Marietta City Schools

2024–2025 District Unit Planner

Grade & Course: 9-12 Chemistry	**Topic:** Properties and Bonding	**Duration:** 6 weeks

Georgia Standards and Content:

SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds.

a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces.

b. Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties.

c. Construct an explanation about the importance of molecular-level structure in the functioning of designed materials. (Clarification statement: Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.)

d. Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding. (Clarification statement: VSEPR theory is not addressed in this element.)

e. Ask questions about chemical names to identify patterns in IUPAC nomenclature in order to predict chemical names for ionic (binary and ternary), acidic, and inorganic covalent compounds.

f. Develop and use bonding models to predict chemical formulas including ionic (binary and ternary), acidic, and inorganic covalent compounds

Narrative / Background Information

Prior Student Knowledge: (REFLECTION – PRIOR TO TEACHING THE UNIT)

S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter.
f. Construct an explanation based on evidence to describe conservation of matter in a chemical reaction including the resulting differences between products and reactants. (Clarification statement: Evidence could include models such as balanced chemical equations

Year-Long Anchoring Phenomena: (LEARNING PROCESS)

Changes to the measurement of chemicals added to Flint Michigan's water supply created dangerous levels of lead contamination in the drinking water.

Unit Phenomena (LEARNING PROCESS)

Hydrophobic coatings, such as Rain-X repel water while preserving the natural behavior of raindrops, creating visually striking and impermanent artworks that become visible during rain events and disappear when the pavement dries.

OR

Water purification and desalination are essential for providing clean drinking water, especially in areas with limited freshwater resources.

MYP Inquiry Statement:

Attractive forces exist between atoms, ions, and molecules and govern the structure, properties, and reactivity of matter.

MYP Global Context:

Scientific and Technical Innovation

Approaches to Learning Skills:	**Disciplinary Core Ideas: (KNOWLEDGE & SKILLS)**	**Crosscutting Concepts: (KNOWLEDGE & SKILLS)**
Communication skills Social skills Self Management skills Research skills Thinking skills	Designed Materials Intermolecular Forces Intramolecular Forces Electron Sea Model	Systems and System Models Structure and Function Stability and Change

	Crystal Lattice Structure Nomenclature Chemical Formula Polyatomic Ions Lewis Structure Nomenclature (including acids/bases) Chemical Formulas Polarity	**MYP Key and Related Concepts:** Key Concept: Systems Related Concepts: Models and Evidence, Asking Questions

Possible Preconceptions/Misconceptions: (REFLECTION – PRIOR TO TEACHING THE UNIT)
Electrons orbit the nucleus similarly to planets orbiting the sun.
Electrons are fixed on specific energy levels (rings) and do not move between levels.

Key Vocabulary: (KNOWLEDGE & SKILLS)

Physical properties	Nonpolar covalent bond	Anion
Chemical properties	Polar covalent bond	Cation
Intermolecular Force	Ionic bond	Lewis structure
Intramolecular force	IUPAC nomenclature	Bond energy
Electrical conduction	Binary	Endothermic
Bonding configuration	Ternary	Exothermic

Inquiry Questions:

Factual -

- What are the observable differences between physical and chemical properties of matter?
- How can we compare the strength of intermolecular and intramolecular forces based on the physical and chemical properties of substances?
- What are the key differences between intermolecular and intramolecular forces?
- Which chemical and physical properties can be used to identify a substance?
- Why are some materials flexible and durable, and how does this relate to their molecular structure?
- How is the design of pharmaceuticals influenced by the molecular-level structure?
- What are the characteristics of nonpolar covalent, polar covalent, and ionic bonds?
- How do bonding configurations differ between nonpolar covalent, polar covalent, and ionic compounds?
- What patterns can be observed in the IUPAC nomenclature for ionic, acidic, and covalent compounds?
- How can chemical names be predicted based on the rules of IUPAC nomenclature?
- How can bonding models help in determining the chemical formulas of different compounds?
- What factors influence the chemical formula of an ionic compound?

Conceptual -

- How do intermolecular and intramolecular forces influence the macroscopic properties of materials?
- In what ways can the strength of molecular forces impact the behavior of substances in different environments?
- How can understanding molecular forces improve our ability to predict the properties and behaviors of unknown substances?
- How do the principles of intermolecular and intramolecular forces help us identify and categorize different substances?
- How can altering the molecular structure of a material change its properties and uses?
- What are some examples of how molecular-level design leads to advancements in technology and medicine?
- How do different types of chemical bonds (nonpolar covalent, polar covalent, ionic) affect the overall properties of a compound?
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- How do patterns in IUPAC nomenclature reflect the underlying structure and bonding in chemical compounds?

- How can the rules of chemical naming guide us in identifying and classifying new or unfamiliar compounds?
- How does understanding bonding models contribute to advancements in chemical synthesis and material design?

Debatable -

- To what extent do macroscopic properties provide an accurate representation of the strength of intermolecular and intramolecular forces?
- Can we rely solely on macroscopic observations to understand the underlying molecular interactions, or are there significant limitations?
- Are intermolecular forces more critical than intramolecular forces in determining the physical and chemical properties of substances?
- Is it possible to accurately identify a substance based solely on its molecular forces, or do other factors play an equally important role?
- Should the molecular structure be considered the most important factor in material design, or are there other aspects that are equally or more significant?
- Can the benefits of designing materials with specific molecular structures outweigh the potential risks and costs associated with such designs?
- Can the current models of bonding configurations fully capture the complexity of chemical interactions, or are they oversimplified?
- Should the IUPAC nomenclature be revised to reflect modern chemical discoveries, or is the current system sufficient?
- Can bonding models truly predict chemical formulas with high accuracy, or do they fall short in the face of complex compounds?
- Should the use of bonding models in predicting chemical formulas be prioritized in chemical education, or should other methods be equally emphasized?

MYP Objectives	**Summative assessment**	
Sciences **Sciences**	Criterion A: Knowing and Understanding ● Common Summative Assessment Criterion B: Inquiring and Designing Criterion C: Processing and Evaluating ● Laboratory Experience	Relationship between summative assessment task(s) and statement of inquiry: Students will perform tasks and respond to assessment items that will gauge their mastery of atoms and moles as required by the Georgia Standards of Excellence. Mastery of these concepts is necessary to move forward in our study of particulate properties and behavior.

Learning Activities and Experiences	**Inquiry & Obtain: (LEARNING PROCESS)**	**Evaluate: (LEARNING PROCESS)**	**Communicate: (LEARNING PROCESS)**
Week 1: **Georgia Standard(s) of Excellence:** **Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties.**			
Week 1:	Engage: Phenomena introduction about hydrophobic coating (Rain-X) OR –Observing Chemical and Physical Changes –Roasting changes coffee beans and produces the aroma and taste associated with coffee. How are the	Evaluate: CER Assessment Identifying patterns in bond type based on collected data Constructed Response: Use provided data on chemical and physical properties as a graded MYP writing task.	Explain: mini lesson on the physical and chemical properties at the macroscopic scale and how to infer the strength of intermolecular and intramolecular forces. Elaborate: Bonding Case Study Writing Task using qualitative and quantitative data

	beans different after the roasting process? –The appearance of a frozen lake near the mountains will change as the lake begins to thaw. In what other ways will the lake change? Explore: What is Metallic Bonding and How Do Metallic Bonds Allow Metals to Conduct Electricity? Hands-On Lab: Student -Design Lab identifying patterns in bond type based on collected lab data		
Weeks 2: **Georgia Standard(s) of Excellence:** **Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties.**			
Week 2:	Engage: Deconstructing Salts –How can salt in seawater be the same as the salt at home? –If pure sodium in water is explosive, how does sodium chloride form a component of seawater? Explore: –How Do Ionic Bonds Form in Binary Compounds? –How Is Electronegativity Used to Determine Which Atoms Form Ionic Bonds?	Evaluate: Ionic and Metallic Bonding Formative	Explain: mini lesson ionic and metallic bonding Elaborate: Deeper comparison of bonding types
Weeks 3: **Georgia Standard(s) of Excellence:** **–Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding.** **–Ask questions about chemical names to identify patterns in IUPAC nomenclature in order to predict chemical names for ionic (binary and ternary), acidic, and inorganic covalent compounds.**			
Week 3:	Engage: Thinking about Covalent Bonding –How can straight hair be made curly? –What makes some hair straight and other hair curly? Explore: How Does the Formation of Covalent Bonds Relate to	Evaluate: Constructed Response: Comparing Patterns in Covalent Bonding MYP Writing Task	Explain: mini lesson formation of covalent bonds Elaborate: covalent bonding model

	the Octet Rule?		
Weeks 4: **Georgia Standard(s) of Excellence:** **–Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding.** **–Ask questions about chemical names to identify patterns in IUPAC nomenclature in order to predict chemical names for ionic (binary and ternary), acidic, and inorganic covalent compounds.**			
Week 4:	Engage: Explore: –What are the similarities and differences between metallic, covalent, and ionic bonds? –Why is there the need for different bond types?	Evaluate: Constructed Response: Comparing Different Bonding Types and their Purpose in the Physical World MYP Writing Task	Explain: graphic organizer: metallic, covalent, and ionic bonds Elaborate: IUPAC practice and extensions

Week 5-6: **Georgia Standard(s) of Excellence:** **–Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces.** **–Construct an explanation about the importance of molecular-level structure in the functioning of designed materials.**			
Week 5-6:	Engage & Explore: The careful selection of the type and design of a material at the atomic level, has allowed technology to progress rapidly over the last few decades.	Evaluate: –Constructed Response: Material Science MYP –Bonding Summative	Explain: review the different types of bonds Elaborate: Connecting the magnitude of inter- and intra- molecular forces to the observed properties and functions of materials.

Resources (hyperlink to model lessons and/or resources):
Discovery Education Science Techbook
Exploration into Material Science with supplemented resources from Georgia Tech

Reflection: Considering the planning, process and impact of the inquiry

Prior to teaching the unit	During teaching	After teaching the unit