Centerville Sr. High School Curriculum Mapping
Chemistry
Mrs. Jessica Maule

Chemistry Overview

The Indiana Academic Standards specify the core, fundamental skills students should learn, master, and apply at grade level beginning in kindergarten and continuing through grade twelve. These academic standards serve as the basis to our curriculum in Centerville-Abington Community Schools but do not serve as curriculum alone. The Indiana Academic Standards are supported through grade-level, content-specific curriculum maps and resources. These curriculum maps and resources are aligned to the Indiana Academic Standards and provide the tools which are necessary to meet the needs of all learners. As a result, the Centerville-Abington Community Schools' curriculum maps are examined regularly and undergo periodic revisions.

Chemistry is a course based on the following core topics: properties and states of matter, atomic structure; bonding; chemical reactions; solution behavior and behavior of gases. Students enrolled in Chemistry compare, contrast, and synthesize useful models of the structure and properties of matter and the mechanism of reactions. A textbook and supplemental materials are used for this course.

Textbook: Glencoe/McGraw Hill. (2017). *Chemistry: Matter and Change.*

Unit 1 Theme	**Duration of Unit**	**Essential Question(s)**
Periodic Trends	10 weeks	How does the number of valence electrons relate to an element's placement on the periodic table and chemical reactivity?

End of Unit 1 Authentic Learning Task

Chemical Reactions Lab-Students will chemically react multiple known substances (e.g. Aluminum and copper) to compare the relative reactivity of the substances. They will then use their knowledge of atomic structure and periodic trends to explain why the chemicals reacted in this way. They will also predict how an untested element (e.g. Gold or Iron) would react in comparison to the substances that were tested.
Assessment-Students will turn in a lab handout which is assessed with an answer key for accuracy.

- I can determine proper safety gear according to the chemical hazards present.
- I can use the correct amount of significant figures in calculations.
- I can take accurate measurements to determine the density of an unknown substance.
- I can explain why elements in the same group have similar properties.
- I can identify and explain period and group trends in atomic radii, reactivity, ionization energy, and electronegativity.

Standards: HS-PS1-1, HS-PS1-2, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Pacing: Unit 1, Chapters 1-6
Semester 1, Quarter 1, 25 block days, 50 school calendar days

Indiana Academic Standards

HS-PS1-1, HS-PS1-2, HS-PS1-8, 11-12.LST.2.1, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.3.1, 11-12.LST.3.3, 11-12.LST.4.1, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.5.1, 11-12.LST.5.2, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Academic Vocabulary

Chapter 1

chemistry, substance, mass, weight, model, scientific method, qualitative data, quantitative data, hypothesis, experiment, safety goggles, Erlenmeyer flask, beaker, graduated cylinder

Chapter 2

base unit, meter, kilogram, kelvin, liter, density, scientific notation, dimensional analysis, conversion factor, accuracy, precision, error, percent error, significant figure

Chapter 3

states of matter, physical property, extensive property, intensive property, chemical property, physical change, density, chemical change, mixture, heterogeneous mixture, homogeneous mixture, solution, filtration, distillation, crystallization, sublimation, chromatography, element, compound, periodic table, percent by mass, law of multiple proportions

Chapter 4

electron, charge, proton, neutron, nucleus, atomic number, isotope, mass number, atomic mass unit, average atomic mass, radioactivity, radiation, nuclear reaction, radioactive decay, alpha radiation, alpha particle, nuclear equation, beta radiation, beta particle, gamma ray

Chapter 5

electromagnetic radiation, wavelength, frequency, amplitude, electromagnetic spectrum, quantum, Planck's constant, photoelectric effect, photon, atomic emission spectrum, electron dot diagram, Pauli exclusion principle, aufbau principle, ground state, atomic orbital, principal energy level, energy sublevel, electron configuration, valence electron

Chapter 6

periodic law, group, period, representative element, transition element, metal, alkali metal, alkaline earth metal, transition metal, inner transition metal, nonmetal, halogen, noble gas, metalloid

Key Concepts/Learning Targets

Chapter 1

- I can read and comprehend science and technical texts within a range of complexity appropriate for grade 11-12 independently and proficiently by the end of grade 12.
- I can write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.
- I can cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- I can determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or

concept; provide an accurate, objective summary of the text.

- I can follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
- I can analyze the structure of the relationships among concepts in a text, including relationships among key terms.
- I can analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
- I can translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
- I can assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
- I can compare and contrast findings presented in a text to those from other sources, noting when the findings support or contradict previous explanations or accounts.
- I can write arguments focused on discipline-specific content.
- I can write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.
- I can plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach, focusing on addressing what is most significant for a specific purpose and audience; and edit to produce and strengthen writing that is clear and coherent.
- I can use technology to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
- I can conduct short as well as more sustained research assignments and tasks to answer a question.
- I can gather relevant information from multiple authoritative sources, using advanced searches effectively.
- I can draw evidence from informational texts to support analysis, reflection , and research.
- I can differentiate between matter types and determine appropriate separation techniques.
- I can compare and contrast mass and weight.
- I can differentiate between qualitative and quantitative data.
- I can determine proper safety gear according to the chemical hazards present.

Chapter 2

- I can choose the correct SI unit for measurements.
- I can convert between standard and scientific notation.
- I can use dimensional analysis for unit conversion.
- I can use the correct amount of significant figures in calculations.

Chapter 3

- I can distinguish between physical and chemical properties in a substance.
- I can differentiate between a physical and chemical change.
- I can use the appropriate separation technique to separate mixtures of substance.
- I can calculate the percent by mass of each element in a compound.

- I can take accurate measurements to determine the density of an unknown substance.

Chapter 4

- I can model an atom of an element, including the quantity, location, and charge of each subatomic particle.
- Given the mass number and atomic number, I can determine the number of electrons, protons, and neutrons.
- Given the isotope percent abundances and masses, I can determine the average atomic mass of an element.
- I can identify the products of radiation
- I can calculate the half-life of an unstable nuclei

Chapter 5

- I can explain how a quantum of energy is related to an energy change of matter.
- I can explain the relationships among a hydrogen atom's energy levels, sublevels, and atomic orbitals.
- I can use the Pauli exclusion principle, the Aufbau principle, and Hund's rule to write electron configurations.
- I can draw electron dot diagrams to model valence electrons.

Chapter 6

- I can identify and use the key features of the periodic table.
- I can identify the four blocks of the periodic table.
- I can explain why elements in the same group have similar properties.
- I can recite group names and properties on the periodic table.
- I can identify and explain period and group trends in atomic radii, reactivity, ionization energy, and electronegativity.

Question Stems

Chapter 1

- Where can you find that in the text?
- How would you write this if you were speaking to another scientist?
- Can you cite specific textual evidence to support your answer?
- Can you summarize what the author is saying?
- What is the next step in the procedures?
- What is the name of the element that has the atomic symbol "C"?
- What is the relationship between the position on the periodic table and the electronegativity?
- Why do you think the author explained this to us?
- What does this graph tell us?
- Does this evidence support the author's claim?
- Does the scientific journal support the claim from the textbook?
- How could you write this so it could be understood by other scientists?
- Is there another way you could describe this that would be more clear to a general audience?
- Is there a way you could link your findings to this document?
- How could you test this hypothesis?

- Is this source authoritative and accurate?
- What evidence can you draw from the text to support your analysis?
- What can you do to determine if these two substances are different types of matter?
- What separation technique would you use to separate water from salt? Water from sand? Iron filings from sawdust?
- What is the difference between mass and weight?
- Is the color of gold a qualitative or quantitative observation?
- What safety gear should be used if the hazard indicated is toxic fumes? Corrosive material?

Chapter 2

- What is the SI unit for mass?
- What is the value of this in scientific notation?
- What is the value of the temperature in celsius and Kelvin?
- How many significant figures should be in this answer?

Chapter 3

- Can you list a chemical and physical property of this substance?
- Which observation indicated a physical change? A chemical change?
- What separation technique would you use to separate these two substances?
- What is the percent of oxygen in water?
- What is the density of the following block of metal?

Chapter 4

- How many electrons does carbon have, and where are they located around the atom?
- If the mass of an atom is 13 amu, and it has 7 protons, how many electrons and neutrons does it have?
- Why does an element have an average atomic mass that is not a whole number?
- If an unstable nuclei undergoes alpha decay, what particle is given off?
- If a substance has a mass of 10.0 grams initially, and a mass of 5.0 grams after 13 days, what is the half-life of the substance?

Chapter 5

- How is a quantum of energy related to an energy change of matter?
- How many orbitals does a hydrogen atom have?
- What is the electron configuration of a Carbon atom?
- How many dots will be around the C in an electron dot diagram of carbon?

Chapter 6

- What element is in period three, group 7A?
- In what block of the periodic table is iron located?
- Why does nitrogen behave in a similar way to phosphorus?

Resources/Activities	**Assessment(s)**
Chapter 1	Bell ringers

• Introductory activities and labs to build foundational skills necessary for chemical sciences. • Introductory activities to build foundational literacy skills necessary for interpreting graphs and data. • Quantitative vs. Qualitative lab **Chapter 2** • Density of pennies lab • Density calculation practice • Dimensional analysis critical thinking practice • Measurements lab **Chapter 3** • Chemical vs. Physical change lab • Separation of mixtures lab • Law of conservation of mass demonstration • Percent by mass lab **Chapter 4** • Atomic model drawings • Isotope calculations practice • Radioactive decay calculations practice • Half-life calculations practice **Chapter 5** • Periodic Table blocks drawing activity • Flame test lab • Electron Configuration videos • Electron configuration practice **Chapter 6** • Periodic Trend modeling Activity • Alien Periodic Table Activity • Atomic Model Drawings • Chemical Reactivity Lab	Exit tickets Quizzes Chapter Tests Lab Reports

Unit 2 Theme	**Duration of Unit**	**Essential Question(s)**
Bond Types	8 weeks	What is the difference in the strength of bonds in sugar and salt, and how does it determine the

		properties of these two substances?

End of Unit 2 Authentic Learning Task

Labeling Chemical Lab-Students will chemically react two unknown white crystalline substances (sugar and salt) to compare their solubility and electrical conductivity. They will then use their knowledge of different strengths of chemical bonds to determine whether the substances are held together covalently or ionically.

Assessment-Students will turn in a lab report which is assessed with a rubric for accuracy.

- I can determine proper safety equipment to use in the presence of unknown substances.
- I can make observations to determine if a chemical or physical reaction has taken place.
- I can label an unknown substance as ionic or covalent based on its physical and chemical properties.
- I can identify when the flash point of a chemical has been reached.
- I can identify if a solution conducts electricity based on observations.
- I can explain observed phenomena based on my knowledge and understanding of bonding types.
- I can predict what types of elements are found in the unknown chemicals based on the type of bond holding them together.

Standards: HS-PS1-3, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Pacing: Unit 2, Chapters 7-8
Semester 1, Quarter 2, 10 block days, 20 school calendar days

Indiana Academic Standards

HS-PS1-3, 11-12.LST.2.1, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.3.2, 11-12.LST.3.3, 11-12.LST.4.1, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.5.1, 11-12.LST.5.2, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Academic Vocabulary

Chapter 7

chemical bond, cation, anion, ionic bond, ionic compound, crystal lattice, electrolyte, lattice energy, formula unit, monatomic ion, polyatomic ion, oxyanion, electron sea model, delocalized electron, metallic bond, alloy

Chapter 8

covalent bond, molecule, bond dissociation energy, electronegativity, Lewis structure, sigma bond, pi bond, endothermic reaction, exothermic reaction, oxyacid, structural formula, resonance structures, coordinate covalent bond, VSEPR model, hybridization, polar covalent bond, single covalent bond, polar molecule, nonpolar molecule

Key Concepts/Learning Targets

Chapter 7

- I can determine the charge an atom will take as an ion.

- I can relate ion formation to electron configuration.
- I can draw a model of how ionic bonds form and how the ions are arranged in a compound.
- I can write the formula for compounds formed from different ions.
- I can name an ion based on its chemical formula.
- I can differentiate between ionic bonds and metallic bonds.
- I can differentiate between ionic compounds and covalent molecules

Chapter 8

- I can use the octet rule to determine the covalent bonds that will form between multiple atoms.
- I can explain why atoms are able to form single, double, and triple covalent bonds. I can differentiate between sigma and pi bonds.
- I can relate the strength of a covalent bond to its bond length and dissociation energy.
- I can name a binary molecular compound.
- I can name acidic solutions.
- I can draw a Lewis structure of simple covalent molecules.
- I can explain why resonance occurs and draw resonance structures.
- I can list exceptions to the octet rule and explain why those exceptions occur.
- I can summarize the VSEPR bonding theory.
- I can use the VSEPR bonding theory to predict the shape and angles in a molecule.
- I can use electronegativity to determine bond type.
- I can identify polar and nonpolar molecules based on their Lewis structures.
- I can compare and contrast the chemical and physical characteristics of polar and nonpolar covalent molecules.

Question Stems

Chapter 7

- What charge will a fluorine atom take as an ion?
- How does ion formation relate to electron configuration?
- When an ionic bond forms between sodium and chloride, how are the ions arranged in the crystal?
- What is the chemical formula of the compound formed between Oxide ion(s) and Sodium ion(s)?
- What is the name of the compound with the formula of MgO_2?
- What is the difference in the electrons of ionic bonds and metallic bonds?

Chapter 8

- Using the octet rule, how many covalent bonds do you think Carbon will make?
- Why is carbon able to form single, double, and triple covalent bonds?
- How many sigma bonds are in a molecule of sucrose? How many pi bonds?
- Carbon monoxide has a stronger covalent bond than methane, so which chemical do you think has a longer bond?
- What is the name of the compound C_2H_6?
- What is the name of the acid H_2SO_4?

- When drawing CH_4, which element will be in the center?
- Why does resonance occur?
- Why is hydrogen an exception to the octet rule?
- In your own words, what does VSEPR theory tell us?
- Which will take up more space-a single bond, or a lone pair of electrons?
- Is a bond between fluorine and carbon a polar bond or a non-polar bond?
- Is methane going to be a polar or nonpolar molecule?
- If sucrose is a polar molecule, will it dissolve in water? Will it conduct electricity after it dissolves?

Resources/Activities	**Assessment(s)**
Chapter 7 ● Modeling electron motion ● Diagramming formation of ions ● Videos on Electron Diagramming ● Electron-Dot Structures ● Ionic Compound Bingo ● Ionic Compound Group activity ● Ionic Compound Naming Practice **Chapter 8** ● Atomic Lewis Structure modeling ● Compound Lewis Structure modeling ● Drawing Resonance Structures ● Exothermic vs. Endothermic Demo ● Molecular Model Lab ● Naming Molecules Practice ● Labeling Chemicals Lab	Bell ringers Exit tickets Quizzes Chapter Tests Lab Reports

Unit 3 Theme	**Duration of Unit**	**Essential Question(s)**
Chemical Reactions and Quantities	8 weeks	What products will form when the given reactants chemically combine?

End of Unit 3 Authentic Learning Task

Hydrogen Bomb Lab-Students read about the Nuremberg before beginning the lab. Students are given three solutions of hydrochloric acid of equal amounts and concentrations. Then students measure out different amounts of a metal, (0.6 grams, 1.2 grams, 2.4 grams). The metal is added

to the acid, and the hydrogen gas (the same gas in the Nuremberg) that forms from the chemical reaction is collected in a balloon. We observe the flasks to see that metal is still present in one, and use our observations to determine the limiting reactant in each flask. We then blow up the balloons and discuss how severe the reaction would be if we blew up a balloon as big as the Nuremberg.
Assessment-Students will turn in a lab report which is assessed with a rubric for accuracy.

- I can determine proper safety equipment to use in the presence of unknown substances.
- I can identify the limiting reactant in each flask.
- I can calculate the amount of gas formed in each flask.
- I can explain why two flasks have the same amount of gas formed based on my understanding of limiting reactants.
- I can write the chemical equation for the reaction occurring in the flasks.

Standards: HS-PS1-7, HS-PS1-9, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Pacing: Unit 3, Chapters 9-11
Semester 1, Quarter 2, 10 block days, 20 school calendar days

Indiana Academic Standards

HS-PS1-6, HS-PS1-7, HS-PS1-9, 11-12.LST.2.1, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.3.2, 11-12.LST.3.3, 11-12.LST.4.1, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.5.1, 11-12.LST.5.2, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Academic Vocabulary

Chapter 9
chemical reaction, reactant, product, chemical equation, coefficient, synthesis reaction, combustion reaction, decomposition reaction, single-replacement reaction, double-replacement reaction, precipitate, spectator ion, aqueous solution, solute, solvent, complete ionic equation, net ionic equation

Chapter 10
mole, Avogadro's number, molar mass, percent composition, empirical formula, molecular formula, hydrate

Chapter 11
stoichiometry, mole ratio, limiting reactant, excess reactant, theoretical yield, actual yield, percent yield

Key Concepts/Learning Targets

Chapter 9

- I can use observations to determine if a chemical change took place.
- I can use appropriate symbols to represent a chemical reaction.
- I can balance chemical reactions and explain why reactions must be balanced.
- I can classify and describe the major types of chemical reactions.
- I can describe an aqueous solution.

- I can write complete and net ionic equations and identify spectator ions.
- I can predict whether or not a reaction will occur based on the chemicals given.

Chapter 10

- I can use a mole to indirectly count the number of particles of matter in a substance.
- I can use dimensional analysis to convert between moles and particles.
- I can convert between the moles of an element and the mass of the element.
- I can convert between the mass of a compound and the moles of the compound.
- I can choose the correct conversion factor to convert between moles, liters, or mass.
- I can determine the percent composition from experimental data, and use this to determine the empirical formula of a substance.
- I can determine the molecular formula if given the empirical formula and mass data.
- I can determine the mass of water in a hydrate through experimental data.

Chapter 11

- I can determine relationships between chemicals from a balanced chemical equation.
- I can write mole ratios from balanced chemical equations.
- I can convert between mass of a reactant to mass of a product given a balanced chemical equation.
- I can determine which reactant is going to limit the amount of product I make.
- I can determine how much of the excess reactant will remain after the reaction is complete.
- I can determine the mass of everything remaining in the beaker at the end of the reaction.
- I can determine the theoretical yield of the chemical reaction.
- I can calculate the percent yield for a chemical reaction.

Question Stems

Chapter 9

- What do you notice that tells you a chemical change took place?
- What is the symbol for yields?
- Why must reactions be balanced?
- What type of reaction always has carbon dioxide and water as products?.
- What does aqueous mean?
- Which ions do you leave out of a net ionic equation?
- If you combine NaCl and LiCl, will a reaction occur?

Chapter 10

- How many carbon atoms are in 3.2 moles of carbon?
- How many moles of carbon are in 14.9 grams of carbon?
- What is the mass of 3.2 moles of water?
- What conversion factor will you use to convert between moles and liters at standard temperature and pressure?
- What is the percent by mass of a compound found to contain 32.00 grams of oxygen and 4.04 grams of hydrogen? What is the empirical

formula of that compound?
- If the empirical formula of a compound is CH_2O and the molar mass of the compound is 60.04 grams, what is the molecular formula?
- What is the formula for a hydrate that is 13% water by mass?

Chapter 11
- Using this balanced equation, if you start with 3 moles of Oxygen gas, how many moles of carbon dioxide gas will you produce?
- What is the molar ratio of oxygen and carbon dioxide?
- If you start with 13.9 grams of oxygen gas, what mass of carbon dioxide gas will you produce?
- Which reactant will you run out of first?
- How much of the other reactant is left?
- At the end of the reaction, what is the total mass?
- Theoretically, how much of the carbon dioxide should you produce?
- If you actually only produced 5.9 grams of carbon dioxide, what was your percent yield?

Resources/Activities	**Assessment(s)**
Chapter 9 ● Chemical Reaction Demos ● Chemical Reaction Lab ● Balancing equations practice ● Predicting Products Practice ● Predicting Products Matching game **Chapter 10** ● Molar Mass Practice ● Formula of a Hydrate Lab ● Empirical Formula Determination Practice **Chapter 11** ● Stoichiometry Calculations Practice ● Limiting reactant lab ● Hydrogen Bomb Lab ● Percent Yield Lab ● Percent Yield Practice	Bell ringers Exit tickets Quizzes Chapter Tests Lab Reports

Unit 4 Theme	**Duration of Unit**	**Essential Question(s)**
States of Matter	3 weeks	What is the primary reason why one chemical will be a liquid at room temperature, while

		another will be a gas?

End of Unit 4 Authentic Learning Task

Popcorn Kernel lab-When the water vapor pressure inside a popcorn kernel is great enough, the kernel bursts and releases the water vapor. Students will use the ideal gas law to find the pressure in the kernel as it bursts. We also put mentos in diet coke and theorize why this causes an explosion of diet coke, bringing in both kinetic-molecular theory, intermolecular forces, and reaction rates.

Assessment-Students will turn in a lab report which is graded with a rubric for accuracy.

- I can determine proper safety equipment to use in the presence of hot plates.
- I can identify the different phases of water within the corn kernel.
- I can use the ideal gas law to determine the pressure of the water vapor in the kernel as it bursts.
- I can use the kinetic-molecular theory, gas laws, and intermolecular forces to theorize why mentos in diet coke causes an explosion.

Standards: HS-PS1-9, HS-PS1-10, HS-PS3-2, HS-PS1-3, HS-PS1-5, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Pacing: Unit 4, Chapters 12-13
Semester 2, Quarter 3, 8 block days, 16 school calendar days

Indiana Academic Standards

HS-PS1-9, HS-PS1-10, HS-PS3-2, HS-PS1-3, HS-PS1-5, 11-12.LST.2.1, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.3.2, 11-12.LST.3.3, 11-12.LST.4.1, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.5.1, 11-12.LST.5.2, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Academic Vocabulary

Chapter 12

kinetic-molecular theory, elastic collision, temperature, diffusion, Graham's law of effusion, pressure, barometer, pascal, atmosphere, Dalton's law of partial pressures, dispersion force, dipole-dipole force, hydrogen bond, viscosity, surface tension, surfactant, crystalline solid, unit cell, allotrope, amorphous solid, melting point, vaporization, evaporation, vapor pressure, boiling point, freezing point, condensation, deposition, phase diagram, triple point

Chapter 13

Boyle's law, absolute zero, Charles's law, Gay-Lussac's law, combined gas law, Avogadro's principle, molar volume, standard temperature and pressure (STP), ideal gas constant (r), ideal gas law

Key Concepts/Learning Targets

Chapter 12

- I can explain the behavior of a gas using the kinetic-moleculary theory.
- I can explain how mass affects the rates of diffusion and effusion.

- I can explain how the partial pressure of a gas is calculated.
- I can rate the strength of intermolecular forces.
- I can explain the difference between intra and intermolecular forces.
- I can explain the difference in the arrangements of particles in liquids and solids.
- I can explain the cause of a phase change in relation to energy change.
- I can use a phase change diagram to determine the phase a chemical is in, given the temperature and pressure.

Chapter 13

- I can explain the relationships among pressure, temperature, and volume of a constant amount of gas.
- I can use the gas laws to solve problems involving the pressure, temperature, and volume of a constant amount of gas.
- I can relate the number of particles of gas to the gas's volume.
- I can explain how the amount of gas present is related to the pressure, temperature, and volume.
- I can explain the difference between ideal gases and real gases.
- I can calculate the amounts of gaseous reactants and products in chemical reactions.

Question Stems

Chapter 12

- How is the kinetic-molecular theory used to explain the behavior of gases?
- Why does mass affect the rates of diffusion and effusion?
- How is the partial pressure of a gas calculated?
- What are intramolecular forces?
- Which is the strongest intermolecular force?
- What is different about the way particles in liquids and particles in a solid arrange themselves?
- How can the addition of energy cause a phase change?
- Using the phase change diagram, what phase is water in at 1.7 atmospheres of pressure at a temperature of 325 K?

Chapter 13

- If the temperature of a gas goes up, what will happen to the pressure as a result?
- Knowing that PV=nRT, how can you rearrange this to solve for the temperature of the gas?
- How does Avogadro's principle relate the number of particles of gas to the gas's volume?
- How is the amount of gas present related to its pressure, temperature, and volume by the ideal gas law?
- What are the properties of real gases and of ideal gases?
- How are the amounts of gaseous reactants and products in a chemical reaction calculated?

Resources/Activities	**Assessment(s)**
Chapter 12 • ConnectED Student Center, • Videos,	Bell ringers Exit tickets Quizzes

• Animations, • WebQuests, • Phase Change Drawings • Rates of evaporation lab **Chapter 13** • Mini Gas laws labs • Vocabulary puzzles • Popcorn Kernel Lab • Gas law critical thinking practice • Gas law demonstration-marshmallow with syringe • Gas law demonstration-balloon with dry ice • Gas law demonstration-balloon with boiling water • Gas law videos	Chapter Tests Lab Reports

Unit 5 Theme	**Duration of Unit**	**Essential Question(s)**
Energy	5 weeks	Can you illustrate the fact that the release of energy from a chemical reaction system depends upon the changes in total bond energy?

End of Unit 5 Authentic Learning Task

Calorimetry Lab-Students learn how scientists determine the amount of calories in the foods they eat, and how to read the packaging labels. Students will perform a calorimetry experiment, where they measure the temperature of the water, add a large piece of hot iron to the water, and take the final temperature of the water. They will calculate how much heat was transferred from the metal into the water, and then relate this to how much energy is released when their favorite granola bar is burned-this amount is how much energy our body gains when we eat the granola bar.

Assessment-Students will turn in a lab report, which is graded with a rubric for accuracy.

- I can determine proper safety equipment to use in the presence of a bunsen burner.
- I can determine where the energy has moved within the system.
- I can calculate the enthalpy change in the reaction for the water and the metal.
- I can use the calorimetry equation to calculate the amount of energy found in my favorite granola bar.
- I understand that Joules and calories are units of energy, and can convert from one to the other.

Standards: HS-PS1-9, HS-PS1-10, HS-PS3-2, HS-PS1-3, HS-PS1-5, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Pacing: Unit 5, Chapter 15
Semester 2, Quarter 3, 12 block days, 24 school calendar days

Indiana Academic Standards

HS-PS1-9, HS-PS1-10, HS-PS3-1, HS-PS3-2, HS-PS3-3, HS-PS1-5, 11-12.LST.2.1, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.3.2, 11-12.LST.3.3, 11-12.LST.4.1, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.5.1, 11-12.LST.5.2, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Academic Vocabulary

Chapter 15

energy, kinetic energy, potential energy, law of conservation of energy, chemical potential energy, heat, calorie, joule, specific heat, calorimeter, thermochemistry, system, surroundings, universe, enthalpy, enthalpy of reaction, thermochemical equation, enthalpy of combustion, molar enthalpy of vaporization, molar enthalpy of fusion, Hess's law, standard enthalpy of formation

Key Concepts/Learning Targets

Chapter 15

- I can explain how potential and kinetic energy differ.
- I can explain how chemical potential energy can be related to the heat lost or gained in chemical reactions.
- I can explain how the amount of heat absorbed or released by a substance is calculated as its temperature changes.
- I can explain the difference between heat and temperature.
- I can explain how a calorimeter is used to measure energy that is absorbed or released.
- I can explain how enthalpy and enthalpy change are related to chemical reactions and processes.
- I can write a thermochemical equation for chemical reactions.
- I can explain how energy is lost or gained during changes of state.
- I can calculate the amount of heat that is absorbed or released in a chemical reaction.
- I can calculate the amount of heat that is absorbed or released during phase changes.
- I can use Hess's law to calculate the enthalpy change for a reaction indirectly.
- I can calculate the change in enthalpy by using thermochemical equations.
- I can use standard enthalpies of formation to determine the enthalpy change for an overall reaction.

Question Stems

Chapter 15

- How do potential and kinetic energy differ?
- How can chemical potential energy be related to the heat lost or gained in chemical reactions?
- How is the amount of heat absorbed by the water calculated as the water's temperature changes?
- What are we measuring when we use a calorimeter?

- What does enthalpy change mean in terms of chemical reactions and processes?
- What do we need to add to turn a regular chemical equation into a thermochemical equation?
- When the frozen water melted, did it gain energy or lose it? Where did the energy come from?
- Why does Hess's law work to calculate enthalpy change indirectly?
- When a phase change occurs, what information do we need to calculate the amount of energy released?
- How do we calculate the enthalpy change using thermochemical equations? What things do we need to add together?
- Using this enthalpy of formation chart, which numbers do we add together to calculate the enthalpy change for the reaction?

Resources/Activities	**Assessment(s)**
Chapter 15 ● videos ● animations ● webquest ● thermochemical equation practice ● enthalpy change practice ● Calorimetry lab ● phase change critical thinking ● Hess's law practice ● Supplemental problems	Bell ringers Exit tickets Quizzes Chapter Tests Lab Reports

Unit 6 Theme	**Duration of Unit**	**Essential Question(s)**
Acids and Bases	8 weeks	What does a change in pH mean about the concentration of hydrogen ions in the solution?

End of Unit 6 Authentic Learning Task

Titration Lab-Students determine the concentration of common household items (oven cleaner, windex, lemon juice, vinegar) in a solution by the titration method. They use their knowledge of indicators to determine which indicator would be the best one to use for their chemical, learn the basics of titration, and see that a clear, innocent looking liquid could have a lethal amount of chemical in it. We then discuss how they would neutralize this solution based on our understanding of chemical equilibrium and thermodynamics.

Assessment-Students will show their work with a lab report, which is assessed with a rubric for accuracy as well as lab technique and percent error.

- I can determine proper safety equipment to use in the presence of acids and bases.
- I can set up titration equipment and know the names of the laboratory equipment.
- I can identify an end point.

- I can determine the best indicator to use.
- I can calculate the concentration of a substance based on data collected during a titration.
- I can neutralize an acid or base to make it safe for disposal.
- I can predict what the products of a neutralization reaction will be.

Standards: HS-PS1-6, HS-PS1-7, HS-PS1-9, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Pacing: Unit 6, Chapter 14 & 18
Semester 2, Quarter 4, 12 block days, 24 school calendar days

Indiana Academic Standards

HS-PS1-6, HS-PS1-7, HS-PS1-9, 11-12.LST.2.1, 11-12.LST.2.2, 11-12.LST.2.3, 11-12.LST.3.2, 11-12.LST.3.3, 11-12.LST.4.1, 11-12.LST.4.2, 11-12.LST.4.3, 11-12.LST.5.1, 11-12.LST.5.2, 11-12.LST.7.1, 11-12.LST.7.2, 11-12.LST.7.3

Academic Vocabulary

Chapter 14

soluble, miscible, insoluble, immiscible, precipitate, concentration, molarity, mole fraction, solvation, heat of solution, unsaturated solution, saturated solution

Chapter 18

acidic solution, basic solution, Arrhenius model, Bronsted-Lowry model, conjugate acid, conjugate base, conjugate acid-base pair, amphoteric, Lewis model, strong acid, weak acid, acid ionization constant, strong base, weak base, ion product constant for water, pH, pOH, neutralization reaction, salt, titration, titrant, equivalence point, acid-base indicator, end point, salt hydrolysis

Key Concepts/Learning Targets

Chapter 14

- I can describe concentration using moles per liter, and parts per million.
- I can determine the concentration of a solution.
- I can calculate the molarity of a solution.
- I can explain how intermolecular forces affect solvation.
- I can define solubility and explain what factors affect it.

Chapter 18

- I can describe the physical and chemical properties of acids and bases.
- I can label a solution as acid, base, or neutral based on its pH value.
- I can explain the difference between the three acid-base theories.
- I can predict the strength of an acid or base based on its degree of ionization.

- I can predict the strength of a conjugate base if given the strength of the original acid.
- I can predict the strengths of acids and bases based on the values of their ionization constants.
- I can explain pH and pOH both verbally and numerically.
- I can explain how pH and pOH are related to the ion product constant for water.
- I can calculate the pH and pOH of aqueous solutions.
- I can predict the products of a neutralization reaction.
- I can use a neutralization reaction to perform an acid-base titrations.

Question Stems

Chapter 14

- How can concentration be described using different units?
- How are the concentrations of solutions determined?
- What is the molarity of a solution and how can it be calculated?
- How do intermolecular forces affect solvation?
- What is solubility?
- Which factors affect solubility?

Chapter 18

- What are the physical and chemical properties of acids? bases?
- How are solutions classified as acidic, basic, or neutral?
- How do the Arrhenius, Bronsted-Lowry, and Lewis models of acids and bases compare?
- How is the strength of an acid or base related to its degree of ionization?
- How does the strength of a weak acid compare with the strength of its conjugate base?
- What is the relationship between the strengths of acids and bases and the values of their ionization constants?
- What are pH and pOH?
- How are pH and pOH related to the ion product constant for water?
- How are the pH and pOH of aqueous solutions calculated?
- What do chemical equations of neutralization reactions look like?
- How are neutralization reactions used in acid-base titrations?

Resources/Activities	**Assessment(s)**
Chapter 14 ● Factors affecting Solvation lab ● Determining concentration activity ● Molarity conversion practice	Bell ringers Exit tickets Quizzes Chapter Tests Lab Reports

Chapter 18 • Aquarium Analysis • Household product pH mini lab • Indicator solution lab • Videos • pH and pOH calculation practice • Titration practice • Titration Lab	

Indiana Academic Standards Addressed and Assessed Each Term Chemistry (A=assessed; I=introduced; P=practiced; R=reviewed) (Green=high priority; Yellow=moderate priority; Blue=low priority)					
Standard	**Standard Statement**	**Term 1**	**Term 2**	**Term 3**	**Term 4**
Matter and its Interactions					
HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	I, P, R, A	R	R	R
HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	I, P, R, A	R	R	R
HS-PS1-3	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.	I, P, R, A	P, R, A	P, R, A	P, R, A
HS-PS1-4	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.			I, P, R, A	P, R, A
HS-PS1-5	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.			I, P	I, P

HS-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.		I, P, R, A		
HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	I, P, R, A	P, R, A	P, R, A	P, R, A
HS-PS1-8	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	I, P			
HS-PS1-9	Use mathematical representations to describe the composition and properties of individual solutions and solutions involved in chemical reactions.			I, P, R, A	P, R, A
HS-PS1-10	Analyze data to support the claim that the combined gas law describes the relationships among volume, pressure and temperature for a sample of an ideal gas.			I, P, R, A	
Energy					
HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.			I, P,	P, R, A
HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).	I	I	P, R, A	
HS-PS3-3	Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).				I, P, R, A
Literacy in Science & Technical Subjects					
11-12.LST.2.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	P	P	P	P

11-12.LST.2.2	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	P	P	P	P
11-12.LST.2.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.	I	P	P	P
11-12.LST.3.1	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.	P	P	P	P
11-12.LST.3.2	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.	P	P	P	P
11-12.LST.3.3	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.	P	P	P	P
11-12.LST.4.1	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	P	P	P	P
11-12.LST.4.2	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.		P		P
11-12.LST.4.3	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	P	P	P	P
11-12.LST.5.1	Write arguments focused on discipline-specific content.	P	P	P	P

11-12.LST.5.2	Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.	P	P	P	P
11-12.LST.6.1	Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach, focusing on addressing what is most significant for a specific purpose and audience; and edit to produce and strengthen writing that is clear and coherent.	P			
11-12.LST.6.2	Use technology to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.	P			
11-12.LST.7.1	Conduct short as well as more sustained research assignments and tasks to answer a question (including a self-generated question), test a hypothesis, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	P	P	P	P
11-12.LST.7.2	Gather relevant information from multiple types of authoritative sources, using advanced searches effectively; annotate sources; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; synthesize and integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and over reliance on any one source and following a standard format for citation (e.g., APA or CSE).	P	P	P	P
11-12.LST.7.3	Draw evidence from informational texts to support analysis, reflection, and research.	P	P	P	P