MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

DISCOVERY SCIENCE CENTER

Third Grade ~ Teacher Packet

Themes: Availability of Water ~ Scarcity and Introduction to Aqueducts

California State Science Standard addressed:

Physical Science

- Matter has three forms: solid, liquid, and gas.
- Heat energy comes from the Sun to the Earth in the form of light.
- Evaporation and melting are changes that occur when objects are heated.

Social Science

- Identify local and regional geophysical features, such as deserts, oceans, etc.
- Understand the use of resources of the local region and the modifications of the physical environment, such as dams, aqueducts, etc.

Key Vocabulary:

Aquifer	Aqueducts	Lake
Groundwater	Dams	Pump

Key Concepts:

Reservoir	Drought	Sources of water
Desert	Percolation	Water delivery system
Geophysical features in California		

Prompting and Closing Questions:

1. Evaporation and melting can each require heat. What is the difference between evaporation and melting? (Evaporation is the change of liquid into a gas, while melting is the change of a solid into a liquid.)
2. 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.)

3. 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.)

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

The prompting and closing questions focus on the standards listed previously, will be used by the program instructor during the visit to your school, and will be incorporated into the take-home Ricki the Raindrop activity booklets distributed to your students.

Background Information for the Teachers:

Solids, Liquids and Gases ~ The 3 Forms of Matter

There are three common forms of matter: solid, liquid and gas. The differences between these three forms depend on the motions and forces of the molecules or atoms of which they are composed.

- A solid has a definite shape and volume (i.e. a block of wood).
- Liquids have definite volumes and assume the shape of their containers (i.e. water in a cup).
- Gases expand to fill the volume and take the shape of their containers (i.e. oxygen).

The atoms of a solid material are very close together and although all of the atoms are moving, or vibrating, they are moving very slowly.

Not only does a liquid have a definite volume and assume the shape of its container, it is also free-flowing. In other words, we can pour a liquid and it all sticks together as a unit while we pour it. The atoms in a liquid are typically farther apart and vibrate faster than in the solid form, but these atoms still remain in contact with each other.

Since a gas has neither a definite shape nor volume, it expands indefinitely. Therefore, it needs a lot of space. The atoms of a gas spread out, passing and occasionally banging into each other.

If the temperature and/or pressure are adjusted, matter may undergo a phase transition. During a phase transition, matter shifts between these three forms. There are different

ways matter can shift from one form to another: melting, freezing, evaporating, condensing, and subliming.
Phase transitions:

- Melting – changing from a solid to a liquid
- Freezing – changing from a liquid to a solid
- Evaporating – changing from a liquid to a gas
- Condensing – changing from a gas to a liquid
- Subliming – changing from a solid to a gas

Examples of these phase transitions:

- Melting – an ice cube melting
- Freezing – the opposite process of melting; freezing water into an ice cube
- Evaporating – steam rising from the surface of boiling water
- Condensing – moisture forming underneath the lid of a boiling pot
- Subliming – solid carbon dioxide (dry ice) changing into carbon dioxide gas

<u>Water Cycle</u>
Water is one of the only substances that can exist in three different forms (solid, liquid, gas) at the same point in time, under the same temperature and pressure conditions. For example, if you experience snow on a sunny day, you would see snow (solid water) slowly melting into liquid water because of the warming sunlight. This liquid water will then evaporate (forming gas water) due to the warming sunlight. As you breathe out, the water vapor (gas water) in your breath condenses into fog (liquid water).

We can see the same situation by carefully observing a glass of ice water. Ice (solid water) is floating in liquid water. Water vapor (gas water) from the surrounding air which is warmer than the glass of ice water, can condense onto the outside of the glass of ice water because the glass provides a cooler surface than the surrounding air ~ forcing the water vapor to change to a liquid water form (the droplets of water on the outside of the glass).

It is through this ease of water moving from one form into another that facilitates the water cycle. The water cycle is the course that water follows as it moves through the different phase transitions:

- The Sun causes liquid water to evaporate, turning the liquid water into water vapor (gas water).
- Hot air containing gas water rises. As it reaches the upper atmosphere, the air containing the gas water cools. This process condenses the gas water into liquid water, forming clouds.
- When clouds become heavily saturated with liquid water, the liquid water falls out of the sky. This process is called precipitation. Depending on the temperature, the precipitation can be in the form of solid water (snow) or liquid water (rain).

- When the liquid water reaches the earth's surface, it accumulates into puddles or pools. Snow accumulates in piles and eventually melts due to the warm sunlight.

Heat Energy from the Sun in the Form of Light

All weather is due to heating of the Earth by the Sun, which emits energy at an almost constant rate. However, certain regions on Earth receive more heat when the Sun's light is more direct and when there are more hours of sunlight in a day. For instance, due to the tilt of the Earth on its axis, the more direct sunlight radiating along the Equator makes this area much warmer than the North and South Poles year round. Also, when the northern end of the Earth's axis is tilted toward the Sun, the Northern Hemisphere experiences summer, while the Southern Hemisphere is experiencing winter. During this time, the sunlight radiates more directly on the Northern Hemisphere, and the daylight hours there are longer than in the Southern Hemisphere. Since the Southern Hemisphere is tilted away from the Sun, the sunlight radiating in that region is indirect and the daylight hours are short. Since the Sun's light never directly hits the Earth's Poles, the polar regions are colder than the rest of the Earth.

Geophysical Conditions Help Determine Local Water Abundance or Scarcity

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. 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: Studying Heat Energy from the Sun

Materials:

- Magnifying lens
- Two small chocolate bars
- Access to an outdoor area
- Water
- Paper towels for clean up

- Four small plates or pie pans
- Drinking straw

Procedure:
Engage the students in a discussion of the Sun. What are some of the characteristics of the Sun? (The Sun is big, hot, bright, "sunny," etc.) Write the students' descriptors on the white board. Explain that the Sun has energy and that energy is the ability to do work. The Sun's energy comes to us in the form of light energy and heat energy. What types of work can the Sun's light energy do? Light energy helps us see; it also helps plants make food. What types of work can the Sun's heat energy do? Heat energy keeps us warm; it also is what makes the water cycle work.

Progress to a demonstration on how the Sun's light contains heat energy. Heat energy can make frozen water melt (turn into a liquid) and make liquid water evaporate (turn into a gas). The more direct the light is, the more focused the heat energy. Use a magnifying lens to show this:

1. Place each of two equal-sized ice cubes on a separate plate or pie pan.
2. Take the ice cubes outdoors into the sunlight.
3. Use the magnifying lens to focus the Sun's light onto one of the ice cubes.
4. Which of the ice cubes melts faster? Remind the students that "melting" is the change from solid to liquid.
5. Use the drinking straw to transfer an equal, but small amount of water drops to each of two plates or pie pans.
6. Take the water drops outdoors into the sunlight.
7. Use the magnifying lens to focus the Sun's light onto one of the small pools of water drops.
8. Which of the small pools of water drops evaporated faster? Remind the students that "evaporating" is the change from liquid to gas.

Have the students think and then write about what would happen if they performed this same activity on two chocolate bars. In their written explanation, have them justify their prediction. Then perform the activity and discuss the results.

Conclusion:
The purpose of the magnifying lens is to focus the Sun's light ~ this concentrated light demonstrates how direct sunlight works by providing more heat to an area. The more heat you have to do "work," such as melting, the faster the job goes. This is why the area around the Earth's equator is hotter than the area near the Earth's poles ~ due to the tilt of the Earth on its axis, the Equator receives more direct sunlight, therefore, more heat.

Activity: Geophysical Features

Materials:

- Modeling clay
- Spray bottle filled with water

Procedure:
Distribute a fistful of modeling clay to each of the students. Discuss a variety of geophysical features and have the students model those features, such as a mountain, a lake, a valley, a plain, and a river.

Then have the students take half of their clay to flatten into a pancake shape (such as a plain) and use the other half of their clay to make hills, mountains, and other geophysical features. Once they have created their landscape, have them draw a picture of their design. Then have them spray their landscape with water and observe how and where the water flows and collects. Have them add this information to their drawing.

Have the students join into teams by attaching their landscape onto another student's landscape (attach at least four landscapes together ~ one representing the northwest quadrant, one the northeast quadrant, one the southwest quadrant, and one the southeast quadrant). Then predict where the water is going to flow and collect. Spray the adjoined landscapes to see if they predicted correctly.

Conclusion:
Discuss how and where the water flows. Let the students know that the water flows downward to the lowest point on their landscapes due to gravity. Imagine that the adjoined landscapes were an island surrounded by the ocean. Are there areas on the island where the water flows off, into the ocean?

Ricki the Raindrop and How We Get Our Water

Materials:

- Ricki Raindrop booklets (you will receive these following the class presentation)

Procedure:
Use the Ricki Raindrop booklets to review with the students how water moves through its different forms and how water is moved through the State of California. Have the students go through their booklets at school and at home with their parents. The students should answer all of the questions asked in the booklet; remember, it is an important science-thinking and language-building skill to have the students articulate what they think or know.

Also, have them perform all of the activities, such as: (1) drawing arrows mapping the different pathways of water; (2) labeling the map of California; (3) conducting the

“Showering or Bathing” experiment at home and (4) calculating their potential savings on their water bill.

Ask your students the prompting and closing questions as a check for understanding.
Conservation of Resources Activities:

The Orange County Department of Education has delivered a copy of the "Water Cycle" and "Water, Who Needs It?" video and accompanying posters to each OC public school district’s curriculum director for distribution to all elementary schools in their district. Please check with your school Principal or librarian to check out this and other incredible resources provided by the California Department of Water Resources.

Additional resources may be obtained from the Department of Water Resources for free at www.publicaffairs.water.ca.gov/education/orderform.cfm

Math and Conservation:
On most city water bills, there is a comparison of water consumption from one year to the next. In some cities, this is measured in gallons; in others it is measured in hundred cubic feet (HCF). [FYI ~ there are 748 gallons in one HCF] Use the Monthly Water Consumption graph to practice interpreting information presented in a graph form. Hand out a copy of the graph and ask these questions:

1. During which time of year (which months) do we use the most water?

2. During which time of year (which months) do we use the least water?

3. Why do you think we use more water during particular months? On what or for what would this extra water be used?

4. Which months did we use more water than in the prior year?

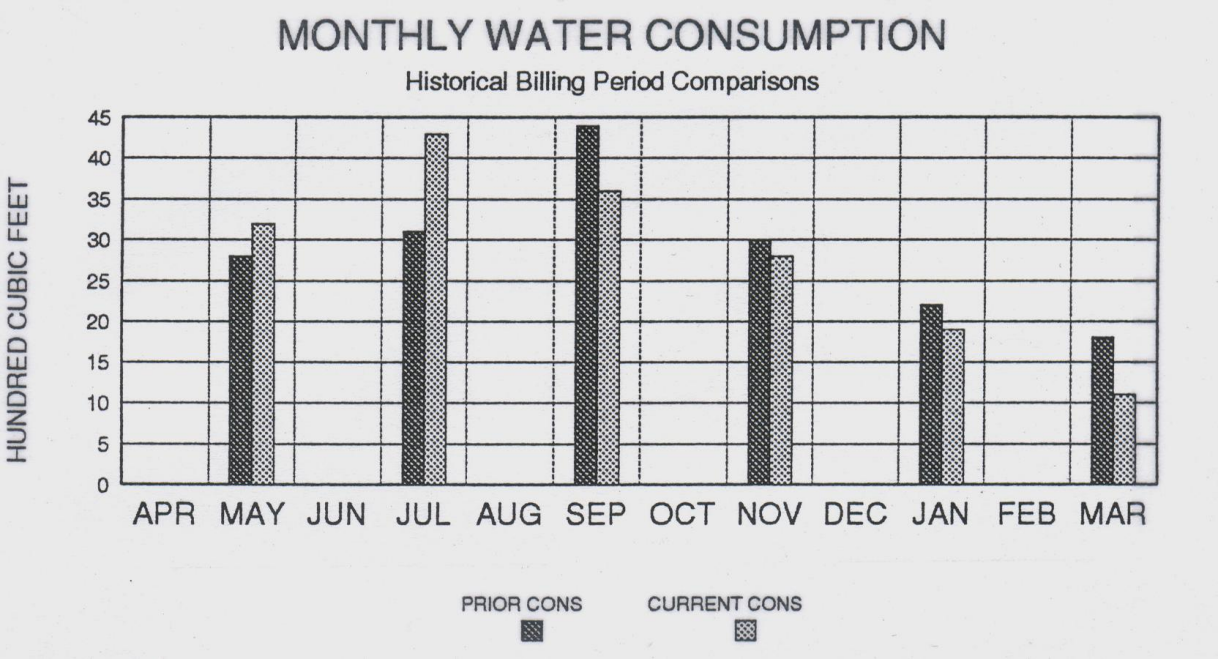
5. Which months did we use less water than in the prior year?

6. What could you do to use less water during particular months?

Encourage a conversation about the connection between water and plants ~ 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.

Monthly Water Use



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