Latent Heat Lab **name:** _____
Understanding Microbursts, Chinook winds, etc. **period:** _____

Pre-Lab Questions . . . We'll do these together.

1. What are clouds made of? Circle two: vapor liquid ice crystals

2. Label the following as "slowest", "medium", and "fastest".

_____ water vapor molecules

_____ frozen water molecules (ice)

_____ liquid water molecules

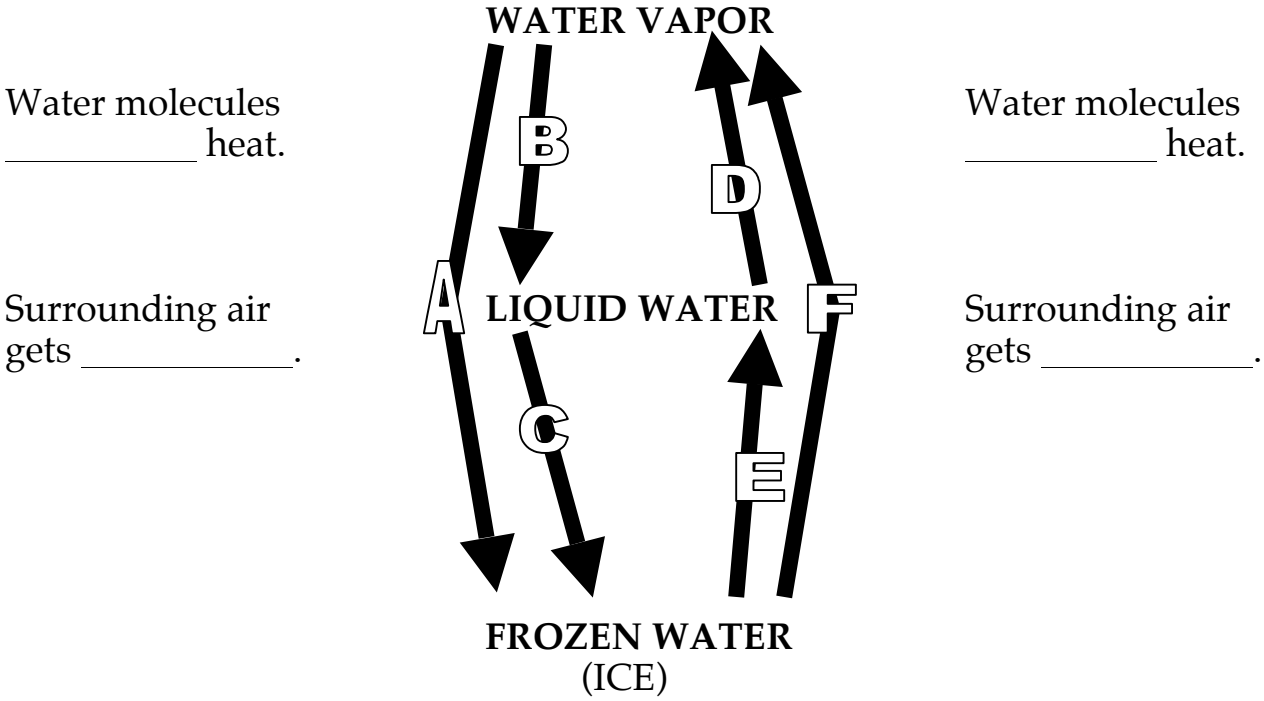
3. When sweat (mostly liquid water) evaporates from your skin, why does this help to cool your body?

4. Most of the water in the clouds over Montana came from the Pacific Ocean. What do water molecules absorb as they evaporate from the ocean?

5. What is the normal freezing point of water? _____F _____C

6. What is "super-cooled water"?

7. Look at the diagram shown below. Name the phase changes and then fill in the blanks.



Materials
400 ml plastic beaker, two thermometers, two test tubes, drinking straw

IMPORTANT: Rinse the test tubes and the thermometers at a sink before you start.

1. Have your instructor fill your beaker with cold, salty slush. Set the beaker aside. Get two test tubes. **REMINDER:** Rinse them out (do not dry them). Add cool tap water to two test tubes until they are about 2/3 full.

2. Get two thermometers. **REMINDER:** Rinse them off (do not dry them). Place one thermometer into each test tube. Set the test tubes into the slush as shown below.

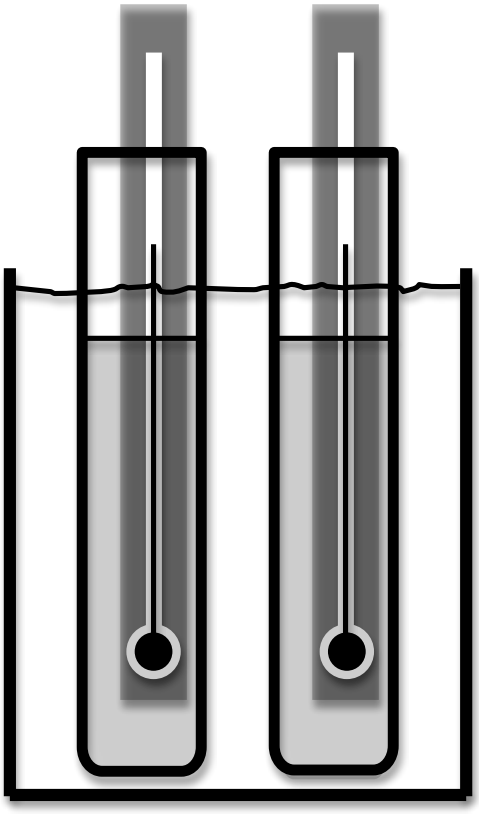
3. Monitor the temperatures of the water in the test tubes. After 5-10 minutes, the temperatures in the test tubes should be way below the freezing point. When the temperature reaches -5 C you are ready to go on to the next steps. Leave the thermometers in the tubes as you do the steps #4 and #5 below.

4. Carefully take **ONE** of the test tubes out of the slush and use a drinking straw to squeeze a small amount of snow into the tube. Observe what happens to the water AND the temperature, and then describe it in the space below. Use sentences!

5. Do the same thing with the other tube. **PAY CLOSE ATTENTON TO THE TEMPERATURE** during the 30 seconds after you drop the snow in. Describe (sentences) what happened.

DO NOT DISTURB!

You might cause the water to freeze before it becomes super-cooled.



When you are finished, rinse the tubes and thermometers off and put them back. Empty the slush back into the plastic box so that it can be used again next period. Answer the questions on the next two pages.

NOTE: You're on your own for these questions. Do NOT ask Benson for help. **THINK**

1. How cold did the water in the tube(s) get before you dropped the snow into it? _____ C

Did the water in the test tube(s) become "super-cooled" you dropped the snow into it? _____

2. What happened to the temperature of the thermometer in the test tube as the water froze? Circle one.

a. The thermometer got warmer because the water molecules released heat.

b. The thermometer got colder because the water molecules absorbed heat.

3. Why did this happen? Circle one.

a. Water molecules absorb heat from their surroundings as they changed from liquid to solid.

b. Water molecules release heat to their surroundings as they changed from liquid to solid.

4. As winds force very humid air up the western slopes of mountains in northwestern Montana, the air is cooled by expansion, causing clouds to form. As vapor changes to solid cloud crystals, the water molecules would . . . (circle one)

HINT: Diagram on First page may help.

a. absorb heat from their surroundings, making the air colder

b. release heat to their surroundings, making the air warmer

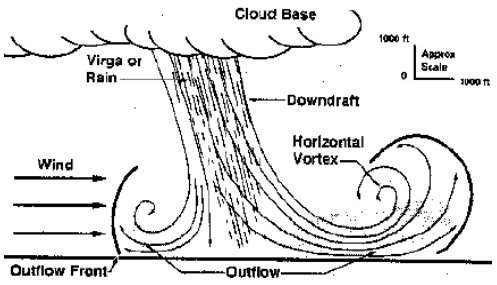
5. As rain falls through very dry air, much (or all) of the rain may evaporate. As this falling rain evaporates the water molecules . . . (circle one)

a. absorb heat from their surroundings as liquid changes to vapor

b. release heat to their surroundings as liquid changes to vapor

6. As the air described in question #5 gets colder, it becomes heavier than the surrounding air, causing it to accelerate toward the ground like a lead weight falling through water. As this rapidly falling air hits the ground surface winds can exceed 150 miles/hour. This is called a "downburst". The most intense ones, which may last only 5 minutes and have wind speeds over 175 miles/hour, are called "microbursts". Scientists can tell whether an area has experienced a tornado, or a microburst by surveying the damage from an airplane.

How would the pattern of damage caused by the straight-line winds of a microburst differ from the pattern of damage caused by a tornado? (Use sentences!)



7. When a hard frost is expected, orange growers may spray their trees with water to keep the oranges from freezing. As the water freezes, the ice provides insulation for the fruit within. As the water freezes, this helps to prevent the fruit from freezing because water molecules . . . (circle one)

a. absorb heat from their surroundings (air, etc.) as they change from liquid to ice

b. release heat to their surroundings (air, etc.) as they change from liquid to ice

8. A psychrometer, which is used to measure relative humidity, consists of a wet-bulb and a dry-bulb thermometer. As water molecules evaporate from the wet bulb the water molecules _____ (absorb/release) heat, causing the wet-bulb to become _____ (warmer/colder) than the dry bulb.

9. TV weather broadcasters occasionally say that a storm has "lots of energy". Why does a storm that contains an abundance of water vapor have "lots of energy"? Circle the correct answer.

a. The storm generates heat as a result of friction between water molecules and the ground.

b. The presence of water molecules in the air makes the air go faster.

c. The water molecules in the air absorbed heat in order to evaporate from the ocean.

10. Circle **the three** phase changes listed below that would release heat into the air.

liquid water changes to vapor	ice changes to liquid
vapor changes to liquid	frost changes to vapor
liquid water changes to ice	vapor changes to frost

11. Consider the phase change listed in question #10 above. Complete the statement below by circling the correct choice.

Water molecules release heat into the air if they change. . . (Circle one.)

a. from a phase where they are going slower to a phase where they are going faster

b. from a phase where they are going faster to a phase where they are going slower

12. Look at the diagram on the first page of this handout. Which arrow is the reason Chinook winds are warm? (A, B, C, D, E, or F) ***Hint: Read question #4 on the previous page.***

13. Which arrow is the reason downbursts (including microbursts) happen? (A, B, C, D, E, or F) ***Hint: Read question #5 on the previous page.***

14. Which arrow is the reason a meteorologist might say that a particular storm "has lots of energy"? (A, B, C, D, E, or F) ***Hint: Read Pre-Lab question #4 on the first page.***

15. What phase change (name it) is the reason for the temperature increase in the test tube as you dropped the snow into it?