Phases & Phase Changes

Unit: Matter

MA Curriculum Frameworks (2016): HS-PS1-3, HS-PS2-8(MA)

Mastery Objective(s): (Students will be able to…)

- Compare observable states of matter and phase transitions with behavior at the molecular level.

Success Criteria:

- Descriptions include connectedness and motion of molecules.
- Descriptions include comparative descriptions of molecular speed.
- Descriptions relate molecular motion and speed to temperature.

Tier 2 Vocabulary: phase, solid, liquid, gas, vapor

Language Objectives:

- Explain phase changes in terms of changes in molecular behavior.

Notes:

macroscopic: objects or bulk properties of matter that we can observe directly.

microscopic: objects or properties of matter that are too small to observe directly.

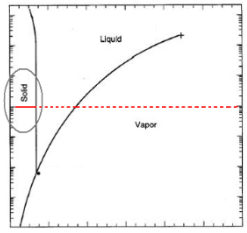
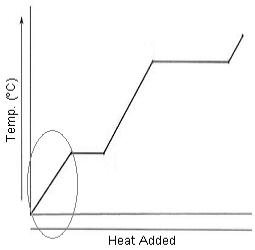
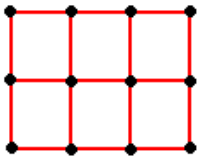
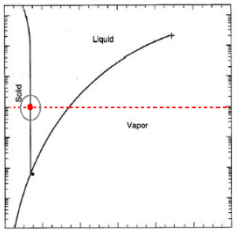
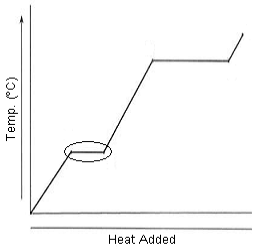
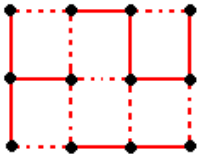
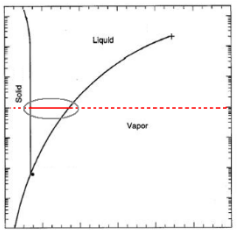
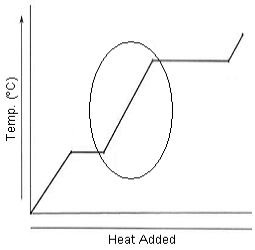
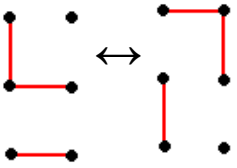
In chemistry, the *macroscopic* properties of a substance are determined by *microscopic* interactions between the individual molecules.*

* In this text, the term "molecules" is frequently used to refer to the particles that make up a substance. A molecule is more properly a group of atoms that are covalently bonded together. A substance can be made of individual atoms, molecules, crystals, or other types of particles. This text uses the term "molecules" because the term gives most students a reasonably correct picture of entities that are firmly attached to each other and cannot be pulled apart by physical means.

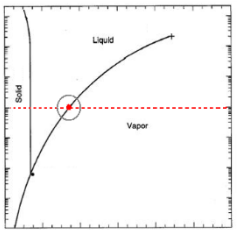
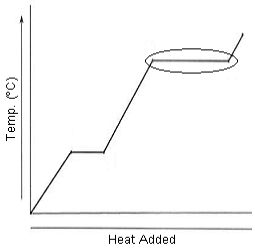
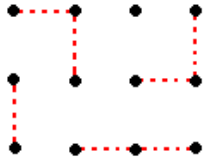
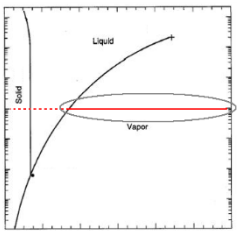
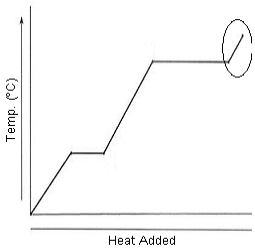
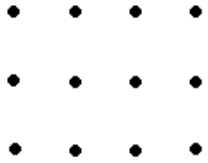
Use this space for summary and/or additional notes:

States of Matter

The following table shows interactions between the molecules and some observable properties for solids, liquids and gases. Note that the table includes heating curves, which will be discussed in more detail later in the course. For now, understand that a heating curve shows how the temperature changes as heat is added. Notice in particular that the temperature stays constant during melting and boiling.

state	phase diagram	heating curve	molecules
solid			rigidly bonded 
	adding energy makes molecules move faster; temperature increases		
melting			some bonds breaking 
	adding energy breaks some of the bonds; temperature remains constant		
liquid			bonds breaking & re-forming rapidly 
	adding energy makes molecules move faster; temperature increases		

Use this space for summary and/or additional notes:

state	phase diagram	heating curve	molecules
boiling			all bonds breaking 
adding energy breaks all remaining bonds; temperature remains constant			
vapor (gas)			molecules moving freely 
adding energy makes molecules move faster; temperature increases			

Note that because liquids are continually forming and breaking bonds, if a liquid molecule at the surface breaks its bonds with other liquids, it can “escape” from the attractive forces of the other liquid molecules and become a vapor molecule. This is how evaporation happens at temperatures well below the boiling point of the liquid.

Use this space for summary and/or additional notes: