Chemistry

UNIT 1: Trends of the Periodic Table

ESSENTIAL QUESTIONS	BIG IDEAS
How are new elements made? Why is the periodic table shaped that way?	• Students understand changes in the nucleus result in new particles. • Students understand that all matter is made of atoms of the elements on the periodic table. • Students understand the periodic table is an organized representation of elements that can be used to predict atomic structure and properties.

GUIDING QUESTIONS

Content:

- What happens when an element undergoes a half-life?
- What are the types of radiation and radioactive decay?
- How do scientists count and measure atoms?
- How is energy related to the arrangement of electrons in an atom?
- How does the structure of an atom affect its mass and charge?
- How are the elements of the periodic table classified into categories?
- How do electron configurations of elements allow us to predict periodic table trends?

Process:

- How are nuclear process represented by a balanced equation?
- Why is the quantum model better at predicting where an electron lives than the shell model?
- What patterns do we see on the periodic table when putting elements in increasing atomic number?

Reflective:

- How does an atomic bomb work?
- What are the lasting impacts of an atomic bomb?
- Why do we wear a lead apron when we get an x-ray?
- If you were Mendeleev, how would you organize the elements?
- Think about each family of the periodic table, do you agree with the name? Why or why not?

UNIT 2: Bonding

ESSENTIAL QUESTIONS	BIG IDEAS
How do atoms interact with each other?	• Students understand how atoms bond, and how the type of bonds give substances their chemical and physical properties.

GUIDING QUESTIONS

Content:

- How can an atom satisfy the octet rule?
- How can a Lewis dot structure be used to identify the shape of a molecule?
- What are the rules for writing formulas and naming compounds containing ionic and covalent bonds?
- What determines the polarity of a compound?
- How do you classify the polarity of a bond?
- How does the type of bonding (ionic, covalent, metallic) in a substance affect its chemical and physical properties?

Process:

- How do ionic, covalent, and metallic bonds determine the properties of a compound?
- What patterns in bonding determine the shape and polarity of a compound?
- What patterns do we see in naming compounds?

Reflective:

- How do the bonds in an item you can't live without relate to its importance?
- How do manufacturers choose the material they use for new products?
- How would our world be different if electrons were positively charged?
- Which is more important: metallic, ionic, or covalent bonds?

UNIT 3: Types of Interactions

ESSENTIAL QUESTIONS	BIG IDEAS
How do interactions between molecules explain the properties for a substance?	• Students understand that the type of interactions between particles determines physical and chemical properties.

GUIDING QUESTIONS

Content:

- How do attractive forces between molecules affect physical properties?
- How does the polarity of a molecule affect the types of intermolecular forces present?
- How is the solvation process different for molecular and ionic substances?
- How is the concentration of a solution measured?
- What are colligative properties and how are these properties useful in everyday life?

Process:

- How do solutions form?
- How can the physical and chemical properties of a substance be used to predict its intermolecular forces?

Reflective:

- How do pollutants affect our water supply?
- Could your cell phone work without intermolecular forces?
- Why is it better to drink milk than water when eating spicy food?
- What could we have done to make this unit more “Green” (environmentally friendly)? This could be a question for any unit and forces students to think about what we did and why.
- What evidence do we have that particles have interactions?

UNIT 4: Chemical Processes

ESSENTIAL QUESTIONS	BIG IDEAS
How are chemical reactions involved in what we do and see?	• Students understand atoms can be rearranged to produce new substances while conserving energy and matter.

GUIDING QUESTIONS

Content:

- How are microscopic rearrangement of atoms observed on a macroscopic level?
- How can a chemical change be represented by a balanced chemical equation?
- How can the products of a chemical reaction be predicted based on the type of reaction?

Process:

- How can the pattern of reaction types predict the products of a chemical reaction?
- How does a balanced equation represent the conservation of matter?

Reflective:

- What chemical processes allow our body to function?

UNIT 5: Equilibrium and Rates

ESSENTIAL QUESTIONS	BIG IDEAS
How are reactions affected by changes in the environment?	• Students understand that reaction rate and direction can be influenced by outside factors.

GUIDING QUESTIONS

Content:

- How do temperature, surface area, volume, concentration, and the addition of a catalyst influence reaction rates?
- How will a reaction shift based on changes in temperature, pressure, and concentration?
- How does adding a catalyst influence the activation energy?
- What is the difference between an endothermic and exothermic reaction?
- How does the potential energy change during a reaction?

Process:

- How do reaction rate principles and reaction mechanisms explain the changes in energy and concentration during a chemical reaction?
- What patterns exist between the concentration of products and reactants in an equilibrium reaction?
- How does a reaction at equilibrium demonstrate a reaction that is both stable and changing?
- How can the direction and speed of a reaction be manipulated?

Reflective:

- How is equilibrium an example of a self-sustaining process?
- Can we make a reversible reaction go to completion?

UNIT 6: Acid/Base

ESSENTIAL QUESTIONS	BIG IDEAS
How do H^+ ions impact many aspects of our life?	• Students understand the chemical relationship between hydrogen and hydroxide ions and their impact on properties of a solution.

GUIDING QUESTIONS

Content:

- How are pH, H^+ concentration and OH^- concentration conceptually related?
- How are indicators used in acid and base chemistry?
- What mathematical information about the reactants and products can be obtained by using a balanced neutralization reaction through a titration process?
- How does the concentration and the pH change when an acid or base is diluted?
- How is the behavior of strong acids different than that of weak acids in aqueous solutions?

Process:

- How does the ion concentration change throughout a titration?
- Use physical and chemical properties to explain if a solution is acidic or basic?
- How do we apply patterns when writing formulas and naming common acids?

Reflective:

- Why is acid rain a problem?
- How can titrations be used in the real world?

UNIT 7: Chemical Quantities

ESSENTIAL QUESTIONS	BIG IDEAS
How are quantities of reactants and products in a chemical reaction mathematically related?	• Students understand quantitative relationships exist in chemical reactions.

GUIDING QUESTIONS

Content:
- How are the amounts of substances consumed and produced in a chemical reaction calculated?
- How can experimental data be used to calculate percent yield?
- How can the limiting reactant be identified and used in stoichiometry problems?

Process:
- Why do stoichiometric calculations always begin with a balanced chemical equation?
- How can dimensional analysis and the mole ratio mathematically determine the amounts of reactant and products involved in a chemical reaction?
- How can data be used as evidence to support the choice of limiting and excess reactants?

Reflective:
- Could using too much fertilizer in the midwest be the reason that fish are dying in the ocean?
- How does the FDA determine how much poison is allowed to be in the food we eat?
- Why do chemists use the unit “mole”?
- How would a business use the concept of stoichiometric relationships/percent yield when creating a product?

UNIT 8: Gas Relationships

ESSENTIAL QUESTIONS	BIG IDEAS
How do gas particles impact our lives?	• Students understand the behavior of gases on the microscopic and macroscopic levels.

GUIDING QUESTIONS

Content:

- How are the amounts of substances consumed and produced in a chemical reaction calculated?
- How can experimental data be used to calculate percent yield?
- How can the limiting reactant be identified and used in stoichiometry problems?

Process:

- Why do stoichiometric calculations always begin with a balanced chemical equation?
- How can dimensional analysis and the mole ratio mathematically determine the amounts of reactant and products involved in a chemical reaction?
- How can data be used as evidence to support the choice of limiting and excess reactants?

Reflective:

- Could using too much fertilizer in the midwest be the reason that fish are dying in the ocean?
- How does the FDA determine how much poison is allowed to be in the food we eat?
- Why do chemists use the unit “mole”?
- How would a business use the concept of stoichiometric relationships/percent yield when creating a product?

UNIT 9: Thermochemistry

ESSENTIAL QUESTIONS	BIG IDEAS
How can energy changes between particles account for energy in the world?	• Students understand energy changes during nuclear, chemical and physical processes.

GUIDING QUESTIONS

Content:

- How do we determine energy exchange within physical processes?
- How do we determine energy exchange based on bonds involved in chemical processes?
- What are similarities and differences between Fission and Fusion?
- How is energy involved in a nuclear process?

Process:

- How can we use calorimetry to determine the amount of energy transferred in a process?
- How does a heating curve represent the changes of energy within a physical process?
- How do nuclear and chemical reactions represent the changes of energy within a process?

Reflective:

- Does the food you eat provide the right amount of energy for your day?
- How does natural gas provide heat for your home?
- Which would you rather live by a nuclear power plant or a wind turbine?
- Which is better: nuclear fusion or nuclear fission?