Curriculum Sample Template – 8 Pages Max. (12 pages for integrated ELA sample)

Grade Level	11	**Content Area**	Science
Course Title (grades 9-12 Only)	Chemistry		
Expected Prior Knowledge *List the knowledge/skills mastered earlier in the year that are foundational to the mastery of the Required Standard(s).*	Students will already know: The names and symbols of the elements, chemical nomenclature including the state symbols (g), (l), (s), and (aq), how to balance chemical equations, safe laboratory practices, and dimensional analysis		
Alignment to Program of Instruction *Describe how the methods of instruction found in this sequence of lessons align to the Program of Instruction described in the application package.*	This science lesson involves active learning techniques in the form of classroom discussions and laboratory experiments. During classroom discussion, students actively engage in the vocabulary and content of the lessons. This gives them the opportunity to practice their new learning in a safe environment. Laboratory experiments help students make abstract concepts like energy transfer in chemical reactions more concrete. Content academic vocabulary is explicitly taught using Sheltered Instruction practices. Students are given multiple opportunities to practice English literacy in this lesson in order to support English Language Acquisition.		
Standard Number* and Description *The standard number and description of the Required Standard(s) being instructed and assessed to mastery in the curriculum sample.*	5 Concept 4 PO# 9&10 4 - Chemical Reactions (Investigate relationships between reactants and products in chemical reactions.) #9 - Predict the products of a chemical reaction using types of reactions (e.g., synthesis, decomposition, replacement, combustion). AND #10 - Explain the energy transfers within chemical reactions using the law of conservation of energy.		
Materials/Resources Needed *List all items the teacher and students will need for the entire sequence of instruction (excluding common consumables)*	Chemistry Glossary, Chemistry Textbook, Magnesium Ribbon, Butane candle lighter, thermometers, Baking Soda, vinegar, 50 mL Beakers, Calcium Chloride, Deionized Water, goggles, ½ teaspoons		

* ***Standard Number****: For English Language Arts (Reading and Writing), use Grade, Strand, Standard (e.g., 3.RI.2). For K-8 Math, use Grade, Domain, Cluster, Standard (e.g., 6.EE.B.7). For HS Math, use Conceptual Category-Domain, Cluster, Standard (e.g., A-REI.C.6).*

Lesson (add as needed)	**Instructional Strategies -** *List and describe teacher actions, lesson by lesson, which will provide students with opportunities to engage the grade-level rigor defined by the Required Standard(s). Indicate alignment of instructional strategies to specific component(s) or content/skill(s) of the Required Standard/component.*	**Student Activities -** *Describe the activities, lesson by lesson, in which students will engage to allow them to master the grade-level rigor defined by the Required Standard(s). Indicate alignment of student activities to specific component(s) or content/skill(s) of the Required Standard/component.*
1	**1. Anticipatory Set –** The teacher will demonstrate to the students the oxidation of magnesium in oxygen and write the equation on the board: "$2Mg + O_2 \rightarrow 2MgO$." **2. Content Objective –** SWBAT identify the type of reaction, given a chemical equation. **3. Instructional Input –** The teacher will explain to the students that most chemical reaction fall into one of five types: Synthesis, Decomposition, Single Displacement, Double Displacement, and Combustion. The teacher will instruct students to include those reaction types in their Chemistry Glossary. The teacher will then give the students the definition and an example of the reaction type for the students to put in their glossary. a) Synthesis: Two or more smaller molecules combine to make a larger one. $A + B \rightarrow AB$ Example: $2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$ b) Decomposition: One larger molecule breaks down to make several smaller ones. $AB \rightarrow A + B$ Example: $2H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$ c) Single Displacement: One element trades places with another element in a compound. $A + BC \rightarrow AC + B$ Example: $Cu_{(s)} + 2AgNO_{3(aq)} \rightarrow 2Ag_{(s)} + Cu(NO_3)_{2(aq)}$ d) Double Displacement: When the anions and cations of two ionic compounds switch places. $AB + CD \rightarrow AD + CB$ Example: $Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \rightarrow PbI_{2(s)} + 2KNO_{3(aq)}$ e) Combustion: A fuel (usually a carbon compound) reacts with oxygen to make an oxide and water and heat. $F + O_2 \rightarrow FO + H_2O$ Example: $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$ + heat **4. Check for Understanding –** The teacher will put several reactions on the board and ask students to identify which type they are. (This would be an excellent opportunity to use classroom clickers, if available, or Poll Everywhere. Otherwise the teacher could devise a game or have the students create cards to show.) **5. Independent Practice –** The teacher will give the students a worksheet to complete on their own and turn in as a formative assessment.	1. Students will observe the reaction and ask questions they may have about it. 2. Students will write the date and the learning objective in their chemistry notebook. 3. Students will take notes, enter the vocabulary words into their glossary, and ask questions as necessary to clarify their understanding. 4. The students will try to determine the type of reaction and answer when called upon. The students will ask questions to clarify their understanding. 5. Students will complete the worksheet and turn it in as a formative assessment. **Alignment to content/skills of Required Standard:** This lesson teaches students the different types of reactions in preparation for them to predict the products.
2	**1. Anticipatory Set –** On the board: "Why do you think it might be a good idea for a chemist to be able to predict the product of a reaction?"	1. Students will record their answer to the question in their notebook and participate in the classroom discussion.

	After a few minutes the teacher will ask students for their responses and add her own to round out the picture. (Answers: For safety, to be able to store chemicals together [the teacher could point out how there are special cabinets for different types of chemicals because we can predict what kinds of compounds react together, and therefore which should be stored separately from each other], to form a hypothesis about a new compound she may be developing, etc.) **2. Content Objective –** SWBAT predict the products of a reaction given the reactants. **3. Instructional Input –** The teacher will explain that being able to predict the products of a reaction they can save time and resources in their own chemical endeavors. The teacher will give students a system of ruling out reactions starting with double displacement reactions. The teacher will explain that a telltale sign of a double displacement reaction is two aqueous ionic compounds as reactants. Nearly always one of the products will be a precipitate (otherwise it's just a mix of ions floating in water and there really isn't a reaction going on.) So, in order to predict what the precipitate will be, we use a solubility chart. The teacher will show the students where the solubility chart is in their textbook (usually in the back as an appendix.) The teacher will show the students how to use the chart by looking for the ions present in the products and looking to see if the new combination forms an insoluble product. Then the teacher will move on to single displacement reactions. The teacher will explain that single displacement reactions can be easily identified by their products because one of the products is always an element (either a metal, hydrogen, oxygen, or a halogen) and an ionic compound and just because you put an element in an ionic compound, it does not guarantee a reaction. A reaction will only happen if the lone element is more reactive than the one that's in the ionic compound. So to predict the product of a single replacement reaction they just need to look at the activity series chart and see if the lone element is more reactive than the ion (either anion or cation) it's potentially replacing. Next are combustion reactions which are easy to spot because they always have oxygen as a reactant, and nearly always involve a carbon-hydrogen based fuel. The products of combustion reactions are nearly always carbon dioxide and water. The teacher will explain that otherwise the reaction is either synthesis or decomposition depending on whether there is one reactant or several reactants. For synthesis they can predict the product by combining the reactants to make sure the equation is balanced. For a decomposition reaction, they can predict the products by making simpler compounds they know of out of the decomposing compound.	2. Students will write the date and the learning objective in their chemistry notebook. 3. Students will take notes, create an algorithm in their notes for determining reaction type, and ask questions as necessary to clarify their understanding. 4. The students will try to determine the type of reaction and predict the products. The students will ask questions to clarify their understanding. 5. Students will complete the worksheet and turn it in as a formative assessment. **Alignment to content/skills of Required Standard:** This lesson teaches students how to predict the products of a reaction using reaction type.

	4. Check for Understanding – The teacher will put several equations on the board and ask students at random to identify the type and predict the products. **5. Independent Practice –** The teacher will give the students a worksheet with different sets of reactants which asks them to predict the products and name the type of reaction.	
3	**1. Anticipatory Set –** On the board: "What are some examples of chemical reactions that release heat?" The teacher will discuss the students' responses as a lead into the lessons objective. **2. Content Objective –** SWBAT explain energy transfers within chemical reactions using the 1st law of thermodynamics. **3. Instructional Input –** The teacher will explain to students that all chemical bonds contain energy called chemical potential energy. Chemical because it's in chemicals, and potential because it's pent up until used. The teacher will explain that stable compounds are stable because they are in a lower energy state than the individual elements that make them up. When a chemical reaction occurs, the bonds of the reacting compounds are broken, which takes energy, and are then reformed into the product compounds. If the product compounds' bonds result in a lower total bond energy, then because of the first law of thermodynamics (aka the law of conservation of energy) the energy must go somewhere, and that somewhere is usually released into the surroundings as heat. Similarly, if a reaction occurs that forms products that have higher energy bonds, then heat energy must be added (resulting in a cooling of the surroundings.) The teacher will ask students to take out their glossary and add exothermic and endothermic to their glossary and give them the definition of exothermic as a chemical reaction that gives off heat energy, and endothermic as a chemical reaction that absorbs heat energy. The teacher will show students how heat can be added to the reactant or product side of a chemical equation just like any other reactant to show whether a reaction is endothermic or exothermic. **4. Check for Understanding –** The teacher will put some reactions up on the board and ask students to identify them as exothermic or endothermic. **5. Independent Practice –** The teacher will give the students a worksheet with practice problems and have them turn it in as a formative assessment.	1. Students will record their responses to the question in their chemistry notebook and participate in the class discussion. 2. Students will write the date and the learning objective in their chemistry notebook. 3. Students will take notes, enter the vocabulary words into their glossary, and ask questions as necessary to clarify their understanding. 4. The students will try to determine whether the reaction is endothermic or exothermic and answer when called upon. The students will ask questions to clarify their understanding. 5. Students will complete the worksheet and turn it in as a formative assessment. **Alignment to content/skills of Required Standard:** This lesson teaches students that energy is transferred into or out of the system as heat depending on the difference in bond energy of the reactants and products as a result of the first law of thermodynamics.
4	**Modeling (Lab) – Set Up:** Each group will need one thermometer, a 250 mL beaker, a 10 mL graduated cylinder, a teaspoon, and enough googles for each student. Students will use the Student Lab Write Up (see **appendix** for Student Lab Write Up) to record their observations.	Student will participate in the lab following safe lab practices, recording their results on the Student Lab Write Up, and using safe laboratory practices.

	Clean Up: All chemicals used in this lab are food ingredients and can be poured down the drain.	
S.A.	*Provide an opportunity for the student to complete the summative assessment items which is clearly separate from instruction and guided or independent practice, and in which the student is assessed independently. In the Student Activities column, provide a brief description of the summative assessment (S.A.) items that will allow students to demonstrate mastery of the rigor of the Required Standard(s)/components, and the context in which the items will be administered.*	An optional review period may be conducted before the end of the unit test. Students will take an end of unit test immediately following the unit. The test will be free response and taken individually and take about 1 class period. Students will have the use of a scientific calculator: either their own, or one provided to them. Smart phones will not be allowed to be used as a calculator. It will a closed note test. The skills addressed in the standard will be assessed a second time (at least) in a Quarterly Common Assessment at the end of the quarter.

Summative Assessment Items and Scoring: *Below, provide at least three Summative Assessment Items that together accurately measure student mastery of the application of the content and/or skills as defined by the grade-level rigor in the Required Standard(s). For each assessment item, provide an answer key or scoring rubric which clearly describes how assessment items are to be scored and how points will be awarded, such that mastery of the application of the content and/or skills as defined by the grade-level rigor in the Required Standard is clearly demonstrated by an acceptable score.*

Summative Assessment Item 1 (clearly identify answer key/scoring rubric, and acceptable score):

Identify the type of each reaction below.

Reaction	Type
1) $2Fe_{(s)} + 6HCl_{(aq)} \rightarrow 2FeCl_{3(aq)} + 3H_{2(g)}$	_____
2) $C_5H_{12(g)} + 8O_{2(g)} \rightarrow 5CO_{2(g)} + 6H_2O_{(g)}$ + heat	_____
3) $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$	_____
4) $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$	_____
5) $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$	_____

KEY

1) Single Displacement; 2) Combustion; 3) Decomposition; 4) Double Displacement; 5) Synthesis

Scoring Guide

The question is worth 5 points. Partial credit may be given (-1 point for each incorrect answer.) 4/5 correct demonstrates mastery.

Summative Assessment Item 2 (clearly identify answer key/scoring rubric, and acceptable score):

Identify the type of each reaction and predict the products.

Reactants	Products	Type
1) $C_4H_9OH_{(g)} + 6O_{2(g)} \rightarrow$	_____	_____
2) $Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \rightarrow$	_____	_____
3) $Ni_{(s)} + ZnCl_{2(aq)} \rightarrow$	_____	_____

KEY

	Products	Type	
1)	$4CO_{2(g)} + 5H_2O_{(g)}$	Combustion	(+1 point for each correct part)
2)	$PbI_{2(s)} + 2KNO_{3(aq)}$	Double Displacement	(+1 point for each correct part)
3)	No Reaction	None OR Single Displacement	(+1 point for each correct part)

Scoring Guide

This question is worth 6 points. Partial credit may be given. (-1 point per mistake) 5/6 points indicates mastery.

Summative Assessment Item 3 (clearly identify answer key/scoring rubric, and acceptable score): (add as needed):

Indicate whether each reaction is endothermic or exothermic.

1) The combustion of gasoline _____

2) Melting of ice _____

3) Cold sulfuric acid when added to room temperature water becomes very hot. _____

4) Solid room temperature ammonium nitrate when added to room temperature water becomes cold. _____

KEY

1) Exothermic; 2) Endothermic; 3) Exothermic; 4) Endothermic

Scoring Guide

This question is worth 4 points. Partial credit may be given. (-1 point for each incorrect answer.) ¾ points indicates mastery.

Total Points: 15 Mastery: 11/15

Appendix Energy Transfer in Chemical Reactions – Student Lab Write Up

Purpose: To investigate energy transfers in chemical reactions.

Materials:
50 mL beaker
Thermometer
Baking Soda
Vinegar
Calcium Chloride
D.I. water

Procedure:

Baking Soda and Vinegar
1. Pour about 10 mL of vinegar into the beaker. Then, place a thermometer into the vinegar. Record the initial temperature (T_i) in the table below.
2. While the thermometer is in the cup, add about ½ teaspoon of baking soda to the cup.
3. Watch the thermometer for any change in temperature. After it has stopped changing, record the final temperature (T_f) and any other observations you made in the table below.

Calcium Chloride dissolved in water
1. Make a baking soda solution by dissolving about ¼ teaspoon of baking soda in 10 mL of water. Stir until no more baking soda will dissolve. Then, place a thermometer into the water. Record the initial temperature (T_i) in the table below.
2. While the thermometer is in the cup, add ½ teaspoon of calcium chloride to the cup and use the thermometer to stir it until the calcium chloride is dissolved.
3. Watch the thermometer for any change in temperature. After it has stopped changing, record the final temperature (T_f) and any other observations you made in the table below.

Data Table for Observations:

Process	T_i	T_f	ΔT	Endothermic or Exothermic?	Other Observations	Did this reaction absorb or release heat?
Baking Soda + Vinegar						
Calcium Chloride + Baking Soda						

Analyzing Evidence
1. Calculate the temperature change for both chemical reactions. To do this, subtract the initial temperature (T_i) from the final temperature (T_f), and record the difference in the column labeled ΔT. You may see this calculation expressed elsewhere as $\Delta T = T_f - T_i$.
2. Based on your observations of the baking soda and vinegar reaction, is the reaction exothermic or endothermic? Apply your knowledge of energy changes in chemical reactions to complete the table above.
3. Based on your observations of the baking soda and calcium chloride reaction, is this chemical reaction exothermic or endothermic? Apply your knowledge of energy changes in chemical reactions to complete the table above.

Interpreting Evidence

1. In the chemical reaction between baking soda and vinegar, what did you observe other than a temperature change? What might this tell you about one of the products of this chemical change?

2. In the chemical reaction between water and calcium chloride, what did you observe other than a temperature change? What might this tell you about one of the products of this chemical change?

3. Use your answers from questions 1 and 2 to help you write the chemical equation for:

- The chemical reaction between baking soda and vinegar

- The chemical reaction between baking soda and calcium chloride

4. Using the language of breaking and making bonds, explain the net energy change for the chemical reaction between baking soda and calcium chloride.

Reflecting on the Investigation

1. Based on your investigation so far, do you think that energy changes only accompany chemical reactions? Using only the materials from the first two reactions, design an experiment that would test this idea. Propose a procedure and have it approved by your teacher before you continue experimenting.

2. Is dissolving calcium chloride in water a chemical change? Explain your reasoning.

3. How might you use exothermic or endothermic processes to solve a real-world problem? Are there any instances when it would be useful to quickly make something hot or cold? Explain how it is useful to know which processes absorb or release energy.