Southern York County School District Instructional Plan

Name:	**Dates: August - September**
Course/Subject: Chemistry 2	**Unit 1: Review and Solutions**

Stage 1 – Desired Results

PA Standard(s)/Assessment Anchors Addressed:

3.1.10E – Describe patterns of change in nature, physical, and man-made systems
3.2.12C – Apply elements of scientific inquiry to solve multi-step problems
3.2.12D – Analyze and use the technological design process to solve problems
3.4.12A – Apply concepts about the structure and properties of matter – classify and describe

S11.A.2.1 Apply knowledge of scientific investigation or technological design to develop or critique aspects of the experimental or design process
Specifically – S11.A.2.1.4
S11.C.1.1 Explain the relationship between the structure and properties of matter
Specifically – S11.C.1.1.1 and S11.C.1.1.3

Understanding(s): ***Students will understand . . .*** 1. What information is conveyed by a balanced chemical equation. 2. Reactions occur in an aqueous solution when a solid, liquid, or gas is formed through double replacement reactions. 3. Stoichiometry can be used to determine the formula of a compound.	**Essential Question(s):** ▪ How can dimensional analysis be used to solve problems? ▪ Why do reactions not always produce the predicted amount of products? ▪ How can stoichiometry be used to analyze a mixture of compounds?
Learning Objectives: ***Students will know . . .*** ▪ How to derive a compounds formula using experimental data ▪ How to predict the products of precipitation reactions using double-replacement reactions. ▪ How to convert between mass, moles, and particles. ▪ How to name basic ionic compounds	***Students will be able to:*** ▪ Use stoichiometry to determine the identity of an unknown carbonate ▪ Use molarity in stoichiometric calculations.

Name:	**Dates: September - October**
Course/Subject: Chemistry 2	**Unit 2: Thermodynamics**

Stage 1 – Desired Results

PA Standard(s)/Assessment Anchors Addressed:

3.1.10E – Describe patterns of change in nature, physical, and man-made systems
3.2.10. A4- Explain the difference between endothermic and exothermic reactions.
3.2.12C – Apply elements of scientific inquiry to solve multi-step problems
3.2.12D – Analyze and use the technological design process to solve problems
3.4.10A – Explain concepts about the structure and properties of matter – describe various types of chemical reactions by applying the laws of conservation of mass and energy

3.4.12A – Apply concepts about the structure and properties of matter – classify and describe, in equation form, types of chemical and nuclear reactions.
3.4.12B – Apply and analyze energy sources and conversions and their relationship to heat and temperature

S11.A.2.1 Apply knowledge of scientific investigation or technological design to develop or critique aspects of the experimental or design process
Specifically – **S11.A.2.1.4**
S11.C.2.1 Analyze energy sources and transfer of energy, or conversion of energy
Specifically – **S11.C.2.1.2**

Understanding(s): ***Students will understand . . .***	**Essential Question(s):**
1. Hess's Law can be used to calculate the enthalpy change for a reaction from thermodynamic data. 2. Energy released or absorbed in a reaction is equal to the difference in the bond energy of the products and reactants. 3. Enthalpy is a measure of the potential energy (bond energy) of a compound. 4. Entropy is a measure of the randomness or disorder of a chemical system. 5. Spontaneous reactions are, "possible, in principle".	▪ How do chemists measure heat transfer? ▪ How are enthalpy, entropy, and Gibbs free energy related? ▪ What does it mean if a reaction is spontaneous? ▪ Why is an understanding of thermodynamics so important when studying chemical reactions?
Learning Objectives: ***Students will know . . .***	***Students will be able to:***
▪ The relationship between energy and reactions spontaneity. ▪ How temperature influences the spontaneity of a chemical reaction (based on the signs of ΔS and ΔH. ▪ How to calculate ΔH from standard enthalpies of formation.	▪ Calculate ΔG, ΔH, and ΔS from thermodynamic (tabulated) values and equations. ▪ Measure the quantity of energy transferred as heat in a chemical reaction using calorimetry. ▪ Predict the sign of the entropy change, ΔS, for a chemical process. ▪ Use ΔG or thermodynamic data to calculate reaction spontaneity. ▪ Determine the calorie content of various foods using calorimetry.
Name:	**Dates: October - December**
Course/Subject: Chemistry II	**Unit 3: Chemical Equilibria and Solubility**

Stage 1 – Desired Results

PA Standard(s)/Assessment Anchors Addressed:

3.1.10E – Describe patterns of change in nature, physical, and man-made systems
3.2.12. A5 - Predict the shift in equilibrium when a system is subjected to a stress.
3.2.12C – Apply elements of scientific inquiry to solve multi-step problems
3.2.12D – Analyze and use the technological design process to solve problems
3.4.10A – Explain concepts about the structure and properties of matter – describe various types of chemical reactions by applying the laws of conservation of mass and energy
3.4.12A – Apply concepts about the structure and properties of matter – classify and describe, in equation form, types of chemical and nuclear reactions.

S11.A.2.1 Apply knowledge of scientific investigation or technological design to develop or critique aspects of the experimental or design process
Specifically – **S11.A.2.1.4**
S11.C.1.1 Explain the relationship between the structure and properties of matter
Specifically – **S11.C.1.1.6**

Understanding(s): ***Students will understand . . .***	**Essential Question(s):**
1. Chemical equilibria are dynamic, both forward and reverse reactions occur at equilibrium. 2. Equilibrium constants allow for the quantitative analysis of equilibria. 3. Solubility is a specific example of chemical equilibrium.	▪ How is equilibrium measured qualitatively and quantitatively? ▪ What information can be gained from the value of the equilibrium constant? ▪ Do reactions still occur in a system at equilibrium? ▪ How do insoluble compounds behave when they are added to water?
Learning Objectives: **Students will know…** ▪ How to use the reaction quotient to determine the properties of an equilibrium system. ▪ How to use K values to predict the extent to which a reaction will go take place ▪ Precipitation reactions are specific examples of a chemical equilibrium. ▪ How equilibrium is affected by the addition of a common ion. ▪ How to predict the effect of a stress on equilibrium using Le Chateliers principle. ▪ The relationship between the Gibb's free energy, ΔG, equilibrium, and the equilibrium constant, K.	**Students will be able to…** ▪ Determine values for Ksp using experimental data. ▪ Identify methods of shifting equilibrium in specific directions. ▪ Calculate values for equilibrium constants using experimental data.
Name:	**Dates: December - January**
Course/Subject: Chemistry II	**Unit 4: Acid-Base**

Stage 1 – Desired Results

PA Standard(s)/Assessment Anchors Addressed:

3.1.10E – Describe patterns of change in nature, physical, and man-made systems
3.2.12.A4 - Describe the interaction between acids and bases
3.2.12C – Apply elements of scientific inquiry to solve multi-step problems
3.2.12D – Analyze and use the technological design process to solve problems
3.4.10A – Explain concepts about the structure and properties of matter – describe various types of chemical reactions by applying the laws of conservation of mass and energy
3.4.12A – Apply concepts about the structure and properties of matter – classify and describe, in equation form, types of chemical and nuclear reactions.

S11.A.2.1 Apply knowledge of scientific investigation or technological design to develop or critique aspects of the experimental or design process
Specifically – **S11.A.2.1.4**
S11.C.1.1 Explain the relationship between the structure and properties of matter
Specifically – **S11.C.1.1.6**

Understanding(s): ***Students will understand . . .***	**Essential Question(s):**
1. Acid-base reactions are specific examples of equilibrium systems. 2. A pH change of 1 represents a 10-fold change in the hydrogen ion concentration. 3. Hydrolysis reactions are the reaction between an acidic/basic ion and water. 4. Acidity of a solution may be measured by pH, pOH, $[H_3O^+]$, $[OH^-]$	▪ Why is there more than one definition of an acid and a base? ▪ How do weak acids behave differently than weak bases? ▪ How is acidity of a solution measured? ▪ How do weak acids behave as an equilibrium system?
Learning Objectives: **Students will know…**	**Students will be able to…**
▪ How to describe acids and bases – Arrhenius and Bronsted-Lowry, ▪ The common properties of acids and bases. ▪ The differences between strong and weak acids and bases. ▪ The relationship between Ka, Kb, $[H_3O^+]$, [OH], pH, and pOH.	▪ Use titration to determine the pH and mass percent of an acid in an aqueous solution. ▪ Determine the Ka of a weak acid both experimentally and by using titration curve data.
Name:	**Dates: January - February**
Course/Subject: Chemistry II	**Unit 5: Acid-Base Titrations and Buffers**

Stage 1 – Desired Results

PA Standard(s)/Assessment Anchors Addressed:

3.1.10E – Describe patterns of change in nature, physical, and man-made systems
3.2.12.A4- Describe the interaction between acids and bases
3.2.12C – Apply elements of scientific inquiry to solve multi-step problems
3.2.12D – Analyze and use the technological design process to solve problems
3.4.10A – Explain concepts about the structure and properties of matter – describe various types of chemical reactions by applying the laws of conservation of mass and energy
3.4.12A – Apply concepts about the structure and properties of matter – classify and describe, in equation form, types of chemical and nuclear reactions.

S11.A.2.1 Apply knowledge of scientific investigation or technological design to develop or critique aspects of the experimental or design process
Specifically – **S11.A.2.1.4**
S11.C.1.1 Explain the relationship between the structure and properties of matter
Specifically – **S11.C.1.1.6**

Understanding(s): ***Students will understand . . .***	**Essential Question(s):**
1. Titration curves can be used to determine equivalence points and Ka 2. The equivalence point is the point at which moles of acid equals moles of base. 3. Hydrolysis reactions are the reaction between and acidic/basic ion and water.	▪ What is a titration? ▪ How is stoichiometry applied in an acid-base titration? ▪ How can a titration curve be used to analyze an acid-base reaction?
Learning Objectives: **Students will know…** ▪ The types of information which can be found by using a titration curve and how to find them. ▪ How to determine the pH during an acid-base titration. ▪ The types of information which can be found by using a titration curve and how to find them. ▪ How a buffer resists changes in the pH of a solution. ▪ How to determine an appropriate acid-base indicator for a titration	**Students will be able to…** ▪ Explain why the study of buffers is important chemically, biologically, and environmentally? ▪ Use titration to determine the pH and mass percent of an acid in an aqueous solution. ▪ Complete an acid-base titration using phenolphthalein as indicator. ▪ Determine the Ka of a weak acid both experimentally and by using titration curve data. ▪ Identify specific mechanisms explaining the process of a buffer working.

Name:	**Dates: February-March**
Course/Subject: Chemistry II	**Unit 6: Organic Chemistry**

Stage 1 – Desired Results

PA Standard(s)/Assessment Anchors Addressed:

3.4.12A - Apply rules of systematic nomenclature and formula writing to chemical substances
3.4.12A - Classify and describe, in equation form, types of chemical and nuclear reactions
3.4.12A - Characterize and identify important classes of compounds
3.4.10A - Understand that carbon can form several different types of compounds.

Understanding(s):	**Essential Question(s):**

The students will understand: 1. Systematic rules for nomenclature are applied to organic compounds. 2. Organic compounds are found in materials used in our daily lifes. 3. Side groups affect the properties of the parent chain. 4. Organic functional groups are often responsible for the chemical properties of molecules.	▪ What is organic chemistry? ▪ Why is an understanding of organic chemistry necessary for scientists? ▪ How are rules applied for the naming of organic compounds? ▪ How do scientists determine the identity of organic compounds? ▪ What are likely products of organic reactions?
Learning Objectives: **Students will know…** ▪ How to draw and name organic compounds. ▪ The names for common side groups and functional groups ▪ The differences between alkanes, alkenes, and alkynes.	**Students will be able to…** ▪ Apply systematic rules for nomenclature. ▪ Draw structures from common household labels ▪ Recognize common alkane molecules ▪ Identify isomers ▪ Interpret H-NMR readouts ▪ Draw isomers, cis and trans isomers, and D or L stereoisomers
Name:	**Dates: March-April**
Course/Subject: Chemistry II	**Unit 7: Oxidation-Reduction**

Stage 1 – Desired Results

PA Standard(s)/Assessment Anchors Addressed:

3.1.10E – Describe patterns of change in nature, physical, and man-made systems
3.2.12. A4 - Apply oxidation/reduction principles to electrochemical reactions.
3.2.12C – Apply elements of scientific inquiry to solve multi-step problems
3.2.12D – Analyze and use the technological design process to solve problems
3.4.10A – Explain concepts about the structure and properties of matter – describe various types of chemical reactions by applying the laws of conservation of mass and energy
3.4.12A – Apply concepts about the structure and properties of matter – classify and describe, in equation form, types of chemical and nuclear reactions.

S11.A.2.1 Apply knowledge of scientific investigation or technological design to develop or critique aspects of the experimental or design process
Specifically – **S11.A.2.1.4**
S11.C.1.1 Explain the relationship between the structure and properties of matter
Specifically – **S11.C.1.1.6**

Understanding(s): ***Students will understand . . .*** 1. Transfers of electrons results in oxidation and reduction 2. Losing electrons is oxidation and gaining electrons is reduction	**Essential Question(s):** ▪ How can electrons be tracked in a chemical reaction? ▪ How can oxidation-reduction reactions be balanced? ▪ How does a battery work? ▪ How can electrochemistry be used to create and improve commonly used items?
Learning Objectives:	

Students will know . . . ▪ Oxygen is an oxidizing agent, and rarely undergoes oxidation ▪ Batteries utilize the energy of electron transfer to generate power from oxidation-reduction reactions ▪ Complex oxidation-reduction reactions can be balanced using the half-reaction method	***Students will be able to:*** ▪ Balance oxidation-reduction reactions ▪ Explain the operation of batteries and electrochemical cells ▪ Predict the voltage potential from a chemical reaction ▪ Relate Gibbs free energy and electrical potential
Name:	**Dates: April - May**
Course/Subject: Chemistry II	**Unit 8: Qualitative Chemistry**

Stage 1 – Desired Results

PA Standard(s)/Assessment Anchors Addressed:

3.1.10E – Describe patterns of change in nature, physical, and man-made systems
3.2.12C – Apply elements of scientific inquiry to solve multi-step problems
3.2.12D – Analyze and use the technological design process to solve problems
3.4.10A – Explain concepts about the structure and properties of matter – describe various types of chemical reactions by applying the laws of conservation of mass and energy
3.4.12A – Apply concepts about the structure and properties of matter – classify and describe, in equation form, types of chemical and nuclear reactions.

S11.A.2.1 Apply knowledge of scientific investigation or technological design to develop or critique aspects of the experimental or design process
Specifically – **S11.A.2.1.4**
S11.C.1.1 Explain the relationship between the structure and properties of matter
Specifically – **S11.C.1.1.6**

Understanding(s): ***Students will understand . . .*** 1. Chemical tests can be used to identify unknown ions	**Essential Question(s):** ▪ What ions are present in the sample?
Learning Objectives: ***Students will know . . .*** ▪ Chemical reactions can be used to separate ions from a solution	***Students will be able to:*** ▪ Use a specific order of chemical tests to identify and isolate ions in an unknown solution