Chemistry - Unit 3 - Chemical Bonding & Intermolecular Forces

Unit Focus

Students will focus on bonding in ionic and covalent compounds as a continuum ranging from equal sharing of electrons to an effective transfer of valence electrons from one atom to another. The degree of electron sharing impacts bond type and is predicted through evaluation of electronegativity, a periodic property, and the differences in electronegativity between bonding atoms. Students, through constructing Lewis dot diagrams, will show how electrons are shared in covalent bonds. Students predict the shapes of small molecules as well as molecular polarity using two dimensional Lewis Structures and the Valence Shell Repulsion Theory as the basis for their predictions. Students use this knowledge to identify the intermolecular forces present in a molecule and how these forces explain and predict the physical and chemical properties of that molecule. The unit will then explore the application of this phenomenon to everyday applications.

Stage 1: Desired Results - Key Understandings

Standard(s)

NGSS/NSTA Science & Engineering Practices
NGSS Science & Engineering Practices: 9-12

- Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. (SE.9-12.2.3)
- Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/ or solve problems. (SE.9-12.2.6)

Next Generation Science Standards
Performance Expectations: High School Physical Sciences

- Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. (HS-PS1-3)
- Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. (HSPS2-6)

Next Generation Science Standards (DCI)
Science: 11

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

Transfer

Students will be able to independently use their learning to...
T1 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.
T2 Communicate effectively based on purpose, task, and audience to promote collective understanding and/or recommend actions.
T3 Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.

Meaning

Understanding(s)

Students will understand that...
U1 The structure and interactions of matter are determined by electrical forces within and between atoms.
U2 Due to electronic repulsions, atoms within a molecule form the largest bond angles possible in order to minimize the energy within the system.
U3 Differences in electronegativities increase the polarity within a bond, impacting the overall polarity of the molecule.
U4 The strength of the polarity within a molecule affects the strength of the attractive force between molecules.
U5 Stronger attractive forces increase physical properties of a substance, such as boiling points and melting points.

Essential Question(s)

Students will keep considering...
Q1 How can the shape, bond angles, and polarity of a molecule be predicted using VSEPR theory?
Q2 Why and how do substances bond?
Q3 How do forces of attraction between particles determine how a substance behaves?
Q4 What determines the physical properties of different substances?

Stage 1: Desired Results - Key Understandings

	Acquisition of Knowledge and Skill	
	Knowledge	**Skill(s)**
• 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) **Madison Public Schools Profile of a Graduate** • Analyzing: Examining information/data/ evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2) • Product Creation: Effectively use a medium to communicate important information. (POG.3.2)	*Students will know...* **K1** The localized electron bonding model describes and predicts the molecular geometry using Lewis diagrams and the VSEPR model. **K2** Electronegativity, dipole moments, and VSEPR geometries must be applied to identify molecules as polar or nonpolar. **K3** Intramolecular forces are the forces that exist between molecules. **K4** Intermolecular forces play a role in determining the properties of substances, including biological structures and interactions. **K5** London dispersion forces are attractive forces present between all atoms and molecules but are the dominant attractive force between nonpolar molecules. K6 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.	*Students will be skilled at...* **S1** Predict the type of bonding present between two atoms based on position in the periodic table and the electronegativity of the elements. **S2** Construct Lewis dot structures to depict the role of valence electrons in chemical bonding. **S3** Use Lewis Dot structures to predict bond polarity, molecular shape, bond angles and molecular polarity of substances.