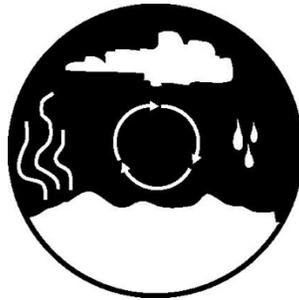


DELTA STUDIES CURRICULUM

Water in the Delta

5-ESS2 Earth's Systems: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.



San Joaquin County Office of Education
STEM Programs

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5-ESS2 Water in the Delta

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WATER IN THE DELTA



Next Generation Science Standards

Working towards Performance Expectation 5-ESS2 Earth's Systems:

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Science and Engineering Practices: Developing and Using Models: Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model using an example to describe a scientific principle. (5-ESS2-1)

Constructing Explanations and Designing Solutions: Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2) In this unit, students design a filter to eliminate pollution from water.

Disciplinary Core Ideas: ESS2.A: Earth Materials and Systems Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

(5-ESS2-1) ESS2.C: The Roles of Water in Earth's Surface Processes Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.

Crosscutting Concepts: Scale, Proportion, and Quantity Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2)

Systems and System Models A system can be described in terms of its components and their interactions. (5-ESS2-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1),(5-ESS2-2)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2)

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1),(5-ESS2-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-ESS2-1),(5-ESS2-2)

MP.4 Model with mathematics. (5-ESS2-1),(5-ESS2-2)

5.G.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)

WATER IN THE DELTA

OVERVIEW

UNDERSTANDINGS

- Water in the Sacramento-San Joaquin Delta must be conserved to provide for all who need it.
- The amount of clean fresh water is limited.
- The Delta is the origin of water used by our local communities and some of this water is contaminated by a variety of pollutants.

ESSENTIAL QUESTIONS

- What does it mean to say that water is “limited”?
- What is fresh water and how does it become no longer “fresh”?
- What can we do to conserve our water supply?

KNOWLEDGE AND SKILLS

Students will know:

- The quantity of fresh water is limited.
- Water is necessary for people and other living things.
- Water is naturally recycled by the water cycle which goes through these processes: evaporation, condensation, precipitation, and accumulation
- Water is often wasted by people.
- How to conserve water.

Students will be able to:

- Conduct a simple model that demonstrates the water cycle.
- Select appropriate tools for cleaning water.
- Design brochures or posters from data collected and draw conclusions.
- Engineer and create a filter to clean dirty water.

WATER IN THE DELTA

STORYLINE

The following lessons have been written to tell the story of the finite amount of fresh water on the Earth, of the water cycle, and of the limited water supply of the Sacramento-San Joaquin Delta. The lessons present the topics that include water purification, water waste, water maintenance, and water conservation.

Lesson 1, “How Has the Earth’s Fresh Water Supply Been Recycled Over Millions of Years?” follows the water cycle from evaporation, condensation, precipitation, to accumulation. In this lesson students will know that fresh water is a limited resource and is only naturally renewable through the water cycle which includes the following processes: evaporation, condensation, precipitation, and accumulation. They will also learn that their source of fresh water most likely comes from the Sacramento-San Joaquin Delta area.

In Lesson 2, “How Do We Waste and How Can We Conserve Water?” students will find out how water can be wasted and understand the need to conserve water. They will share their ideas for water conservation by designing brochures, which can be shared with other classes.

Lesson 3, “How Can We Clean Our Water?” focuses on the concept that in order to provide a continued source of pure water, people can conserve it by reusing it and this can be done by filtering and purifying the water once it is used. Students will learn how communities purify water before it is pumped to homes and businesses and will also understand how a sewage treatment plant works. They will construct a water filter to understand the process of purifying water.

Lesson 3, “How Is Water Being Wasted?” addresses the issue that water is often wasted and conservation efforts are necessary to maintain our limited supply of fresh water.

WATER IN THE DELTA

Instructional Materials Required

Lesson 1

- Ice Cubes (one tray)
- An available source of heat to heat water, such as a small burner or hot plate (or use the microwave oven in the teacher's lounge)
- Map of the Delta
- Copies of "Water Cycle Boogie"
- Video: "All About the Water Cycle" or "The Water Cycle" from California Department of Water Resources
- Poster: "The Water Cycle" free from the Department of Water Resources

Lesson 2

- One empty half-gallon milk carton
- A stopwatch, phone or watch that shows seconds
- Video: Water – "Who Needs it?" (From California Dept of Water Resources)
- A variety of simple brochures on any topic (but preferable about water)
- Optional: a measuring cup and a calculator

Lesson 3

- Book: The Magic School Bus at the Waterworks by Joanna Cole
- For the water filter (per group of four students)
 - A two liter plastic bottle
 - Funnel (or a two liter bottle cut in half and use the top half as a funnel)
 - Sand (about one cup)
 - Gravel (about one cup)
 - A water sample with dirt and leaves in it (to simulate Delta water)

Investigation 1

How Has the Earth's Fresh Water Supply Been Recycled Over Millions of Years?

CONCEPT

Fresh water is limited and is only naturally renewable through the water cycle.

OBJECTIVE

Students will understand that there is limited amount of fresh water. Students will learn that water is naturally recycled through the water cycle and will be able to describe the water cycle process: evaporation, condensation, precipitation, and accumulation. They will know that their source of fresh water most likely comes from the Sacramento-San Joaquin Delta area.

BACKGROUND

Heat from the sun causes water from the oceans to evaporate. The water vapor from the ocean and other surface waters rises into the atmosphere. As the water cools, it forms droplets in clouds that produce rain and/or snow. Rain and snow return to the ground and water collects in streams, rivers, reservoirs, and lakes. It also collects below the ground in porous rocks. Eventually, the water reaches the ocean again by way of streams and rivers. In this way, water has been recycling for millions of years.

About 70% of the Earth is water; however, only one percent of this fresh water. Less than 1/3 of that one percent is readily available for humans and other living things. The consumption of water is increasing even though the amount of water on Earth has remained approximately the same for millions of years.

Most of the water to the Sacramento-San Joaquin Delta comes from the Sierra Nevada Mountains. The northern rivers (Sacramento, Feather, and American) flow down from the Sierra Nevada Mountains and drain into the Sacramento River. The southern Sierra Nevada rivers (Cosumnes, Mokelumne, Calaveras, Tuolumne, and Merced) drain into the San Joaquin River. The Sacramento and San Joaquin rivers join at the Sacramento-San Joaquin Delta to flow into the San Francisco Bay and then to the Pacific Ocean.

PREPARATION

- Bring ice cubes to class
- Have an available source of heat to heat water, such as a small burner or hot plate (or use the microwave oven in the teacher's lounge)

MATERIALS

- "The Delta Map" (provided in kit)
- Video: *All About the Water Cycle* or *The Water Cycle* (provided in kit)
- Poster of "The Water Cycle" from the California Department of Water Resources (provided in kit)
- Chalk (if students will draw the water cycle on the school grounds) or butcher paper (if students will draw the water cycle on paper to post in the classroom)

To estimate the fraction of water on Earth

Note: If you wish to have groups of students do this demonstration then provide the following four items to each group.

- Two measuring cups
- One medicine dropper
- One gallon of water
- One globe of the world

For Rain in a Bottle

- Canning jar (that can contain hot water without breaking)
- Plastic wrap and rubber band
- Ice
- Water
- Small pan (into which hot water will be poured out of the jar)
- Tongs or oven mitt
- Heat source for heating water (e.g., hot plate or microwave in teacher's lounge)
- Notebooks for journal writing

TIME

Preparation: 30 minutes

Lesson: 60-120 minutes, which can be spread over three or four days

ENGAGEMENT/PHENOMENON

- Read the following quotation to the students from *The Rime of the Ancient Mariner* by Samuel Taylor Coleridge:

*Water, water, everywhere,
And all the boards did shrink;
Water, water, everywhere,
Nor any drop to drink.*

- Ask the students to explain what the poem means to them. Explain that all water on Earth is not fresh and that the Mariner was a sailor in a ship on the ocean.
- Ask students where the fresh water they drink comes from. After discussion, tell them that their fresh water comes from the Sacramento-San Joaquin Delta, either from a reservoir, from a river, or from underground wells.
- Show students a map of the Sacramento-San Joaquin. In a class discussion, ask the students where the water in the Delta comes from. (See the “Background” section.)

EXPLORATION

1. Ask the students to estimate by using fractions how much of the Earth’s surface is covered by water (both fresh and salt water). Have each group arrive at one answer. Write these answers on the chalkboard.
2. Have students more closely estimate the fraction of water on Earth. To do this:
 - a. Show and pass around a globe of the world.
 - b. Ask students to locate all of the areas with water.
 - c. Ask students to once again estimate how much of the Earth is covered by water using their skills with fractions.
 - d. Write the student’s answers on the chalkboard.
3. Now ask students to use fractions to estimate how much water on Earth is fresh water.
Write the group answers on the chalkboard.
 - a. Show a gallon of water to students. Ask students how many cups there are in one gallon. (16). Inform the students that all of the water on Earth will be represented by one gallon. Ask the students to estimate how much of this gallon will be fresh water. Once again, have the students estimate by using fractions.
 - b. Write the student’s answers on the chalkboard.

4. To demonstrate the amount of fresh water on Earth, do the following tasks:
 - a. Use a one-gallon jug of water and take out $\frac{1}{2}$ cup of water. This represents the fresh water on the Earth's surface.
 - b. From this $\frac{1}{2}$ cup, remove $\frac{1}{3}$ cup to represent the fresh water that is located in glaciers, ice caps, and icebergs and is not available for use as this time.
 - c. From the remaining $\frac{1}{6}$ cup, take away one drop. The cup that has had the one drop removed represents water that is not readily available (e.g., deep in the soil, in the atmosphere) or too polluted to drink.
 - d. The drop in the dropper represents the Earth's available supply of fresh water for people and other living things to use. This is the water in streams, rivers, lakes, and reservoirs and water that is easily accessible under the ground (though wells).
5. Tell the students that they will discover the process by which the Earth's water supply has been recycled over millions of years. To do the activity "Rain in a Bottle":
 - a. Fill the jar with hot water.
 - b. Pour out all but one inch of the water in the jar.
 - c. Cover the jar with plastic wrap.
 - d. Place ice on the plastic wrap.
 - e. Students should observe for several minutes. (The inside of the jar will cloud up.)
6. Ask the students to describe what happened after the ice was put on top of the jar.
 - From where did the water on the inner sides and inside of the plastic wrap come from?
 - How is what happened in the jar similar to the way clouds form?
7. Have students fill out an investigation sheet that includes the following items the "Rain in a Bottle":
 - Name of student
 - Name of investigation
 - What we did
 - What we saw
8. Show the poster of "The Water Cycle" from the California Department of Water Resources and ask students to point out the similarities between the demonstration with the jar and the poster.
9. Show the video *All About the Water Cycle*. Tell the students to remember the four stages of the water cycle: evaporation, condensation, precipitation, and

accumulation (students could label “accumulation” areas on the poster of the water cycle). Write these words on the chalkboard.

10. After a discussion of the video, have the students write and illustrate the journey of a drop of water in their journals.
11. Complete the lesson by having the class illustrate the water cycle on the school ground using chalk as a medium or on a large sheet of butcher paper to be posted in the classroom (this could also be done in groups with each group contributing to one part of the water cycle or completing the entire water cycle).

EVALUATION

- Check the investigation sheets on “Rain in a Bottle”.
- Observe chalk/butcher paper illustrations making certain that the students have identified the four stages of the water cycle (evaporation, condensation, precipitation, and accumulation).
- Ask students to describe the water cycle as it applies to the Delta. (For example, water evaporates from the land, rivers, and other surface waters including the ocean and is transported to other areas by clouds that are moved by the wind. The rain and snow fall across California as the clouds approach the Sierra Nevada Mountains. Water flows from the Sierra Nevada Mountains into the rivers. The rivers flow into the Delta.)

EXTENSIONS

- Obtain copies of the “Water Cycle Boogie” that is sung to the tune of “Skip to My Lou” and sing it with your students. The song can be used with a set of colored beads, each color representing a different part of the water cycle, and students string these beads to make a water cycle necklace.
- Have students write their own songs about the water cycle using a familiar tune.
- Teach students the song: “The Water Cycle Boogie” by the Banana String Band (this is a different song from the song by the same title described above).
- Obtain and have students play the “Discover California’s Water” board game (see resources).

CREDIT

Parts of this lesson were adapted from Lesson 3 from *Unit 4: Caring for Aquatic Systems* by Olga Clymire (*A Child’s Place in the Environment* series) Sacramento: California Department of Education, 1997.

RESOURCES

Books

- *Follow The Water From Brook To Ocean* by Arthur Dorros
- *Water, Water Everywhere: A Book About the Water Cycle* by Melvin Berger, et al
- *The Magic School Bus Wet All Over: A Book About the Water Cycle* by Patricia Relf
- *Water* by Christin Ditchfield (True Books)
- *The Water Cycle* by Helen Frost
- *Rising Up, Falling Down* by Craig Hammersmith (Spyglass Books)

Videos

- *Earth Science for Children: All About the Water Cycle*. Schlessinger Media: Wynnewood, PA., 2000.
- *The Water Cycle* from the California Department of Water Resources; 016 653-4893.

Websites

<http://publish.uwrl.usu.edu/h20cycle.html/>

All about the hydrological cycle.

<Http://wwwdwr.water.ca.gov>

The California Department of Water Resources website that contains information about water in California.

Audiocassette

Slugs at Sea. Produced by the Banana Slug String Band in cooperation with the Oceanic Society, 1991.

This recording includes a song called "The Water Cycle Boogie."

Other Resources

- "Water Cycle Boogie" words to the song and beads. Obtain from Santa Clara Valley Water District; 408-265-2600.
- "Discover California's Water" board game. This is available free to teachers in California from the California Department of Water Resources. To order call 916-653-1067 or visit the website <http://wwwdwr.water.ca.gov/>

Investigation 2

How Do We Waste and How Can We Conserve Water?

CONCEPT

Water in the Sacramento-San Joaquin Delta must be conserved to provide for all who need it.

OBJECTIVE

Students will find out how water can be wasted and understand the need to conserve water. They will share their ideas for water conservation by designing brochures, which can be shared with other classes.

BACKGROUND

People need water to live. We use it to drink, bathe, and to clean things. In fact, people use water in many different ways. People use it to grow crops and other plants and for livestock. People use water to manufacture most products, such as paper, and just about everything else we use in our everyday lives.

There are many places in the world where there is not enough fresh water for people to drink. This may happen in California some day. In the past ten years, California has experienced a 25 percent rate of population growth. This is two times the national average. It is estimated that the current population of 32 million people in California will reach nearly 48 million by 2020. This is an increase of 53 percent.

This poses critical questions. Will there be enough water for everyone? Where will additional fresh water come from? How can we provide water to homes and maintain an adequate water supply for local agriculture in the Central Valley that is considered to be the “breadbasket of the nation”? Will there be enough water for wildlife, such as Salmon?

One possible solution is for all Californians to participate in water conservation so that the same amount of water can be used by more people for different purposes and by wildlife. People can conserve water simply by not wasting it. They can also filter and reuse water (this will be addressed in Lesson 3).

We can help conserve our water supply by not wasting water. Some of the ways we can conserve water are to turn off the water while we are brushing our teeth. When we wash dishes, we can fill up the sink or tub and rinse dishes in it instead of letting the water run; or make certain that the dishwasher is completely full before starting it. We can take showers instead of bath (short showers take less water). If we must take baths, we can use a smaller amount of water and remember to plug the tub before we let the water run. When we take a shower, we can get wet, shut the shower off, lather up, and rinse off instead of letting the water run for the length of our shower. Storing water in the refrigerator instead of letting the water run until it is cool will also save water. According to the book, *50 Simple Things Kids Can Do to Save the Earth*, a person can save up to 20,000 gallons of water a year by not letting the water run when we are not using it directly. This is enough water to fill a swimming pool. Also some households have leaky faucets that could be fixed to avoid wasting water.

PREPARATION AND MATERIALS

Materials

- One empty half-gallon milk carton
- A stopwatch or watch that shows seconds
- Optional: a measuring cup and a calculator
- *Water—Who Needs It?* from the California Department of Water Resources (in kit)
- Butcher paper or chart paper on which to write students' responses
- Paper for brochures (8.5" x 11" white paper)
- Pencils
- Assorted markers or colored pencils
- A variety of simple brochures on any topic (but preferably about water)

TIME

Preparation: 30 minutes

Lesson: 60-120 minutes, which can be spread over three or four days

ENGAGEMENT

- Discuss ways that we have wasted water.
- Demonstrate how much water can be wasted. Ask students how long it might take to fill a milk carton with water. Open an empty milk carton and hold it under the faucet. Turn the faucet on and time it. Use a clock or a stopwatch to determine how long it takes to fill the carton. Explain that all over California people are letting water run like that. (To avoid wasting water, have the class water a plant with the water collected.) A similar activity can be allowing a faucet to drip and having a student collect the water in a milk carton for one minute. Then use a measuring cup to

determine how much water was wasted. Calculate how much water a leaky faucet can waste over a period of time (i.e., one day, one week, one month, one year).

PROCEDURE

1. Explain to students about the population growth of California, and that if we do not conserve water now, there might not be enough for their children and grandchildren. Explain to students that in the past, people in the United States used a bucket and later a hand pump to get water from a well just to brush their teeth. Now, all we do is turn the water on and it flows like magic from a faucet. Unfortunately, water comes out of a faucet faster than we think. At school, we turn the water fountain on and let it run to get the water cold enough to drink. During this time period, you could fill up several half-gallon milk cartons.

Note: See the “Variation” section at the end of this lesson to determine how to proceed with this lesson.

2. Have students make posters on ways people waste water. Post these in the classroom and discuss what can be done not to waste water.
3. Brainstorm with students how people can conserve water. Write their responses on large sheet of paper hung in the room.
4. Show the video, *Water—Who Needs It?* Have students add to their brainstormed list some additional ways people can conserve water.
5. Tell the students that they will design illustrated brochures on water conservation to share with younger students. But they should first look at examples of brochures to get ideas. Distribute a variety of brochures to each group of students to look at. Ask the students what they like about each brochure (e.g., it is simple, easy to read, lots of illustrations) and write down their ideas on chart paper. If you wish, make a rubric with your class to assess the brochures that will be completed by students.
6. Help groups select a brochure style that they would like to use. Provide paper and pencils.
7. Ask students to make a rough sketch of how their brochures will look, what illustrations they would have, and what text would be included.
8. Have students do the work in pencil, until you approve their designs. Then they can complete the brochures using colored markers or colored pencils.

9. Arrange for students to share these brochures with students in other classes.

VARIATION

Instead of making brochures, have students design posters. Half the class should focus on ways people waste water and the other half on ways people conserve water. Post these in the classroom and do a “gallery” walk with your students. The student artist could mention one thing about his or her poster that he or she wanted the viewers to see.

ASSESSMENT

- Review brochures made by students.
- Have students make up a short song to a familiar tune about how they can conserve water or use it more wisely.

EXTENSIONS

- Take the students out for a walk around the school to see if they can find water leaks. Let your administrator know about the leakage problem so it could get fixed as soon as possible.
- Do the following activity (you will need a small bottle of blue food coloring and plastic gloves):
 - Obtain permission from your administrator to take students into a bathroom at school to place food coloring in the toilet tank to check for leaks.
 - Take your students into a bathroom at school. If needed for supervision, invite another teacher to accompany you. Wearing plastic gloves, take the top off the toilet tank. Put 12 drops of blue food coloring in the tank. Put a sign on the door to the toilet preventing people from using the toilet for 15 minutes while you are waiting for results.
 - Go back to your classroom for about 15 minutes. Explain to the students that they are going to be water detectives. Explain to them that it has been estimated that up to 20 percent of all the toilets in American homes leak. In one year, a leaky toilet can waste over 22,000 gallons of water. Encourage students to begin this discussion in groups.
 - After 15 minutes, take your students back to the bathroom. Observe the toilet water. If the blue water appears in the bowl, you have found a leak.
 - Let your administrator know about the leakage problem to get it fixed as soon as possible.
 - Students might want to try this demonstration at home with adult supervision.

RESOURCES

Books

- *Water, Water Everywhere* by Mark J. Rauzon and Cynthia Overbeck Bix
- *The Earth Works Group. 50 Simple Things Kids Can Do To Save The Earth.* Scholastic

Videos

- *Water—Who Needs It?* From the California Department of Water Resources
- *Water for Farming.* Sacramento: California Department of Water Resources, 1982

Investigation 3

How Can We Clean Our Water?

CONCEPT

To provide a continued source of pure water, people can conserve it by reusing it. This can be done by filtering and purifying the water once it is used.

OBJECTIVE

Students will learn how communities purify water before it is pumped to homes and businesses. They will also understand how a sewage treatment plant works. They will construct a water filter to understand the process of purifying water.

BACKGROUND

Living things require enough fresh water to survive. A human needs about two quarts of water a day to remain healthy. Our fresh water supply, the Sacramento-San Joaquin Delta, is affected by pollutants, such as oil, garbage, pesticides, and fertilizers.

Water is purified by the water cycle. Water is also cleaned naturally when a stream flows through rocks and gravel and when the water picks up oxygen as it moves. Bacteria and other organisms clean the water by consuming organic material. Melting snow from the mountains also flushes out the streams and rivers as they flow to the ocean. However, the fresh water is being polluted faster than the natural processes can clean it up, and drought years reduce the amount of fresh water that is available. Therefore, people should keep the water from getting polluted and filter polluted water whenever possible.

Most cities that use groundwater as a source of fresh water chlorinate the water to kill bacteria that may be harmful to people.

Surface water is purified in a water purification plant. At the plant, screens are used to remove large objects. Then alum might be added to help clean the water. When the alum is added to water, particles in the water cling to the alum and stick together forming larger particles called floc. The floc settles to the bottom of a settling basin and is removed from the water. The water might also flow through filters of sand and gravel to trap any remaining particles. Then chlorine or other disinfectants are added to kill harmful bacteria. Fluoride is also added because it can help prevent tooth decay. The

water is stored in a closed tank or reservoir. The water is then ready to flow into the distribution system for use in homes and businesses.

Most urban areas have sewage treatment plants that clean the water that comes from the drains in homes and businesses. First, sewage that enters these plants passes through screens that filter and remove large objects. The water then passes to a settling tank. Light materials float to the top, where they are skimmed off. Heavier materials sink and are removed. Next, the water goes through an aeration system that adds oxygen to assist bacteria in digesting and therefore removing organic materials. The water may then be pumped through a filter and then to a second settling tank. It is treated with chlorine and is then returned to lakes, streams, rivers, or ocean. People sometimes use this treated water for irrigation. Some communities have sewage treatment plants that further clean the water with carbon and with chemicals that can remove nitrogen and phosphorous (which are plant fertilizers that could create algae blooms in areas where the water is released). These sewage treatment facilities are much more expensive to build and maintain, but are more effective in purifying the water before it is released into surface waters or used again by people.

PREPARATION AND MATERIALS

Preparation

- Make a transparency of “How Water Gets to Our Homes.”
- Make a transparency of “An Example of a Sewage Treatment Plant.”

Materials

- Big book of *The Magic School Bus at the Waterworks* by Joanna Cole (in kit)
- For the water filter (per group of four students)
 - A two-liter plastic bottle
 - Funnel (or a two-liter bottle cut in half and use the top half as a funnel)
 - Sand
 - Gravel
 - A water sample with dirt and leaves in it (to simulate Delta water)

TIME

Preparation: 30 minutes Lesson: 60-120 minutes, which can be spread over three or four days

ENGAGEMENT

- Show parts of *The Magic School Bus at the Waterworks* by Joanna Cole to your students. This book is about a class that takes a magical field trip through the water

cycle and a water purification plant. Focus on what happens at the water purification plant.

EXPLORATION

10. Ask students from where does the water come to their home. (From the Delta area: either from surface waters like a river and reservoir or from the ground via a well.)
11. Show the transparency “How Water Gets to Our Homes.” Tell students that if their water comes from surface water, like a river or reservoir, then it is usually purified at a water purification plant before it is pumped to homes and businesses. Go over each step in the process of purifying the water. Note that water purification plants may differ, so the one described in *The Magic School Bus at the Waterworks* may have some differences from the one shown in the transparency.
12. Ask students what happens to the water when they are done using it, like in the kitchen or bathroom. Tell the students that sewage pollutes the water causing it to have an unpleasant odor, and can contain harmful bacteria and viruses that can makes us sick. It can cause the death of some organisms and overgrowth of others (such as algae).
13. Show the transparency “An Example of a Sewage Treatment Plant.” Tell students that the used water from their homes goes to a sewage treatment plant. After it is cleaned at the sewage treatment plant, it usually goes to a nearby river, lake, or ocean. Depending on the type of treatment the water gets (usually based on what the community can afford), the water may be somewhat clean, but could still contain some pollutants; or be almost as clean as it was before it was used. Also, if the water that was being treated is especially polluted with toxic chemicals, the treatment plant may not be able to take out all pollutants. For example, if people illegally dumped toxic chemicals down the drain, the sewage treatment plant may not be able to remove all traces of these chemicals. Therefore it is important to avoid pouring hazardous chemicals down the drain. (Proper treatment of household hazardous wastes will be addressed in Lesson 4.)
14. Inform students that one of the ways that we can conserve water is to use it over and over again. A good way to do this is to filter it and then use it again. Tell students that they will construct a simple filter to clean some “polluted” water from the Delta. This water is actually tap water with some soil and leaves added, so it is safe to use in this activity.

15. Show students the filter materials that they will work with and have them draw the filter and the placement of the various materials within the filter.
16. Once students have completed their drawings, allow them to make and test their filters. Here is one way to setup the filter:
- Set the funnel inside the bottle opening.
 - Fill the funnel with gravel and sand in layers starting with the gravel and then the sand.
 - Pour the Delta water sample into the funnel.
 - Observe the water as it flows into the bottle.
 - Determine if the water looks cleaner than it did before it was filtered.
17. Have students fill out an investigation sheet that includes the following items:
- (a) Name of student
 - (b) Name of investigation
 - (c) What we did
 - (d) What we saw
18. Ask students:
- What did you do to clean up the dirty water?
 - Do you think that you took out all of the pollutants from the water with the filter you made? Explain your answer. (Students should be aware that the type of filter they made would not remove bacteria or many hazardous chemicals.)
 - Do you think that purifying water is expensive? Explain your answer.
 - How might this activity be similar to the way people clean water at a sewage treatment plant? How might it be different?

ASSESSMENT

- Check investigation sheets.
- Have students illustrate on whiteboards or chart paper how a water filter works.
- Have students describe in writing how the filtering activity is similar to the way people clean water at a sewage treatment plant and how it is different. They can also use drawings to illustrate the similarities and differences.

FURTHER STUDY

Have your class visit your community's water purification plant and/or sewage treatment plant.

CREDIT

Moore, Jo Ellen. *Water*. Evan-Moor: Monterey, CA., 1998.

RESOURCES

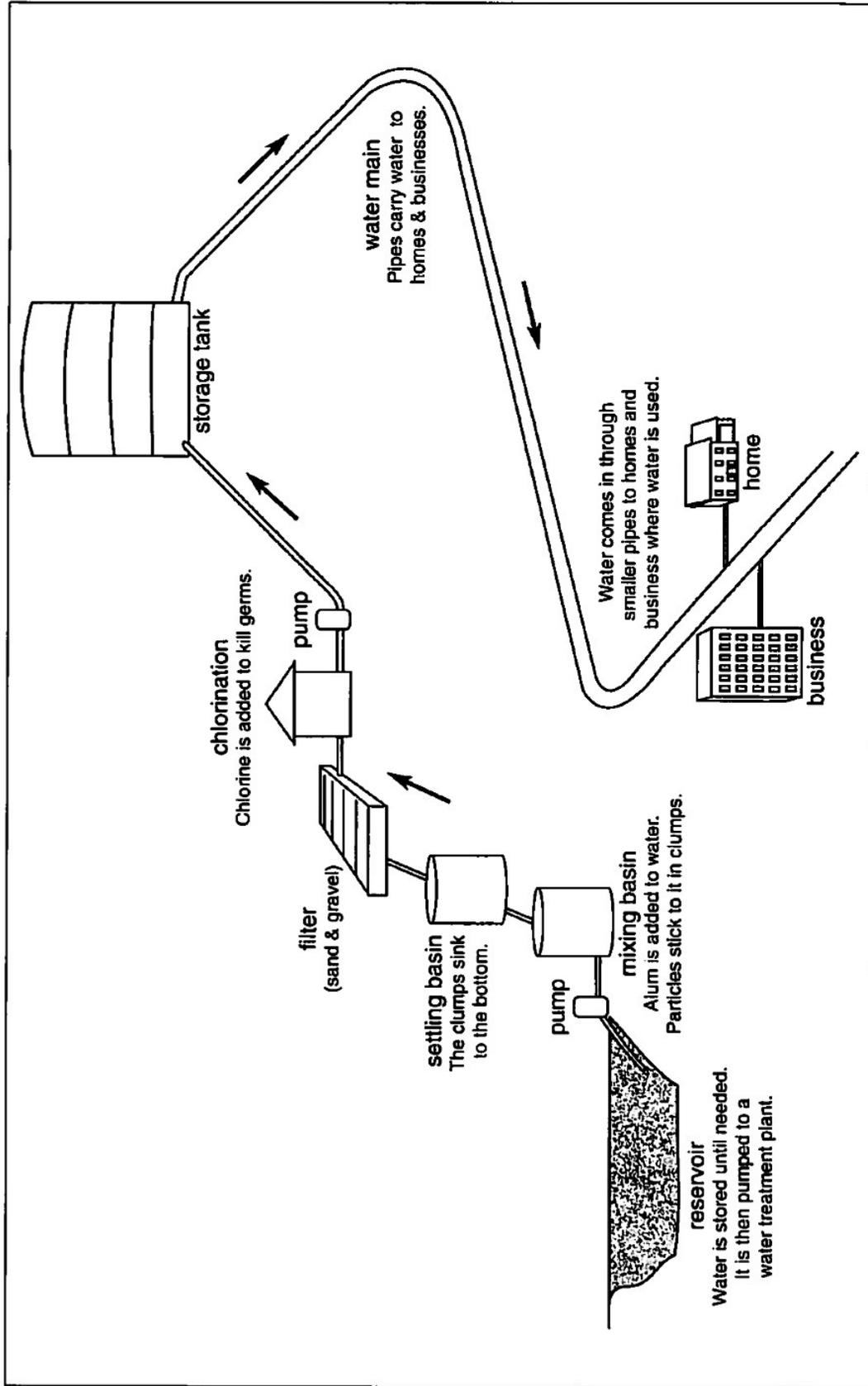
Books

- *The Magic School Bus at the Waterworks* by Joanna Cole
- *Chattanooga Sludge* by Molly Bang
- *The Drop In My Drink* by Meredith Hooper.

Video

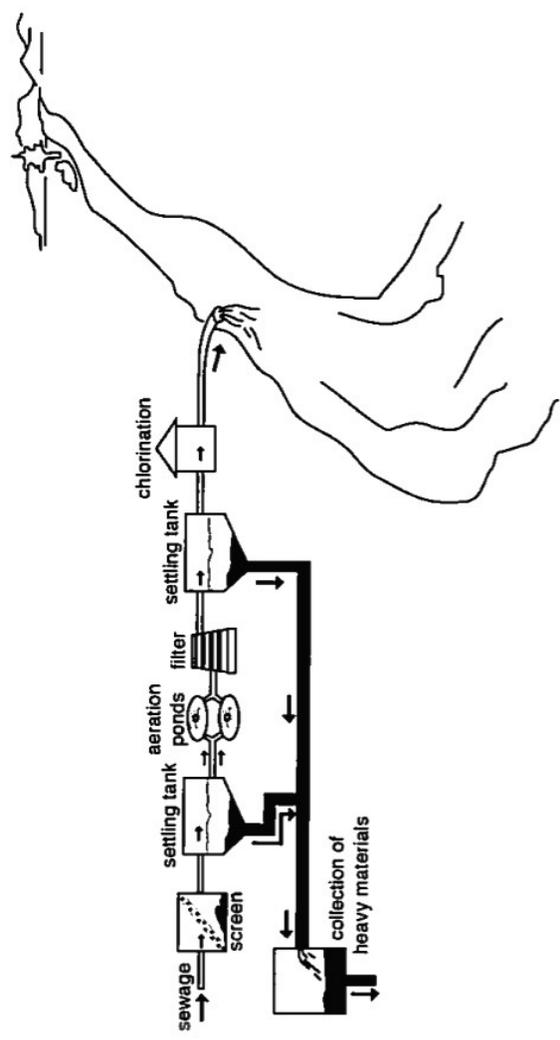
- *Our Watery World*. The Outside Story Series. Produced by Slim Goodbody Corporation, 1991 (15 minutes)
Reviews the water cycle, explains fresh water, explains water pollution.

How Water Gets to Our Homes

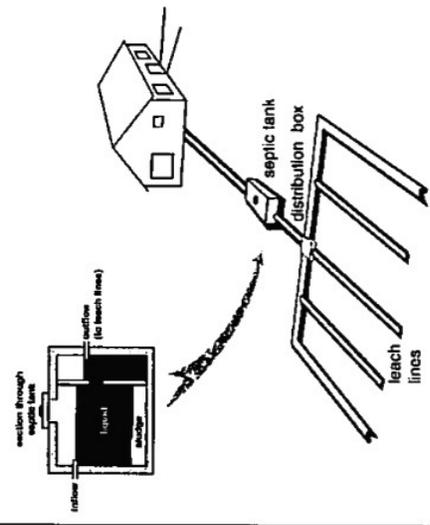


Ways to Treat Sewage

Sewage Treatment Plant



Septic Tank System



Water in the Delta Pre-Test/Post Test

1. List and illustrate the four processes of the water cycle.
2. The amount of fresh water on Earth is limited or unlimited? Explain your answer.
3. Describe ways our community recycles water.
4. What are some ways that our community uses less water?
5. What are some ways that our community wastes water?
6. How do you conserve water in your home?
7. Is the water in the Delta important and why?

Water in the Delta
Pre-Test/Post Test
Answer Key

1. Precipitation, accumulation, evaporation, condensation (in any order)
2. Limited because the water cycle is a closed system.
3. Water treatment plant
4. Bathing, washing cars, watering lawns, agriculture, drinking, etc,
5. Dripping faucets, flood irrigation, watering the cement, over-watering, letting the hose run, polluting water, etc
6. Fix leaks, don't over-water, don't let water run when it is not being used, do full loads of laundry, model conservative users, educate a friend, etc.
7. It is one of the main parts of the water cycle, directly related to water use.
We get our water from the Delta. Many people and wildlife depend on the Delta for water and habitat.

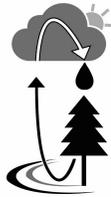
California's Environmental Principles & Concepts



Principle I: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.



Principle II: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.



Principle III: Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.



Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.



Principle V: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.