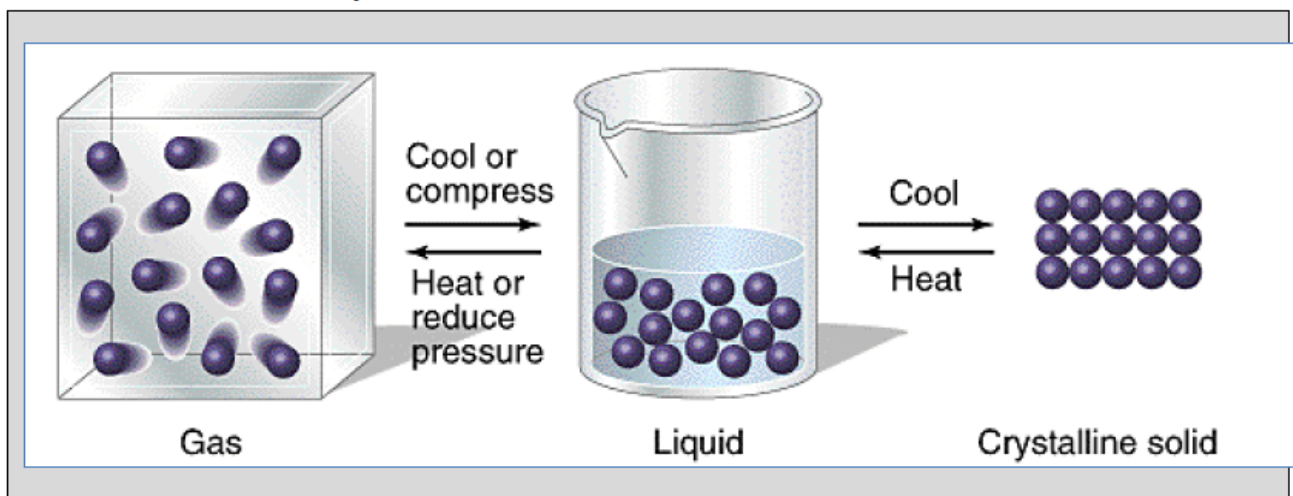


States of Matter & Phase Changes

<p>Why? Most substances go through a phase change when heated or cooled. Molecules of a substance are held together in either the solid, liquid, or gaseous phase by intermolecular forces. It is necessary to discuss what is occurring at the molecular level in order to explain how an ice cube is melted or how water is boiled.</p> <p>New Concepts</p> <ul style="list-style-type: none"> • Heating / cooling curves • Intermolecular Forces 	<p>Learning Objective:</p> <ul style="list-style-type: none"> • To determine what is occurring on the molecular level during a phase change
	<p>Success Criteria</p> <ul style="list-style-type: none"> • Students will be able to construct their own heating or cooling curve when given the temperatures at which phase changes occur. • Students will be able to explain the heating curve on the micro-view.
	<p>Prerequisites</p> <ul style="list-style-type: none"> • Temperature (average kinetic energy) • Phases of matter: solid, liquid, gas • Molecules (particles)

Model 1: Kinetic Theory and States of Matter



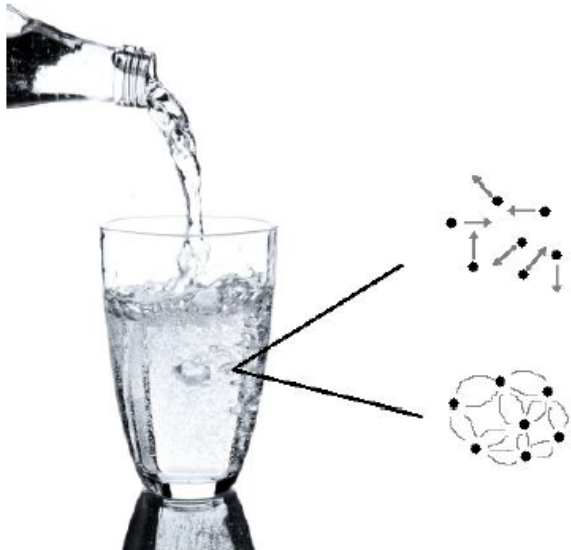
1. What are the key characteristics of atoms and molecules in gases, liquids, and solids? In table 2 below, describe the characteristics of particles for each phase of matter based on Model 1 above. Be specific with regard to spacing of particles, the potential of particles for movement, and whether or not the particles will fill the containers.

	Solid	Liquid	Gas
Spacing			
Motion of the particles			
Filling a container			

2. In which phase of matter is there the least spacing between particles? _____
3. In which phase of matter is there the most potential for movement? _____
4. Which phase of matter does not have a definite shape yet the particles will not fill the container?

5. What would be necessary to change from a solid to a liquid? What is this change called and how is this accomplished in terms of temperature and kinetic energy (of the molecules)?
6. What would be necessary to change a liquid to a gas? What is this change called and how is this accomplished in terms of temperature and kinetic energy (of the molecules)?
7. What would be necessary to change a liquid to a solid? What is this change called and how is this accomplished in terms of temperature and kinetic energy (of the molecules)?

Model 2: States of Matter and Intermolecular Forces

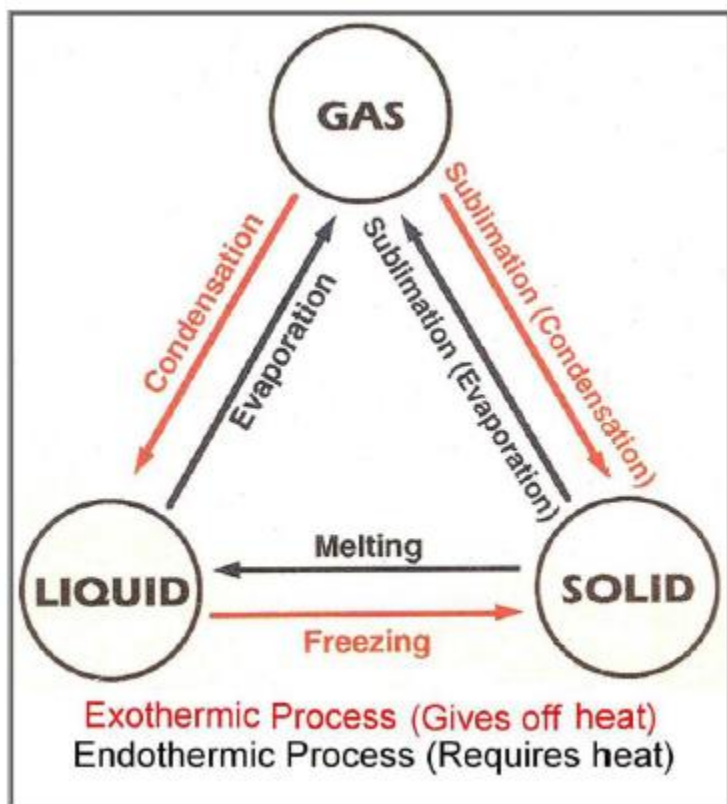
	<p>Kinetic Energy: Energy of motion.</p> <ul style="list-style-type: none"> • The kinetic energy allows the particles to move. • Highest in gasses. <p>Intermolecular Forces: Forces of attraction.</p> <ul style="list-style-type: none"> • Attractive forces between atoms or molecules. • These forces exist between atoms or molecules when they are very close to one another. • Determine the phase of matter.
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1. In your own words, explain what intermolecular forces are:
2. Similar to magnets, it takes _____ energy to move atoms that have stronger attractive forces.
3. Intermolecular forces are (*stronger/weaker*) when particles are closer together.
4. Rank the states of matter (high, medium, low) for each of the two categories below. Include a brief explanation.

	Solid	Liquid	Gas
Kinetic Energy of Particles			
Intermolecular Forces			

5. Look at your descriptions for the spacing, movement, and ability to fill a container in Table 2. Are they consistent with what you now know about intermolecular forces? Explain why or why not, and revise any discrepancies.

Model 3 Phase Changes



- Which arrows in model 3 require the addition of energy?
- Which term, endothermic or exothermic, is used to describe the situation when energy is added into a system from the surroundings?
- Which phase changes are endothermic?
- Which arrows in Model 3 indicate the release of energy?
- Which term, endothermic or exothermic, is used to describe the situation when energy is released into the surroundings by the system?
- Which phase changes are exothermic?

Complete the table below about phase changes.

Phase Change	Name	Intermolecular Forces	Kinetic Energy	Exothermic or Endothermic
		Increase or Decrease?		
solid → liquid				
liquid → gas				
gas → solid				
solid → gas				
gas → liquid				
liquid → solid				