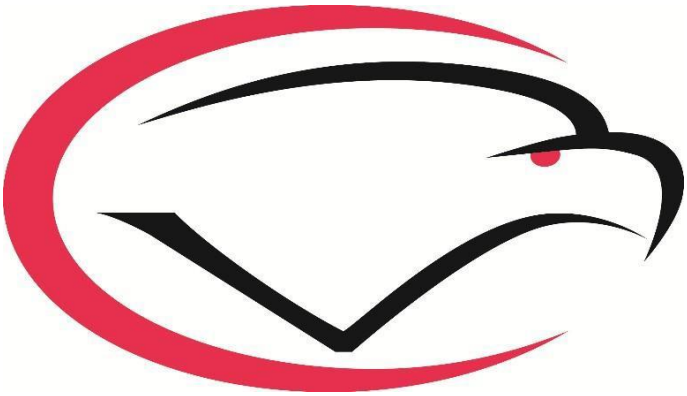
# Secondary Curriculum Maps



Cumberland Valley School District

Soaring to Greatness, Committed to Excellence

Chemistry

| Grade: | | | SUBJECT |
|---|---|---|---|
| **Unit** | **Timeline** | **Topics** | **Priority Standards** |
| **1 Introduction to Chemistry** | 20 Days | Scientific Method | **3.2.10.A1.b Identify properties of matter.** |
| | | Problem Solving and Conversions | **3.2.C.A1 Use the mole concept to determine number of particles and molar mass for elements and compounds** |
| | | Significant Figures and Scientific Notation | |
| | | Proper Lab Etiquette and Safety | |
| | | | |
| **2 Matter & Energy** | 20 Days | Parts of the Periodic Table | **3.2.10.A1.b Identify properties of matter.** |
| | | Classification and Properties of Matter | **3.2.10.A2.a Compare and contrast different bond types that result in the formation of molecules and compounds** |
| | | Methods of Separation and Conservation of Matter | **3.2.10.A3 Describe phases of matter according to the kinetic molecular theory.** |
| | | Energy and Work | **3.2.C.A1 Use the mole concept to determine number of particles and molar mass for elements and compounds** |
| | | Heat, Temperature, and Phase Change Relationships | **3.2.C.A4 Interpret and apply the laws of conservation of mass and energy.** |
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| **3. Atomic Theory & Nuclear Chemistry** | 18 Days | Development of the Atomic Theory of Matter | **3.2.10.A1.a Predict properties of elements and their behavior using trends of the periodic table.** |
| | | Atomic Structure | **3.2.10.A1.b Identify properties of matter.** |
| | | Nuclear Chemistry | **3.2.10.A3 Describe phases of matter according to the kinetic molecular theory.** |
| | | | **3.2.C.A1 Use the mole concept to determine number of particles and molar mass for elements and compounds** |
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| **4. Electron Structure & Periodic Table** | 16 Days | Electron Configuration | **3.2.10.A1.a Predict properties of elements and their behavior using trends of the periodic table.** |
| | | Development and Parts of the Periodic Table | **3.2.10.A3 Describe phases of matter according to the kinetic molecular theory.** |
| | | Periodicity | |
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| **5. Chemical Formulas, the Mole, and Stoichiometry** | 20 Days | Parts of Ionic Compounds | **3.2.10.A1.a Predict properties of elements and their behavior using trends of the periodic table.** |
| | | Ionic and Molecular Nomenclature | **3.2.10.A2.a Compare and contrast different bond types that result in the formation of molecules and compounds** |
| | | Formula Calculations | **3.2.C.A1 Use the mole concept to determine number of particles and molar mass for elements and compounds** |
| | | Mole Conversions | |
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| **6. Chemical Bonding** | 18 Days | Covalent Bonding and Molecules | **3.2.10.A1.a Predict properties of elements and their behavior using trends of the periodic table.** |
| | | Using Lewis/Electron Dot Structures to Show Covalent Bonding | **3.2.10.A1.b Identify properties of matter.** |
| | | Shape of Covalent Molecules and Molecular Geometry | **3.2.10.A2.a Compare and contrast different bond types that result in the formation of molecules and compounds** |
| | | | **3.2.10.A4.a Describe chemical reactions in terms of atomic rearrangement and/or electron transfer** |
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| **7. Chemical Equations** | 18 Days | Balancing and Classifying Chemical Equations | **3.2.10.A1.b Identify properties of matter.** |
| | | Identifying Physical Phases | **3.2.10.A4.a Describe chemical reactions in terms of atomic rearrangement and/or electron transfer** |
| | | Using Balanced Equations to Determine Mole Ratios for Conversions | **3.2.10.A4.b Predict the amounts of products and reactants in a chemical reaction using mole relationships.** |
| | | Limiting Reactant Problems | **3.2.C.A4 Interpret and apply the laws of conservation of mass and energy.** |
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| **8. Gas Laws** | 15 Days | Kinetic Molecular Theory of Matter | **3.2.10.A1.b Identify properties of matter.** |
| | | Relationships of Gas Variables | **3.2.10.A4.b Predict the amounts of products and reactants in a chemical reaction using mole relationships.** |
| | | Dalton's Law and Graham's Law | **3.2.10.A4.c Identify the factors that affect the rates of reactions.** |
| | | | **3.2.C.A1 Use the mole concept to determine number of particles and molar mass for elements and compounds** |
| | | | |
| **9. Solutions, Kinetics, Thermodynamics, and Equilibrium** | 20 Days | Solutions and Solubility | **3.2.10.A3 Describe phases of matter according to the kinetic molecular theory.** |
| | | Collision Theory | **3.2.10.A4.a Describe chemical reactions in terms of atomic rearrangement and/or electron transfer** |
| | | Reaction Rate and Equilibrium | **3.2.10.A4.b Predict the amounts of products and reactants in a chemical reaction using mole relationships.** |
| | | | **3.2.10.A4.c Identify the factors that affect the rates of reactions.** |
| | | | **3.2.C.A1 Use the mole concept to determine number of particles and molar mass for elements and compounds** |
| | | | **3.2.C.A4 Interpret and apply the laws of conservation of mass and energy.** |
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| **10. Acids & Bases** | 15 Days | Acid and Base Theories | **3.2.10.A1.b Identify properties of matter.** |
| | | Measuring and Calculating pH | **3.2.10.A4.a Describe chemical reactions in terms of atomic rearrangement and/or electron transfer** |
| | | Neutralization Reactions | **3.2.10.A4.b Predict the amounts of products and reactants in a chemical reaction using mole relationships.** |
| | | | **3.2.10.A4.c Identify the factors that affect the rates of reactions.** |
| | | | **3.2.C.A1 Use the mole concept to determine number of particles and molar mass for elements and compounds** |

# Curriculum Map

| CV Priority Standard/PA Academic Standard |
|---|
| 3.2.10.A4.c Identify the factors that affect the rates of reactions. |
| **Taught in Unit(s)** |
| Unit 8: Gas Laws<br>Unit 9: Solutions, Kinetics, Thermodynamics and Equilibrium<br>Unit 10: Acids and Bases |
| **Common Misconceptions** |
| 1. Students often believe that equilibrium means there are equal amounts of reactants and products.<br>2. Students struggle with applying logarithms in pH problems.<br>3. Students think that larger numbers in an exponent means that the number is larger.<br>4. Students will struggle with the power of ten differences in a pH value based on p function. |

| Big Idea(s) | Essential Question(s) |
|---|---|
| Matter can be understood by the interactions between atoms and within atoms. | How can the gas laws be used to predict the behavior of gases?<br><br>How are solutions characterized using solubility, colligative properties and concentration?<br><br>How can one affect the rate and equilibrium position of a chemical reaction?<br><br>What are the characteristics and properties of Acids and Bases? |

| Assessments |
|---|
| Unit 8 Test (common)<br>Unit 9 Test (common)<br>Unit 10 Test (common) |

| Concepts<br>(what students need to know) | Skills<br>(what students must be able to do) |
|---|---|
| ● **Unit 8**<br>● 7 gas laws<br>● STP<br>● Pressure, temperature, and volume<br><br>● **Unit 9**<br>● Parts of a solution<br>● Saturated, unsaturated, supersaturated<br>● Molarity<br>● Five factors on reaction rate<br>● Dynamic equilibrium<br>● LeChatelier's principle<br>● Equilibrium constant<br><br>● **Unit 10**<br>● Acids vs bases<br>● Arrhenius theory<br>● Bronsted -Lowry<br>● Neutralization reactions<br>● pH<br>● Concentration of hydronium ion and | ● **Unit 8**<br>● Describe the relationship between pressure, temperature and volume<br>● Derive and perform calculations for the 7 different gas laws<br>● Know and apply the concepts of standard temperature and pressure (STP)<br><br>● **Unit 9**<br>● Identify the parts of a solution<br>● Read and interpret a simple solubility curve<br>● Describe how molarity is calculated<br>● Describe the five factors on reaction rates and a reaction mechanism<br>● Draw energy diagrams for reactions and show reactants, products, change in energy, activation energy, and labeled axes<br>● Write equilibrium constant expressions and calculate the equilibrium constant<br>● Apply LeChatlier's Principle to determine how equilibrium will shift |

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|---|---|
| hydroxide ion | ● **Unit 10**<br>● List properties of acids and bases<br>● Define acids and bases according to Arrhenius and Bronsted-Lowry<br>● Identify acids and bases as strong or weak and write ionization equations<br>● Calculate [$H3O^{+}$] for strong and weak acids and [$OH^{-}$] for strong bases<br>● Calculate pH using the log formula and identify a solution as acidic, basic, or neutral<br>● Identify Bronsted-Lowry acids, Bronsted-Lowry bases, conjugate acids, conjugate bases, and conjugate pairs |

# Curriculum Map

| CV Priority Standard/PA Academic Standard |
|---|
| 3.2.C.A4 Interpret and apply the laws of conservation of mass and energy. |
| **Taught in Unit(s)** |
| Unit 2: Matter and Energy<br>Unit 7: Chemical Equations<br>Unit 9: Solutions, Kinetics, Thermodynamics and Equilibrium |
| **Common Misconceptions** |
| 1. Students often change subscripts when balancing equations with coefficients..<br>2. Students will often struggle with how a supersaturated solution is formed.<br>3. Students will struggle to understand that energy loss is a negative value for exothermic reactions while endothermic reactions are a positive value. |

| Big Idea(s) | Essential Question(s) |
|---|---|
| Matter and energy interact in predictable ways. | What are matter and energy interactions and how is matter and energy classified through change (reactions)?<br><br>How do balanced equations describe and represent chemical reactions?<br><br>How are solutions characterized using solubility, colligative properties and concentration?<br><br>How can one affect the rate and equilibrium position of a chemical reaction? |

| Assessments |
|---|
| Unit 2 Test (common)<br>Unit 7 Test (common)<br>Unit 9 Test (common) |

| Concepts<br>(what students need to know) | Skills<br>(what students must be able to do) |
|---|---|
| ● **Unit 2**<br>● Substance vs mixture<br>● Homogeneous vs heterogeneous<br>● 5 types of compounds<br>● 3 types of elements<br>● Forms of energy<br>● Exothermic vs endothermic<br>● Energy conversions<br>● Heat capacity<br>● Types of changes and properties<br><br>● **Unit 7**<br>● 5 types of chemical reactions<br>● Activity series<br>● Solubility table<br>● Limiting vs excess reactants<br>● Oxidation vs reduction<br><br>● **Unit 9**<br>● Parts of a solution<br>● Saturated, unsaturated, supersaturated | ● **Unit 2**<br>● Classify matter<br>● Classify properties as intensive physical, extensive physical, or chemical<br>● Classify changes as physical, chemical, or nuclear<br>● Describe how the law of conservation of mass and energy relate to a chemical reaction<br>● Differentiate between potential and kinetic energy and the 7 forms of energy<br>● Describe the difference between the 3 states of matter<br>● Describe and give examples of exothermic and endothermic reactions<br>● Perform calculations using the specific heat capacity equation<br><br>● **Unit 7**<br>● Classify and balance chemical reactions |

| | |
|---|---|
| ● Molarity<br>● Five factors on reaction rate<br>● Dynamic equilibrium<br>● LeChatelier's principle<br>● Equilibrium constant | ● Write word, sentence, and chemical equations<br>● Predict if single and double replacements will occur<br>● Solve stoichiometry problems using the expanded mole diagram<br>● Identify limiting and excess reactants<br>● Determine oxidation numbers of each element in a formula<br>● Identify the element that is oxidized and the element that is reduced and write oxidation and reduction half reactions<br><br>● **Unit 9**<br>● Identify the parts of a solution<br>● Read and interpret a simple solubility curve<br>● Describe how molarity is calculated<br>● Describe the five factors on reaction rates and a reaction mechanism<br>● Draw energy diagrams for reactions and show reactants, products, change in energy, activation energy, and labeled axes<br>● Write equilibrium constant expressions and calculate the equilibrium constant<br>● Apply LeChatlier's Principle to determine how equilibrium will shift |

# Curriculum Map

| CV Priority Standard/PA Academic Standard |
|---|
| 3.2.C.A1 Use the mole concept to determine the number of particles and molar mass for elements and compounds. |
| **Taught in Unit(s)** |
| Unit 1: Introduction to Chemistry<br>Unit 2: Matter and Energy<br>Unit 3: Atomic Theory and Nuclear Chemistry<br>Unit 5: Chemical Formulas, the Mole, and Stoichiometry<br>Unit 8: Gas Laws<br>Unit 9: Solutions, Kinetics, Thermodynamics and Equilibrium<br>Unit 10: Acids and Bases |
| **Common Misconceptions** |
| 1. Initially, students struggle with understanding that the mole is a number, and understanding the magnitude of a mole.<br>2. Students will often confuse mole and molecule.<br>3. Once added to stoichiometry, students often think they need to place the coefficient with the mole when using unit analysis to convert to grams.<br>4. Students think that larger numbers in an exponent(power of ten) means that the number is larger. Negative powers of ten are smaller values that cause slight confusion. |

| Big Idea(s) | Essential Question(s) |
|---|---|
| Chemists use the mole and mathematical relationship to relate chemicals and reactions. | How does the use of the scientific process in chemistry allow us to describe and better understand the physical world around us?<br><br>What are matter and energy interactions and how is matter and energy classified through change (reactions)?<br><br>How is the atomic theory of matter used to describe and explain the atomic and nuclear structure of atoms?<br><br>What are the characteristics of ionic compounds and how are ionic compounds named to reflect these characteristics?<br><br>How can the gas laws be used to predict the behavior of gases?<br><br>How are solutions characterized using solubility, colligative properties and concentration?<br><br>How can one affect the rate and equilibrium position of a chemical reaction?<br><br>What are the characteristics and properties of Acids and Bases? |

| Assessments |
|---|
| Unit 1 Test (common)<br>Unit 2 Test (common)<br>Unit 3 Test (common) |

Unit 5 Test (common)
Unit 8 Test (common)
Unit 9 Test (common)
Unit 10 Test (common)

| **Concepts**<br>(what students need to know) | **Skills**<br>(what students must be able to do) |
|---|---|
| ● **Unit 1**<br>● Inorganic vs organic<br>● Qualitative vs quantitative<br>● Mass vs weight<br>● Accuracy vs precision<br>● Direct vs inverse relationships<br>● Density<br>● Common lab equipment<br>● SI base units<br>● Kelvin vs Celsius<br>● Metric system<br>● Convert units<br><br>● **Unit 2**<br>● Substance vs mixture<br>● Homogeneous vs heterogeneous<br>● 5 types of compounds<br>● 3 types of elements<br>● Forms of energy<br>● Exothermic vs endothermic<br>● Energy conversions<br>● Heat capacity<br>● Types of changes and properties<br><br>● **Unit 3**<br>● Subatomic particles<br>● Atoms vs ions<br>● 3 types of radiation<br>● 6 atomic models<br>● Fission vs. Fusion<br>● Molar mass vs average atomic mass<br><br>● **Unit 5**<br>● Diatomic molecules<br>● Polyatomic ions<br>● Chemical formulas<br>● Convert between mass, mole, number of particles and volume<br>● Avogadro's number<br>● Monatomic vs polyatomic<br>● Oxidation<br><br>● **Unit 8**<br>● 7 gas laws<br>● STP<br>● Pressure, temperature, and volume<br><br>● **Unit 9**<br>● Parts of a solution | ● **Unit 1**<br>● Differentiate between the branches of chemistry<br>● Differentiate between qualitative and quantitative observations<br>● Graph and differentiate between inverse, direct, and no relationship in graphical data<br>● Solve problems for converting units using dimensional analysis<br>● Correctly report a measurement using a ruler, graduated cylinder, thermometer, and balance<br>● Identify and properly use lab equipment<br>● Determine the number of significant figures in a measurement and apply the rules to calculations<br>● Convert standard form to scientific notation and vice versa<br><br>● **Unit 2**<br>● Classify matter<br>● Classify properties as intensive physical, extensive physical, or chemical<br>● Classify changes as physical, chemical, or nuclear<br>● Describe how the law of conservation of mass and energy relate to a chemical reaction<br>● Differentiate between potential and kinetic energy and the 7 forms of energy<br>● Describe the difference between the 3 states of matter<br>● Describe and give examples of exothermic and endothermic reactions<br>● Perform calculations using the specific heat capacity equation<br><br>● **Unit 3**<br>● Describe the six models of atom evolution<br>● Differentiate between protons, neutrons, and electrons<br>● Determine the molar mass of a compound<br>● Calculate original and final masses for radioactive isotopes using half-life equation<br>● Calculate the weighted average atomic mass of an element<br>● Identify which type of radiation has the most penetrating power |

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|---|---|
| ● Saturated, unsaturated, supersaturated<br>● Molarity<br>● Five factors on reaction rate<br>● Dynamic equilibrium<br>● LeChatelier's principle<br>● Equilibrium constant<br><br>● **Unit 10**<br>● Acids vs bases<br>● Arrhenius theory<br>● Bronsted -Lowry<br>● Neutralization reactions<br>● pH<br>● Concentration of hydronium ion and hydroxide ion | ● **Unit 5**<br>● Determine the number of atoms present in a formula<br>● Identify the 7 diatomic molecules and polyatomic ions<br>● Differentiate between and calculate empirical, molecular, and structural formulas<br>● Identify a compound as ionic or molecular by its formula and perform ionic, molecular, and hydrate nomenclature<br>● Identify cations that do not require roman numerals in nomenclature<br>● Describe the concept of the mole, state Avogadro's number, and use the mole to convert units<br><br>● **Unit 8**<br>● Describe the relationship between pressure, temperature and volume<br>● Derive and perform calculations for the 7 different gas laws<br>● Know and apply the concepts of standard temperature and pressure (STP)<br><br>● **Unit 9**<br>● Identify the parts of a solution<br>● Read and interpret a simple solubility curve<br>● Describe how molarity is calculated<br>● Describe the five factors on reaction rates and a reaction mechanism<br>● Draw energy diagrams for reactions and show reactants, products, change in energy, activation energy, and labeled axes<br>● Write equilibrium constant expressions and calculate the equilibrium constant<br>● Apply LeChatlier's Principle to determine how equilibrium will shift<br><br>● **Unit 10**<br>● List properties of acids and bases<br>● Define acids and bases according to Arrhenius and Bronsted-Lowry<br>● Identify acids and bases as strong or weak and write ionization equations<br>● Calculate $[H3O^{+}]$ for strong and weak acids and $[OH^{-}]$ for strong bases<br>● Calculate pH using the log formula and identify a solution as acidic, basic, or neutral<br>● Identify Bronsted-Lowry acids, Bronsted-Lowry bases, conjugate acids, conjugate bases, and conjugate pairs |

# Curriculum Map

| CV Priority Standard/PA Academic Standard |
|---|
| 3.2.10.A4.b Predict the amounts of products and reactants in a chemical reaction using mole relationships. |
| **Taught in Unit(s)** |
| Unit 7: Chemical Equations<br>Unit 8: Gas Laws<br>Unit 9: Solutions, Kinetics, Thermodynamics and Equilibrium<br>Unit 10: Acids and Bases |
| **Common Misconceptions** |
| Students will confuse the coefficients in chemical reactions representing moles, volume or particles.<br>Students will confuse the use of subscripts for balancing charges and the use of coefficients for balancing a reaction.<br>Students will think that dynamic equilibrium means that the quantity of reactants and products will be equal when they are remaining constant when the forward reaction and reverse reaction rates are equal. |

| Big Idea(s) | Essential Question(s) |
|---|---|
| Chemists use the mole and mathematical relationship to relate chemicals and reactions. | How do balanced equations describe and represent chemical reactions?<br><br>How can the gas laws be used to predict the behavior of gases?<br><br>How are solutions characterized using solubility, colligative properties and concentration?<br><br>How can one affect the rate and equilibrium position of a chemical reaction?<br><br>What are the characteristics and properties of Acids and Bases? |

| Assessments |
|---|
| Unit 7 Test (common)<br>Unit 8 Test (common)<br>Unit 9 Test (common)<br>Unit 10 Test (common) |

| Concepts<br>(what students need to know) | Skills<br>(what students must be able to do) |
|---|---|
| ● **Unit 7**<br>● 5 types of chemical reactions<br>● Activity series<br>● Solubility table<br>● Limiting vs excess reactants<br>● Oxidation vs reduction<br><br>● **Unit 8**<br>● 7 gas laws<br>● STP<br>● Pressure, temperature, and volume<br><br>● **Unit 9**<br>● Parts of a solution<br>● Saturated, unsaturated, supersaturated<br>● Molarity | ● **Unit 7**<br>● Classify and balance chemical reactions<br>● Write word, sentence, and chemical equations<br>● Predict if single and double replacements will occur<br>● Solve stoichiometry problems using the expanded mole diagram<br>● Identify limiting and excess reactants<br>● Determine oxidation numbers of each element in a formula<br>● Identify the element that is oxidized and the element that is reduced and write oxidation and reduction half reactions<br><br>● **Unit 8** |

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|---|---|
| ● Five factors on reaction rate<br>● Dynamic equilibrium<br>● LeChatelier's principle<br>● Equilibrium constant<br><br>● **Unit 10**<br>● Acids vs bases<br>● Arrhenius theory<br>● Bronsted -Lowry<br>● Neutralization reactions<br>● pH<br>● Concentration of hydronium ion and hydroxide ion | ● Describe the relationship between pressure, temperature and volume<br>● Derive and perform calculations for the 7 different gas laws<br>● Know and apply the concepts of standard temperature and pressure (STP)<br><br>● **Unit 9**<br>● Identify the parts of a solution<br>● Read and interpret a simple solubility curve<br>● Describe how molarity is calculated<br>● Describe the five factors on reaction rates and a reaction mechanism<br>● Draw energy diagrams for reactions and show reactants, products, change in energy, activation energy, and labeled axes<br>● Write equilibrium constant expressions and calculate the equilibrium constant<br>● Apply LeChatlier's Principle to determine how equilibrium will shift<br><br>● **Unit 10**<br>● List properties of acids and bases<br>● Define acids and bases according to Arrhenius and Bronsted-Lowry<br>● Identify acids and bases as strong or weak and write ionization equations<br>● Calculate $[H3O^{+}]$ for strong and weak acids and $[OH^{-}]$ for strong bases<br>● Calculate pH using the log formula and identify a solution as acidic, basic, or neutral<br>● Identify Bronsted-Lowry acids, Bronsted-Lowry bases, conjugate acids, conjugate bases, and conjugate pairs |

# Curriculum Map

| CV Priority Standard/PA Academic Standard |
|---|
| 3.2.10.A4.a Describe chemical reactions in terms of atomic rearrangement and/or electron transfer |
| **Taught in Unit(s)** |
| Unit 6: Chemical Bonding<br>Unit 7: Chemical Equations<br>Unit 9: Solutions, Kinetics, Thermodynamics and Equilibrium<br>Unit 10: Acids and Bases |
| **Common Misconceptions** |
| Students will confuse the types of acids and bases.<br>Students will mix up the nonpolar and polar bond types in covalent compounds.<br>Students will not balance equations correctly which will change the stoichiometry calculations that go along with them.<br>Students will mix up the effects of concentration, temperature and pressure changes in reactions using LeChatelier's principle. |

| Big Idea(s) | Essential Question(s) |
|---|---|
| Matter can be understood by the interactions between atoms and within atoms. | What are the characteristics of covalent molecules?<br><br>How do balanced equations describe and represent chemical reactions?<br><br>How are solutions characterized using solubility, colligative properties and concentration?<br><br>How can one affect the rate and equilibrium position of a chemical reaction?<br><br>What are the characteristics and properties of Acids and Bases? |

| Assessments |
|---|
| Unit 6 Test (common)<br>Unit 7 Test (common)<br>Unit 9 Test (common)<br>Unit 10 Test (common) |

| Concepts<br>(what students need to know) | Skills<br>(what students must be able to do) |
|---|---|
| ● **Unit 6**<br>● Lewis structure<br>● VSEPR<br>● Ball-and-stick vs space-filling<br>● Polarity<br>● Single, double, and triple bonds<br>● Dipole<br><br>● **Unit 7**<br>● 5 types of chemical reactions<br>● Activity series<br>● Solubility table<br>● Limiting vs excess reactants<br>● Oxidation vs reduction | ● **Unit 6**<br>● State the reason why atoms bond and how ionic and covalent bonds form<br>● Draw Lewis dot symbols and structures for atoms, ions and molecules<br>● Predict the geometry of molecules using VSEPR<br>● Determine the polarity of bonds and molecules<br>● Describe how a hydrogen bond occurs<br>● Describe the polarity and bonding of water<br><br>● **Unit 7**<br>● Classify and balance chemical reactions |

| | |
|---|---|
| ● **Unit 9**<br>● Parts of a solution<br>● Saturated, unsaturated, supersaturated<br>● Molarity<br>● Five factors on reaction rate<br>● Dynamic equilibrium<br>● LeChatelier's principle<br>● Equilibrium constant<br><br>● **Unit 10**<br>● Acids vs bases<br>● Arrhenius theory<br>● Bronsted -Lowry<br>● Neutralization reactions<br>● pH<br>● Concentration of hydronium ion and hydroxide ion | ● Write word, sentence, and chemical equations<br>● Predict if single and double replacements will occur<br>● Solve stoichiometry problems using the expanded mole diagram<br>● Identify limiting and excess reactants<br>● Determine oxidation numbers of each element in a formula<br>● Identify the element that is oxidized and the element that is reduced and write oxidation and reduction half reactions<br><br>● **Unit 9**<br>● Identify the parts of a solution<br>● Read and interpret a simple solubility curve<br>● Describe how molarity is calculated<br>● Describe the five factors on reaction rates and a reaction mechanism<br>● Draw energy diagrams for reactions and show reactants, products, change in energy, activation energy, and labeled axes<br>● Write equilibrium constant expressions and calculate the equilibrium constant<br>● Apply LeChatlier's Principle to determine how equilibrium will shift<br><br>● **Unit 10**<br>● List properties of acids and bases<br>● Define acids and bases according to Arrhenius and Bronsted-Lowry<br>● Identify acids and bases as strong or weak and write ionization equations<br>● Calculate $[H3O^{+}]$ for strong and weak acids and $[OH^{-}]$ for strong bases<br>● Calculate pH using the log formula and identify a solution as acidic, basic, or neutral<br>● Identify Bronsted-Lowry acids, Bronsted-Lowry bases, conjugate acids, conjugate bases, and conjugate pairs |

# Curriculum Map

| CV Priority Standard/PA Academic Standard |
|---|
| 3.2.10.A3 Describe phases of matter according to the kinetic molecular theory. |
| **Taught in Unit(s)** |
| Unit 2: Matter and Energy<br>Unit 3: Atomic Theory and Nuclear Chemistry<br>Unit 4: Electron Structure and Periodic Table<br>Unit 9: Solutions, Kinetics, Thermodynamics and Equilibrium |
| **Common Misconceptions** |
| Students will not recognize the difference between the three kinetic molecular energies of translational, vibrational and rotational energy.<br>Students will mix up which way reactions shift when different variables are changed using LeChatelier's principle.<br>Students will confuse the trends on the periodic table. |

| Big Idea(s) | Essential Question(s) |
|---|---|
| Scientific processes allow us to describe and better understand the physical world around us. | What are matter and energy interactions and how is matter and energy classified through change (reactions)?<br><br>How is the atomic theory of matter used to describe and explain the atomic and nuclear structure of atoms?<br><br>How can the periodic table be used to predict the properties of elements?<br><br>How are solutions characterized using solubility, colligative properties and concentration?<br><br>How can one affect the rate and equilibrium position of a chemical reaction? |

| Assessments |
|---|
| Unit 2 Test (common)<br>Unit 3 Test (common)<br>Unit 4 Test (common)<br>Unit 9 Test (common) |

| Concepts<br>(what students need to know) | Skills<br>(what students must be able to do) |
|---|---|
| ● **Unit 2**<br>● Substance vs mixture<br>● Homogeneous vs heterogeneous<br>● 5 types of compounds<br>● 3 types of elements<br>● Forms of energy<br>● Exothermic vs endothermic<br>● Energy conversions<br>● Heat capacity<br>● Types of changes and properties<br><br>● **Unit 3**<br>● Subatomic particles<br>● Atoms vs ions<br>● 3 types of radiation | ● **Unit 2**<br>● Classify matter<br>● Classify properties as intensive physical, extensive physical, or chemical<br>● Classify changes as physical, chemical, or nuclear<br>● Describe how the law of conservation of mass and energy relate to a chemical reaction<br>● Differentiate between potential and kinetic energy and the 7 forms of energy<br>● Describe the difference between the 3 states of matter<br>● Describe and give examples of exothermic and endothermic reactions |

| | |
|---|---|
| ● 6 atomic models<br>● Fission vs. Fusion<br>● Molar mass vs average atomic mass<br><br>● **Unit 4**<br>● Groups and Families on p.t.<br>● Electron configuration<br>● Electron structure<br>● Mendeleev vs Moseley<br>● Atomic radius, ionization energy, electronegativity, reactivity<br>● Valence electrons<br><br>● **Unit 9**<br>● Parts of a solution<br>● Saturated, unsaturated, supersaturated<br>● Molarity<br>● Five factors on reaction rate<br>● Dynamic equilibrium<br>● LeChatelier's principle<br>● Equilibrium constant | ● Perform calculations using the specific heat capacity equation<br><br>● **Unit 3**<br>● Describe the six models of atom evolution<br>● Differentiate between protons, neutrons, and electrons<br>● Determine the molar mass of a compound<br>● Calculate original and final masses for radioactive isotopes using half-life equation<br>● Calculate the weighted average atomic mass of an element<br>● Identify which type of radiation has the most penetrating power<br><br>● **Unit 4**<br>● Describe the history of the periodic table<br>● Describe the electronic structure of the atom in terms of energy levels, sublevels, and orbitals<br>● Write the electron configuration, noble gas core notation, and orbital diagrams for elements and ions<br>● State the trends for atomic radius ionization energy, electronegativity, reactivity of metals and reactivity of nonmetals<br><br>● **Unit 9**<br>● Identify the parts of a solution<br>● Read and interpret a simple solubility curve<br>● Describe how molarity is calculated<br>● Describe the five factors on reaction rates and a reaction mechanism<br>● Draw energy diagrams for reactions and show reactants, products, change in energy, activation energy, and labeled axes<br>● Write equilibrium constant expressions and calculate the equilibrium constant<br>● Apply LeChatlier's Principle to determine how equilibrium will shift |

# Curriculum Map

| CV Priority Standard/PA Academic Standard |
|---|
| 3.2.10.A2.a Compare and contrast different bond types that result in the formation of molecules and compounds |
| **Taught in Unit(s)** |
| Unit 2: Matter and Energy<br>Unit 5: Chemical Formulas, the Mole, and Stoichiometry<br>Unit 6: Chemical Equations |
| **Common Misconceptions** |
| Students will struggle to differentiate ionic and covalent compounds.<br>Students will struggle to assign charges to ions and therefore misrepresent the compounds ionic formula.<br>Students will confuse bond polarity and calculating electronegativity differences.<br>Students will struggle with symmetry which makes labeling molecule polarity difficult. |

| Big Idea(s) | Essential Question(s) |
|---|---|
| Matter can be understood by the interactions between atoms and within atoms. | What are matter and energy interactions and how is matter and energy classified through change (reactions)?<br><br>What are the characteristics of ionic compounds and how are ionic compounds named to reflect these characteristics?<br><br>What are the characteristics of covalent molecules? |

| Assessments |
|---|
| Unit 2 Test (common)<br>Unit 5 Test (common)<br>Unit 6 Test (common) |

| Concepts<br>(what students need to know) | Skills<br>(what students must be able to do) |
|---|---|
| ● **Unit 2**<br>● Substance vs mixture<br>● Homogeneous vs heterogeneous<br>● 5 types of compounds<br>● 3 types of elements<br>● Forms of energy<br>● Exothermic vs endothermic<br>● Energy conversions<br>● Heat capacity<br>● Types of changes and properties<br><br>● **Unit 5**<br>● Diatomic molecules<br>● Polyatomic ions<br>● Chemical formulas<br>● Convert between mass, mole, number of particles and volume<br>● Avogadro's number<br>● Monatomic vs polyatomic<br>● Oxidation<br><br>● **Unit 6** | ● **Unit 2**<br>● Classify matter<br>● Classify properties as intensive physical, extensive physical, or chemical<br>● Classify changes as physical, chemical, or nuclear<br>● Describe how the law of conservation of mass and energy relate to a chemical reaction<br>● Differentiate between potential and kinetic energy and the 7 forms of energy<br>● Describe the difference between the 3 states of matter<br>● Describe and give examples of exothermic and endothermic reactions<br>● Perform calculations using the specific heat capacity equation<br><br>● **Unit 5**<br>● Determine the number of atoms present in a formula |

| | |
|---|---|
| ● Lewis structure<br>● VSEPR<br>● Ball-and-stick vs space-filling<br>● Polarity<br>● Single, double, and triple bonds<br>● Dipole | ● Identify the 7 diatomic molecules and polyatomic ions<br>● Differentiate between and calculate empirical, molecular, and structural formulas<br>● Identify a compound as ionic or molecular by its formula and perform ionic, molecular, and hydrate nomenclature<br>● Identify cations that do not require roman numerals in nomenclature<br>● Describe the concept of the mole, state Avogadro's number, and use the mole to convert units<br><br>● **Unit 6**<br>● State the reason why atoms bond and how ionic and covalent bonds form<br>● Draw Lewis dot symbols and structures for atoms, ions and molecules<br>● Predict the geometry of molecules using VSEPR<br>● Determine the polarity of bonds and molecules<br>● Describe how a hydrogen bond occurs<br>● Describe the polarity and bonding of water |

# Curriculum Map

| CV Priority Standard/PA Academic Standard |
|---|
| 3.2.10.A1.b Identify properties of matter. |
| **Taught in Unit(s)** |
| Unit 1: Introduction to Chemistry<br>Unit 2: Matter and Energy<br>Unit 3: Atomic Theory and Nuclear Chemistry<br>Unit 6: Chemical Bonding<br>Unit 7: Chemical Equations<br>Unit 8: Gas Laws<br>Unit 10: Acids and Bases |
| **Common Misconceptions** |
| 1. Differentiation of intensive physical and extensive physical properties.<br>2. Understanding the difference in polarity of bonds versus polarity of a molecule can be difficult for students.<br>3. Differentiation between assigning liquid versus aqueous phases of matter. |

| Big Idea(s) | Essential Question(s) |
|---|---|
| Scientific processes allow us to describe and better understand the physical world around us. | How does the use of the scientific process in chemistry allow us to describe and better understand the physical world around us?<br><br>What are matter and energy interactions and how is matter and energy classified through change (reactions)?<br><br>How is the atomic theory of matter used to describe and explain the atomic and nuclear structure of atoms?<br><br>What are the characteristics of covalent molecules?<br><br>How do balanced equations describe and represent chemical reactions?<br><br>How can the gas laws be used to predict the behavior of gases?<br><br>What are the characteristics and properties of Acids and Bases? |

| Assessments |
|---|
| Unit 1 Test (common)<br>Unit 2 Test (common)<br>Unit 3 Test (common)<br>Unit 6 Test (common)<br>Unit 7 Test (common)<br>Unit 8 Test (common)<br>Unit 10 Test (common) |

| Concepts<br>(what students need to know) | Skills<br>(what students must be able to do) |
|---|---|

- **Unit 1**
- Inorganic vs organic
- Qualitative vs quantitative
- Mass vs weight
- Accuracy vs precision
- Direct vs inverse relationships
- Density
- Common lab equipment
- SI base units
- Kelvin vs Celsius
- Metric system
- Convert units

- **Unit 2**
- Substance vs mixture
- Homogeneous vs heterogeneous
- 5 types of compounds
- 3 types of elements
- Forms of energy
- Exothermic vs endothermic
- Energy conversions
- Heat capacity
- Types of changes and properties

- **Unit 3**
- Subatomic particles
- Atoms vs ions
- 3 types of radiation
- 6 atomic models
- Fission vs. Fusion
- Molar mass vs average atomic mass

- **Unit 6**
- Lewis structure
- VSEPR
- Ball-and-stick vs space-filling
- Polarity
- Single, double, and triple bonds
- Dipole

- **Unit 7**
- 5 types of chemical reactions
- Activity series
- Solubility table
- Limiting vs excess reactants
- Oxidation vs reduction

- **Unit 8**
- 7 gas laws
- STP
- Pressure, temperature, and volume

- **Unit 10**
- Acids vs bases
- Arrhenius theory

- **Unit 1**
- Differentiate between the branches of chemistry
- Differentiate between qualitative and quantitative observations
- Graph and differentiate between inverse, direct, and no relationship in graphical data
- Solve problems for converting units using dimensional analysis
- Correctly report a measurement using a ruler, graduated cylinder, thermometer, and balance
- Identify and properly use lab equipment
- Determine the number of significant figures in a measurement and apply the rules to calculations
- Convert standard form to scientific notation and vice versa

- **Unit 2**
- Classify matter
- Classify properties as intensive physical, extensive physical, or chemical
- Classify changes as physical, chemical, or nuclear
- Describe how the law of conservation of mass and energy relate to a chemical reaction
- Differentiate between potential and kinetic energy and the 7 forms of energy
- Describe the difference between the 3 states of matter
- Describe and give examples of exothermic and endothermic reactions
- Perform calculations using the specific heat capacity equation

- **Unit 3**
- Describe the six models of atom evolution
- Differentiate between protons, neutrons, and electrons
- Determine the molar mass of a compound
- Calculate original and final masses for radioactive isotopes using half-life equation
- Calculate the weighted average atomic mass of an element
- Identify which type of radiation has the most penetrating power

- **Unit 6**
- State the reason why atoms bond and how ionic and covalent bonds form
- Draw Lewis dot symbols and structures for atoms, ions and molecules

| | |
|---|---|
| ● Bronsted -Lowry<br>● Neutralization reactions<br>● pH<br>● Concentration of hydronium ion and hydroxide ion | ● Predict the geometry of molecules using VSEPR<br>● Determine the polarity of bonds and molecules<br>● Describe how a hydrogen bond occurs<br>● Describe the polarity and bonding of water<br><br>● **Unit 7**<br>● Classify and balance chemical reactions<br>● Write word, sentence, and chemical equations<br>● Predict if single and double replacements will occur<br>● Solve stoichiometry problems using the expanded mole diagram<br>● Identify limiting and excess reactants<br>● Determine oxidation numbers of each element in a formula<br>● Identify the element that is oxidized and the element that is reduced and write oxidation and reduction half reactions<br><br>● **Unit 8**<br>● Describe the relationship between pressure, temperature and volume<br>● Derive and perform calculations for the 7 different gas laws<br>● Know and apply the concepts of standard temperature and pressure (STP)<br><br>● **Unit 10**<br>● List properties of acids and bases<br>● Define acids and bases according to Arrhenius and Bronsted-Lowry<br>● Identify acids and bases as strong or weak and write ionization equations<br>● Calculate $[H3O^{+}]$ for strong and weak acids and $[OH^{-}]$ for strong bases<br>● Calculate pH using the log formula and identify a solution as acidic, basic, or neutral<br>● Identify Bronsted-Lowry acids, Bronsted-Lowry bases, conjugate acids, conjugate bases, and conjugate pairs |

# Curriculum Map

| CV Priority Standard/PA Academic Standard |
|---|
| 3.2.10.A1.a Predict properties of elements and their behavior using trends of the periodic table. |
| **Taught in Unit(s)** |
| Unit 3: Atomic Structure and Nuclear<br>Unit 4: Electron Structure and Periodic Table<br>Unit 5: Chemical Formulas, the Mole, and Stoichiometry<br>Unit 6: Chemical Bonding |
| **Common Misconceptions** |
| 1. Students will often confuse the alkali metals and the alkaline earth metals when categorizing groups.<br>2. Students will struggle with the "d" and "f" sublevel arrangements in an electron configuration.<br>3. When writing a chemical formula for an ionic compound, the criss-cross method can cause confusion with empirical formula. (should be avoided unless students are confused) |

| Big Idea(s) | Essential Question(s) |
|---|---|
| Scientific processes allow us to describe and better understand the physical world around us. | How is the atomic theory of matter used to describe and explain the atomic and nuclear structure of atoms?<br><br>How can the periodic table be used to predict the properties of elements?<br><br>What are the characteristics of ionic compounds and how are ionic compounds named to reflect these characteristics?<br><br>What are the characteristics of covalent molecules? |

| Assessments |
|---|
| Unit 3 Test (common)<br>Unit 4 Test (common)<br>Unit 5 Test (common)<br>Unit 6 Test (common) |

| Concepts<br>(what students need to know) | Skills<br>(what students must be able to do) |
|---|---|
| ● **Unit 3**<br>● Subatomic particles<br>● Atoms vs ions<br>● 3 types of radiation<br>● 6 atomic models<br>● Fission vs. Fusion<br>● Molar mass vs average atomic mass<br><br>● **Unit 4**<br>● Groups and Families on p.t.<br>● Electron configuration<br>● Electron structure<br>● Mendeleev vs Moseley<br>● Atomic radius, ionization energy, electronegativity, reactivity<br>● Valence electrons<br><br>● **Unit 5** | ● **Unit 3**<br>● Describe the six models of atom evolution<br>● Differentiate between protons, neutrons, and electrons<br>● Determine the molar mass of a compound<br>● Calculate original and final masses for radioactive isotopes using half-life equation<br>● Calculate the weighted average atomic mass of an element<br>● Identify which type of radiation has the most penetrating power<br><br>● **Unit 4**<br>● Describe the history of the periodic table<br>● Describe the electronic structure of the atom in terms of energy levels, sublevels, and orbitals |

| | |
|---|---|
| ● Diatomic molecules<br>● Polyatomic ions<br>● Chemical formulas<br>● Convert between mass, mole, number of particles and volume<br>● Avogadro's number<br>● Monatomic vs polyatomic<br>● Oxidation<br><br>● **Unit 6**<br>● Lewis structure<br>● VSEPR<br>● Ball-and-stick vs space-filling<br>● Polarity<br>● Single, double, and triple bonds<br>● Dipole | ● Write the electron configuration, noble gas core notation, and orbital diagrams for elements and ions<br>● State the trends for atomic radius ionization energy, electronegativity, reactivity of metals and reactivity of nonmetals<br><br>● **Unit 5**<br>● Determine the number of atoms present in a formula<br>● Identify the 7 diatomic molecules and polyatomic ions<br>● Differentiate between and calculate empirical, molecular, and structural formulas<br>● Identify a compound as ionic or molecular by its formula and perform ionic, molecular, and hydrate nomenclature<br>● Identify cations that do not require roman numerals in nomenclature<br>● Describe the concept of the mole, state Avogadro's number, and use the mole to convert units<br><br>● **Unit 6**<br>● State the reason why atoms bond and how ionic and covalent bonds form<br>● Draw Lewis dot symbols and structures for atoms, ions and molecules<br>● Predict the geometry of molecules using VSEPR<br>● Determine the polarity of bonds and molecules<br>● Describe how a hydrogen bond occurs<br>● Describe the polarity and bonding of water |