International Baccalaureate
Baccalauréat International
Bachillerato Internacional

MYP/3D Science Unit Planner

Marietta City Schools

MARIETTA CITY SCHOOLS

Grade & Course: 9-12 Chemistry	**Topic:** Properties and Bonding	**Duration:** 7 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 on the functioning of designed materials.

d. Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding.

e. Ask questions about chemical names to identify patterns in IUPAC nomenclature in order to predict chemical names for ionic (binary and tertiary), 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.

SC3c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate molar volumes of gases.

SC5c. Develop and use models to quantitatively, conceptually, and graphically represent the relationships between pressure, volume, temperature, and number of moles of a gas.

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.

a. Develop and use a model to compare and contrast pure substances (elements and compounds) and mixtures. (Clarification statement: Include heterogeneous and homogeneous mixtures.)

c. Plan and carry out investigations to compare and contrast chemical (i.e. reactivity, combustibility) and physical (i.e. density, melting point, boiling point) properties of matter.

e. Develop models (e.g., atomic-level models, including drawings, and computer representations) by analyzing patterns within the periodic table that illustrate the structure, composition, and characteristics of atoms (protons, neutrons, and electrons) and simple molecules.

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 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.

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:

- Communication skills
- Social skills
- Self management skills
- Research skills
- Thinking skills

Disciplinary Core Ideas: (KNOWLEDGE & SKILLS)

- Physical and Chemical Properties
- States of Matter
- Gas Laws
- Molar Volumes of Gases
- Intermolecular Forces
- Intramolecular Forces
- Ionic Bonding

Crosscutting Concepts: (KNOWLEDGE & SKILLS)

Structure and Function
Stability and Change
Patterns

	● Covalent Bonding ● Metallic Bonding ● Nomenclature ● Lewis Dot Structures ● Polarity	**MYP Key and Related Concepts:** Key Concept: Relationships Related Change: Patterns, Form, Consequences, Interaction

Possible Preconceptions/Misconceptions: (REFLECTION – PRIOR TO TEACHING THE UNIT)

- Particles possess the same properties as the materials they compose. For example, atoms of copper are “orange and shiny,” gas molecules are transparent, and solid molecules are hard.
- Particles are viewed as mini-versions of the substances they comprise.
- Particles are often misrepresented in sketches. No differentiation is made between atoms and molecules.
- Particles misrepresented and undifferentiated in concepts involving elements, compounds, mixtures, solutions and substances. Particles cannot be “seen”, so they do not need to exist in a functioning model to explain the behavior of matter.
- Particles are in constant random motion. Students may have a hard time realizing this concept applies to atoms.
- Space between particles is "empty". Novick and Nussbaum (1978, 1981) investigated this notion in studies involving Israeli 13-14 year olds and 10-20 year old Americans. They showed that the notion that empty space exists between particles causes students considerable difficulties.

Key Vocabulary: (KNOWLEDGE & SKILLS)

- Physical and Chemical Properties
- Density
- Melting Point
- Boiling Point
- Reactivity
- Combustibility
- States of Matter
- Solid
- Liquid
- Gas
- Pressure
- Volume
- Temperature
- Moles
- Molar Volumes of Gases
- Intermolecular Forces
- Intramolecular Forces
- Ionic Bonding
- Covalent Bonding
- Metallic Bonding
- Nomenclature
- Lewis Dot Structures
- Polarity

Inquiry Questions:

Factual -
What is the chemical formula and structure of a material?
What is the magnitude of a material’s inter- and intra- molecular forces?

Conceptual -
How does the magnitude of a material’s inter- and intra- molecular forces explain its physical and chemical properties?

Debatable -
How does a material impact our world? What problems is the material solving? What problems is the material creating?

Unit Objectives:			
Learning Activities and Experiences	**Inquiry & Obtain: (LEARNING PROCESS)**	**Evaluate: (LEARNING PROCESS)**	**Communicate: (LEARNING PROCESS)**
Week 1:	**Engage** Considering Metallic Bonding ● Why are pans such as a skillet often made of metals? ● Why are coins always made of metal? What properties does a coin need in order to be passed from person to person many times? ● Why are the conductivity and malleability of copper useful properties for electrical wiring? **Explore** ● What is Metallic Bonding and How Do Metallic Bonds Allow Metals to Conduct Electricity?	**Evaluate** Formative: Metallic Bonding	**Explain** Explaining Metallic Bonding ● Aluminum is used to make foil and soda cans. How are aerospace engineers using aluminum to design airplanes and spacecraft? ● What property of titanium makes it useful for aircraft parts? ● Titanium parts can be used to replace bone in the body. What properties of titanium are important for this application?
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** Formative: Ionic Bonding	**Explain** Explaining Ionic Bonding ● How does the nature of ionic bonds influence the availability of nutrients for plants? ● Roots absorb minerals from soil and water. Why do these minerals exist as ions?

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 the Octet Rule?	**Evaluate** Formative: Covalent Bonding Summative: Bonding	**Explain** Explaining Covalent Bonding ● What gases do you think are present in scuba diving tanks? Which of these gases contain covalent bonds? ● Why do you think air has to be pressurized for a diver to use it?
Week 4:	**Engage** Observing Chemical and Physical Changes ● Roasting changes coffee beans and produces the aroma and taste associated with coffee. How are the 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 are the similarities and differences between chemical and physical properties?	**Evaluate** Formative: Properties	**Explain** Applying Chemical and Physical Properties and Changes ● Cooking eggs and bacon involves chemical reactions. What chemical changes do you think occur here? ● The water cycle involves physical changes of water. What change in water occurs during the process of evapotranspiration?
Week 5:	**Engage** Understanding the Physical Behavior of Matter ● When ice melts, water changes from a solid to a liquid. How does water behave in its liquid form that is different from its behavior as a solid form? **Explore** ● As water freezes, what happens to the	**Evaluate** Formative: Forces	**Explain** Explaining Physical Behavior of Matter ● Some species of frog can survive in very cold environments. How do frogs survive winter?

	intermolecular forces between the water molecules? ● What properties of the internal combustion engine are required to make it run?		
Week 6:	**Engage** Thinking About Gas Behavior ● What is going on inside a balloon as you inflate it? Why is it such hard work? What happens to the temperature of the balloon and its contents? **Explore** ● What is Boyle's Law? ● What is Charles' Law? How do Charles' Law and Gay-Lussac's Law Describe Gas Behavior? ● How is the Combined Gas Law Used to Calculate Changes in Pressure, Temperature, and/or Volume for a Fixed Amount of Gas? ● What is the Ideal Gas Law?	**Evaluate** Formative: Gases Summative: Forces and Gases	**Explain** Explaining Gas Law ● The polka-dot batfish lives 70m below the surface, over twice that of where scuba divers visit. Why is it important for scuba divers to stay within 40m of the surface?
Week 7:	**Engage** 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.	Summative: Materials	**Explain** 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 (See Above)			

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

Prior to teaching the unit	During teaching	After teaching the unit