MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

DISCOVERY SCIENCE CENTER

Fourth Grade ~ Teacher Packet

Themes: Movement of Water & Water Usage

California State Science Standards addressed in today's lesson:

Life Science
- Ecosystems can be characterized by their living and nonliving components.
- In any particular environment, some kinds of plants and animals survive well, some less well, and some not at all.

Earth Science
- Water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places.

Social Science
- Regions of California contain different physical environments and human activity.
- Locate the Pacific Ocean, and major rivers, valleys, and mountains in California and understand their effects on growth of the towns.
- How California became an agricultural and industrial power.

Key Vocabulary:

Aqueduct	Desert	Delta	Reservoirs
Ecosystems	Wetlands	Pumping Stations	Filtration
Drought	Aquifer	Dams	

Key Concepts:

Transportation of water Dependency on water
Living and nonliving components of ecosystems & their interdependency

<u>Prompting and Closing Questions:</u>

1. How have people changed the natural flow of water to help give more water to people in Southern California? (People have built dams, aqueducts, and pumping stations to move water from Northern California and the Colorado River to Southern California.)

2. Why have people changed the natural flow of water to help give more water to Southern California? What would Southern California be like without aqueducts? (Without the additional water, Southern California would more closely resemble a desert; Southern California has a natural scarcity of water; A desert-like environment supports less life than a water-abundant environment.)

3. Where are these features located in California: (a) the Mojave/Mohave Desert (b) the Central Valley (c) the Sierra Nevada Mountains and (d) the San Francisco Bay Delta? (Use the California relief map to locate.)

4. What are some of the differences between the nonliving parts of a desert ecosystem and the nonliving parts of an ocean coastline (or beach) ecosystem? (The desert is more greatly influenced by the abundance of direct sunlight and has much less water than the ocean coastline. The water available in the desert arrives by rainfall and is freshwater, whereas the ocean's water is abundant and salty.)

The prompting and closing questions focus on the standards listed above and will be used by the program instructor during the visit to your school.

Background Information for the Teachers:

<u>Geophysical Conditions Help Determine Local Water Abundance or Scarcity</u>
Certain geological features can affect where precipitation falls, accumulates, and flows. The Sun warms the land, the water and the air. Water has the ability to hold more latent heat (additional heat required to evaporate water) than the soil. Therefore, soil heats up faster than water. The soil, after becoming warmed by the sunlight, will radiate heat back into the surrounding air. The water will hold more of the heat from the sunlight and not radiate it back into the air as readily as the soil.

Along the California coastline, as the warm air from the soil rises, the cooler, water vapor-laden air from the ocean moves in to take its place. This air movement gives us our typical, inland-moving sea breeze. As this breeze hits the mountains, it is forced upward into higher altitudes. This action cools the air, causing the water vapor to condense into clouds, dropping rain or snow in the mountainous areas. Dry air arrives on the eastward side of the mountains, contributing to the formation of desert areas.

When snow from the mountains melts, the liquid water flows downhill forming lakes, rivers, and streams. Water collects in valleys and other low-lying areas. Flowing water that is not trapped in a lake or reservoir can continue its course back to the ocean.

Activity: Geophysical Features (The Shape of the Land)

Procedure:
Distribute the Shape of the Land sheet for the students to complete. Have the students draw arrows on Diagram A to designate the direction of the air flow: (1) hot air rising upward over the land and (2) cool air moving from the left of the picture to the right of the picture; from the ocean to the land.

On Diagram B, have the students draw arrows to show the airflow. Also, have the students draw a cloud raining on the westward side of the mountains to show where most rain and snow are deposited. Have them label the eastward side of the mountains showing where the desert forms.

In addition on Diagram B, have the students draw a stream that forms a lake on the westward side of the mountain. Students may also show the water's flow into the ocean.

Conclusion:
Discuss how and where the air and water flows in accordance with the shape of the land. Let the students know that the water flows downward to the lowest point due to gravity.

Activity: Map of California

Procedure:
Distribute copies of the Map of California to the students. Have them follow the instructions, including coloring and labeling the different objects and locations. If you have a California map in your classroom, use that to help emphasize some of the geophysical features.

Conclusion:
Tie together the previous activity (The Shape of Land) with this activity by showing the students where our mountains are located in relationship to where the ocean and the desert are. Remind them that the water flows downhill and that the water falling in the mountains will tend to flow to the westward side of the mountains in California. Therefore, some of our water drains into the Pacific Ocean and some of our water is held in the Central Valley. By the time the clouds move from west to east over two mountain ranges, the air is pretty dry, so this action causes the high deserts in Nevada and Arizona.

Our staff will be sharing a relief map of California with the students when we visit. Any pre-visit interaction with the map of California will be beneficial to their understanding how water is deposited and transported across the State. Thanks.

The Shape of the Land

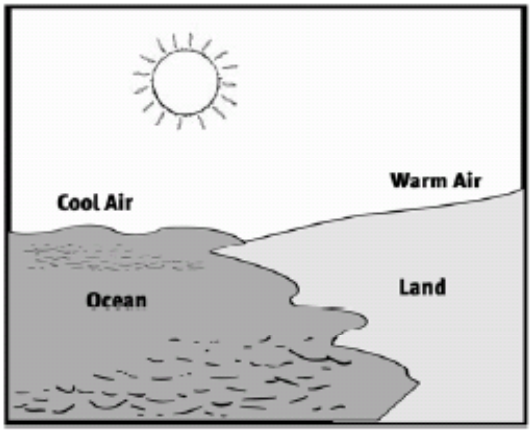


Diagram A

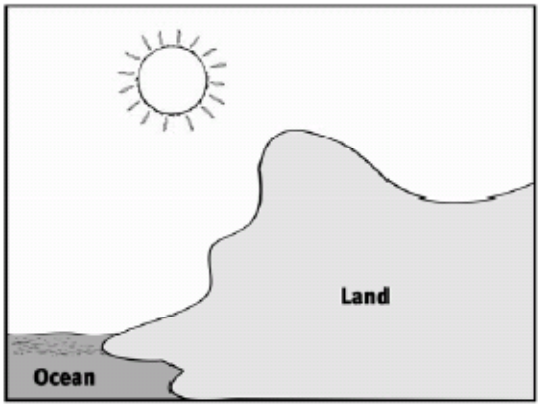
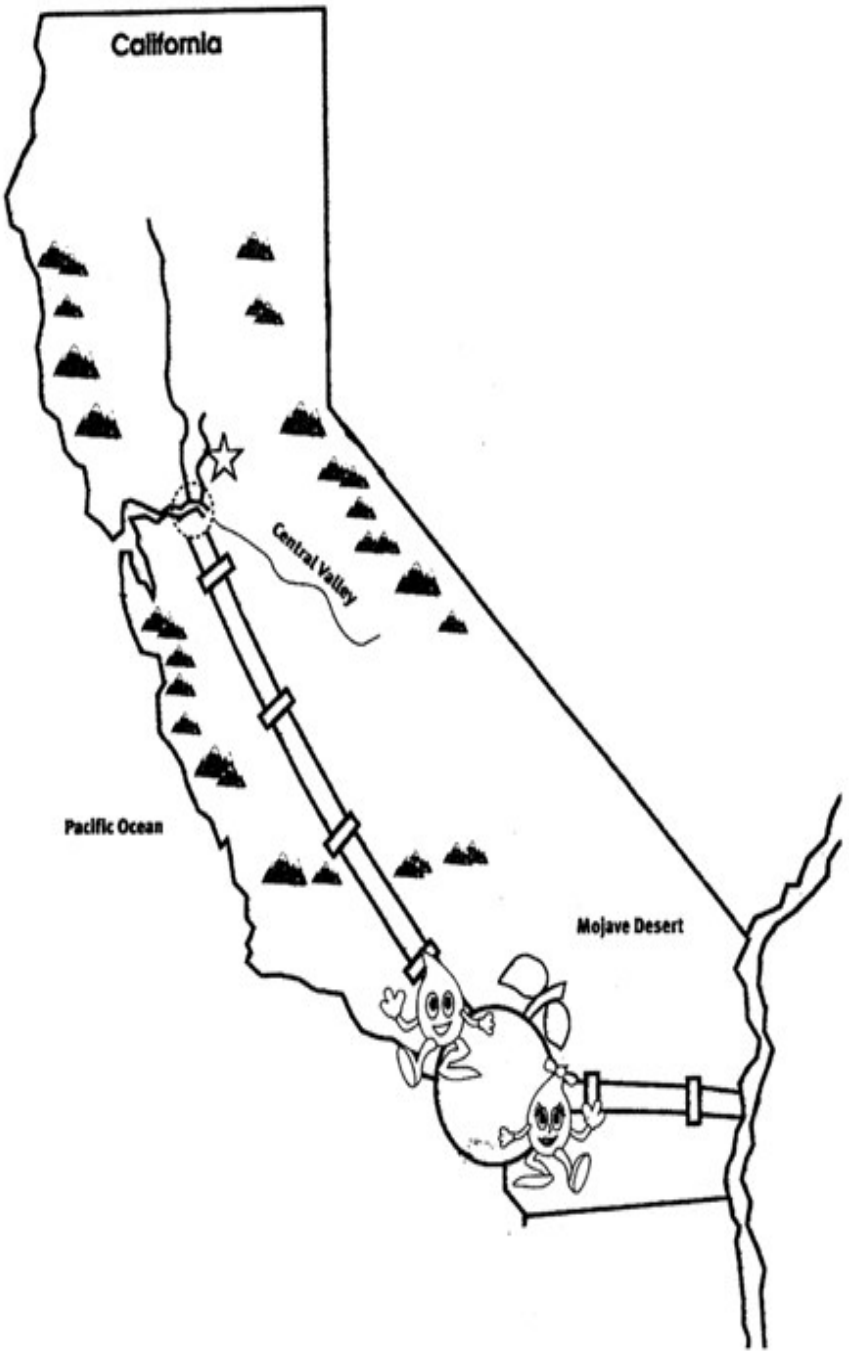


Diagram B

The Sun warms the land, the water and the air. Soil heats up faster than water. The warm soil gives heat back into the air. This hot air rises. Cool air near the water moves in to fill the space left behind from the rising hot air. This air movement gives the California coast its typical, inland-moving ocean breeze.

The cool air near the water holds water vapor that has evaporated from the water's surface. As this breeze hits the mountains, it is forced upward. This action cools the air even more, causing the water vapor to condense into clouds. These clouds drop rain or snow in the mountains. Dry air arrives on the eastward side of the mountains. Since very little rain is dropped on the eastward side of the mountains, that area forms a desert.

When snow from the mountains melts, the liquid water flows downhill forming lakes, rivers, and streams. Water collects in valleys and other low-lying areas. Flowing water that is not trapped in a lake or reservoir can flow to the ocean.


California
Central Valley
Pacific Ocean
Mojave Desert

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Map of California

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

Instructions:

1. Color the orange orange. This is where Orange County is. Label Orange County.

2. Label the map to show North, South, West, and East.

3. Color the short pipe that runs east to west, purple. This is where the Colorado River Aqueduct brings water to us. Label the Colorado River Aqueduct.

4. Color the squiggly line running north to south on the bottom rightside of the map blue. This is a part of the Colorado River that supplies the Aqueduct with water. Label the Colorado River.

5. Color the long pipe that runs north to south, red. This is where the California Aqueduct brings water to us. Label the California Aqueduct.

6. Color the mountains on the eastern side of California gray. These are the Sierra Nevada Mountains that receive a lot of rain and snow. Label the Sierra Nevada Mountains and draw arrows showing how the water flows westward into the Central Valley.

7. Color the mountains on the western side of California brown. These are the Coast Ranges. Label the Coast Ranges and draw arrows showing how the water flows westward into the Pacific Ocean.

8. Color the dotted circle green. This is where water is captured in the San Francisco Bay Delta before it flows into the Pacific Ocean. Label the Delta. This water supplies the Califonia Aqueduct with water.

9. Color the star yellow. This is where our state capital, Sacramento, is.

10. Put an X on the Mojave Desert.

Activity: Salt Water vs. Fresh Water

Southern California is very geologically diverse, comprised of the coastline, mountains, deserts, and almost anything in between. The types of plants and animals that live in these diverse areas are designed to survive within specific conditions. An essential condition for survival is a reasonable supply of water.

California is bordered by the Pacific Ocean, which supplies its plants and animals with an abundance of saltwater. However, Southern California's freshwater sources are limited. Plants and animals that rely on freshwater, as do we, are designed for particular ecosystems that contain at least some freshwater. For example, a desert animal, such as a kangaroo rat can live without ever drinking liquid water ~ however, it must eat plants from which it obtains a certain amount of moisture.

Some fish are designed to live in saltwater and others are designed to live in freshwater. This experiment will demonstrate why you cannot release your freshwater goldfish into the ocean and hope that it will survive ~ nor can you catch a shark from the ocean and keep it alive in the freshwater from your bathroom tap.

Osmosis is the movement of liquids through membranes. The cell's membrane is permeable, meaning it has very tiny holes that allow the passage of certain materials in and out of the cell. A liquid, such as water, moves across the membrane toward the liquid of greater density. More dissolved materials cause a liquid to have greater density. Therefore, saltwater is denser than freshwater.

Materials Needed:
Salt
Teaspoon
Two shallow bowls
A cucumber, cut into slices
Masking tape and pen

Procedure:
Label one bowl "SALTWATER" using the tape and pen. Label the second bowl "FRESHWATER." Fill both bowls about half full of water. Stir in one or two spoonfuls of salt into the bowl labeled "SALTWATER." Place four slices of cucumber into each bowl and wait at least thirty minutes. Remove the soaked cucumber slices and test their flexibility by carefully bending them back and forth. Record the results.

Now switch the slices and place those that were in the saltwater into the freshwater instead, and visa versa. Wait for at least thirty minutes. Then test the cucumbers for their flexibility again. Record the results.

Conclusion:
The cucumbers soaked in saltwater become limp while the cucumbers soaked in the freshwater become firm. The cucumbers have a certain amount of liquid naturally

inside their cells. When placed in the saltwater, the liquid inside the cells is drawn out of the cucumber into the saltwater through osmosis, causing the cucumber to become limp. (Remember, the liquid inside the cells passes through the membrane to the liquid of greater density.) However, since cucumber cells are naturally denser than freshwater, when the cucumber is placed in the freshwater, the cell's membrane allows the addition of freshwater, causing the cells to swell, making the cucumber firm.

Ocean-dwelling and freshwater fishes' cells respond the same way as the cucumber cells. Ocean-dwelling fish tend to dehydrate or lose water naturally, due to their salty surroundings, so they compensate for this by drinking lots of extra water, secreting salt from their gills, and urinating very small amounts of water. Freshwater fish have the opposite problem and tend to bloat due to excess water inside their bodies. Therefore, they have to urinate large amounts of water. Even though their cells perform similarly, ocean-dwelling and freshwater fishes are designed to function differently. That is why an ocean-dwelling fish cannot live long in freshwater, nor can a freshwater fish live in the ocean.

Have the students discuss other types of animals and how they are designed to live in specific ecosystems.

Conservation of Resources Activities:

A copy of the "Water Cycle" and "Water, Who Needs It?" video and accompanying posters may be obtained from the Department of Water Resources for free at www.publicaffairs.water.ca.gov/education/orderform.cfm

Distribute the "How Much Water Do You Use" sheet in order to conduct a daily water usage survey. Discuss the results with the students. Remind the students that the survey only looks at the amount of water they use inside their houses.

To encourage a conversation about water usage outside of their houses, introduce the connection between water and plants ~ as an example, perhaps we tend to water our plants more in the summertime, whether they need it or not. Perhaps we tend to play outdoors in the hose, sprinkler or pool in the summertime, using extra water that we would not use in the wintertime. If we play outdoors in the water, does the water ever run off into the street? If so, that is wasted water. An average hose releases 6 ½ gallons of water per minute! Do the math on that!

Check out the website www.bewaterwise.com/calculator.html to see how much water you should use and how often to water your plants.

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HOW MUCH WATER DO YOU USE?

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

Find out how much water you and your family use in one day. Place a tally mark in the "Number of Times" column every time someone in your family does the activity. At the end of the day, multiply the amount of water used with the number of times that the activity was done to get the total amount of water used for each activity. Then add all of the total amounts of water used to get the grand total.

Activity	Amount of Water Used	Number of Times		Total
Flush a toilet	5 gallons	X _____	=	_____
Take a shower	25 gallons	X _____	=	_____
Take a bath	35 gallons	X _____	=	_____
Brush teeth (water running)	2 gallons	X _____	=	_____
Brush teeth (water off while brushing)	0.2 gallon	X _____	=	_____
Wash dishes (water running)	30 gallons	X _____	=	_____
Wash dishes (by filling the sink)	10 gallons	X _____	=	_____
Use the dishwasher	20 gallons	X _____	=	_____
One load of wash in washing machine	40 gallons	X _____	=	_____

Grand Total _____

To find the average amount of water used per person in your family, divide the grand total by the number of people in your family. The answer is: _____

1. Which activity happened most often in your home? _____
2. Which activities use the most water each time they happen? _____
3. Which activity at your home used the most water? _____