No

5. Do you run your dishwasher when it is not full? Yes No

6. Do you water the lawn on windy days? Yes No

7. Do you water your lawn and garden in the early morning? Yes No
8. Do you let the water run while washing the car? Yes No

9. Do you take showers that last over five minutes? Yes No

10. Do you only use the washing machine for full loads? Yes No
Lesson 7: Ways to Save Water

1. Fix leaky toilets, pipes, and faucets.

2. Do not let the water run when you brush your teeth.

3. Do not let the water run when you shave. Fill the sink with a few inches of water and use this to rinse your razor.

4. If you take showers that last over five minutes, take a shallow bath instead.

5. Only run the dishwasher and washing machine for full loads.

6. Rinse vegetables and fruit in a partially filled sink of water.

7. Use a bucket to wash cars. Use the hose only for very quick rinses.

8. Wash your dog in the tub and not with a running hose.

9. Water the lawn and garden only when they need it.
10. Do not water on windy days.

11. Water during the early morning.

12. Use plants in your yard that do not require a lot of water.

13. Recycle because it takes less water to change a recycled item than it does to make something new.

14. Keep drinking water in the refrigerator so you do not have to let the faucet run while waiting for cool water.

15. If you must let the water run to get hot or cold water, collect the water in a bucket and use it to water plants.
Lesson 8: Reservoirs

Materials:

- "Water Use Math" exercise for each student
- A piece of tag board
- An opaque projector
- A 9 x 12 piece of white construction paper for each student

Advanced Preparation:

- Make a copy of the "Water Use Math" exercise for each student.
- Using an opaque projector, make a tag board sized picture of Silverwood Lake.

Vocabulary:

- reservoir: a human-made lake where water is collected and stored for later use.

Procedures:

A. Conduct the "Water Use Math" exercise

- Distribute a copy of the "Water Use Math" exercise to each student.
• Read through the problems together. Have the students solve each problem as you go along. For the younger students that are not skilled in multiplication, have them solve the multiplication problems through repeated addition.

• When everyone is finished, correct the problems together.

• Have the students make up their own water word problems and solve them. (Or the students can trade papers with a neighbor and solve each others problems.)

B. Discuss reservoir uses

• Tell the students that when the California State Water Project was built the agreement stated that the reservoirs along the project should have multiple uses. This means that the reservoirs would not be only for water storage. Reservoirs would also be available to the public for recreation. But since water storage is the reservoir's primary use, if the water was needed to supply consumers, it would be used to do that even if it meant letting the level in the lake run low. Ideally reservoirs are maintained at about the same level because the amount of water going into the reservoir is about the
same as the amount of water going out. The problems arise when the amount of water being taken out of the reservoir is greater than the amount of water being put back in.

C. Give a history of the local reservoir, Silverwood Lake

- Silverwood Lake was named after a man named W.E. "Ted" Silverwood. He was a Riverside County resident who worked unceasingly for water and soil conservation. He also worked hard to bring more water to Southern California. The lake was completed in 1973. When the lake is full it can be up to 225 feet deep. The Serrano Indians lived in the valley where the lake is now located long before the lake was built.

D. Conduct the Silverwood Lake art project

- Have the students brainstorm the many different uses for a reservoir like Silverwood Lake. (i.e., swimming, boating, camping, water skiing, fishing, scenic beauty, and to support plants and wildlife)

- List the students' ideas on the board.
- Tell the students that they will be drawing pictures of the different things that were listed on the board.

- Have the students pick the reservoir use that they think is the most important.

- Have the students draw a picture of that water use.

- Pick several students to color in Silverwood Lake.

- Have the students cut out their drawings and glue them on the map of Silverwood Lake.
Lesson 8: Water Use Math Answer Key

Directions: Work the following math problems.

1. Last month Joe used 100 gallons of water because he let the hose run while he washed the car. This month he only used 20 gallons of water because he used a bucket to wash the car and he only ran the hose a short time to rinse it. How much water did he save this month? 80 gallons

2. If it takes 40 gallons to water to do one load of laundry, how much water does it take to do 5 loads of laundry? 200 gallons

3. If a leaky faucet wastes 2 gallons of water a day, how much water does it waste in a week? 14 gallons

4. When Sue took a bath she used 18 gallons of water because she filled the bath only half full. If she had filled the bath all the way, how much water would she have used? 36 gallons

5. If it takes 10 gallons of water to wash dishes in a dishwasher
and 30 gallons of water to wash the dishes by hand, how much 20 gallons
water do you save by doing the dishes in the dish washer?

6. When watering the lawn 8 gallons of water is used each minute, how much water is used in 10 minutes? 80 gallons

7. This morning Mary used 1 gallon of water to brush her teeth, 18 gallons of water to take a bath, and 6 gallons of water to flush the toilet. How much water did she use in all? 25 gallons

8. If each person in a family uses 70 gallons of water each day and there are 4 people in the family, how much water does the family use each day? 280 gallons

9. If it takes 100,000 gallons of water to make one car, how much water does it take to make 2 cars? 200,000 gallons

10. It takes 10 gallons of water to make one can of coke, how much water does it take to make a six-pack of coke? 60 gallons
Lesson 9: Vocabulary Review

Materials:

- A copy of the "Vocabulary Crossword Puzzle"
- Writing paper

Advanced Preparation:

- Make a copy of the "Vocabulary Crossword Puzzle" for each student.

Procedures:

A. Conduct a brief oral review quiz

- Use the questions below to review the concepts taught in this unit.

- Conduct the review by asking these questions and calling on individual students to answer them.

1. Where does our local water come from? (It comes from the groundwater through wells and from the California State Water Project.)
2. Seventy-five percent of the water in California comes from above or below Sacramento? (above)

3. What is it called when water changes from a liquid to a gas? (evaporation) What is it called when water vapor turns back to liquid water? (condensation)

4. What are the three phases or forms that water can be found in? (solid, liquid, gas)

5. What is another name for rain and snow? (precipitation)

6. Does the earth have more, less, or the same amount of water it did one million years ago? (the same)

7. In a hydroelectric power plant, what is used to spin the turbine? (water pressure)

8. What part of the power plant produces electricity? (the generator)
9. How is a pumping plant the opposite of a power plant? (Power plants produce electricity and pumping plants use electricity. In a power plant water pressure spins the turbine, or water wheel, and this spins the generator. In a pumping plant the electricity is used to turn the water wheel. The turning of the water wheel increases the water pressure and pushes the water uphill.)

10. What are the five steps in water treatment and what happens in each step? (1. In aeration water is squirted into the air to remove gases and help it absorb oxygen. 2. In coagulation alum attaches to the dirt particles making them heavy. 3. In sedimentation the floc settles out and the clear water is taken off the top. 4. During filtration the water is passed through gravel, sand, and charcoal to take out additional impurities. 5. During chlorination a disinfectant such as chlorine is added to the water to destroy any remaining organisms.)

11. Name four uses for reservoirs. (fishing, swimming, boating, water skiing, water storage, water for plants and animals)

12. What is the most important function of reservoirs? (to store water for future use)
B. Conduct the "Vocabulary Review Crossword Puzzle" exercise

- Distribute a copy of the "Vocabulary Review Crossword Puzzle" to each student.

- For younger students it will probably be necessary to read the clues to the students and to read the word list. It would probably be best to work through the exercise together.

- For older students allow them to work through the exercise alone while helping when necessary.

- When the exercise is complete, collect it and correct it.

- If necessary go back and review any areas that the students are still having difficulty with.
Lesson 9: Crossword Puzzle Clues

Directions: Read the clues and fill in the crossword puzzle using the word list.

Word List

<table>
<thead>
<tr>
<th>aeration</th>
<th>earth</th>
<th>ice</th>
<th>river</th>
</tr>
</thead>
<tbody>
<tr>
<td>aqueduct</td>
<td>electricity</td>
<td>lake</td>
<td>sedimentation</td>
</tr>
<tr>
<td>coagulation</td>
<td>energy</td>
<td>liquid</td>
<td>turbine</td>
</tr>
<tr>
<td>chlorination</td>
<td>evaporation</td>
<td>pipeline</td>
<td>waste</td>
</tr>
<tr>
<td>condensation</td>
<td>filtration</td>
<td>polluted</td>
<td>water</td>
</tr>
<tr>
<td>cloud</td>
<td>groundwater</td>
<td>precipitation</td>
<td>well</td>
</tr>
<tr>
<td>dam</td>
<td>hydroelectric</td>
<td>reservoir</td>
<td></td>
</tr>
</tbody>
</table>

Across

1  a clear liquid
6  structure for storing water
7  when alum combines with dirt, becomes heavy and sinks
8  a large stream
9  a mass of tiny water drops suspended in the air

Down

2  when water is sprayed in the air to release trapped gases
3  when chlorine is added to water
4  a hole made to reach groundwater
5  a line of pipes
10 a wall that holds back water
<table>
<thead>
<tr>
<th>Across Continued</th>
<th>Down Continued</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 opposite of condensation</td>
<td>11 a small body of water surrounded</td>
</tr>
<tr>
<td>14 to use more than is needed</td>
<td>12 usable power</td>
</tr>
<tr>
<td>16 solid water</td>
<td>13 a canal to move water</td>
</tr>
<tr>
<td>18 process where water changes from a vapor to a liquid</td>
<td>15 hail, mist, snow, or rain</td>
</tr>
<tr>
<td>19 the engine which turns the generator</td>
<td>17 soil</td>
</tr>
<tr>
<td>20 how impurities are removed from water</td>
<td>21 capable of flowing, not solid</td>
</tr>
<tr>
<td>22 energy produced by generators</td>
<td></td>
</tr>
<tr>
<td>23 to be made unclean</td>
<td></td>
</tr>
<tr>
<td>24 when heavy particles settle out of water</td>
<td></td>
</tr>
<tr>
<td>25 power which is produced by water pressure</td>
<td></td>
</tr>
<tr>
<td>26 water in porous rock</td>
<td></td>
</tr>
</tbody>
</table>
Lesson 10: Posttest and Closing

Materials:

• A copy of the posttest for each student
• Writing paper

Advanced Preparation:

• Make copies of the posttest for each student.

Procedures:

A. Administer the Posttest

• Distribute the posttest. (Note - a more difficult, short answer posttest is also included. Choose the test that is most appropriate for your students.)

• Read the directions.

• Read each question. Allow enough time for students to complete their answers.
• Collect the test. Later correct the tests and compare the student’s scores to their pretest scores.

• Return the tests to the students. Discuss each question.

B. Conduct the "Water Poem" activity

• Explain to the students that they will be writing cinquains (sin-kanez). A cinquain is a five line poem.

• Write the following information on the blackboard:

  Line one - one word that names a thing, an idea, or a feeling

  Line two - two words to describe the first word (This can be what it looks like, feels like, tastes like, or smells like.)

  Line three - three words which tell how it acts; what it is doing, has done, or will do
Line four - four words telling how you feel about it, an observation about
it, or how it affects other things (This can be a phrase or single
words.)

Line five - a synonym for the title; or a word that connects to it, or relates
to it

Example: WATER
SLIPPERY, COOL
SLIDING, RACING, CRASHING
CAN'T LIVE WITHOUT IT
LIFE

• Read together the requirements for each line of the poem.

• Write a class poem. Take suggestions for each line.

• Practice until the students understand what to do.

• Have the students write their own poems about something they have
  learned in this program.
• Have the students share their finished poems with the class.

• Have the students illustrate their poems. (optional)

• Display the poems.
Lesson 10: Posttest Answer Key

Directions: Circle "Yes" or "No" to answer each question.

1. Should you save water whenever possible? (Yes) (No)

2. Is water cleaned naturally when it filters into the ground? (Yes) (No)

3. Is some local water brought down from Northern California in the aqueducts for our use? (Yes) (No)

4. Is there less water on earth now than there was 100 years ago? (Yes) (No)

5. Could conserving water now help assure that we will have enough water for our needs in the future? (Yes) (No)

6. Is chlorine added to water to make it smell good? (Yes) (No)

7. Does most local water come from wells? (Yes) (No)
8. Can plants, animals, or people live without water? Yes \[\bigcirc\] No

9. Is water from lakes, streams, and rivers treated to remove things too small for people to see? Yes \[\bigcirc\] No

10. Is water the only substance that is found on earth naturally in a solid, liquid, and gas form? Yes \[\bigcirc\] No
Lesson 10: Alternate Posttest Answer Key

1. Name one way to save water. Answers will vary.

2. What are the two ways water can be cleaned? Water is cleaned when it filters down into the ground or when it goes through a water treatment plant.

3. What is the California State Water Project? It is a series of aqueducts, pumping plants, and power plants which move water from Northern California to Southern California.

4. What is the water cycle? The water cycle is the continuous movement of the earth's water from the oceans through evaporation, to condensation in the air, and back to the ocean or land through precipitation.

5. Does the amount of water on the earth change? No, the amount of water on earth has remained the same for millions of years.

6. Why is chlorine added to water during water treatment? Chlorine is added to water to kill any remaining bacteria or disease organisms that are still in the water after it is treated.

7. Where does the majority of our local water come from? The majority of local water comes from the groundwater through wells.
8. Name the five parts of the water treatment process. \textit{aeration, coagulation, sedimentation, filtration, coagulation, chlorination}.

9. Why are evaporation and condensation opposites? \textit{In evaporation water changes from a liquid to a gas and in condensation water changes back from a gas to a liquid.}

10. What three natural forms can water be found in? \textit{Water can be found as a liquid, a solid (ice), and a gas (water vapor).}
Unit Vocabulary List

• **aeration**: water is sprayed into the air to release any trapped gases and to absorb additional oxygen.

• **aqueduct**: a large canal or channel used to transport great amounts of water.

• **coagulation**: in water treatment alum is dissolved in the water; the alum attaches to dirt particles; these become heavy and sink.

• **chlorination**: when a small amounts of chlorine gas are added to water to kill any bacteria or microorganisms.

• **condensation**: water that has changed from a vapor back to a liquid.

• **contaminated**: to be made unclean or impure.

• **cloud**: a visible mass of tiny water drops or ice particles suspended in the air.

• **dam**: any wall or framework used to obstruct a current of water.
- **distribution system**: the system of pipe lines in which water is distributed to houses and buildings.

- **earth**: soil, areas of land.

- **electricity**: energy produced by a generator, which can produce light, heat, and make machines run.

- **energy**: the ability to work or usable power.

- **evaporation**: the process by which water that is heated changes from a liquid to a gas.

- **filtration**: the process by which impurities are removed from water when it is passed through sand, gravel, and charcoal.

- **floc**: heavy particles of alum combined with dirt.

- **generator**: a device for converting mechanical energy into electrical energy.

- **groundwater**: water that is found underground in porous rock.
- **hydroelectric**: having to do with the production of electricity through the use of water power.

- **ice**: the solid phase of water.

- **impurities**: things such as dirt, plant matter, and germs that make water unclean.

- **lake**: an inland body of fresh water surrounded by land and formed by the drainage of a river.

- **liquid**: fluid or capable of flowing; not solid or fixed.

- **molecules**: the smallest part of a substance that still retains the characteristics of the substance.

- **ocean**: a great body of salt water.

- **organism**: any living thing.

- **penstock**: an above ground pipe that goes up hill from a pumping station or down hill to a power plant.
• **pipeline**: a line of pipes with pumps and control devices used to take water from one place to another.

• **polluted**: water which is made unclean or contaminated.

• **power plant**: a building containing all the equipment needed for generating power, especially electric power.

• **precipitation**: water that falls to the earth as hail, mist, sleet, snow or rain.

• **pumping plant**: a facility where water is pushed from a lower elevation to a higher elevation with the use of an electrically powered water wheel.

• **reservoir**: a human-made lake where water is collected and stored for later use.

• **river**: a natural stream of water, larger than a creek, which empties into a lake or ocean.

• **sedimentation**: in water treatment, when the heavy particles sink so the clear water above can be skimmed off.
• **spreading pond:** a large earthen pool that is filled with water; the water is then allowed to filter into the ground to add to the underground water supply.

• **turbine:** an engine or motor fitted with bowl-like parts that are driven around by the pressure of water or steam.

• **waste:** the action of wasting, using more than what is needed.

• **water:** a colorless liquid found in river, lakes and oceans; it can also be found naturally as a solid (ice) and a gas (water vapor).

• **water cycle:** the natural cycle water goes through: evaporation from lakes and oceans, condensation into clouds, precipitation as rain or snow, and falling back to the earth to eventually flow back to the ocean.

• **water drop:** a very small amount of water.

• **watermaster:** a person or a group of people appointed by the court to monitor the use of water in a determined geographic area. They insure that court approved water agreements are followed.
• **water wheel:** a wheel with scooplike buckets on its rim that is used when producing power or when moving water to a higher elevation in a pumping plant.

• **well:** a hole made in the earth to reach underground water.
Supplemental Lessons

Project WILD Aquatic

Alice in Waterland*, page 175

In this lesson students will explore water use and its effects on wildlife through the use of data gathering, lecture/discussion, and imagery.

Aqua Words, page 1

After brainstorming water words and making a word tree, students will write poetic statements about water.

To Dam or Not to Dam*, page 125

In this activity students will role play different positions on the issue of whether or not a hypothetical river should be dammed.

Deadly Waters, page 137

In this activity students will graph and analyze the pollutants found in a hypothetical river. They will then recommend change to improve the condition of the river.
How Wet is Our Planet?, page 7

In this activity students will calculate different water volumes with the use of percentages to show how only a small amount of the earth’s water is usable for people’s everyday needs.

Water Wings*, page 3

In this lesson students participate in a guided imagery experience; then they paint pictures and write poetry about their imagined journey.

Project Learning Tree (1977 edition)

Water You Know?, page 94

In this activity students demonstrate the importance of water to all living things by acting out sense in which water is used.
Project WILD

Flip the Switch for Wildlife*, page 217

In this activity students do research to determine where their local power comes from and determine what impact producing that energy might have on their environment. They then invent ways to save energy and thus cut down the effect making more energy has on the environment.

Water's Going On*, page 213

In this activity students determine how much water they use in school each day. They then design and practice ways to cut that water use.

Water Precious Water (Project Aims)

All of these activities could be used to supplement this unit.

* These activities may have to be simplified for children in the lower grades.
List of Children’s Books that Reinforce the Concepts taught in the Program

CONSERVATION


DROUGHT


EFFECTS OF WATER ON PEOPLE


EFFECTS OF WATER ON PLANTS


EXPERIMENTS WITH WATER


FUN


POLLUTION


WATER CYCLE


WATER PHASES


WATER SOURCES


WATER TREATMENT


WATER USES


WEATHER


American Water Works Association. (1989). *25 Things you can do to prevent water waste.* (Available from West San Bernardino County Water District)


Wanda The Water Drop

An Environmental Education Coloring And Writing Book
Wanda Flowing Down The Sacramento River
The Sacramento - San Joaquin Delta
Bird Flying Over The Delta
Water Going Over The Tehachapi Mountains
Wanda Swimming In Silverwood Lake
Wanda Sailing In Silverwood Lake
The Devil Canyon Power Plant

Devil Canyon

Afterbay
Wanda And Wally
Wanda In A Water Pipe
Wanda Getting Sucked Into A Pipe
Inside The Water Treatment Plant

Chlorine
Chlorine Destroying A Disease Organism
Water Going Into A House
Wanda Pouring Into A Glass
The Watermaster's Son