Honors Chemistry - Unit 7 - Chemical Bonding, Molecular Geometry, and Intermolecular Forces of Attraction

Unit Focus

Students will focus on bonding in ionic and covalent compounds, through constructing Lewis dot diagrams through which students will show how electrons are shared in covalent bonds. Students will learn that, on a continuum bonds, range from equal sharing of electrons to unequal sharing of electrons, to an effective transfer of valence electrons from one atom to another. The bond type is predicted through evaluation of electronegativity, a periodic property, and the differences in electronegativity between bonding atoms. Students' understanding of Lewis structures, resonance, and the use of formal charge to assess candidate structures for a molecule, will lead to the study of three-dimensional shapes of molecules. Students will learn that the shapes of molecules will vary depending on the number of atoms and electrons involved and that molecular shapes can be predicted using the Valence Shell Repulsion Theory (VSEPR). The presentation of three bonding theories (Lewis, Valence, and Molecular) will lead students from diagrams of Lewis structures, to the prediction of shapes, bond angles, molecular polarity, to hybridization of bonding orbitals, which in turn explains the different bond angles that we can measure. Knowing the shape and subsequent polarity of a molecule, students will be able to explain and predict the physical and chemical properties of that molecule. The culminating experience for this unit sets the stage for students to create a video which follows the evolution of material science through an analysis of compositional changes of a consumer product, through the ages.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science Standards (DCI)
Science: 10

- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. *PS1.9.A2*

Science: 11

- A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. *PS1.9.A4*
- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. *PS2.9.B1*

Transfer

T1 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.

Meaning

Understanding(s)	Essential Question(s)
U1 The structure and interactions of matter are determined by electrical forces within and between atoms. **U2** Chemical and physical properties of materials can be explained by the structure and the arrangements of atoms, ions, or molecules, and the forces between them.	**Q1** What is the role of valence electrons in covalent bonding? **Q2** How can the shape, bond angles, and polarity of a molecule be predicted using VSEPR theory? **Q3** What is the role of valence electrons in ionic and metallic bonding? **Q4** Why are some substances gases and others liquids and solids at room temperature? **Q5** What makes water so unique?

Acquisition of Knowledge and Skill

Knowledge	Skill(s)
K1 Ionic bonding results from the net attraction between oppositely charged ions closely packed together in a crystal lattice.	**S1** Construct Lewis dot structures to depict the role of valence electrons in ionic and covalent bonds.

Stage 1: Desired Results - Key Understandings		
NGSS/NSTA Science & Engineering Practices *NGSS Science & Engineering Practices: 9-12* • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects *SE.9-12.6.3* **Madison Public Schools Profile of a Graduate** *Critical Thinking* • Analyzing: Examining information/data/evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)	**K2** Ionic solids have high melting points, are brittle, and conduct electricity when molten or in solution. **K3** Metallic bonding describes an array of positively charged cations surrounded by a sea of mobile electrons forming a crystal lattice. **K4** Metallic solids are good conductors of heat and electricity, have a wide range of melting points, and are shiny, malleable, and ductile. **K5** In covalent bonding, electrons are shared between the nuclei of two atoms to form a molecule or polyatomic ion. Electronegativity differences between the two atoms account for the distribution of shared electrons and the polarity of the bond. **K6** The localized electron bonding model describes and predict the molecular geometry using Lewis diagrams and the VSEPR model. **K7** There are four types of crystal lattice structures: ionic, molecular, covalent (network solids), and metallic. **K8** London dispersion forces are attractive forces present between all atoms and molecules. London dispersion forces are often the strongest net intermolecular force between large molecules. **K9** Dipole forces result from the attraction among the positive ends and negative ends of polar molecules. Hydrogen bonding is a strong type of dipole-dipole force. **K10** Intermolecular forces play a role in determining the properties of substances, including biological structures and interactions. **K11** The amount of energy absorbed or released during a phase change depends on the strength of the intermolecular forces and the amount of the substance present. **K12** The hydrogen bonding between water molecules explains the many unique properties of water.	**S2** Interpret Lewis Dot structures to predict molecular shape and polarity (including bond angles, bond polarity, and hybridization). **S3** Interpret phase diagrams. **S4** Relate physical properties of liquids to the strengths of the intermolecular forces of attraction. **S5** Calculate the heat transfer associated with a heating curve that includes phase changes and temperature changes.