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Enriched Chemistry

Unit 10 -- States and Intermolecular Forces

Relevant Textbook Reading:
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Polar bonds page 248-250
Dipoles page 249
Hydrogen bonds pages 251, 489, 653-654
Miscibility page 521
IMF pages 250-251
KE and States of Matter pages 420-434
Phase Changes pages 435-439

Unit Learning Objectives/ Goals	By the end of this unit students should be able to: ● Know that polar and nonpolar molecules can also be differentiated by their three dimensional structures, specifically the symmetry or lack thereof, in the spatial arrangement of the atoms. ● Explain whether a molecule is polar using molecular geometry and bond dipoles. ● Explain that intramolecular forces are much stronger than intermolecular forces. ● Identify the three types of IMF and rank them in order of strength. ● Appreciate that hydrogen bonding is a unique characteristic of water molecules. ● IMF lead to surface tension, viscosity, capillary action, and adhesion/cohesion. ● Know that polar and nonpolar molecules can be differentiated by their trends in a variety of physical properties. Polar molecules tend to have a higher melting point, higher boiling point, liquids/solids at room temperature, higher water solubility. Lower vapor pressure, higher density, higher viscosity, higher surface tension, etc. ● Know liquids are miscible with each other depending on likeness of polarity. ● Relate IMF to states of matter at a given temperature.

	• Know that according to the kinetic-molecular theory, the particles in solids, liquids, and gasses are different in the ways they interact with each other. • Differentiate between solids, liquids and gasses in terms of IMF and KE. • Energy changes are associated with phase changes. • Differentiate between evaporation and vaporization. • Identify melting/freezing and vaporization/condensation in phase diagrams. .
Performance Task- what are we working towards?	Attractive forces between molecules are called intermolecular forces. The strength of these forces determines what phase of matter a substance is in at a given temperature. Substances with weak attractive forces (London dispersion) between their molecules tend to be gasses at room temperature and substances with strong forces (ionic) tend to be solids at room temperature. Gasses have molecules with no attractive forces, allowing the molecules to fly freely past one another. Liquids have stronger attractive forces, allowing the molecules to flow past each other but still stay together. Solids are made up of strong attractive forces which lock the molecules into a crystal lattice where the molecules can vibrate but cannot move relative to one another. Liquid molecules near the surface can escape into the vapor phase below the boiling point in a process called evaporation. In order to go from one state of matter to another, kinetic energy must be added in order to break the intermolecular forces holding molecules together.
Unit Activities	
Day 1: Polar and Non polar molecules	Objectives • Know that polar and nonpolar molecules can also be differentiated by their three dimensional structures, specifically the symmetry or lack thereof, in the spatial arrangement of the atoms. • Explain whether a molecule is polar using molecular geometry and bond dipoles. Activities • Discussion of polar and nonpolar molecules. • Determination of polar molecules based on electronegativity differences and symmetry.

	Assignments • Determining molecular polarity handout in class • WebAssign Molecular Polarity due day 3
Day 2: Polar and Non polar molecules	Objectives • Know that polar and nonpolar molecules can also be differentiated by their three dimensional structures, specifically the symmetry or lack thereof, in the spatial arrangement of the atoms. • Explain whether a molecule is polar using molecular geometry and bond dipoles. Activities • Practice identification of polar and nonpolar molecules (Handout from day 1). • Determination of polar molecules based on electronegativity differences and symmetry. • Webassign on Molecular Polarity due day 3
Day 3: Lesson on IMF types.	Objectives • Explain that intramolecular forces are much stronger than intermolecular forces. • Identify the three types of IMF and rank them in order of strength. • Appreciate that hydrogen bonding is a unique characteristic of water molecules. Activities • Explanation of temporary dipoles vs permanent dipoles • LDF and Dipole dipole forces • Identify the three types of IMF and rank them in order of strength. • Appreciate that hydrogen bonding is a unique characteristic of water molecules and essential to biological interactions. Assignments • WebAssign molecular polarity due tonight • WebAssign IMFs due Day 5

Day 4: IMFs and physical properties.	Objectives ● IMF lead to surface tension, viscosity, capillary action, and adhesion/cohesion. ● Know that polar and nonpolar molecules can be differentiated by their trends in a variety of physical properties. Polar molecules tend to have a higher melting point, higher boiling point, liquids/solids at room temperature, higher water solubility. Lower vapor pressure, higher density, higher viscosity, higher surface tension, etc. ● Know liquids are miscible with each other depending on likeness of polarity. Activities ● Vapor pressure definition ● Relate strength of IMF to boiling point, melting point, vapor pressure, viscosity, surface tension. ● Define evaporation in terms of kinetic energy. ● Conditions under which boiling occurs. ● Relate relative boiling points to IMF strength. Assignments ● WebAssign IMFs due day 5 ● WebAssign IMFs and Physical Properties due day 7
Day 5: Liquids and vapor in equilibrium	Objectives ● IMF lead to surface tension, viscosity, capillary action, and adhesion/cohesion. ● Know that polar and nonpolar molecules can be differentiated by their trends in a variety of physical properties. Polar molecules tend to have a higher melting point, higher boiling point, liquids/solids at room temperature, higher water solubility. Lower vapor pressure, higher density, higher viscosity, higher surface tension, etc. ● Know liquids are miscible with each other depending on likeness of polarity. Activities ● Vapor pressure of different substances at different temperatures ● Vapor pressure vs Temperature Graph

	Assignments • WebAssign IMFs due tonight • WebAssign IMFs and Physical Properties due day 7
Day 6: IMFs between unlike molecules	Objectives • Know liquids are miscible with each other depending on likeness of polarity. Activities • Discuss adhesion and cohesion and explain meniscus of water and glass vs mercury and glass. • Discuss solubility as the strength of the IMF's between solute and solvent vs. the IMF strength between molecules in the pure substances. • Introduce ion-dipole force to explain dissociation. Assignments • WebAssign IMFs and Physical Properties due day 7 • Optional in class worksheet
Day 7: Changes of State	Objectives • Know that polar and nonpolar molecules can be differentiated by their trends in a variety of physical properties. Polar molecules tend to have a higher melting point, higher boiling point, liquids/solids at room temperature, higher water solubility. Lower vapor pressure, higher density, higher viscosity, higher surface tension, etc. • Relate IMF to states of matter at a given temperature. • Know that according to the kinetic-molecular theory, the particles in solids, liquids, and gasses are different in the ways they interact with each other. • Differentiate between solids, liquids and gasses in terms of IMF and KE. • Energy changes are associated with phase changes. • Differentiate between evaporation and vaporization. • Identify melting/freezing and vaporization/condensation in phase diagrams. Activities: • Reading a phase diagram • Phase Diagram of Water • Heat and changes of state

	• Name of processes converting from one state to another. Assignments: • Worksheet on phase diagrams in class • WebAssign IMFs and Physical Properties due tonight • WebAssign Phase Diagrams due Day 8
Day 8: Assessment	Activities: • Quiz on States and IMFs
Lab 1: Intermolecular Forces and boiling point of liquids.	Objectives • Use Lewis Structure and molecular polarity to predict the boiling points of various liquids. Activities • Students predict the relative boiling points based on structure, then boil the liquid in a capillary tube in a water bath. The water bath cools and the boiling point is recorded as the temperature at which the rolling boil stops. Comparison is made to the predicted structure. Assignments • Complete lab
Optional (if time permits) Lab 2: Solubility and polarity	Objectives • Compare and contrast relative polarity of various liquids and solutions by observing mixing or not Activities • Place molecules of various polarity into test tube in varying order to determine mixing or lack there of Assignments • Complete lab