Name: ____
Partner(s): ____

CAUTION!!
HOT PLATES ARE HOT!!! Duh!

Lab: Particle Behavior

<u>**Important Information:**</u>. Over the course of this unit, we will be observing the physical behavior of matter and explaining our observations in terms of the behavior of particles that make up matter. This lab is your opportunity to explore 9 stations to explore particle behavior.

At all stations, make sure you CLEAN UP and return all materials exactly how you found them. Part of your grade on this lab will include your behavior, safety, and care of equipment during this lab.

<u>**Pre-Lab:**</u> Draw particle diagrams of the following substance in its appropriate phase.

H_2O Solid: [ ] H_2O Liquid: [ ] H_2O Gas: [ ]

Station #1: Particle Motion

<u>**SAFETY**</u>**:** wear **GOGGLES** at all times and use **TONGS** to handle hot glassware.
***Assume your hot plate is **HOT**, since it looks the same hot or cold!

<u>**MATERIALS:**</u> 2-100mL beakers, beaker tongs, hot plate, 2 bottles of food coloring, plastic dropper.

<u>**PREDICTION:**</u> Higher temperature makes particles move ____________________ (faster/slower/not at all)

<u>**PROCEDURE:**</u>

1. Fill one beaker with approximately 50 ml of water and heat it on the hot plate until you see steam coming from the surface of the water.
2. Now fill a plastic dropper with hot water from the beaker.
   a. As you were sucking the water out of the beaker and into the dropper, the temperature of the water in the beaker was _______________ (higher than/lower than/the same as) the temperature of the water in the dropper.
   b. Which has more heat? ___________________ (dropper/beaker). Explain your answer: _________
   ____
   ____
3. Fill another beaker with approximately 50 ml of cold water from the tap.
4. *At the same time*, add one drop of food coloring to both beakers (warm and cold). Observe and compare your results.
   c. Observations: ____
   ____
   ____

   c. What do these observations tell you about the motion of the water particles at different temperatures?
   ____
   ____
   ____

Station #2: Viscosity

SAFETY: Keep containers closed and wash hands when you are finished.

MATERIALS: 3 test tubes (stoppered & labeled A, B, C) with different colored unknown fluids in them, test tube (stoppered) labeled "maple syrup", test tube rack, test tube holder, hot plate, 250 mL beaker, water

PREDICTION: Higher temperature __________________ (increases/decreases) attractions between particles.

PROCEDURE:

1. Gently tilt test tubes A, B, and C back and forth to observe the motion of the fluid in each one. Record your observations in a data table below:

A	
B	
C	

2. Define *viscosity*: ____

3. Which fluid had the highest viscosity? Explain how you know. ________________________________
____
____

4. Do you think water is more or less viscous than the liquids tested? How do you know? _______________
____
____

5. What do you think the relationship is between the strength of particle attractions in a liquid and its viscosity? ____
____
____

6. Now tilt the test tube labeled "maple syrup". Observe the fluid motion. Then prepare a warm (not hot) water bath in a beaker and gently place the syrup test tube in the water to warm it. Once it is warm, pull it out and tilt it again to observe. Record your observations below.

Cold syrup	
Warm syrup	

7. What happens to a liquid's viscosity as it is heated? ____
____

8. What do you think the relationship is between the strength of particle attractions in a liquid and its temperature? ____
____
____

Station #3: Hole in a Bottle

SAFETY: None **MATERIALS:** 1 bottle with a small hole in the side, 1 cap for the bottle

PROCEDURE:

1. Get a bottle with a hole in its side.
2. Cover the hole with your finger and fill the bottle with water.
3. Replace the cap on the bottle.
4. Hold the bottle over a sink and remove your finger.
5. Now remove the bottle cap.
6. Observations: ____
____

7. What was inside the bottle, above the water level, when the top was on? Explain in terms of particles. ____
____

9. What was inside the bottle, above the water level, when the top was removed? Explain in terms of particles. ____
____

10. What kept the water in the bottle when the top was on? Explain in terms of particle motion. _______
____
____
____

Station #4: Balloon in a Bottle

SAFETY: None **MATERIALS:** 1 bottle, 1 balloon

PROCEDURE:

1. Note: you will be using the *same balloon* for the next 2 stations, so make sure to KEEP IT.
2. Blow up a balloon and then deflate it. Do this a couple of times until it gets easy to blow up the balloon.
3. Insert the balloon into a bottle and stretch the balloon over the bottle's mouth.
4. Blow up the balloon inside the bottle.
5. Observations: ____
____

6. Explain, in terms of properties of matter and particle behavior, why you got these results.
____
____
____

Station #5: Balloon Takes a Bath

SAFETY: wear **GOGGLES** at all times and use **TONGS** to handle hot glassware.
***Assume your hot plate is **HOT**, since it looks the same hot or cold!

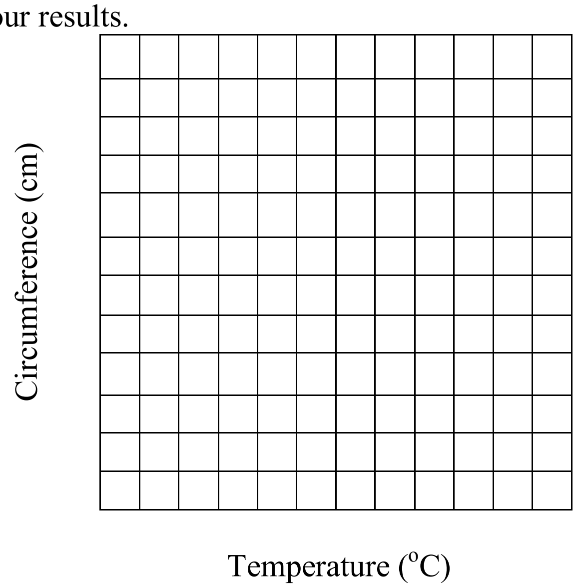
MATERIALS: 2-1000mL beakers, beaker tongs, hot plate, ice, 3 thermometers, measuring tape.

PREDICTION: Higher temperature __________________ (increases/decreases) volume of a gas.

PROCEDURE:

1. Blow up your balloon and tie it off. It needs to fit easily into a 1000 ml beaker with *lots* of room to spare.
2. Using measuring tape, measure the circumference around the widest part of the balloon in cm. Also, record current room temperature in ^oC using a thermometer. Record measurements in the data table below.
3. Fill one beaker about 2/3 full of water and add ice cubes to make a cold-water bath.
4. Completely submerge the balloon in the cold-water bath for a few minutes, then take it out and measure the circumference around the widest part of the balloon in cm. Record water temperature in ^oC.
5. Fill the other beaker about 2/3 full of water and heat the water to about 50 ^oC. Record the temperature.
6. Using beaker tongs, completely submerge the balloon in the warm-water bath. After a few minutes, take the balloon out and measure the circumference around the widest part of the balloon in cm.
7. Complete the data table below, and make a line graph of your results.

Temperature (^oC)	Circumference (cm)



8. State the relationship between temperature and volume of a gas. Tell whether the relationship is direct or inverse. ____
____

9. Describe what affect increasing the temperature has on the molecular motion of the molecules inside the balloon, and explain why they caused the change you observed. ______________________________
____
____
____

Station #6: Does Air Have Mass?

SAFETY: None **MATERIALS:** Your balloon, electronic balance, scissors

PREDICTION: Does air have mass? _______ (yes/no) Explain: ______________________________________

PROCEDURE:
1. Make sure your balloon is dry.
2. Put your inflated balloon on the mass balance (use tape to hold it in place if necessary)
3. Find the mass of the inflated balloon. (subtract mass of tape, if necessary)
4. Gently puncture the balloon near the neck with a pair of scissors.
5. Mass the deflated balloon.
6. Create a data table below to record your results WITH UNITS

7. Explain, in terms of properties of matter and particle behavior, why you got these results. ___________
____
____
____
____

Station #7: Marshmallow Pressure

SAFETY: Do not eat the marshmallow – it will be contaminated!

MATERIALS: 1 small marshmallow (see your teacher), 1 syringe

PREDICTION: Higher external pressure _____________________ (increases/decreases) volume of a gas.

PROCEDURE:
1. Remove the plunger from the syringe, put one small marshmallow into the syringe.
2. Replace the plunger and set the volume to 25 cc (use the gauge on the side of the syringe).
3. Put your finger over the small opening of the syringe and keep it there.
4. Push the plunger into the syringe until it reads 20cc. Are you increasing or decreasing the pressure on the marshmallow? ______________________ (increasing/decreasing). What happens to the volume of the marshmallow?____

5. Keeping your finger over the end of the syringe, pull the plunger out until the volume in the syringe reads 30cc. Are you increasing or decreasing the pressure on the marshmallow? __________________ (increasing/decreasing). What happens to the volume of the marshmallow? ______________________
____

Station #7 ctd…

6. Why is a marshmallow a good choice for observing how gases behave? ________________________
____

7. State the relationship between pressure and volume of a gas. Tell whether the relationship is direct or inverse. ____
____

8. Explain, in terms of particle behavior, why you observed the relationship in question #7. __________
____
____
____

9. Do you think changing the pressure on a liquid or solid would have the same effect? Why or why not?
____
____
____

Station #8: IMFs

SAFETY: Wear goggles, wash hands and table when finished.

MATERIALS: 3 dropper bottles with unknown clear liquids (labeled A, B, C), stopwatch

PREDICTION: Liquids with _________________ (stronger/weaker) IMFs will evaporate faster.

PROCEDURE:

1. Reset your stopwatch and get ready with all 3 droppers full of liquids A, B, and C.
2. *At the same time*, place 1 drop of all 3 liquids onto the lab table and *immediately* start the stopwatch.
3. Record the time it takes for each liquid to evaporate completely and record your results. If the time for a drop to evaporate exceeds 10 minutes, you may stop and record your time as 10+ min.

Liquid	A	B	C
Time to evaporate (sec)			

4. Which of the three liquids has the strongest intermolecular forces of attraction? Explain.____________
____

5. Based on your observations, which liquid has the highest vapor pressure? Explain your answer. ______
____
____

6. Predict which of the three liquids would have the highest boiling point. Support your prediction with an explanation. ____
____

7. Use Table H to determine the identity of the unknown liquids. Write the correct letter of the bottle (A,B,C) next to the name of the liquid. ____ **water** ____ **ethanol** ____ **propanone**

8. Explain, using information from Table H, how you determined your answer to question #7. ____________
____
____

Station #9: Phase Change Diagram

PROCEDURE: Your teacher will heat ice water to boiling during your class period, and every 2 minutes a lab group will be assigned to record the temperature of the water on the board/overhead. Copy this data and create a line graph (heating curve) below. Be sure to include a TITLE, LABELS and UNITS on the axes, clearly defined POINTS, and a LINE connecting all the points.

DATA: (Turn your paper sideways to record data here)

Temp (°C)	
Time (min)	

On the curve clearly label the following items in the appropriate locations (use arrows as needed to indicate direction or exact location on the curve. Some terms may be used more than once, as needed.):

Solid	Liquid	Gas
Condensation	Vaporization	Fusion
KE changing	KE not changing	PE changing
PE not changing	Melting Point	Freezing Point
Particle Attractions decreasing	Particle Attractions increasing	Solidification
Direction of Endothermic Changes	Direction of Exothermic Change	

Questions: (Expect to see these on your quiz & test, so make sure you check your answers with someone else or your teacher!!)

1. What is the Kinetic Molecular Theory? List the key points of KMT:

2. Under what conditions (temp, pressure, volume, particle size) does a REAL gas behave most like an IDEAL gas?

3. There is a government warning on all aerosol cans that states: Do not store at a temperature above 120^oF (50^oC) Explain why this warning is required in terms of the relationship between temperature and pressure and KMT. What could happen if an aerosol can were to be heated above 120^oF (50^oC)?

4. What would happen to a completely inflated balloon if it were taken from inside a house to the outside in the middle of February in Rochester? Explain this prediction in terms of KMT.

5. Why do the manufacturers of tires suggest that tire pressure be checked before a car has been driven any distance? Why does tire pressure increase after driving long distances?

Name: ____

Lab: Particle Behavior

Lab Credit Sheet

For Teacher Use Only:

Minutes ____________

Approved ___________



For each lab station, *briefly* summarize 1) what you did and 2) what you learned about particle motion and behavior. Each summary should be between 3-5 sentences in length.

1. **Station #1: Particle Motion**

2. **Station #2: Viscosity**

3. **Station #3: Hole in a Bottle**

4. **Station #4: Balloon in a Bottle**

5. **Station #5: Balloon Takes a Bath**

6. **Station #6: Does Air Have Mass?**

7. **Station #7: Marshmallow Pressure**

8. **Station #8: IMFs**

9. **Station #9: Phase Change Diagram**