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

Grade Level	9th	**Content Area**	Science
Course Title (grades 9-12 Only)	Biology		
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 have been exposed to the scientific process which has them form a hypothesis and test it in a relevant experiment, analyze their results and modify as needed, and share their results. They also will have created an Edmodo (www.edmodo.com) account to access videos and assignments uploaded by the instructor.		
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 unit will incorporate a connection between physical and life science and will use learning targets that are clearly defined for students in order for them to master the objectives of the standards. The learning targets are connected to NGSS in that students will analyze data and communicate their results. It will also utilize the flipped model of classroom instruction in order to optimize class time for inquiry labs and timely feedback between students and the teacher in order ensure learning targets are continuously met. Students who are engaged in small group lessons will benefit from the type of instruction described here.		
Standard Number* and Description *The standard number and description of the Required Standard(s) being instructed and assessed to mastery in the curriculum sample.*	HS.5.4.9 Predict the products of a chemical reaction using types of reactions (e.g., synthesis, decomposition, replacement, combustion), AND HS.5.4.10 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)*	www.edmodo.com, phet.colorado.edu, laptops or tablets, hydrogen peroxide, vinegar, sodium bicarbonate, beef or chicken liver, potato, apple, test tubes, test tube holders, stirring rods, hot plate, ice, microspatula, pH tester, pipette		

* ***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	**Learning Targets (Objectives):** Introduce learning targets to students so they know what they are being assessed on. 1. I can balance a chemical equation by making the correct amount of elements match both sides of the equation. **Key Terms:** Key vocabulary terms students will need to understand in order to know the learning targets. ● Products, reactants, chemical equation, coefficient **Key/Advancing Questions:** ● What is the difference between a reactant and a product? ● How do I know if a chemical equation is balanced? ● Why do I need data to support my conclusion? **Activate Prior Knowledge:** Teacher asks the students write any kind of math question and think-pair-share their choice and state why it is true. Then teacher will call on several students to share their choice and reasoning and then introduce chemical equations. **Modeling:** The **teacher will** break down the key terms and demonstrate how to balance a chemical equation. The **teacher will** walk the students through several exmaples. **Guided Practice:** Then, in groups, students will be assigned various chemical equations (without giving them the type yet) and will be required to demonstrate how to balance the equation to the class. The observers will double check their steps for accuracy and provide appropriate feedback on a peer rubric sheet. **Independent Practice:** The **teacher will** give each student a handout with various chemical equations and students will be required to demonstrate how to balance two of the equations the equations. **Assessment:** The view the independent practice problems as an assessment for the lesson. **Closure:** The **teacher will** assign the key/advancing questions on www.edmodo.com for students to login (setup will have occurred prior to this lesson) and answer.	**Students will** write down the learning target(s) in a science notebook that they access frequently. Their science notebook will also be shared with peers for accuracy and alignment of knowledge. **Students will** write down the key/advancing questions in their science notebook to answer at the end of class. These questions will serve as a closure/self-reflection for students. **The students will** be provided specific feedback from the teacher so that the student can identify their own gaps of understanding and if they are hitting the learning target of balancing an equation. **Students will** work with a partner and in groups to give and receive feedback from peers and respect the class with active listening. **Students will** take notes on balancing a chemical equation by making the correct amount of elements match both sides of the equation. **Students will** work through several examples with the teacher. **Students will** check the notes with peers for accuracy and also work in groups to prepare to communicate how to balance their assigned equations clearly and accurately to the class. **Students will** receive a handout with equations and work with the group to balance the equations and then demonstrate their work to the rest of the class. **Students will** complete the independent practice handout, which will require them to balance two equations.

	The **teacher will** provide the students with a link so that, for homework, they can view video lessons on synthesis, decomposition, and combustion reactions.	
2	**Learning Targets (Objectives):** 2. I can predict the product of a synthesis chemical reaction. 3. I can predict the product of a combustion chemical reaction. 4. I can predict the product of a decomposition chemical reaction. 5. I can predict the product of a single replacement reaction. 6. I can predict the product of a double replacement reaction. **Key Terms:** ● Combustion reaction, synthesis reaction, decomposition reaction, single replacement reaction, double replacement reaction **Key/Advancing Questions:** ● Which learned chemical reactions are similar and which are different and why? ● Why are you able to predict the product of the learned chemical reactions? ● Where do you see evidence of chemical reactions in organisms? **Activate Prior Knowledge:** The teacher will review the assigned key/advanced questions from previous lesson and discuss student responses and also review the assigned video lessons. Then teacher will introduce new learning targets and also ask students where they see evidence in everyday life of the five types of chemical reactions and think-pair-share their responses with the class. **Modeling:** Teacher will introduce replacement reactions and demonstrate to the class single and double replacement chemical reactions (provided access to common compounds) and have them predict the products for each demonstration in partners or small groups. **Guided Practice:** The teacher will have students use laptops in partners or in small groups and assign them the PhET simulation lab (http://phet.colorado.edu/en/simulation/balancing-chemical-equations) on how to predict products of a synthesis, decomposition, and combustion chemical reactions. They will share their conclusions using data from their labs to the class. **Independent Practice**: The **teacher will** ask the students to write a quick write (paragraph) summarizing their lab report. The **teacher will** review these	**Students will** write down the learning target(s) in a science notebook that they access frequently. Their science notebook will also be shared with peers for accuracy and alignment of knowledge. **Students will** write down the key/advancing questions in their science notebook to answer at the end of class. These questions will serve as a closure/self-reflection for students. **The students will** be provided specific feedback on their discussion points and notes from the video from the teacher. This will aid the students to identify their own gaps of understanding and if they are hitting the learning targets. **Students will** follow along, watching the teacher demonstrate the reactions and write notes as he/she explains the process. **Students will** answer all questions from the teacher, and write down significant information so that they will be able to do this in small groups next. **Students will** work in small groups to work through the lab simulation. Students will actively write their observations, data, and notes in their science notebooks. They will work cooperatively in their groups and then share their results with their peers and class in a clear and relevant manner. **Students will** share their conclusions with peers and check for similarities and discrepancies. They will also actively listen and provide relevant discussion points.

	paragraphs to assess their comprehension of the simulation. **Assessment:** The **teacher will** collect and view the summary paragraphs to gauge what the students have gained towards the daily objective. **Lesson Closure:** The **teacher will** assign the key/advancing questions on Edmodo for students to answer. They will also be assigned video lessons on the law of conservation of energy and enzymes.	**Students will** write a quick paragraph summary of their lab experience, highlighting their new knowledge gained regarding single and double replacement chemical reactions. **Students will** reflect on their learning and respond to the Edmodo assignment by answering the key/advancing questions. They will also take detailed notes on the assignment Edmodo videos and be prepared to discuss them for the next class.
3	**Learning Targets (Objectives):** 7. I can explain how the law of conservation of energy makes sure energy is preserved in a closed system. 8. I can explain how an open system affects the law of conservation of energy. 9. I can explain how an enzyme affects the rate of a chemical reaction. 10. I can explain how endothermic and exothermic reactions transfer energy. **Key Terms:** ● Law of conservation of energy, activation energy, catalyst, enzyme, endothermic reaction, exothermic reaction **Key/Advancing Questions:** ● What is the difference between an open and closed system? ● Is it possible to demonstrate the law of conservation of energy in a closed system? Justify your answer. ● How do enzyme-based reactions relate to the law of conservation of energy? ● What is the importance of enzymes in how heat energy is transferred? **Activate Prior Knoweldge:** The **teacher will** review the assigned essential questions and video lessons from the previous lesson and discuss student responses. **Modeling:** The **teacher will** then introduce new learning targets and model how to come up with chemical reactions that occur in organisms. The **teacher will** ask the students to come up with chemical reactions that occur in organisms and think-pair-share their discussion with the class. **Guided Practice:** The teacher will introduce the enzyme lab procedures and safety steps. Students will be provided with lab materials to measure the effects	**Students will** write down the learning target(s) in a science notebook that they access frequently. Their science notebook will also be shared with peers for accuracy and alignment of knowledge. **Students will** write down the key/advancing questions in their science notebook to answer at the end of class. These questions will serve as a closure/self-reflection for students. **The students will** be provided specific feedback from the teacher so that the student can identify their own gaps of understanding and if they are hitting the learning targets. **Students will** follow along, writing examples from the teacher in their journal as they teacher introduces the new learning targets. **Students will** answer all questions from the teacher, and write down significant information. **Students will** respond with valid points from their conclusions and also critique the conclusions of their peers. They will also be challenged to think of the various chemical reactions that occur in plants and animals when it comes to obtaining and transferring energy. **Students will** make sure to follow the safety steps and instructions provided

	of temperature change, pH, and enzyme concentration in an enzyme catalyzed reaction. They will connect the importance of chemical reactions in organisms and how energy is transferred in relation to the law of conservation of energy. Students will hypothesize and observe the enzyme Catalase in various tissues in how it reacts with hydrogen peroxide (H_2O_2) and then share their conclusions with another peer or group for comparison. **Independent Practice**: The **teacher will** ask the students to write a quick write (paragraph) summarizing their lab report. The **teacher will** review these paragraphs to assess their comprehension of the simulation. **Assessment:** The **teacher will** collect and view the summary paragraphs to gauge what the students have gained towards the daily objective. **Lesson Closure:** The teacher will assign the essential questions on Edmodo for the students to answer and also complete a self-evaluation on how well they know the learning targets and what intervention methods they will take to close any learning gaps.	by the teacher. They are expected to work together with a partner or small groups, make precise measurements, and stay on task. They also must form a hypothesis and make detailed observations and then form a valid conclusion based on their results. **Students will** write a quick paragraph summary of their lab experience, highlighting their new knowledge gained in the importance of chemical reactions in organisms. **Students will** reflect on their learning and respond to the Edmodo assignment by answering the key/advancing questions. They will also actively self-assess their own learning progress and rely on feedback from the teacher on how to master the learning targets in preparation for the summative assessment.
4	The **teacher will** instruct students to complete the summative assessment.	**Students will** complete the summative test as assigned.
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.*	1. Write a step-by-step explanation of how you would balance a chemical equation. Use Nitrogen (N_2) and Hydrogen (H_2) as reactants and Ammonia (NH_3) as the product in your example. 2. For the chemical reactions of synthesis, decomposition, combustion, single replacement, and double replacement, predict what the product will be in the following table. Also write a sentence explaining your prediction. 3. Explain how energy is transferred during a chemical reaction in an open and closed system and how the law of conversation of energy applies in each case. Choose a different chemical reaction each for open and closed system. 4. How does an enzyme affect the rate, pH, and temperature of a chemical reaction? Make sure to discuss how energy is transferred and also be sure to cite data from the enzyme lab that was completed in class.

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.*

Scoring Rubric for Each Summative Assessment Item:

	0-1 point	**2 points**	**3 points**	**4 points**
Precision and Relevance	Answer is not precise in	Answer has some precise	Answer is mostly precise	Answer is precise and

	calculation or has little or no relation to the topic of the question	calculations but also inaccurate ones and somewhat relates to the question	in calculations and essentially relates to the main point of the question with slight errors	entirely relevant to the question with no errors
Clarity and Evidence	Answer is unclear and difficult to understand and has little or no evidence to support it	Answer is somewhat clear but with inconsistent parts and minor supporting evidence	Answer is mostly clear with a few key supporting evidence and has few inconsistencies	Answer is clear and consistent and has sufficient evidence to support it
Point Scale	**0-5.5 = incomplete, 5.6-6.3 = C, 6.4-7.1 = B, 7.2 -8 = A; TOTAL: _____ out of 8(mastery = 5.6)**			

To achieve mastery of Standard HS.5.4.9 and HS.5.4.10, students must receive 5.6 out of 8 or 70% on the summative assessment items.

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

1) Write a step-by-step explanation of how you would balance a chemical equation. Use Nitrogen (N_2) and Hydrogen (H_2) as reactants and Ammonia (NH_3) as the product in your example. (8 points)

Mastery answer: (Note that the order of the steps does not matter just as long the student understands that a subscript cannot be changed and that elements must be balanced on both sides of the equation.) The first step in balancing a chemical equation is to identify the elements and their coefficients on the reactants side and products side. The second step is to recognize which element has a subscript which cannot be changed and then assign a coefficient multiple to an element that has the smaller atom amount to balance the element atom total on the other side. The third step is to recount the element atom totals for both sides and then repeat the second step for another element that is unbalanced. The fourth step is to continue balancing all the elements by assigning coefficients until the equation is completely balanced for reactants and products. Below is an example using nitrogen (N_2) hydrogen (H_2) as reactants and ammonia (NH_3) as the product.

$$N_2 + H_2 \rightarrow NH_3$$

Step 1: On the left side (reactants) there are 2 nitrogen atoms and 2 hydrogen atoms, on the right side (products) there is one nitrogen atom and three hydrogen atoms.

Step 2: Understanding that subscripts cannot be changed, I will add a coefficient of 2 to the ammonia (NH_3) compound which will make the products have 2 nitrogen atoms and 6 hydrogen atoms. This is will balance the number of nitrogen atoms on both sides.

$$N_2 + H_2 \rightarrow 2(NH_3)$$

Step 3: I need to balance the hydrogen atoms so I will add a 3 to the coefficient of the hydrogen molecule on the left side which will make 6 hydrogen atoms on both sides.

$$N_2 + 3H_2 \rightarrow 2(NH_3)$$

Step 4: All the elements are balanced which makes the equation balanced.

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

1) For the chemical reactions of synthesis, decomposition, combustion, single replacement, and double replacement, predict what the product will be in the following table. Also write a sentence explaining your prediction. (8 points)

Reaction	Reactant	Product	Explanation
Synthesis	$C + O_2$	CO_2	The carbon and oxygen atoms will synthesize or combine to form carbon dioxide.
Decomposition	$2H_20_2$	$2H_2 + O_2$	The water molecule will decompose or breakdown into hydrogen and oxygen.
Combustion	$CH_4 + O_2$	$CO_2 + H_2O$	(Note that students are not required to balance the equation) Methane and oxygen will combust or release heat in an exothermic reaction and produce water and carbon dioxide.
Single replacement	$CuCl_2 + Al$	$Cu + AlCl_3$	The copper in the copper chloride will be replaced by aluminum in a single replacement reaction that will produce copper and aluminum chloride.
Double replacement	$KI + Pb(NO_3)_2$	$PbI_2 + KNO_3$	The potassium iodide will have a double replacement reaction with lead nitrate to form lead iodide and potassium nitrate where the positive ions switched.

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

1) Explain how energy is transferred during a chemical reaction in an open and closed system and how the law of conservation of energy applies in each case. Choose a different chemical reaction each for open and closed system. (8 points)

(Please note the following are examples of several that a student can provide with supporting evidence). The law of conservation of energy states that the total energy is conserved or stays the same during an interaction. In a closed system, the energy should be entirely contained between the interacting systems and in an open system, some of the energy may be transferred to an outside, unintended system.

For an example of energy conservation in a closed system, you can have the chemical reaction of photosynthesis:

$$CO_2 + H_2O + (light) \rightarrow C_6H_{12}O_6 + O_2$$

Here the carbon dioxide and water molecules form a sugar molecule and oxygen with sunlight being the transfer of energy from the sun to the plant system. The light energy is absorbed and contained in the plant system and used to store chemical energy.

For an example of energy conservation in an open system, you can have the combustion of hydrogen and oxygen:

$$2H_2 + O_2 \rightarrow 2H_2O$$

Here hydrogen and oxygen ignite and combust in an exothermic reaction where heat is released into the surrounding system which results in a lower amount of heat energy in the product than in the reactants. Having an open system gives the heat energy the ability to transfer to the surrounding, cooler system.

Summative Assessment Item 4 (clearly identify answer key/scoring rubric, and acceptable score): (add as needed)

1) How does an enzyme affect the rate, pH, and temperature of a chemical reaction? Make sure to discuss how energy is transferred and also be sure to cite data from the enzyme lab that was completed in class. (8 points)

(Please note that students will use data from their enzyme lab to answer this assessment item) An enzyme will speed up a chemical reaction by lowering its activation energy by breaking down the substrates. In the enzyme lab, we observed how hydrogen peroxide and catalase interact and how the rate, temperature, and pH were affected. When hydrogen peroxide was added to the animal liver, it had a higher reaction than the apple and potato which released oxygen and heat. We concluded that the animal liver had the highest amount of catalase and that will cause the breakdown of hydrogen peroxide to occur faster and increase the temperature in an exothermic reaction. When we boiled the animal liver and then added the hydrogen peroxide there was very little reaction occurring. When tested in the ice and warm water baths, the warm bath had a stronger reaction so therefore, the warmer the temperature of the interaction, the stronger the reaction. However, boiling will breakdown down the catalase and cause it not to react to hydrogen peroxide.
As for pH the lab data results showed that the catalase reacts most effectively in an acidic solution so therefore a lower pH favors an enzyme reaction.