

Grade: 10-11

Course Title: Academic Chemistry

Topic/Concept: Introduction to Chemistry

Time Allotment: 19 days

Unit Sequence: 1

Major Concepts to be learned:

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|---|---|---|
| <ul style="list-style-type: none">• Nature of chemistry• Nature of measurement• Experimental Design | <ul style="list-style-type: none">• Measurement and Significant Figures• Classification of Matter• Properties of Matter | <ul style="list-style-type: none">• Dimensional Analysis• Scientific Notation• Lab Safety and Equipment |
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Expected Skills to be demonstrated:

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| <ul style="list-style-type: none">• Explain the difference between accuracy and precision, and the significance of having data that is both.• List the standard units for length, mass, time, temperature, and amount of substance and mathematically convert between units of measurement using dimensional analysis.• Identify the nature of chemistry• Classify and differentiate matter as elements, compounds, homogeneous mixtures, and heterogeneous mixtures based on its composition.• Distinguish between properties of matter that are extensive vs. intensive and physical vs. chemical including examples in your explanation.• Explain the difference between a chemical change and a physical change, including which results in a chemical reaction occurring.• List some signs that may demonstrate that a chemical reaction has occurred.• Be able to classify matter as elements, compounds, homogeneous mixtures, and heterogeneous mixtures based on a picture description, or real-world example and to defend your classification with reasoning.• Given a scenario or description, classify a property or change as chemical or physical and relate it to its composition.• Calculate density and use it to identify unknown substances.• Explain how the law of conservation of matter applies to physical or chemical changes. |
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PA Standard/NGSS:

SEP/DCI/CCC:

3.2.9-12.B
3.2.9-12.D
HS-PS1-2

SEP: Developing and Using Models, Planning and Carrying Out Investigations, Using Mathematics and Computational Thinking
DCI: PS1:A, PS1.B, PS2:B,
CCC: Patterns, Energy and Matter

Instructional Strategies:

Assessments:

Cooperative groups
Problem solving activities
Lecture
Written work
Hands-on activity
Graphic organizers
Evaluating

Group discussion
Note Taking
Charting
Summarizing
Outlining
Graphic Calculators

Discovery Stations: Safety and Equipment
Activity: Lab Equipment Posters
Card Sort: Lab Equipment
Review: I Have, Who Has
Activity: Introduction to CER
Research and Report: Careers in Chemistry
Review: Experimental Design
Practice: Measurements
Practice: Significant Figures

Practice: Dimensional Analysis
Practice: Scientific Notation
Lab Activity: Fun with Fudge
Inquiry Activity: Intro to Concept 3
Practice: Classification of Matter
Practice: Properties of Matter
Lab Stations: Exploring Matter

Grade: 10-11

Course Title: Academic Chemistry

Topic/Concept: The Atom

Time Allotment: 18 days

Unit Sequence: 2

Major Concepts to be learned:

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| <ul style="list-style-type: none">• Atomic Theory• Atomic Structure• The Periodic Table | <ul style="list-style-type: none">• Isotopes• Bohr Models• Nuclear Chemistry |
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Expected Skills to be demonstrated:

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| <ul style="list-style-type: none">• Differentiate between the Bohr model, the plum pudding model, the nuclear model and the electron cloud model.• Draw a sketch that represents our current understanding of the structure of the atom. Label the two main parts, the subatomic particles, and their charges.• Explain the structure of the electron cloud.• Describe the forces that hold the atom together.• Understand how scientific discoveries, like the atomic theory, are based upon experimentation and build upon each other exemplifying the very nature of science.• Describe the pattern/shared characteristics that elements in the same group share vs. elements in the same period.• Explain why elements in the same group often have similar properties, names and characteristics which define these groups,• Differentiate between the characteristics of metals, nonmetals and metalloid including where they can be found on the periodic table.• Give an example of hyphen and nuclear notation for the most common isotope of hydrogen and explain what the notation tells you about the atom.• Explain what it means for an atom to be electrically neutral, and include the name for an atom that is NOT electrically neutral.• Be able to use and interpret a periodic table to determine information about an element.• Distinguish between a nuclear reaction and a chemical reaction |
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PA Standard/NGSS:

SEP/DCI/CCC:

3.2.9-12.A
3.2.9-12.C
HS-PS1-1
HS-PS1-8

3.2.9-12.H
3.2.9-12.G

SEP: Developing and Using Models, Obtaining, evaluating and communicating information
DCI: PS1:C, PS1.B, PS2:B,
CCC: Patterns, Energy and Matter, Cause and Effect, Systems and System Models

Instructional Strategies:

Assessments:

Cooperative groups
Problem solving activities
Lecture
Written work
Hands-on activity
Graphic organizers
Evaluating

Group discussion
Note Taking
Charting
Summarizing
Outlining
Graphic Calculators

Activity: Atomic Theory
Timeline Model
Practice: Atomic Structure
Project: The Atom Children's
Book
Discovery Stations: Periodic
Table
Practice: Atomic Calculations
Practice: Isotope Calculations #1

Practice: Isotope Calculations #2
Practice: Isotope Race
Class Project: Bohr Model
Periodic Table
Inquiry Activity: Intro. to
Concept 3
Research Project: Nuclear
Chemistry

Grade: 10-11

Course Title: Academic Chemistry

Topic/Concept: Electrons

Time Allotment: 13 days

Unit Sequence: 3

Major Concepts to be learned:

- Electrons and the EM Spectrum
- Electrons and Stability
- Electron Configuration
- Periodic Trends

Expected Skills to be demonstrated:

- Explain both the wave and particle natures of electrons.
- Explain the relationship between electrons, energy, and electromagnetic radiation.
- Summarize the mathematical relationship between the speed, wavelength and frequency of electromagnetic radiation.
- Write out the types of radiant energy in the electromagnetic spectrum including the trends in wavelength, frequency, and energy along the spectrum.
- Draw a picture that represents the difference between an electron's ground state vs. excited state, and what impacts it.
- Explain what makes an atom stable and what an atom may do to become stable. Identify which elements are already stable and why.
- Differentiate between cations and anions.
- Compare two waves and determine which has the greater wavelength, frequency, and/or energy based on the electromagnetic spectrum.
- Be able to illustrate the valence electrons of atoms using Lewis structure.
- Differentiate between Bohr's model of the atom and the quantum model of the atom.
- Summarize the organization of the first three shells of the electron cloud. Include their orbitals and how many total electrons they can hold.
- Explain the three laws that determine the electron configuration of an atom.
- Summarize what starts happening in the fourth period that makes the configuration of electrons more complicated.
- Be able to distinguish the s, p, d, and f blocks on the periodic table and relate them to an atom's electron configuration.
- Be able to write the electron configuration for an atom when given a periodic table for reference, using both electron-configuration notation and noble-gas notation.
- Summarize the connection between Coulomb's law and the periodic trends.
- Explain the following trends seen in the periodic table. Use a visual if it helps you to explain the patterns: atomic radii, reactivity, electronegativity, ionization energy, and ionic radii
- Explain how the shielding effect works.
- Describe how the difference in electronegativity between two atoms can be used to predict the type of bond that could form. Include an example to support your description.
- Identify the oxidation numbers for elements in groups 1, 2, and 13-17.

PA Standard/NGSS:

SEP/DCI/CCC:

3.2.9-12.A 3.2.9-12.C HS-PS1-1 HS-PS1-2	3.2.9-12.H 3.2.9-12.G HS-PS1-5	SEP: Developing and Using Models, Asking questions, Using mathematics and computational thinking, Obtaining, evaluating and communicating information DCI: PS1:C, PS1.B, PS2:B, CCC: Patterns, Energy and Matter, Cause and Effect, Systems and System Models
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Instructional Strategies:

Assessments:

Cooperative groups Problem solving activities Lecture Written work Hands-on activity Graphic organizers Evaluating	Group discussion Note Taking Charting Summarizing Outlining Graphic Calculators	Practice: Electrons and the EMS Lab: Flame Tests Practice: Lewis Structures Practice: Electron Configurations Activity: Puny Configurations Game: Electron Confingo Inquiry Activity: Graphing	Periodic Trends Practice: Predicting Bonds Game: This or That Research and Report: Elements in the Body Project: Element Family Portrait
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Grade: 10-11

Course Title: Academic Chemistry

Topic/Concept: Chemical Bonds

Time Allotment: 25 days

Unit Sequence: 4

Major Concepts to be learned:

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| • Introduction to Bonding | • Covalent Bonding |
| • Lewis Structures | • Molecular Geometry |
| • Ionic Bonding | • Intermolecular Forces |
| • Metallic Bonding | |

Expected Skills to be demonstrated:

- Differentiate between the forces between different substances versus the forces within a substance.
- Explain why most atoms form chemical bonds and why some atoms don't.
- Distinguish covalent bonds from ionic bonds and the properties of covalent compounds from the properties of ionic compounds.
- Be able to explain what a chemical formula tells you about a compound and predict properties of the compound based on the bonds that hold it together.
- Be able to identify a bond or a compound as ionic or covalent based on a picture, description, difference in electronegativity, or example.
- Be able to use an element's location on the periodic table to predict its oxidation number and bonding tendencies.
- Explain the connection between electronegativity and the formation of an ionic bond and the "rule of zero charge".
- Differentiate between binary ionic compounds, compounds with polyatomic ions, and binary molecular compounds.
- Explain why it is necessary to include a Roman numeral when naming an ionic compound with a transition metal.
- Give an example of a common compound and how the properties of the elements that make it up are different from that of the compound itself.
- Be able to apply nomenclature rules to determine the chemical formula and the name of an ionic compound, including those with polyatomic ions and/or transition metals.
- Draw Lewis structures to represent ionic compounds.
- Name and write the chemical formulas for ionic compounds, including those with polyatomic ions and transition metals.
- Explain what makes a metallic bond different from an ionic versus a covalent.
- Explain why the "sea of e⁻" forms in metallic bonds and why this makes them good electrical conductors.
- Differentiate between polar covalent and nonpolar covalent bonds. Give an example of each.

PA Standard/NGSS:

SEP/DCI/CCC:

3.2.9-12.B 3.2.9-12.C HS-PS1-1 HS-PS1-3	3.2.9-12.D 3.2.9-12.F HS-PS1-6	SEP: Developing and Using Models, Asking questions, Using mathematics and computational thinking, Obtaining, evaluating and communicating information DCI: PS1:C, PS1.B, PS2:B, CCC: Patterns, Energy and Matter, Cause and Effect, Systems and System Models
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Instructional Strategies:

Assessments:

Coooperative groups Problem solving activities Lecture Written work Hands-on activity Graphic organizers Evaluating	Group discussion Note Taking Charting Summarizing Outlining Graphic Calculators	Lab Stations: Exploring Compounds Practice: Interpreting Chemical Formulas Practice: Ionic vs. Covalent Inquiry Activity: Drawing Lewis Structures for Compounds Practice: Drawing Lewis Structures for Compounds Research and Report: Common Compounds Activity: Modeling Ionic Compounds Practice: Naming Ionic Compounds w/ Polyatomic Ions Practice: Naming Ionic Compounds w/ Transition Metals	Practice: Ionic Naming Race Activity: Alloy Ads Card Sort: Chemical Bonds Practice: Naming Covalent Compounds #1 Practice: Naming Covalent Compounds #2 Task Cards: Naming Practice: Mixed Nomenclature Inquiry Activity: Molecular Model
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Grade: 10-11

Course Title: Academic Chemistry

Topic/Concept: Chemical Reactions

Time Allotment: 16 days

Unit Sequence: 5

Major Concepts to be learned:

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| <ul style="list-style-type: none">• Writing Reactions• Balancing Reactions• Classifying Reactions | <ul style="list-style-type: none">• Chemical Equilibrium |
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Expected Skills to be demonstrated:

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| <ul style="list-style-type: none">• Differentiate between physical and chemical changes.• Explain the collision theory and provide evidence that a chemical reaction has occurred.• Explain the Law of Conservation of Mass and how it relates to chemical reactions.• Differentiate between, label, interpret, balance and write equations for chemical reactions with correct notation including coefficients and subscripts.• Be able to list the number of atoms of each element in a compound.• Create a chart to summarize and organize the characteristics of the types of chemical reactions.• Be able to classify reactions based on an equation or description.• Be able to identify if a chemical reaction will occur using the activity series.• Be able to predict the products that will result from a chemical reaction when given the reactants.• Be able to write, balance, and classify reactions when given a written description.• Explain what chemical equilibrium is and what it is not.• Describe an example of Le Chatelier's principle at work.• Describe the response to a change in concentration, temperature, and pressure for a chemical reaction in equilibrium.• Be able to predict the response to a specific change in condition on a chemical reaction in equilibrium when given a model, description, or example.• Be able to interpret diagrams and graphs that represent reactions in chemical equilibrium.• Be able to identify reactions as endothermic or exothermic. |
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PA Standard/NGSS:

SEP/DCI/CCC:

3.2.9-12.A
3.2.9-12.C
HS-PS1-2
HS-PS1-6

3.2.9-12.H
3.2.9-12.G
HS-PS1-7

SEP: Constructing Explanations and Designing Solutions, Using mathematics and computational thinking, Obtaining, evaluating and communicating information
DCI: PS1.B, PS2:B,
CCC: Stability and Change, Systems and System Models

Instructional Strategies:

Assessments:

Cooperative groups
Problem solving activities
Lecture
Written work
Hands-on activity
Graphic organizers
Evaluating

Group discussion
Note Taking
Charting
Summarizing
Outlining
Graphic Calculators

Inquiry Lab Activity: Law of Conservation of Mass
Activity: Balancing Chemical Reactions with Candy
Practice: Balancing Equations #1
Practice: Balancing Equations #2
Practice: Balancing Equations #3
Stations: Types of Reactions

Practice: Balancing and Classifying
Practice: Predicting Products
Inquiry Activity: An Equilibrium Model
Practice: Le Chatelier's Principle
Research Activity: Ocean Acidification
Review Game: Chemical Reactions
Unit exam and quizzes

Grade: 10-11

Course Title: Academic Chemistry

Topic/Concept: Stoichiometry

Time Allotment: 16 days

Unit Sequence: 6

Major Concepts to be learned:

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| <ul style="list-style-type: none">• The Mole• Molar Mass• Percent Composition• Empirical Formulas | <ul style="list-style-type: none">• Stoichiometry• Limiting Reactants• Molecular Formulas• Percent yield | <ul style="list-style-type: none">• Percent error |
|--|---|---|

Expected Skills to be demonstrated:

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| <ul style="list-style-type: none">• Explain the relationship between the following terms: mole, Avogadro's number, and molar mass.• Differentiate between the empirical and molecular formula of a compound and explain how it applies differently to ionic vs. covalent compounds.• Use Avogadro's number to convert from moles to atoms or molecules, and vice versa.• Determine the formula or molar mass of an element or a compound.• Find the percent composition of a compound and use percent composition to determine the empirical and molecular formulas for an unknown compound.• Explain the significance of the mole ratio in stoichiometric calculations.• Be able to calculate the amount of moles or mass of a reactant or product when given the amount of moles or mass for another reactant or product• Explain why the amount of product formed from a reaction is always determined by the limiting reactant.• Differentiate between actual and theoretical yields.• Be able to determine the limiting and excess reactant when given starting amounts of reactants.• Be able to determine the amount left unused from an excess reactant.• Be able to determine how much product can be made when given the amount of moles or masses of the reactants.• Be able to calculate percent yield when given the actual yield and quantity of a reactant. |
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PA Standard/NGSS:

SEP/DCI/CCC:

3.2.9-12.A 3.2.9-12.C HS-PS1-7	SEP: Developing and using models, Using mathematics and computational thinking, Obtaining, evaluating and communicating information DCI: PS1.A, PS2:B, CCC: Energy and matter, Patterns
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Instructional Strategies:

Assessments:

Cooperative groups Problem solving activities Lecture Written work Hands-on activity Graphic organizers Evaluating	Group discussion Note Taking Charting Summarizing Outlining Graphic Calculators	Lab Activity: Homemade Hot Chocolate Activity: Magnitude of a Mole Practice: Molar Mass of Elements Practice: Molar Mass of Compounds Inquiry Lab Activity: Percent Composition Practice: Determining Formulas	Practice: Stoichiometry Lab Activity: Stoichiometry with S'mores Practice: Limiting Reactants Practice: Percent Yield Lab: Homemade Chalk Stations: Stoichiometry Review Unit exam and quizzes
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Grade: 10-11

Course Title: Academic Chemistry

Topic/Concept: States

Time Allotment: 16 days

Unit Sequence: 7

Major Concepts to be learned:

- States of Matter
- Phase Changes
- Gas Laws
- Gas Stoichiometry

Expected Skills to be demonstrated:

- Explain the kinetic-molecular theory and the relationship between temperature, kinetic energy, and the velocity of particles in a substance.
- Differentiate between the three main states of matter. List the characteristics that distinguish them from each other in regards to volume, shape, and particle movement.
- Differentiate between an intermolecular force and a chemical bond.
- Explain the relationship between intermolecular forces and each state of matter.
- Distinguish between ideal and real gases.
- Describe the properties of ideal gases.
- Describe the properties of liquids, highlighting those that are unique to them.
- Explain how both gases and liquids can be described as fluids.
- Differentiate between crystalline and amorphous solids.
- Differentiate between liquids and amorphous solids.
- Be able to identify a state of matter based on a description of its properties.
- Draw a particle diagram to represent each state of matter.
- Explain whether or not a phase change is physical or chemical.
- Relate phase changes to temperature and the kinetic-molecular theory.
- Differentiate between melting and freezing.
- Differentiate between vaporization and condensation.
- Differentiate between sublimation and deposition and give an example of each.
- Explain what is happening to particles during evaporation vs. boiling.
- Draw a diagram to summarize the different phase changes.
- Explain what it means for particles in a substance in a closed container to be in equilibrium.
- Be able to interpret a heating curve, cooling curve, or phase diagram.
- Summarize the relationship between variables in each of the following gas laws: Dalton's Law, Boyle's Law, Charles's Law, Gay-Lussac's Law, Combined Gas Law, Avogadro's Law, Ideal Gas Law, Graham's Law of Effusion.
- Explain why each of the following gas laws makes sense according to the kinetic-molecular theory: Dalton's Law, Boyle's Law, Charles's Law, and Gay-Lussac's Law.
- Use stoichiometry, standard molar volume of a gas, and/or the ideal gas law to calculate mass, molecules, or volume

PA Standard/NGSS:

SEP/DCI/CCC:

3.2.9-12.A
3.2.9-12.C
HS-PS1-3
HS-PS1-2

SEP: Developing and using models, Using mathematics and computational thinking, Obtaining, evaluating and communicating information
DCI: PS1.A, PS2.B,
CCC: Energy and matter, Patterns

Instructional Strategies:

Cooperative groups	Group discussion	Problem solving activities
Note Taking	Lecture	Charting
Written work	Summarizing	Hands-on activity
Outlining	Graphic organizers	Graphic Calculators
Evaluating		

Assessments:

Inquiry Activity: Intro. to Concept 1	Practice: Gas Laws
Practice: Summary Chart	Practice: Ideal Gas Law
Card Sort: States	Practice: Gas Stoichiometry
Inquiry Lab Activity: Phase Changes	Project: Gas Laws in the “Reel” World
Task Cards: States	Lab: Air Bag Egg Drop
Inquiry Activity: Graphing Gas Laws	

Grade: 10-11

Title: Academic Chemistry

Topic/Concept: Solutions

Time Allotment: 16 days

Unit Sequence: 8

Major Concepts to be learned:

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| <ul style="list-style-type: none">• Types of Solutions• Solubility• Concentration of Solutions | <ul style="list-style-type: none">• Properties of Solutions• Molarity• Molality• Colligative Properties |
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Expected Skills to be demonstrated:

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| <ul style="list-style-type: none">• Draw a particle diagram to distinguish between homogeneous and heterogeneous mixtures.• Create a table to differentiate between solutions, colloids, and suspensions.• Explain why water is considered the universal solvent.• Describe a real-world example of how "like dissolves like".• Differentiate between dissolution and dissociation.• Compare and contrast how ionic substances dissolve vs. how covalent substances dissolve.• Describe the factors that affect the solubility of a substance.• Differentiate between saturated, unsaturated, and supersaturated solutions.• Given a table of solubility guidelines, be able to determine if an ionic compound is soluble or not.• Be able to analyze and interpret solubility curves.• Be able to write the balanced chemical equation, overall ionic equation, and net ionic equation for a reaction between aqueous ionic substances.• Explain the different ways you can quantify the concentration of a solution.• Be able to calculate the molarity and molality of a substance when given the mass of the solute and volume or mass of the solvent.• Be able to calculate the amount of solute or solvent in a solution when given its concentration.• Explain how a colligative property, like freezing-point depression, is different from a non-colligative property, like density.• Summarize the four colligative properties we discussed.• Explain why the boiling point and freezing point of salt water is different from that of pure water.• Describe the relationship between molal concentration of a solution and freezing-point depression, boiling-point elevation and osmotic pressure. Give an example. |
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PA Standard/NGSS:

SEP/DCI/CCC:

3.2.9-12.A 3.2.9-12.C HS-PS1-3 HS-PS1-5	SEP: Developing and using models, Using mathematics and computational thinking, Obtaining, evaluating and communicating information DCI: PS1.A, PS2:D CCC: Energy and matter, Patterns
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Instructional Strategies:

Assessments:

Cooperative groups Problem solving activities Lecture Written work Hands-on activity Graphic organizers Evaluating	Group discussion Note Taking Charting Summarizing Outlining Graphic Calculators	Inquiry Mini-Lab: Mystery Mixtures Practice: Solubility Curve Lab Stations: Solubility Practice: Net Ionic Equations Inquiry Lab Activity: Concentration	Practice: Concentrations Lab: The Chemistry of Cleaning Clothing Research and Report: Colligative Properties Lab Activity: Ice Cream and Colligative Properties
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Grade: 10-11

Course Title: Academic Chemistry

Topic/Concept: Acids & Bases

Time Allotment: 17 days

Unit Sequence: 9

Major Concepts to be learned:

- Defining Acids and Bases
- Describing Acids and Bases
- Reacting Acids and Bases
- Titrations

Expected Skills to be demonstrated:

- Explain what an acid-base reaction is. Include a labeled example and an explanation of why it can be referred to as a neutralization reaction.
- Differentiate and provide examples between the different definitions of acids and bases.
- Differentiate between ionization and dissociation.
- Show the differences between Bronstead Lowry and Arrhenius acids and bases using chemical equations.
- Provide examples of how water can be amphoteric.
- Be able to identify substances as acids, bases, or amphoteric based on a specific theory/definition when given a model, description, or example.
- Write a chemical equation to represent what happens to an acid or base when put in water.
- Explain what makes an acid or base strong versus weak.
- Summarize the relationship between polarity, percent dissociation, and the strength or weakness of an acid or base.
- Sketch a graph that shows the concentration of substances at the end of a reaction with a strong/weak acid/base.
- Summarize the relationship between pH, pOH and ion concentration.
- Explain what is different about a reaction between a strong acid and a strong base versus a reaction in which one of those is considered weak. Include examples to help with your explanations.
- Describe a real-world example of a buffer and its purpose.
- Give an example of a specific buffer made from a weak acid and its salt. Explain what will happen when a strong acid and a strong base are added. Use chemical equations to support your explanations.
- Describe how to perform a titration and the equipment and information needed to do one.
- Be able to use stoichiometry to determine the amount of acid needed to neutralize a base, and vice versa.

PA Standard/NGSS:

3.2.9-12.A
HS-PS1-1
HS-PS1-6
HS-PS1-7

SEP/DCI/CCC:

SEP: Developing and using models, Using mathematics and computational thinking, Obtaining, evaluating and communicating information
DCI: PS1.A, PS2:B,
CCC: Cause and Effect, Systems and System Models

Instructional Strategies:

Cooperative groups
Problem solving activities
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Hands-on activity
Graphic organizers
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Group discussion
Note Taking
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Graphic Calculators

Assessments:

Inquiry Activity: Defining Acids and Bases
Card Sort: Acids and Bases
Practice: Summary Chart
Practice: Acid and Base Identification
Research Activity: Science or Pseudoscience

Inquiry Lab Activity: Describing Acids and Bases
Practice: Strong vs. Weak
Practice: Acid-Base Reactions
Lab: An Investigation of Antacid Effectiveness
Creative Writing Activity: A Case for Acids and Bases

Grade: 10-11

Course Title: Academic Chemistry

Topic/Concept: Thermochemistry

Time Allotment: 16 days

Unit Sequence: 10

Major Concepts to be learned:

- Reaction energy
- Reaction kinetics
- Enzymes

Expected Skills to be demonstrated:

- Explain how energy exchanges are different in physical vs. chemical changes.
- Describe how heat flows when someone is holding a cold object and why this happens.
- Differentiate between the three types of thermal energy transfer. Include an example or picture of each.
- Explain how energy is stored in food and how that energy can be measured.
- Be able to perform calculations involving thermal energy, specific heat, and temperature.
- When given a model, description, or example, identify the energy conversion that's occurring.
- Explain the relationship between energy and the breaking and formation of chemical bonds during a chemical reaction.
- Explain how ΔH can be used to identify whether a reaction is exothermic or endothermic.
- Explain how a catalyst impacts the energy exchange in a reaction. Then sketch a potential energy diagram and add a catalyst to it. Clearly label the catalyst.
- Be able to calculate a change in enthalpy.
- Sketch and label potential energy diagrams for both an endothermic and an exothermic reaction, labeling key parts and describing what energy exchanges are occurring throughout the reaction.
- Summarize the main tenets of the collision theory.
- Identify the conditions that are most likely to cause a reaction to occur spontaneously.
- Explain why exothermic reactions tend to be more spontaneous than endothermic and what condition would make an endothermic reaction occur spontaneously.
- Describe how different factors affect the rate of a chemical reaction.
- If given an example, description, or model, be able to predict how changing conditions will impact the rate of a reaction.

PA Standard/NGSS:

SEP/DCI/CCC:

3.2.9-12.A
3.2.9-12.C
HS-PS1-3
HS-PS1-5

SEP: Developing and using models, Using mathematics and computational thinking, Obtaining, evaluating and communicating information
DCI: PS1.A, PS2:D
CCC: Energy and matter, Patterns, Cause and Effect, Systems and System Models

Instructional Strategies:

Assessments:

Cooperative groups
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Graphic Calculators

Discovery Stations: An
Introduction to Thermochemistry
Practice: Heat Calculations
Activity: Conversions Cartoon
Lab: Food as Fuel
Inquiry Mini-Lab: Reaction Energy

Practice: Potential Energy
Diagrams
Lab: Reaction Rate Simulation
Task Cards: Thermochemistry
Review
Project: Enzyme Deficiencies