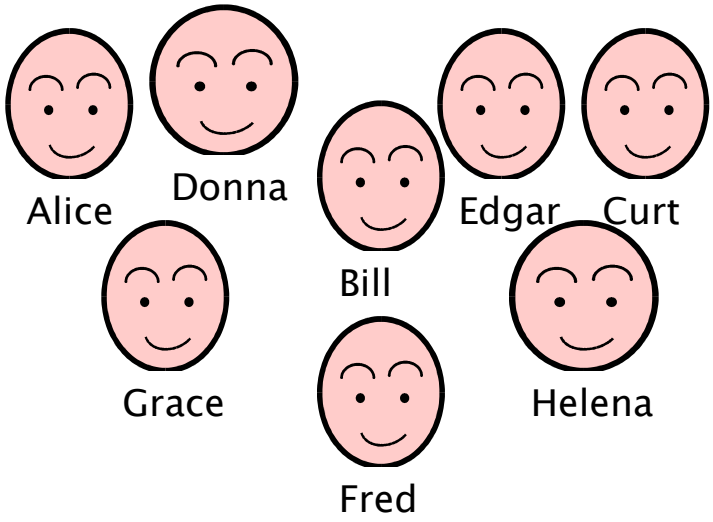
NAME_____ DATE_____ PERIOD_____

MOVING MOLECULES WORKSHEET

A different way to think about heat energy and the phases of matter is to think about the speeds of the molecules. Answer all the questions as best you can.

Let's pretend there are 8 molecules of water near the surface. We'll even give them names:



Each molecule is moving at a different speed. In any group of molecules, you find that they are all moving at different speeds. Let us assign speeds to our 8 friends:

ALICE: 9 miles an hour DONNA: 6 miles an hour GRACE: 3 miles an hour
BILL: 6 miles an hour EDGAR: 1 miles an hour HELENA: 9 miles an hour
CURT: 10 miles an hour FRED: 3 miles an hour

1) What is the average speed of these 8 molecules? (add them all up and divide by 8!)
47/8 = 5.875 mi p h

2) The average speed of the molecules is like what property that you could measure?
Temperature (average kinetic energy)

All of the molecules really want to leave the surface. But in this case they need to reach a speed of 10 miles per hour to change from liquid to gas, and have enough energy to overcome gravity, to push up against air pressure, and break their bonds with their friends. One way to give them enough energy is to heat them, and raise all of their speeds. So let's cook them up!

3) Suppose all the molecules are now heated so that they each increase their speed by 1 miles per hour. What is the speed of each of the 8 molecules now?

ALICE: ***10*** DONNA: ***7*** GRACE: ***3***

BILL: ***7*** EDGAR: ***2*** HELENA: ***10***

CURT: ***11*** FRED: ***4***

4) Obviously the average speed (and the temperature) has gone up. But some molecules now have enough energy to leave the surface. Which molecules now (have a speed of at least 10 miles per hour?

Curt, Alice and Helena

Well, it turns out that those molecules do leave their friends. But, Helena happens to be stuck behind Edgar, so she can't leave the surface.

5) What do you think would Helena now become?

Helena becomes a water vapor bubble stuck inside the liquid

6) There are now 6 molecules left, including Helena. Who are they, and what are their speeds? :

NAME	***SPEED (from question # 3)***
Donna	***7***
Grace	***3***
Bill	***7***
Edgar	***2***
Helena	***10***
Fred	***4***

7) What is the average speed of the 6 molecules left? (add them up and divide by 6!)

33/6 = 5.5 mi p hr

8) Look at the average speed before it was heated, and any molecules left. (question # 1). Is it higher or lower now than in the beginning?

It is lower than 5.875 , even though we heated up! That's because it is an AVERAGE, and some (the hot molecules) left, leaving the cold ones behind.

9) Would the temperature of the molecules in the liquid be higher or lower than in the beginning?

The temp is lower

10) How does this help explain that evaporation is a cooling process?

Evaporation is a cooling process because the hot molecules leave, and the cooler ones are left behind.