



PUZZLING PIPES

Overview: Students will learn about the various paths that water takes after it is used. They will trace the path of wastewater either through the storm drain system or the sanitary sewer system and construct a diagram of the different paths that wastewater takes.

Content Standards Correlations: Science, p. 290, and History/Social Science, p. 296.

Grade Level: 4-6

Key Concepts: Water will eventually end up somewhere - nothing just "goes away". Untreated wastewater from outdoor use flows untreated through the watershed to creeks, rivers, and the Bay. Treated wastewater from indoor use flows into the San Francisco Bay and the rest is recycled and used for irrigation at schools, parks, businesses, and for industrial processes.

Objectives:

Students will be able to:

- trace the paths wastewater takes from indoor use and outdoor use.
- name at least two places effluent goes once it leaves the wastewater treatment plant.
- state at least one thing they can do to reduce harmful effects of wastewater.

Time: 50 minutes

Materials:

- *Puzzling Pipes* diagram (make into a transparency), p. 132
- *Where Does the Water Go?* picture (1 copy per student), p. 134
- Flex straws in a variety of colors
- Crayons, markers, or colored pencils
- Cotton swabs
- White glue
- Scissors

SUPPORTING INFORMATION FOR THIS ACTIVITY

South San Francisco Bay Ecosystems: Salt marshes and their inhabitants

- Salt marshes can be described as transition zones between aquatic (water) and terrestrial (land) ecosystems that exhibit some characteristics of each.
- Around the Bay, salt marshes are most noted for the abundant plant life (especially cordgrass and pickleweed) that grow in the salty soil. These plants thrive in the salty environment and in a freshwater environment are displaced (out-competed) by nonsalt-tolerant plant species.
- A variety of animals are found throughout the salt marsh. Found nowhere else in the world, the California clapper rail and salt marsh harvest mouse are two endangered species that need the San Francisco Bay salt marshes for their survival. The clapper rail, a secretive bird, hides and nests in the cordgrass and pickleweed. The salt marsh harvest mouse makes its nest out of and eats pickleweed, and drinks salt water. These animals have become endangered due to loss of habitat.
- Bay area salt marsh habitat began disappearing near the end of the 19th Century. Not knowing the value of the salt marsh, people filled in these wetlands for development, and created a vast network of salt ponds to use for the commercial production of salt.
- Additionally, the tremendous volume of effluent entering the San Francisco Bay from the San Jose-Santa Clara Water Pollution Control Plant has affected over three hundred acres of salt marsh in the South Bay. Today, even though this effluent is high-quality, it is fresh (containing no salt), and greater volumes threaten to convert remaining salt marsh to either brackish or fresh water marsh. With only about 20% of the salt marshes remaining, any *loss of salt marsh* has a devastating impact the South Bay ecosystem and the endangered species that live there.

The Sanitary Sewer System: Wastewater from Indoor Use

- Wastewater from taking a shower, washing dishes, and flushing the toilet goes down the drain into the sanitary sewer system.
- Through a series of large pipes, the sanitary sewer system transports wastewater to a wastewater treatment plant; most South Bay residents and industries use Plants located in San Jose. Here the wastewater is thoroughly cleaned. The water that leaves

the treatment plants (called effluent) is nearly as clean as our drinking water. However, the treatment plants can't remove all pollutants. Heavy metals (such as copper and nickel) and solvents (such as paint thinner) cannot be completely removed.

- After the wastewater is treated, the effluent from the wastewater treatment plants will take one of two paths, ending up in various places. For example:
- In San Jose, up to 120 million gallons of effluent will be discharged into the South San Francisco Bay every day.
- In San Jose, up to 15 million gallons of effluent per day may be used for irrigation. South Bay Water Recycling is a system of pipes and pump stations that allow treated effluent to be distributed to schools, parks, and businesses for irrigation. Pollutants, such as tiny trace amounts of copper, the wastewater treatment plant can't remove will flow into the Bay or South Bay Water Recycling pipeline.
- Since treated wastewater can be used for irrigation, there is now a way to help reduce the amount of effluent discharged to the Bay, while providing a second source of water for public facilities.

The Storm Drain Sewer System: Wastewater from Outdoor Use

- Not all wastewater makes its way to a wastewater treatment plant. Unlike the sanitary sewer system, the storm drain system is not connected to a wastewater treatment plant.
- As water moves through the watershed, it picks up pollutants as it runs through both agricultural and urban areas. In cities and surrounding areas, pesticides and lawn clippings that wash into the street, soapy water, and dripped oil and antifreeze from cars that wash into the street will likely flow through the storm drain system.
- Water that goes into storm drains, along with all the pollutants introduced upstream, eventually flows into creeks, rivers, and the Bay, completely untreated. Therefore, if the watershed is polluted, in all probability, the Bay will also be polluted.
- For the last 20 years, we've depended on the pollutant reduction efforts from large industries to solve our water pollution problems. It is now recognized that agricultural, residential, and small business sources play a major role in contributing

to the pollutants entering our creeks and the San Francisco Bay.

Why all the Fuss?

Concern: Less than 20% of the salt marsh habitat remains in the South Bay. These salt marshes must be preserved for endangered species and future generations.

Solutions: Conserve water to reduce fresh water flows to South Bay salt marshes; support the use of recycled water in your community.

Concern: Pollutants enter the San Francisco Bay with runoff that travels through the watershed.

Solutions: Ensure nothing but rain goes down the storm drain; properly dispose of household hazardous wastes; use less toxic alternatives to hazardous household products.

HOW TO LEAD THIS ACTIVITY BY FOLLOWING THE "DO, READ, ASK" TEACHING FORMAT

Introduction

Do

Have students name a few ways they use water *outdoors*. [Examples include: 1) watering the lawn, 2) washing a bicycle, 3) bathing a pet.] Using the transparency of the *Puzzling Pipes* diagram on p. 132, call on a student to trace the path that wastewater takes after it's used *outside*.

Ask

? **Where does the water go?** (Down storm drains, and then it flows *untreated* to creeks and the Bay)

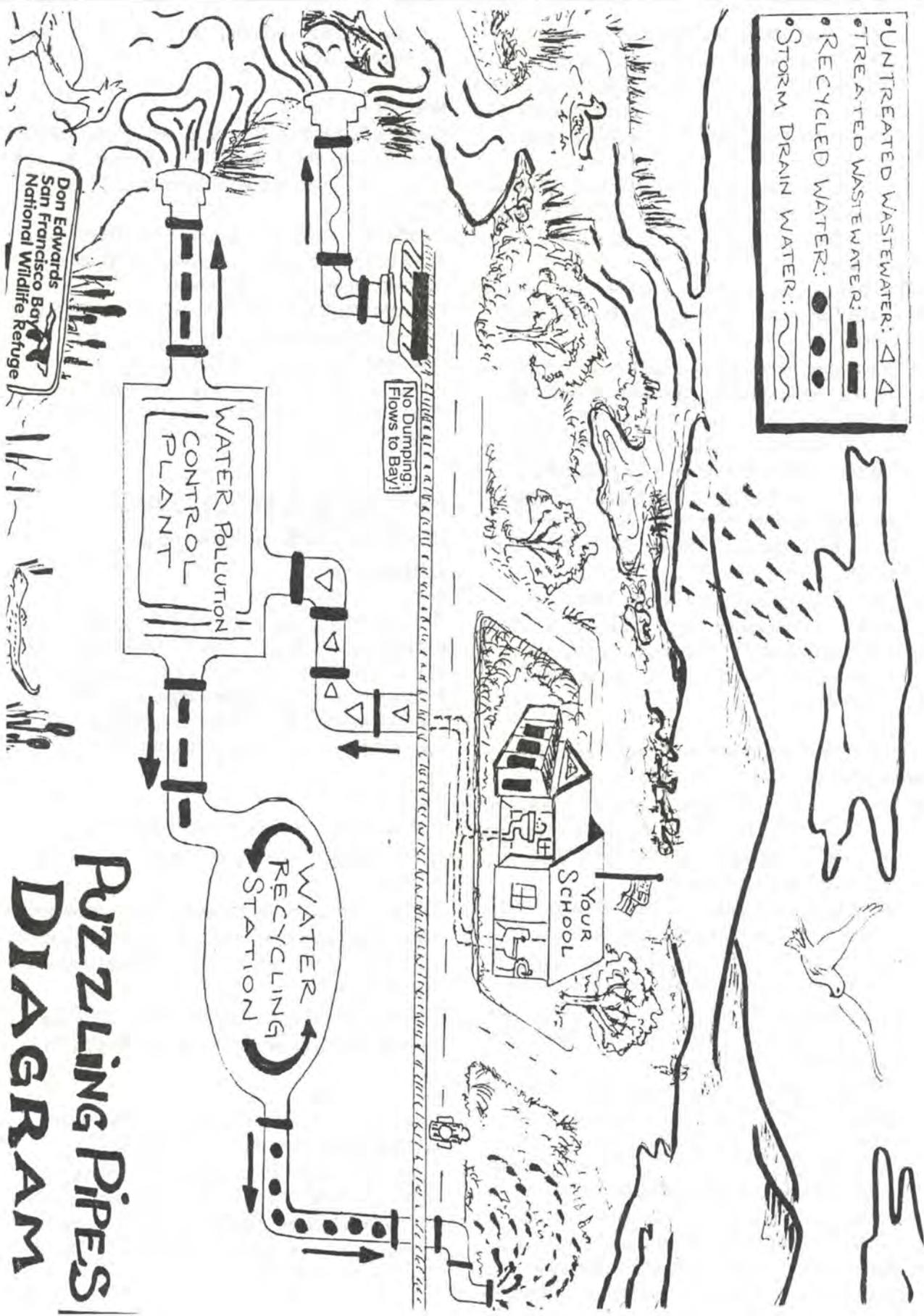
? **Can anyone name the waterway our school's storm drain empties into?** (You should be able to find the answer by looking at a stenciled storm drain near the school.)

? **Is soapy water and fertilizer good for the animals that live in the creek and Bay?** (No.)

Do

Have students name a few ways they use water *indoors*. [Examples include: 1) drinking, 2) showering/bathing, 3) washing dishes, 4) brushing teeth, 5) flushing toilets] Again, using the transparency of the *Puzzling Pipes* diagram, call on a student to trace the paths that the wastewater takes after it's used *indoors*.

- UNTREATED WASTEWATER: ▽ ▽
- TREATED WASTEWATER: ■ ■
- RECYCLED WATER: ● ● ● ●
- STORM DRAIN WATER: ~ ~ ~ ~



Don Edwards
San Francisco Bay
National Wildlife Refuge

Puzzling Pipes DIAGRAM

Ask

? Where does this water go? (First to the Water Pollution Control Plant where it is treated. The treated water travels either to the Bay or to South Bay Water Recycling to be used for irrigation.)

Do

Reinforce the different paths wastewater takes, using the *Puzzling Pipes* diagram and background information. Emphasize that the sanitary sewer system and storm drain system are two separate systems — water used *indoors* will be treated at the wastewater treatment plant; water used *outdoors* will flow untreated to a waterway and then to the Bay.

Making the *Where Does the Water Go?* Picture
Do

Give each student a copy of *Where Does the Water Go?* picture on p. 134, crayons, markers or colored pencils, and one each of 4 different colors of flex straws.

Read

"We are now going to complete the drawing of the *Where Does the Water Go?* pictures. First, color the picture and design the features of your house and school. Next, cut out your house and school models and glue the models on the picture."

Ask

? Should the water from the house and school be connected to the storm drain or the water pollution control plant? (The water from houses and schools goes to the water pollution control plant to be cleaned.)

? Where will the water from the water pollution control plant go? (After the water is cleaned it goes to the water recycling station and/or the bay.)

? Where does the water go after it leaves the water recycling station? (The water from a recycling station becomes irrigation water at a park or school.)

? Where will the storm drain water flow? (Storm drain water flows directly to the bay through creeks and sloughs.)

Read

"Once the scene is complete you are ready to 'lay pipe.' Select different colored straws to correspond to the different paths that wastewater takes. Cut the straw to fit, using the bendable part of the flex straw to make the curve in the pipes. Affix them to the picture."

Do

While students are working, walk around the room to check for understanding and to answer any questions.

Read

"Let's list things we can do *outdoors* so that when it rains it doesn't harm the creatures in the creek or Bay." [Examples include: 1) pull weeds rather than using weed killer, 2) wash your bicycle on the grass so that the soap goes into the lawn instead of into the storm drain, 3) pick up pet waste so it doesn't wash into the storm drain.]

Do

Record the list on the board.

Read

"Now let's list ways we can reduce the amount of water we use *indoors*." [Examples include: 1) shorter showers 2) turn the water off while brushing teeth, 3) place a liter bottle filled with water into the toilet tank]

Do

Record the list on the board.

Read

"We are now going to put ourselves and our family and friends into the picture. Glue the top part of your drawing to an 8 X 11" sheet of paper. Using the two lists we've created, draw people you know doing these things."

Do

Have students share how their friends and family are helping to protect the creek and Bay habitats.

