MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

DISCOVERY SCIENCE CENTER

First Grade ~ Teacher Packet

Themes: The Water Cycle; Affect of Temperature on Water

California State Science Standards addressed:

Physical Science

- Solids, liquids, and gases have different properties.
- Properties of substances can change when the substances are mixed, cooled, or heated.

Earth Science

- How to use simple tools (e.g. thermometer) to measure weather conditions and record changes from day to day.
- Weather changes from day to day but trends in temperature or of rain (or snow) tend to be predictable during a season.
- The sun warms the land, air, and water.

Key Vocabulary:

Solid	Gas	Liquid
Temperature	Thermometer	

Key Concepts:

Evaporation	Condensation	Precipitation
Accumulation	Sun as a Warming Source	Water Cycle

Prompting and Closing Questions:

1. How is liquid water different from solid water? (it flows; it's not as cold)
2. How can you change liquid water into solid water? (freeze it; make it cold)
3. How can you change solid water into a liquid? (melt it; heat it)

4. What do we use a thermometer for and what can it tell us about the weather? (a thermometer is used to measure temperature and tells us whether something, such as the air, is hot or cold)

5. What can warm the air and the Earth? (the Sun)

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.

- 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

Water Cycle

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.

Sun as a Warming Source

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. Therefore, the Sun heats the Earth unevenly, contributing to seasonal differences and changes in the weather.

Activity: Reading, Recording and Comparing Temperature

Materials:

- Three thermometers
- Desk lamp
- Bowl of ice

Procedure:

1. Set up 3 thermometers:
   One in a bowl of ice
   One under a desk lamp
   One at room temperature

2. Show students how to read temperature using a thermometer and then have them record the temperature of each thermometer.

3. Next as a class, have the students plot these recordings next to a large picture of a thermometer on the whiteboard for them to see how temperature rises from cold to hot.

Conclusion:
The purpose of this activity is to teach the students how to use and read a thermometer and to understand that if the red liquid is low in the thermometer's tube, that indicates that the temperature is cold, like ice ~ and that if the red liquid is high in the thermometer's tube, that indicates that the temperature is hot, like the heat from a light bulb. This is also a good time to discuss that light can produce heat. Just as the light from the desk lamp heats the temperature of the air and tabletop, so does the light from the Sun heat the land, the water, and the air.

Activity: Studying Direct and Indirect Light

Materials:

- Flashlight
- Paper and pencil
- Two thermometers

- Two containers
- Water
- Soil

Procedure:

1. Turn on a flashlight and project the light directly onto a piece of paper.
2. Draw a circle around the area of light projected onto the paper, explaining to the students that you are shining direct light onto the paper.
3. Mention that if the flashlight was the Sun and the sunlight was shining directly on them, that they would be getting very hot ~ and the longer they were in the direct light, the hotter they would get.
4. Project the light onto a second piece of paper at a low, sideways angle.
5. Draw a circle around the area of light projected onto the paper, explaining that you are shining indirect light onto the paper.
6. Mention that if the flashlight was the Sun and the sunlight was shining indirectly on them, that they would not be as hot as they would be in the direct light.
7. Take the two thermometers and have the students determine where to place them outside of the classroom where one thermometer would be in the Sun's direct light and the other would be in the Sun's indirect light (the shade).
8. Have the students predict which thermometer would measure the hottest temperature after 5 minutes.
9. Check the temperature readings after 5 minutes and discuss the results.
10. Place a container of soil and a container of water in an area where they get the same amount of direct or indirect sunlight.
11. Bury a thermometer in each container.
12. Have the students predict which thermometer will measure hotter after 5 minutes or if the thermometers will measure the same temperature.
13. After 5 minutes, have the students feel the soil and the water, by simultaneously placing one hand on each substance, to determine which substance they think is going to measure hotter on the thermometers.
14. Check the temperature readings and discuss the results.

Conclusion:

The Sun warms the land, the water and the air. The more direct sunlight can increase the temperature of an area. The longer the area is under direct sunlight, the hotter it becomes. We receive more direct sunlight in the summer and more indirect sunlight in the winter due to the tilt of the Earth on its axis. This is why summer generally is hotter than the winter….the seasons help determine the weather.

Water has the ability to hold more latent heat (additional heat required to evaporate water) than the soil. The soil may feel warmer than the water because 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, therefore the water may feel cooler to the touch.

Ricki the Raindrop and the Water Cycle

Materials:

- Ricki Raindrop booklets (you will receive these following the class presentation)
- Ice cubes
- Empty cups
- Water
- Thermometer

Procedure:
Use the Ricki Raindrop booklets to review with the students the three forms of water, how water changes into its different forms, and the water cycle story. 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) experiencing the solid nature of ice cubes by holding them in their hands and by placing them in the empty cups to observe them as they melt; (2) freezing water to observe how it expands; (3) and recording temperatures.

Ask your students the prompting and closing questions as a check for understanding.

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

Encourage student input as you create a list of some of the water sources in and around the school. Take a short walk around the school grounds if possible to look for more ideas (sprinklers, drinking fountains, sinks and toilets, water cooler or coffee pot in the teachers' lounge, fire hydrant, hoses, etc). Discuss the uses of each type of water source and whether it is necessary. In fact, you should discover that all of the water sources are necessary. While taking your walking tour, pinpoint ideas about how water can be used wisely or can be wasted; for example, hoses supply water to plants, but over-watering plants can lead to wasted water.

Check for leaky faucets or fountains during your walking tour, or areas where water may have pooled or the ground is muddy due to over-watering. If you discover these areas, discuss with the students a strategy for correcting this wastefulness. Perhaps the students can create a short picture story to encourage saving water; these stories can be passed along to the principal or maintenance crew or even taken home to the students' parents. Have the students conduct a similar walking tour at home with their parents in order to have the students encourage their parents to help conserve water.