ESS 100 Name: _____

Physical Properties: Temperature's Relation to Volume and Pressure

Kinetic Molecular Theory: a way of understanding physical properties of matter by thinking about matter as being made up of tiny, moving particles. This is the theory we will be using and exploring on this handout.

Temperature: the average kinetic energy of the molecules or atoms in a substance

Kinetic Energy: Energy of motion; more speed = more energy

Pressure: A pushing force. Gases like air have pressure when their individual particles push outward (like the air in a car tire).

States of Matter (a.k.a. phases of matter):

- **Solid phase:** Molecules (or individual atoms)are locked in place, touching one another, vibrating. Hotter solids vibrate more violently.
- **Liquid phase:** Molecules are touching one another, but sliding and bumping around and changing positions; flowing. Hotter liquid molecules slide and bump around faster.
- **Gas phase:** Molecules flying free, but occasionally bumping into one another. Hotter gas molecules fly faster.

Open the PhET States of Matter Simulation: Choose **solid**, and click on any substance other than water.

1. Heat up the substance and describe what happens to the motion of the particles.

They move faster and spread out

2. Cool down the substance and describe what happens to the motion of the particles.

They slow down and move back together

3. Reset. Select either Neon, Argon, or Oxygen. Heat up the substance. When you heat it up, what happens to its overall…

	What happens?	How can you tell?
Mass	=	Nothing is added or removed
Volume	+	It spreads out into a bigger space.
Density	−	Same stuff in larger space → less crowded
Weight	=	Same mass, same weight.

4. Switch the simulation mode to "phase changes." What happens to the pressure inside the container…

a. Heat up the substance and describe what happens to the pressure.

Pressure increases

b. Cool down the substance and describe what happens to the pressure.

Pressure decreases

c. What do you think is causing the pressure inside the container?

5. Suppose you inflate a balloon with hot air and tie off the balloon. No air can enter or escape. After you're done, the balloon begins to cool. As it cools, what happens to its…

	What happens?	Why? or How can you tell?
Mass	=	Nothing enters or leaves
Volume	−	Air shrinks when it cools down
Density	+	Same stuff in smaller space ⇒ More crowded
Weight	=	Same mass → same weight
Pressure	−	Slower particles don't push as hard against the balloon walls.

6. Car tires tell you how much pressure you should put in them when they are cold. When you drive, friction heats up your tires. As friction heats up your tires, what happens to their…

	What happens?	Why? or How can you tell?
Mass	=	Same tires with same air
Volume	+	Hot air expands
Density	−	Same stuff in larger space ⇒ Less crowded
Weight	=	Same mass ⇒ same weight
Pressure	+	Hot, fast air particles push harder against the tire walls.