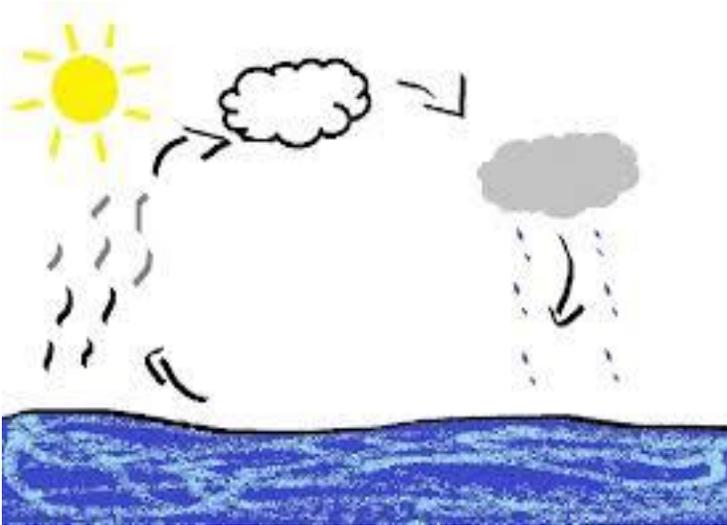




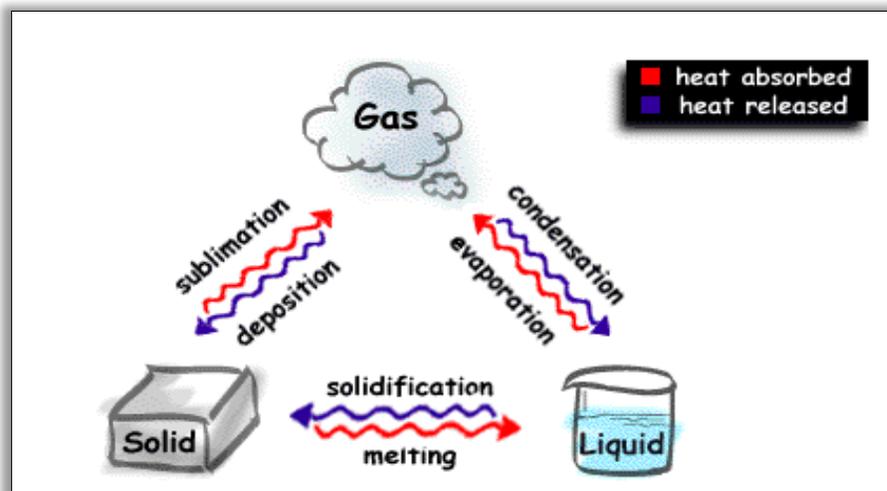
CRITICAL THINKING ACTIVITY: THE WATER CYCLE



Water is the only substance that exists on Earth in each of its three **states** and easily changes from one state to another. Water sometimes changes its location by changing state in a continuous pattern called the **water cycle** or the **hydrologic cycle**. The water cycle is self-

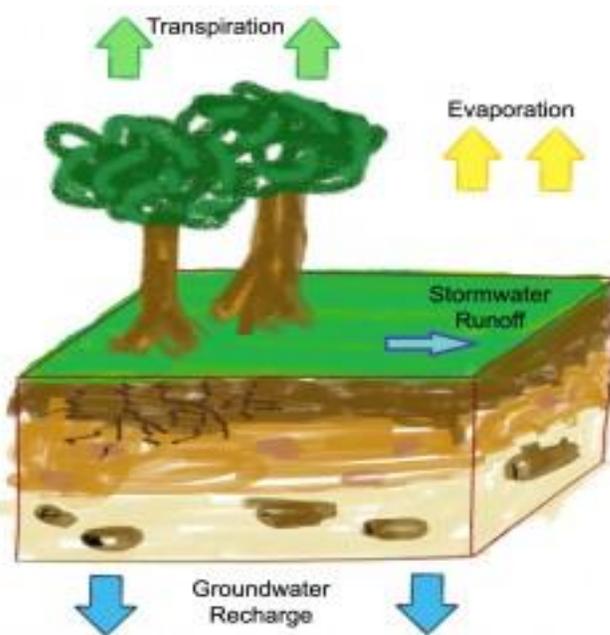
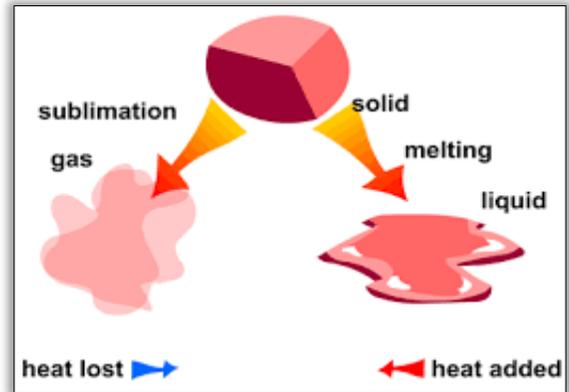
renewing and continuous. The Sun provides the energy to power the water cycle.

When water changes state in the water cycle, the total number of water particles remains the same. The changes of state include **melting**, **sublimation**, **evaporation**, **freezing**, **condensation**, and **deposition**. All changes of state involve the transfer of energy. The water particles in each state behave as energy is absorbed or released. . Condensation, deposition, and freezing are processes that occur as a result of a decrease in the heat energy of water particles.



Student Sheet 2

When solid ice gains heat, it changes state from solid ice to liquid water in a process called **melting**. Ice cubes in a cold drink, for example, gradually melt. Each spring you see snow melt into slush and puddles. Sometimes adding heat energy to solid ice causes a change of state from a solid to a gas. This change, directly from a solid to a gas without becoming a liquid, is called **sublimation**. On crisp, dry winter days you might notice that snow banks shrink, or ice gradually disappears, without first becoming slushy and wet.



When water absorbs enough heat, it becomes a gas (water vapor). This process is called **evaporation**. Water vapor (steam) mixes with the air and seems to disappear. A simple example is water boiling in a teapot and escaping into the air. Another type of evaporation occurs from the surface of plant leaves as the plant's temperature increases and water vapor is released into the air as the plant "breathes" in the process of **transpiration**.

When water vapor loses thermal energy and becomes liquid water, **condensation** has occurred. Rain and dew are examples of condensation. A cold can of pop placed outside on a hot summer day often accumulates water droplets. This is because water vapor in the air condenses when the cold can cools it.



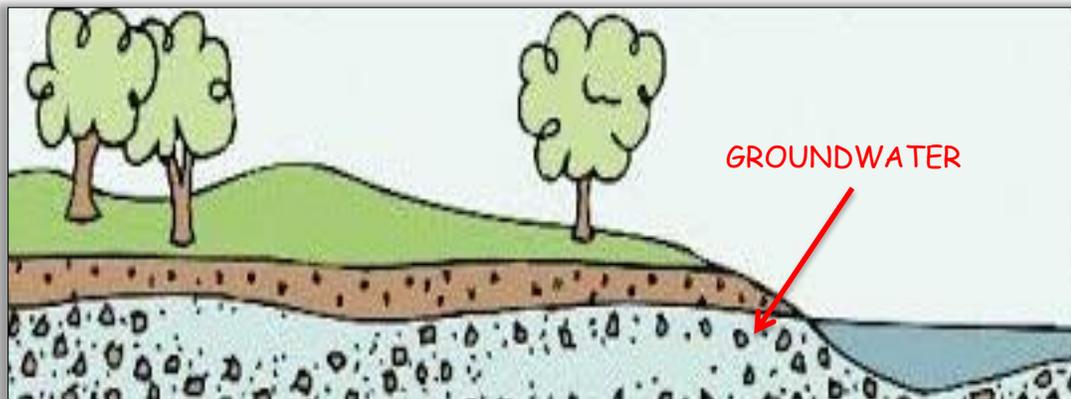
Student Sheet 3

Sometimes, removing heat energy from water vapor causes it to become a solid, rather than a liquid. **Deposition** occurs when water vapor changes state directly from a gas to a solid. Deposition is the reverse of sublimation. One example of deposition occurs high in the atmosphere or on the top of high mountains where the temperature is very low. In these conditions, water vapor forms snow without becoming a liquid first.



Solid water includes permanent ice and snow in glaciers and polar regions, and ice and snow that form in the winter. Liquid water falls to the ground in the form of rain. Liquid water also forms when winter ice and snow begin to melt. Much of this water is called **runoff**. Runoff water flows downhill under the influence of gravity, through streams, rivers, and lakes and some eventually reaches the oceans. All the water on Earth's surface is called **surface water**.

Some liquid water seeps into the ground. This water, called **groundwater**, trickles down through openings in the soil and cracks in rocks until it hits bedrock and cannot flow down any farther. The water spreads out until it fills all the available spaces in the loose rock and soil above the bedrock



Student Sheet 4



Once water vapor is in the atmosphere, low temperatures cause the vapor to either condense into a liquid or undergo deposition to form ice crystals. Water droplets and ice crystals in the atmosphere form clouds, which are moved

around the planet by air currents. The water droplets in clouds collide to form larger droplets that fall as rain. Ice crystals fall to the ground as snowflakes. Both rain and snow are forms of **precipitation**—water that falls to Earth's surface. Fallen snow may gradually accumulate as **polar ice sheets**, **icecaps** and **glaciers**.

When liquid water loses thermal energy, it undergoes **freezing**: changing state from a liquid to a solid. We see many examples of this in everyday life. Puddles, ponds, lakes, and even parts of oceans freeze when the water becomes cold enough. At low temperatures, Earth's



surface water freezes and forms solid **ice**. Ice is slightly less dense than liquid water. This explains why, in the winter, lakes and ponds develop a layer of ice that floats on the liquid water underneath. As a result, animals and plants can survive through the winter without being frozen solid.

Winter snow melts as spring arrives. The snowmelt flows into streams and rivers, and eventually into the oceans. Some of the snowmelt sinks into the ground, becoming groundwater, while the surface water evaporates to become water vapor, starting the water cycle all over again.

Student Sheet 5

ACTIVITY #1- MODELING AND OBSERVING THE WATER CYCLE

OBSERVATIONS:

1.

2.

3.

4.

5.

6.

7.

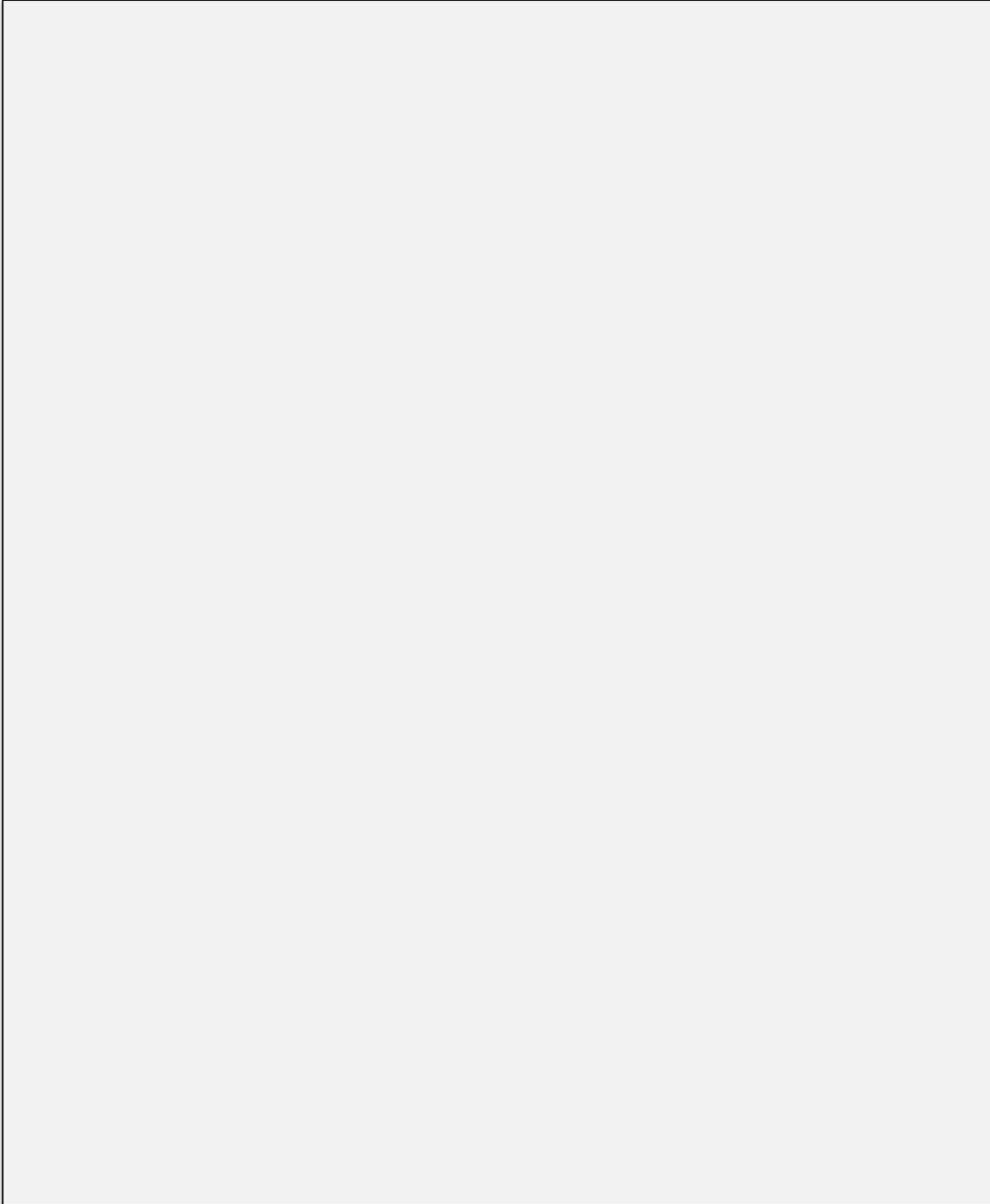
8.

9.

10.

Student Sheet 6

PART 1: DIAGRAM OF OBSERVATION



PART 1: ANALYSIS

1. Relate each part of your model to the water cycle diagram at the top right of this page. For example, the lamp represented the sun. What other Earth system processes were demonstrated in this lab?
2. What was the energy source for the water cycle?
3. How does the water cycle "transport" energy?
4. What do you think would happen if you added a second or even third lamp?
5. Describe what you think would happen if you left the water cycle in a shoebox in the dark for several hours.
6. Which parts of the water cycle were clearly demonstrated with this lab and which parts were not well represented?
7. How might you document and share your demonstration with other students?
8. Draw a sketch of your water cycle model and add words to describe the processes taking place in the model.

ACTIVITY 2: CREATIVE WRITING

Use story maps to plan out your story. Remember to use the scientific terms related to the water cycle and write in complete sentences. Choose one scenario from the list below.

-  You are a molecule of water (in solid form) sitting on a mountaintop in the middle of spring. You are surrounded by millions of your relatives—all of them snow. The sun is bright and it is starting to get very warm, when all of a sudden.....

Student Sheet 8

- ✚ You are a molecule of water (in liquid form) floating along happily in the ocean when suddenly.....
- ✚ You are a drop of water (in liquid form) sitting by yourself on a rock in the desert. Everyone around you is thirsty. You notice a desert lizard slowly approaching you when suddenly.....
- ✚ You are a drop of water (in gas form) floating in the air after someone took a hot shower. It is starting to get less and less hot when suddenly.....
- ✚ Write a story about a water droplet taking the following journey: Lake -> Clouds -> Ocean -> Cloud-> River -> Ocean -> Clouds -> Glacier
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