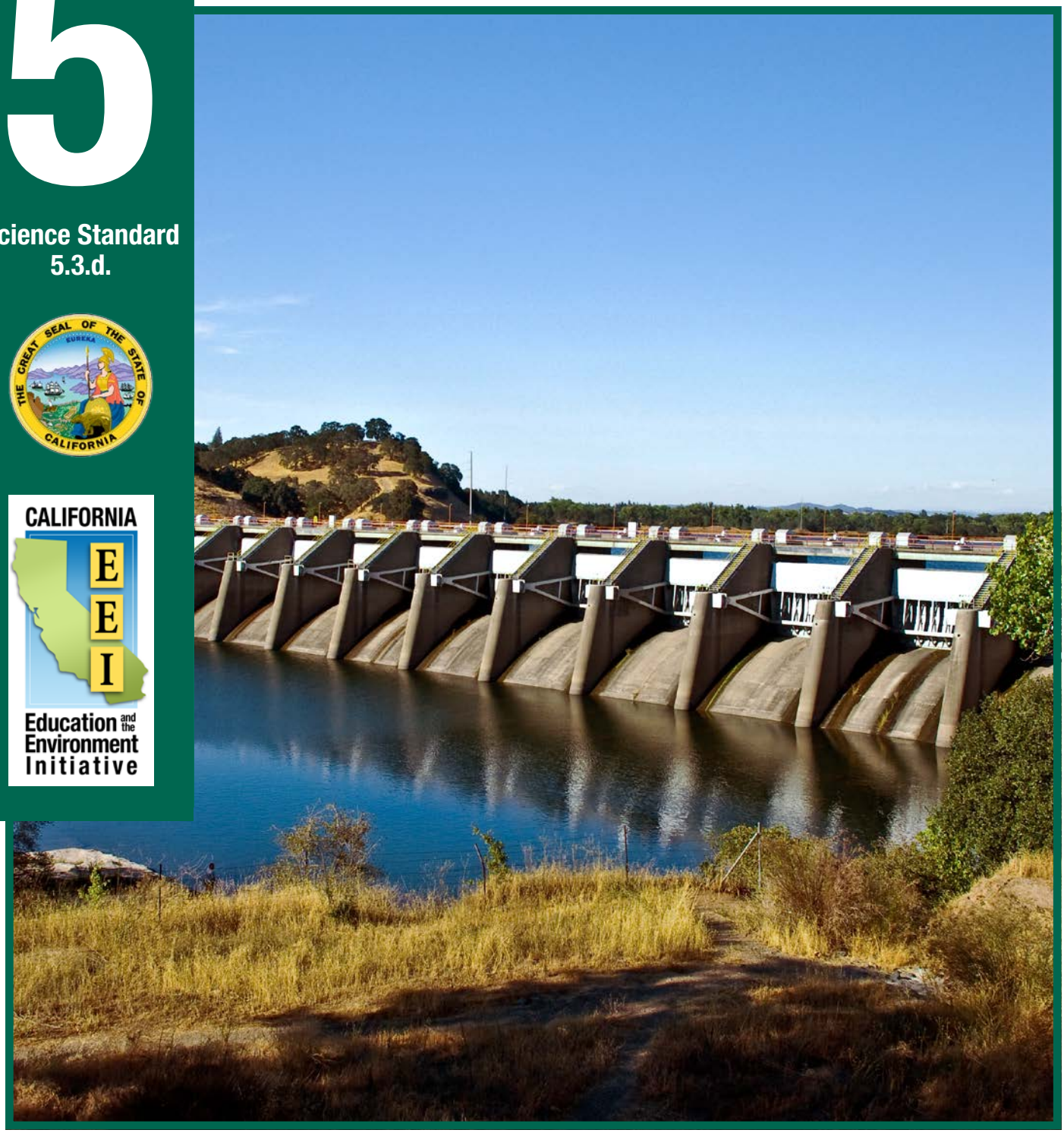
5

Science Standard
5.3.d.

Student Edition

California Education and the Environment Initiative



Our Water: Sources and Uses

California Education and the Environment Initiative

Approved by the California State Board of Education, 2010

The Education and the Environment Initiative Curriculum is a cooperative endeavor of the following entities:

California Environmental Protection Agency

California Natural Resources Agency

California State Board of Education

California Department of Education

Department of Resources Recycling and Recovery (CalRecycle)

Key Partners:

Special thanks to **Heal the Bay,** sponsor of the EEI law, for their partnership and participation in reviewing portions of the EEI curriculum.

Valuable assistance with maps, photos, videos and design was provided by the **National Geographic Society** under a contract with the State of California.

Office of Education and the Environment

1001 I Street • Sacramento, California 95814 • (916) 341-6769

http://www.CaliforniaEEI.org

© Copyright 2011 by the California Environmental Protection Agency

© 2013 Second Edition

All rights reserved.

This publication, or parts thereof, may not be used or reproduced without permission from the Office of Education and the Environment.

These materials may be reproduced by teachers for educational purposes.

Contents

Lesson 1 Reservoirs Revealed

California Connections: California Drought 2

California's Lakes and Reservoirs 6

Lesson 2 Water Consumption Considered

None required for this lesson.

Lesson 3 Working with Wastewater

Wastewater Treatment 7

Water Cycle 9

Lesson 4 What Would You Do with the Water?

Water Conservation Case Studies 10

Lesson 5 What a Difference Water Makes

California's Watersheds 13

California Drought

A light rain fell on Wednesday. It was less than an inch, but it made David happy. It had been many days since the last drop of rain had fallen in Southern California. “Drought” was a word that David heard often on the weather forecasts.

He knew it had something to do with lack of rain. In fact, that night the weather forecaster had made it clear that the light drizzle was not enough to end the drought in Southern California.

Every night, David watched the weather on the six o’clock news. On Thursday, the day after it rained, the Weather Service issued a warning that was hard to believe. The warning said that Santa Ana wind conditions were forming in the Great Basin deserts of Nevada and Utah. The hot dry winds would soon reach Southern California. They could blow up to 100 miles per hour. David knew what this meant for the dry Southland. The Santa Ana winds could spark and spread dangerous wildfires.

Oak tree in drought

Even before the warning, many people were talking about the drought. They talked mostly about the need to save water. David knew that fresh water was one of our most important natural resources. He was not exactly sure what caused the drought, but he knew that it meant trouble. If this drought continued for many years, there might not be enough water to drink. People can live without many things, but water is not one of them.

Snow covered trees, Yosemite, California

Rain and Snow in California

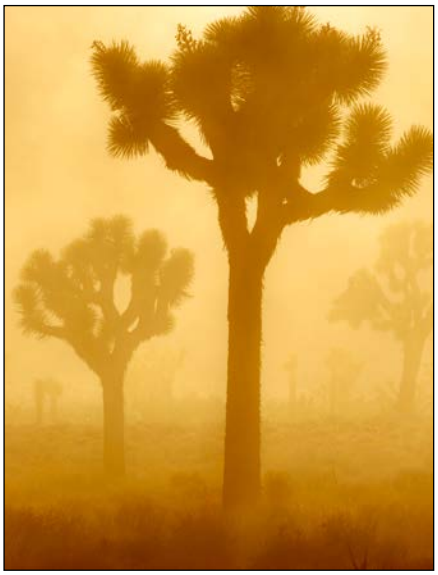
California is more than 800 miles from end to end. The state has many climate zones. Northern California often gets more precipitation than Southern California. Precipitation is water that falls from the clouds in the form of rain, drizzle, sleet, snow, and hail. Scientists have recorded the amounts of precipitation in California for many years. They came up with a normal (or average) amount that can be expected each year. Average precipitation varies from place to place. For example, the northern coast of California receives over 64 inches of rain in an average year. It rains less than 8 inches in some parts of the Southern California desert.

In winter, snow usually falls above 6,000 feet. Some places in the mountains have 10 feet of snow on the ground for many months. The snow that builds up in winter and melts in the summer is called the "snowpack." In a normal year, water from the snowpack melts and flows into rivers and into large reservoirs, mostly in northern California. This fresh water is carried to the cities and towns through a system of aqueducts, channels, and pipes. It is used for tap water, agriculture, industry, and recreation all year.

When There is Not Enough

Drought conditions occur when it rains and snows very little during the rainy season (November through April, typically). Reservoirs are drained over the dry months and years. There is little rain to fill them back up. This may not matter for a while, if there is plenty of stored water. If the drought continues, there will be problems for thirsty plants, animals, and humans. The first people to feel the effect of drought are the ranchers and farmers. There is no green grass for grazing cattle, sheep, and horses. Wells go dry. Firefighters may not have enough water to fight wildfires.

Drought is part of a larger climate pattern. This



Dust storm, Death Valley, California

pattern repeats over the years. Drought, like floods, hurricanes, tornadoes, earthquakes, and wildfires, can cause a lot of damage. The difference between drought and other natural disasters is that it begins slowly, and can last for years. Scientists began recording information about patterns of drought and rainfall around 1890. They also studied tree rings to find out about dry periods in our past. In California, there have been 12 droughts in the last 100 years. Each of these droughts lasted more than one year.

Periods of Drought

Between 1929 and 1934, there was a long and severe drought in California. The Great Plains also suffered at this time. Choking dust storms during the Dust Bowl swept across the land. Many people migrated to California looking for work. After the drought was over, California made a plan that would help people survive the next drought. Over the next few decades, the state built a system of reservoirs and aqueducts to store water for dry years to come.

In 1976 and 1977, there was another statewide drought. In fact, 1977 was the driest year in California since weather records were recorded. On average, 11 inches of rain fell across the entire state. The runoff from the mountain snowpack was one-fifth of what it is normal. People started to conserve by turning off their sprinklers. They stopped washing their cars. Restaurants no longer served water. Some people used rinse water from their washing machines to water their gardens.

Droughts continue to happen. From 1987 to 1992, there was not enough water to keep some plants and trees alive. Landscaping businesses lost 460 million dollars in one year. The year 2002 set a record for being the driest year in Southern California, until 2007 broke that record and brought virtually no rain! Finally, in 2008, Governor Arnold Schwarzenegger officially declared a drought in California. The declaration came after the driest spring in 88 years.

How Does Drought End?

When it rains, precipitation amounts return to normal. When this happens, it takes a while for the thirsty soil to soak up all that water. Farms and ranches get relief first. Their fields turn green. Seeds sprout from the moist ground. Streams, lakes, and reservoirs fill up.

Finally, water seeps down to pockets deep in the ground, called aquifers.

Do we really know what causes drought? Scientists have some ideas. Many of them believe La Niña may have caused many dry years in Southern California. During La Niña, the sea surface temperature is cooler in the Eastern Pacific Ocean. This means dry weather for most of central and Southern California. Scientists also warn that climate change also may cause long periods of drought. This is a hypothesis based on hydrologic and climatic records related to California's climate. Experts are studying climate change in order to predict future weather patterns.

Wildfires and Drought

David continued to watch the weather every day. The Santa Ana winds were blowing down signs, trees, and even trucks. "Luckily," he thought, "there are no fires." On Saturday, David helped his family clear dried wood, grass, and brush from around their home. They helped their neighbors, too. Then it happened. Fires erupted throughout Southern California. On Sunday at noon, one was reported near David's home. Hot winds fanned the blaze. Flames devoured the dry grass and chaparral in seconds.

Firefighters came from all over the state to fight Southern California wildfires. In only three days, the fires destroyed thousands of homes. Half a million people had to move to shelters or out of the fire's path. David's family went to his uncle's house in Los Angeles until the fire was under control. In the end, David's house was safe. So were all of the houses around it.

David learned that drought is a natural event that repeats over time. He also learned that there are ways to manage water during times of drought, so that the effects are less severe. David liked to think that clearing the brush around his house saved it from the fire, and he hoped the rain would come again soon.

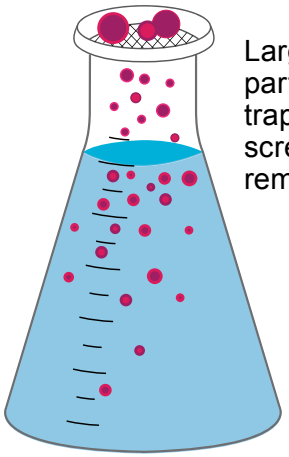
Firefighter checks house

California's Lakes and Reservoirs

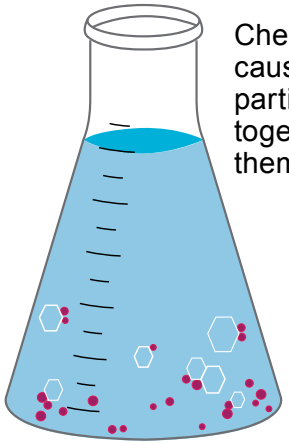
Primary Treatment

The first step in wastewater treatment uses mechanical processes (filters and settling).

Trapping

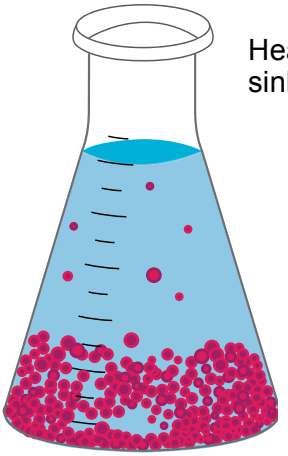


Large-sized particles are trapped in the screen and removed.



Chemicals cause small particles to clump together, making them heavier.

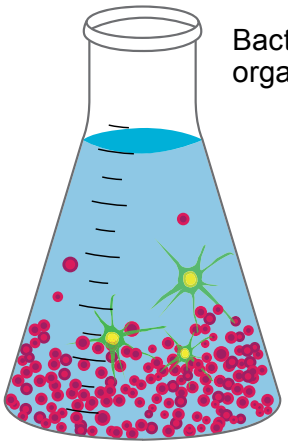
Settling



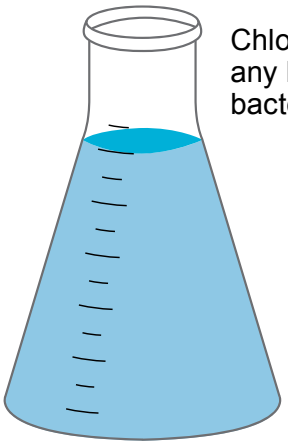
Heavy particles sink.

Secondary Treatment

The second step in wastewater treatment uses biological and chemical processes (bacteria and chemicals).



Bacteria digest organic matter.

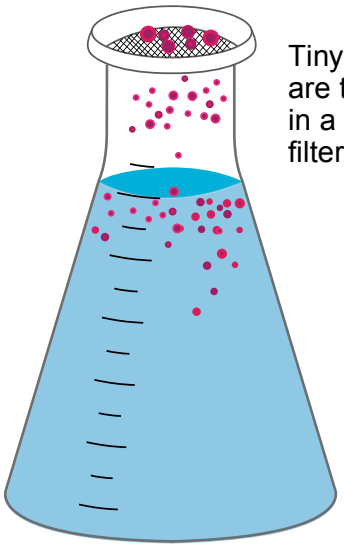


Chlorine kills any harmful bacteria.

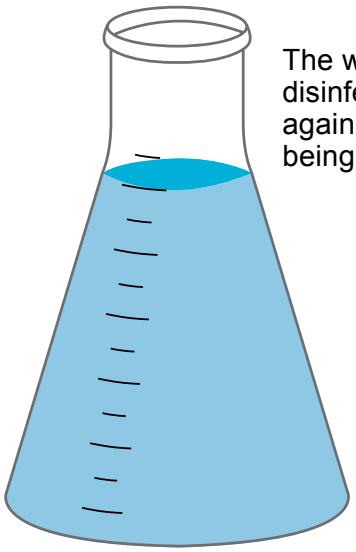
Advanced Treatment

These two steps follow primary and secondary wastewater treatment and use additional mechanical and chemical processes.

Micro-Filtration



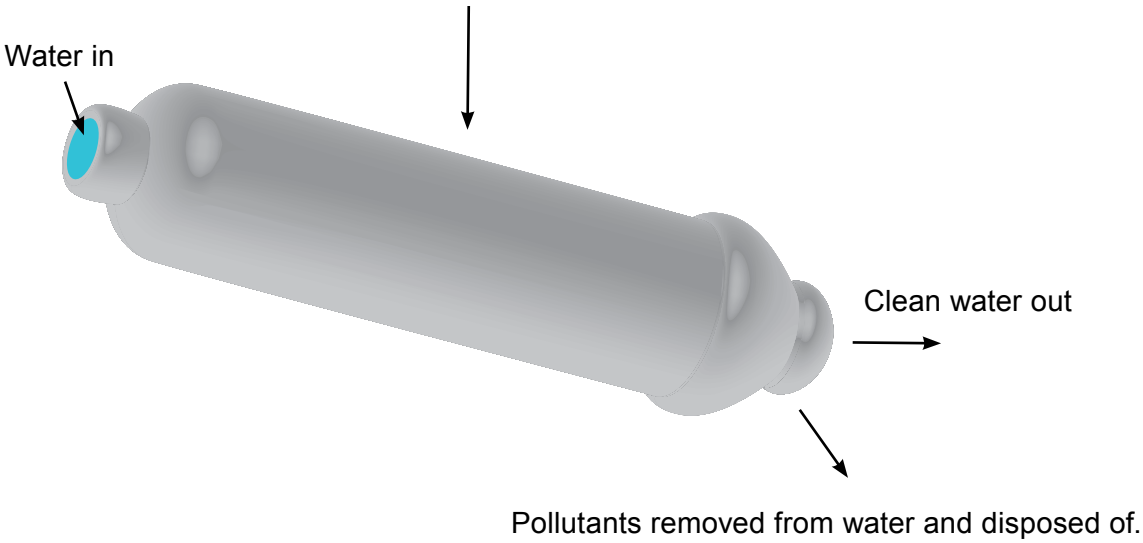
Tiny particles are trapped in a very fine filter.

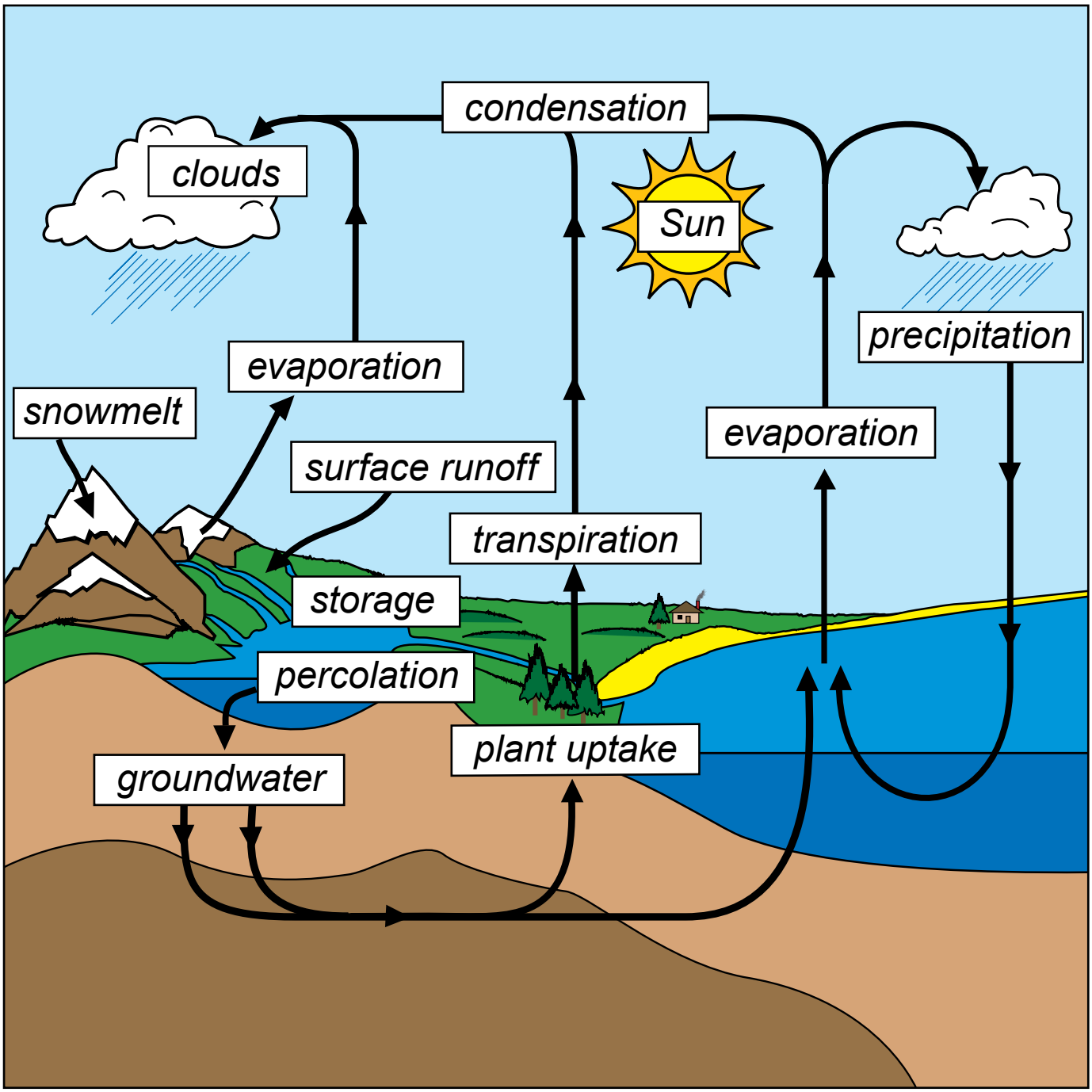


The water is disinfected again before being used.

Reverse Osmosis

A tube containing a reverse osmosis membrane collects pollutants.




condensation
clouds
Sun
precipitation
evaporation
snowmelt
evaporation
surface runoff
transpiration
storage
percolation
plant uptake
groundwater

Case Study #1

Javier lives in Southern California. It does not rain much there. The plants in his garden rarely need water because they are native plants. They are used to growing in a climate with cool, moist winters and hot, dry summers. Javier also times his showers. His record is two minutes for washing his hair and body! Every day he tries to beat his record. Javier loves making salad for his family. He puts a big empty bowl in the kitchen sink. When he washes the vegetables, the bowl catches the water. After dinner, he waters his houseplants with the water in the bowl. Javier also just bought a new high-efficiency, front-loading washing machine that has the lid on the front side instead of on the top. This design uses less energy and water than traditional washing machines.

Case Study #2

People and businesses have to pay for the water they use. They pay their water district, a government agency. Water districts provide clean water for their communities. In the 1990s, one water district in California wanted people to conserve water. They started charging different prices for water use. People who use very little water pay a low rate. People who use a lot of water pay a higher rate. Often, charging people more for something makes them want to use less of it. It pays to conserve!

Case Study #3

The Environmental Nature Center in Newport Beach, California, recently built a new building. The staff wanted to make sure it would be a "green," environmentally-friendly building. To conserve water, the toilets have two flushing options. One is a half flush, and one is a full flush. After people use the bathroom, they can choose how much water they need to use to flush the toilet. The boys' toilets, or urinals, do not use any water! The building also has low-flow showerheads and low-flow sinks. This way, less water comes out at a time. The plants near the parking lot do not need water because they are native to the dry Southern California climate. The parking lot is slightly slanted to one side and has a drain. When it rains, the water goes to the drain instead of to the street. The water gets filtered as it moves through the soil. It trickles into the groundwater, where people can use it, instead of going to storm drains and out to the ocean.

Case Study #4

On June 4, 2008, Governor Schwarzenegger declared that California was in a drought. This means the weather had been drier than normal. During droughts, there is not enough water to meet the needs of everyone in the state. People have to save water. The governor does not have the power to require water conservation across California, but he can strongly suggest it! In the San Francisco Bay and the Southern California regions, water agencies are asking people to decrease their water use. Some areas with extra water have to give their water to areas that do not have enough. If the situation gets much worse, water companies could tell people when they can water their plants or wash their cars. The price of water may also increase.

Case Study #5

The Orange County Water District began operation of its Groundwater Replenishment System in January 2008. This program is designed to recycle wastewater that used to flow into the ocean, where people could not use it. Water from homes and businesses is collected at a central treatment plant and run through all three treatment methods described in the last lesson. This water is then pumped upstream and released in lakes created to recharge groundwater. This purified water then is naturally filtered as it moves through the soil. Eventually it is pumped out, disinfected, and placed into the drinking water distribution system. It is sent, full circle, back to homes and businesses, and the recycling process starts once more.

Case Study #6

In most years, a lot of rain falls in northern California. At times, plants do not need to be watered because there has been enough rain. One school wanted to conserve water, so they put in "smart sprinklers." A computer in this sprinkler system keeps track of the weather, climate, and time of year. The sprinklers turn on only if the soil is dry. Although some people worried the plants would die, they are doing fine! The school also put in a greywater recovery system. Greywater is the water from bathroom and kitchen sinks, showers, and clothes washing machines. At this high school, the locker room showers were wasting a lot of water. Now, with the new system, the greywater goes to a special tank to water the grass on the sports field and the plants around the buildings.

OREGON
IDAHO
NEVADA
ARIZONA
MEXICO
PACIFIC OCEAN
North Coast
North Lahontan
Sacramento River
San Francisco Bay
San Joaquin River
Central Coast
Tulare Lake
South Lahontan
South Coast
Colorado River
N
W
E
S
0
50
100
200
Miles

California Education and the Environment Initiative

53dSE

Printed on post-consumer recycled paper