

## Exemplary Planning Commentary: Secondary Science

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### 1a. Central focus of the segment

For the lesson section I will be teaching, my central focus will be: “Explain the purpose of enzymes in our bodies, and justify with evidence that you know how they work, and how are they regulated.” The school I am working with uses the Washington State Essential Academic Learning Requirements (EALRs) as their standards. Washington State will be moving to the Next Generation Science Standards (NGSS) soon. For this reason my central focus was based mainly on EALR 9-11 LS1F and 9-11 LS1G. Enzymes have an importance in everyday life for the students. The focus tries to help students to understand the role enzymes play in our bodies. This starts off in the first lesson. The students begin the unit with a lab where they see interactions of sucrose with sucrase. The students follow the lab handout shown in the instructional materials document. The students put sucrose in one test tube, sucrase in another, and in another test tube sucrose and sucrase. They then use Benedict’s solution as an indicator for monosaccharides. They will see that with just sucrose (which is a disaccharide), and with just sucrase (Which they know is not a monosaccharide but a protein) the Benedict’s solution doesn’t indicate positive for monosaccharides. But when the two compounds are put together, they see an indication of monosaccharides. This starts them on the path to seeing how a protein can break things down when they see that sucrose seems to turn sucrose, a disaccharide, into monosaccharides. As the lessons progress, they see that in order to use any food at all, our bodies must break down our food into usable parts. And the machinery that does this are called enzymes. We see this connection being made in Lesson 4, when they learn of the different types of macromolecules that are in food, and the parts they must be broken down into to be useful to us. This is all to emphasize the importance of this topic to their everyday lives.

### 1b. Linking skills, knowledge, and context

The lesson’s learning target (i.e. learning objective) and the central focus support the student’s understanding of the scientific concepts found in the EALR standards 9-11 LS1F and 9-11 LS1G. The central focus takes all of the concepts found in the standards, and focuses it around enzymes. The learning targets (i.e. learning objective) then take that central focus, and bring in the other scientific concepts in the standards in support of that central focus. The EALRs given discuss multiple things. They talk about macromolecules in the food that must be broken down, and enzymes that do this work, and how enzymes can be regulated to help our bodies adapt to the environment. These are all included in the learning targets to support to central focus. A good example of this is found in the learning targets for lesson 3. They are as follows: “Define enzyme and give at least 2 examples of enzymes”, “Explain the specificity an enzyme to their substrates, and justify this with two real world examples.” We see that these concepts of specificity tie back to the central focus by giving evidence for how enzymes work. They also tie back to the standards. The standards ask that students show “Breakdown and synthesis are made possible by proteins called enzymes” and these learning targets give further evidence that the students can pull from. This also gives a little more information past what the standards seem ask for when the learning targets talk about specificity. This was included to help the honors students to have a bit more depth in their studies and for evidence in supporting how enzymes work. Further examples include the learning targets for Lesson 4 are as follows: “Students will be able to explain why our bodies need enzymes. They will be able to justify this by describing the 4 main types of macromolecules, and what they break down into so the body can use them.” These concepts from this learning target come directly from the standards, seen when the standards discuss how macromolecules must be broken down into smaller parts and reassembled into different macromolecules our bodies can use as building blocks. This then ties back to the central focus by giving further evidence that enzymes have an

important role in the human body. All of these examples also give the students chances to develop evidence-based explanations for real world phenomena. For example, the central focus itself asks the students to justify with evidence how enzymes work, and how they are regulated. We see that learning targets like the ones shown above help the students to have that evidence. We also see in the Lesson 2 section of the instructional materials document that the students are given a rubric to properly write an evidence-based conclusion with a range of data as evidence to support their ideas. The rubric comes from the writing rubric from a past Washington State End of Course (EOC) exam. The students are graded based on their range of data, how they show that their data supports their claim, and how their data supports a scientifically plausible explanation in their lab conclusions. Further learning targets give the students more evidence they can use to help them on their summative test at the end of the unit.

### **1c. Explaining how lessons build and link to other skills**

One of the important things this lesson sequence does is to show students that all of science is connected. This is done by having learning targets that build and add to what has already be taught. For example, my central focus across the lessons combines the EALR standards 9-11 LS1F and 9-11 LS1G to a statement as follows: “Explain the purpose of enzymes in our bodies, and justify with evidence that you know how they work, and how are they regulated.” The learning targets then build on one another and on previous knowledge to show how they relate to each other, and to information from other units. The learning targets from lesson 1 are “Students will observe what sucrose does to sucrose (table sugar)” and “Students will be able to describe the phenomenon of sucrose breaking down sucrose.” These involve sucrose, which is a disaccharide they have worked with before. It shows an example of a real world phenomenon of sucrose breaking down sucrose that they will have to explain with evidence from the lab. The learning targets from lesson 2 have the students looking at the evidence from their labs, and creating a conclusion of what they know thus far about enzymes based on how sucrose behaved. The conclusion requires them to pull from a range of data, and give reasons why the data supports their claim. This is done via the rubric they are given in the instructional materials document. Lesson three learning targets have the students better defining what an enzyme is, and how enzymes have specificity based on their active sites. These learning targets link back to the central focus in that they show the purpose of enzymes, and a how they work. The students can use this information they have as evidence to explain and justify the phenomenon they are seeing. The learning targets of lessons 4 and 5 give the students more evidence as to the importance of enzymes, and then how our bodies can regulate those enzymes. All of these learning targets tie back to the central focus and give the students multiple chances to explain and give evidence for the importance of enzymes, how they work, and how they are regulated.

### **1d. Opportunities to express learning targets (Washington State only).**

In my lessons I tried to give the students multiple chances to express their understanding of the learning targets and why they are important. On each lesson there are three sections for informal assessments, and each of these involves the students being able to discuss concepts found in the learning targets. An example showing this would be in lesson 5. The learning targets for lesson 5 are as follows: “Students will be able to explain that living things regulate cellular functions by changing the activity of proteins within cells” and “Students will be able to describe two examples of how living things can regulate protein activity in response to their environment.” The students get an opportunity to discuss this learning target in a think/pair/share model when answering the following question: “How do you think your bodies could adapt to increasing altitude with what you know about hemoglobin and how it carries O<sub>2</sub> in the blood stream?” This will allow students a chance to talk about how a real enzyme is regulated, and involves one of the ways human bodies can adapt to their environment. This will also tie back to the central focus in giving them evidence to justify how the human body regulates enzyme activity.

### **2a. Summary of students’ prior knowledge**

Each of the 5 lessons included times when the teacher could pre-assess the students’ knowledge. For example in Lesson 2, I ask the students to answer the following questions on a piece of paper, “What is a protein? What are their repeating units called? What is an enzyme?” This will be more of a formal preassessment of the students’ knowledge. However, throughout the lesson plans, I will try to have many more informal methods of preassessment to gauge my students’ background knowledge of the concepts. An example of this can be seen in Lesson 4 on p. 2, where I will have the

students answer the following questions: “When we eat broccoli, can we use the broccoli DNA as it is? Would that give us broccoli parts? What would need to do with the broccoli DNA then to be able to use it to build our own?” in a pair/share model. While the students are discussing their thoughts with each other, I will listen in on their conversations and get a feel for how much previous knowledge they have on the subject. From these pre-assessments and from having worked with my mentor teacher, I know that many of the students have worked with mono-, di-, and polysaccharides, and can tell the difference between them. They also know on a more basic level what lipids, carbohydrates, nucleic acids and proteins are. However they are still in the process of learning the purpose and composition of these different macromolecules. The students have also worked with Benedict’s solution previously, which we will use as an indicator in our lab to identify monosaccharides. In addition, they have written lab conclusions before, and are in the process of improving the “statement, evidence, reasoning” model.

## **2b. Summary of student assets**

In the school I am working at, “49.9% of the student body accept free or reduced-price meals” (Context for Learning, p. 1). Based on this information, about half of the students in my classroom most likely come from low-income households. Additionally, the school I am working at has a high amount of diversity and “6.9% of students are transitional bilingual” (Context for Learning, p. 1). Students come from a variety of cultures and backgrounds, which provides a wide knowledge base adding depth to classroom discussions. From my lesson plans, the focus to “explain the purpose of enzymes in our bodies, and justify with evidence how they work, and how are they regulated” allows for multiple opportunities to pull from my students’ knowledge base. For example, in Lesson Plan 1, when I am asking the students questions during the 20 minute wait time in their lab, I ask the questions: “Where do you see starch in your everyday life?” “Where do you see sucrase in your everyday life?” These kinds of questions will allow the students to interact with the academic language (in this case, the substrates for our enzyme lab) and connect it to what they know. Often students will help out around the house, and some will have dealt with starch in their laundry. This is a specific way they can connect what we are learning to their everyday experiences. For relating my students to the central focus, I know that I have a wide diversity of backgrounds, so I will try and relate to my students using more universal concepts such as starch in laundry. Enzymes in the human body are very universal as well, as we all have enzymes to break down starch and sucrase. The students who have 504 plans in my class, as the Context for Learning says, have illnesses that cause them to miss a lot of classes. For my central focus, these students don’t have high needs for a specially designed central focus, except that they may need some explanation on the side so they can get the material they miss in class.

## **3a. Selecting learning activities based on prior knowledge and other assets**

For my learning tasks and materials, my knowledge of personal/cultural/community affected my choices quite a bit. As mentioned in 2a-b, much of my class is very diverse and comes from many different backgrounds. As Westwood (2013) says, “the golden rule for adapting curriculum must always be that the content should actually be modified a little as necessary, while still ensuring that all students can cope successfully with the subject matter and participate positively in the learning activities” (p. 33). I took this to heart in designing my lessons. The 504 plans I have in this class are concerned with giving a few students extra time because of a diagnosis that causes them to miss classes. However, my students come from many different backgrounds, and many of those students will have had very different life experiences. To follow Westwood’s recommendation, I attempted to design my lessons in a way to which everyone could relate. This meant finding a subject to relate enzymes in my learning objectives to concepts that everyone would understand. As an example of this, I will discuss Lesson 3. My learning objectives in Lesson 3 are “Define enzyme and give at least 2 examples of enzymes” and “Explain the specificity an enzyme to their substrates, and justify this with two real world examples.” In order to help my students understand enzymes and specificity, I will do an activity where the students will have to race me to staple a piece of paper. However, I will have a stapler, and they will have to staple the paper with only their fingers. This will connect with the students in helping them see how an enzyme speeds up a chemical reaction, without being a product or reactant, much like the stapler helped me as the teacher staple much faster. The example of the stapler follows Westwood in that everyone in the class has seen a stapler and has worked one. I also had every student attempt to staple a piece of paper with only their hands. This was a demonstration that will help students from multiple backgrounds understand enzymes and how they work because “all students can cope successfully with subject matter” (Westwood, 2013, p.33) of a stapler.

Reference: Westwood, P. S. (2013). Inclusive and adaptive teaching: Meeting the challenge of diversity in the classroom. London: Routledge.

### **3b. Selecting learning activities for the whole-class and individuals**

My instructional strategies and planned supports are appropriate for the whole class because of what Westwood (2013) talks about in "Inclusive and adaptive teaching: Meeting the challenge of diversity in the classroom". In this article we read that wherever possible, supports and strategies should be accessible to all students in the classroom. He says that "the golden rule of adapting curriculum must always be that the content should actually be modified a little as necessary, while still ensuring that all students can cope successfully with the subject matter and participate positively in the learning activities" (p. 33, 2013). From my context for learning document, we see that many of the students come from very different backgrounds. "49.9% of the student body accept free or reduced-price meals" (Context for Learning, p. 1), which shows that half of the students in my classroom most likely come from low-income households. Also, the school I am working at has a high amount of diversity where the "ethnicity of the school as a whole is 37.8% White, 26.4% Hispanic, 12.1% Asian or Pacific Islander, 08.3% Black, 00.7% American Indian or Alaskan Native, and 14.7% of students are unlisted" (Context for Learning, p.1).

Also, "6.9% of students are transitional bilingual" (Context for Learning, p. 1). Which such a wide variety of backgrounds, my lesson plan had to include strategies and supports that were fairly universal so as to follow Westwood's (2013) golden rule. He says "All students have a basic right to be exposed to more or less the same experiences, and given the same learning opportunities" (p. 33, 2013). In lesson 3, I use the example of the stapler. Almost universally, my students will have worked with staplers. I know that all my students have at least been in the class since the beginning of the school year, so they at least have a few months of exposure to staplers, if we are not to assume they had exposure before this class. So in lesson 3, I will plan on comparing stapler to enzymes. A stapler allows you to staple a piece of paper much easier than if you tried to do it by hand. It makes the process of stapling much faster. An enzyme does the same things in our cells, and using a stapler to help demonstrate the concept seems like it would reach many of the students.

My supports and strategies also incorporate the needs of groups of students. One of those groups of students include a few high-achieving students. For the high achieving students, I try to incorporate a few things that will add to their experience, without going over the heads of the other students too much. One way I will do this in the same lesson, Lesson 3, I gave the students a diagram and complex computer animation of the enzyme complex that replicates DNA. The information the students need to get from it is that it is just another example of enzymes at work. But for the high-achieving students, I put this in because all of the students have seen DNA replication before, but not the enzymes that perform the action, so the high achieving students will have some more detail to apply to the process. I also tried to incorporate the needs of individual students into my support and strategies. The two students with 504 plans in my class have medical conditions that cause them to miss days of school. My support for them is four fold. First I let them know that the best way to get all of the information they need is to copy the notes from a friend for the days they missed. I tell them to ask a reliable source for good notes. Secondly, I give them the review sheet seen in Lesson 5 (instructional materials, Lesson 5 section). Depending on whether or not they were able to find good notes or not, I may fill out the blanks on the review sheet for them to use to study if they don't have friends that take reliable notes. Thirdly, after giving the students time to study, I ask them to come in during lunch, advisory, or before or after school to come and ask any questions they have and ask them to explain a few things to see if they understand the material. The fourth step involves giving the students plenty of chances to come and take the test late, or retake the test if they did poorly when they did take it because they didn't have enough of a chance to study. All of these strategies show my support appropriate for the needs of the class, smaller groups of students, and individual students. There are also supports in this example for my student who is an English language learner. By using the stapler, I can give her a visual for words like "active site" because I can point out where on the stapler would be considered the active site. Students who are more familiar with English will understand how to connect those two words (active and site) but an English language learner may find that more difficult. By giving a more universal option, I allow them to see an example in front of them. For the student who is an English language learner, I am also sure to include written text in the form of PowerPoint presentations so she can see the questions and important concepts as well as hear them.

### 3c. Resources for getting help on learning targets (Washington state only)

To support their progress toward the learning targets, students have several resources available to them. In almost all of my lesson plans, before the new lesson, I will have the students interact with the learning targets in some way. An example of this is shown in Lesson 5, when I have the students write the learning targets in their own words in their notebooks. I then have a few of the students share with the whole class. This is the first step in allowing the students to support their progress toward the learning targets. The exercise allows them to interact with the learning targets and try to phrase them in a way they can understand later. They identify resources to support further progress mainly by asking me or the mentor teacher in the room. There are many different ways that we can support their progress, and the mentor teacher and I will be the main way to identify those resources. The students can also look online for other resources once they know the learning targets. The students can input key words from the learning targets to help them see if there is any further information available. One example of a resource is seen in Lesson 3. At the end of the lesson, I have my students look at the learning targets again, and attempt to assess their learning of the learning targets. I emphasized to the students that I wasn't asking them to answer the learning target, but rather asked them to self-assess their learning, and respond saying things like "I really didn't understand this" or "With some more time, I could do well on a test on this subject." Other resources available to the students are text books in the classroom. The students have access to many textbooks in the classroom for extra support. One of these is mentioned in the Context for Learning. The text is Third Edition BSCS Biology: A Human Approach. Other places where they can support their progress is by coming in to the class before and after school and during lunch. I always try and stay in the room when I can during normal school hours to be accessible to my students. This way they can come and ask questions to support their progress toward the learning targets any time they want.

### 3d. Anticipating misconceptions

From the lesson plans, we see that the central focus is "Explain the purpose of enzymes in our bodies, and justify with evidence that you know how they work, and how are they regulated." In students prior learning this year, they had worked with amylose along with a couple of other enzymes and had seen it break down starch, but they didn't delve into what an enzyme was beyond that. They had also run into many of the macromolecules we go through in this unit. For example, in addition to the starch, they had made and built models of DNA molecules and learned about RNA as well. The students had worked with lipids in the cellular membrane in a previous unit dealing with the parts of a cell. They had also seen many proteins performing various functions, but these functions had never been categorized as they see in these lessons. The above information I received from my mentor teacher about previous lessons and units. I realize many students may have missed some of the information from these previous lessons, or simply not internalized or retained it well, so I will usually ask questions at the beginning of a lesson or unit to gauge where the students are in their knowledge. My students also have a lot of previous knowledge they have accumulated outside of the classroom. However, in Lesson 1 there is a preassessment for the students that is meant to be given a few days before they begin the lesson, and so was asked before this planning phase was written. The preassessment asks the following questions: "What is a protein? What are their repeating units called? What is an enzyme?" These are very connected to the central focus. Common responses included thinking the role of enzymes is to break things down, and that protein is found in meat. Responses such as these were correct, so those students only had to reinforce that knowledge with some more content to fill in the gaps. Many of the students however showed misconceptions in answering the pretest questions. Some of these included that protein is used for energy, or that it is a type of DNA or made of DNA parts (A, T, G, and C). Some also thought the repeating units of proteins were monosaccharides. And still others simply didn't know what an enzyme was at all, and wrote that. I address this confusion and these specific hang-ups in my lessons. For example, in lesson 4, we go into each of the 4 main types of macromolecules, so the students can see the distinction. In Lesson 3 we give the definition of an enzyme. During my lesson plans, I also have multiple locations where I ask the students what they know about a topic, and I will try to emphasize that they don't have to tell me what they know only as a scientific concept. For example, when I am asking my students what they know about catalysts, I am hoping some students will remember hearing that word in an English class as a device to move along a plot. That way they can connect science vocabulary to other fields where the same words are used. I plan on making little adjustments as I go along so I can correct any misconceptions I hear.

### 4a. Identifying the language function

Justify with evidence is essential for student learning. The central focus for my unit is “Explain the purpose of enzymes in our bodies, and justify with evidence that you know how they work, and how are they regulated.” Explain is important as well, because it has students looking for the reason the unit is important, but the questions about justifying with evidence show that they understand how enzymes work and are regulated gets the students to a deeper level of understanding about what is happening in their bodies.

#### **4b. Learning activities enabling practice with the language function**

A great learning task in for students to practice using the language function is found in Lesson 5: Enzyme Wrap-Up that will take place on a Wednesday. It is a discussion that takes place after the students have seen a short “I Love Lucy” clip. In the clip two characters (Lucy and Ethel) are put in a factory where they are to wrap candy on a conveyor belt, but they can’t keep up. The students will watch the clip, and then we will come together and ask questions like “what could Lucy and Ethel have done to help them do a better job in the candy factory?” And as the students discuss the topic, we will bring back the analogy of our body as a factory, and then have the students try and compare the two, and see if their thoughts on how Lucy and Ethel could regulate their work flow, could be applied to the machinery in our bodies: enzymes. If the discussion goes the direction I am hoping, the students will eventually come to the conclusion that enzymes can be regulated by changing the number of enzymes, and changing how well they are at doing their job, or their efficiency. This will help the students take real life scenarios that they can relate to (being overwhelmed by a task and needing to make adjustments) and connect that knowledge to enzymes in our bodies.

#### **4c. Additional language demands**

For the vocabulary in Lesson 5, the students will have seen most of the words before, but not in this context or combination. For example, one of the vocabulary words is regulatory molecule. Most of students will know the definition molecule and regulatory, but not understand with the term when put together. One exception may be my student who is an English language learner. She may not have seen the word regulatory. For her, I will be sure to explain the concept to the class to reinforce her understanding. The definitions of the two words alone should help the students see the function of a regulatory molecule when they see that regulatory enzymes regulate the function of enzymes. Examples I give them are of insulin and glucagon. Insulin and glucagon are vocabulary words that may be new to them, especially glucagon. Some will have heard of insulin because there is a high incidence of diabetes in this country. For the vocabulary in this example, the student will also need to understand the inhibitory symbol ( $\dashv$ ) and a reaction arrow ( $\rightarrow$ ). They will have seen the reaction arrow in other units because they have discussed the chemical formula for photosynthesis among other things, though they have struggled a bit with chemical formulas in lessons I have done in the past, so if they see them they may be resistant to it at first. But they probably won’t have seen the inhibitory symbol, at least not in biology this year. As we can’t do a pretest for everything, I will simply ask if they have seen the symbol before I introduce it, to gauge how much of an explanation the students will need. One of the language demands for the students will involve showing that they understand the relationship between insulin, glucagon, and blood glucose enough to use it as an example for regulatory molecules. They can show this on a test via symbols, or in written words. If they are using symbols they could use the reaction arrow to show blood glucose being turned into energy or storage, and the inhibitory symbol to show that glucagon is inhibiting the above reaction and insulin inhibits glucagon. This would be syntax as they are showing the symbols as a representation of what is happening. They can show that they understand regulatory molecules and how enzymes are regulated, by describing the insulin and glucagon process in written words (or in a discussion if the students are discussing the concepts among themselves.) This would be discourse, as they are writing or speaking their understanding using words. The students with 504 plans will miss multiple classes. If they miss Lesson 5, or any of the other lessons, they will be able to practice their language demands with a classmate outside of school, or come and practice with me. I make myself available to them and the rest of my class before and after school, and during lunch. I will also give them extra worksheets if they would like for them to practice. For my student who is an English Language Learner, I will also be available for her to come and practice with me. I will write examples of almost all of the language demands either on the white board, or in my PowerPoint Slideshow.

#### **4d. Supporting language use**

In Lesson 5, where we have been for questions 4a-c, we have seen multiple language tasks that help the user complete the language function in the central focus. That language function in the central focus is to justify with evidence. The students are to justify with evidence that they know how enzymes work, and how they are regulated. In Lesson 5, I will try to give them multiple language supports so they can practice the language demands needed. I plan to go over the learning target at the beginning of class, and “have the students write the learning targets for the day in their notes. A few of them will then share with the class” (Lesson 5, p. 1). This will give them a chance to interact with the learning targets and the language function of the learning targets and allow them a chance to share. Then throughout the lesson, I will try and have the students go over the various vocabulary words and new symbols, giving them examples on the board of what it looks like to work with them. In Lesson 5, we see this involves going through the symbols and words involved in the feedback mechanisms of insulin and glucagon. I will then allow the students to practice with another method to regulate an enzyme. We will talk about hemoglobin, and I will give the students a scenario where they are high on a mountain, and feel out of breath. I will then ask questions like “Why do you get out of breath? How might your body respond to less oxygen in the air? What can we pull from the example of the factory Lucy and Ethel were in?” This will hopefully give the students a scaffolded path to find the solution themselves. I will explain a few things about hemoglobin as well such as how it works, and its structure of heme with iron in it (this is mainly to keep the high achieving students more interested with a bit more depth). After having a chance to discuss, they will see it again on their review worksheet. In the “Instructional Materials” under the Lesson 5 section, there is a review worksheet for the students to work on. Question 12 asks the students: “How do our bodies regulate cell activities via enzymes and other proteins? They can answer these questions using syntax with reaction arrows and inhibitory symbols, or with discourse and use words to describe the answer. The students can also always come in and ask me questions before or after school, and during lunch if they are still unsure.

### **5a. Assessing student learning**

The informal assessments provide direct evidence for my students and me to monitor their understanding of science concepts and the phenomenon, the nature of science, and the application of scientific practices through inquiry of the unit because they get all the students to think critically about what they are learning, and see if their thoughts agree with the rest of the class’. An example of an informal assessment monitoring science concepts and phenomenon is seen in Lesson 1. I ask the students questions during the 20 minute wait time in the lab: “Where do you see starch in your everyday life? Where do you see sucrase in your everyday life?” and “What is an indicator? What does Benedict’s solution indicate for? What happens that would indicate it is indicating?” These types of informal assessments will allow me to get a feel for the students’ thinking about the phenomenon happening in front of their eyes in the lab, and will allow me as a teacher to monitor how much they are comprehending from the lab, and if anything seems to be misunderstood. An example of an informal assessment for the nature of science will come in Lesson 2. There, I will ask the questions “Are there any outliers in the data? Where do we see trends or data points that don’t fit with what we know about our lab?” The nature of science is that there will be anomalies, and data is never perfect. By asking these questions I can see if my students understand a key part of the nature of science, how to look at your data, and see what isn’t following suit, maybe because of contamination, or human error. But I will have them put forth their best ideas to see what they can come up with. I will then encourage them saying research scientists deal with failure or bad data more often than good usable data. A good example of an informal assessment reporting to the students and me in terms of their learning of application of scientific practices through inquiry is given in Lesson 3 as well. After I race my students in stapling a piece of paper, me using a stapler and them using their fingers, I will ask them questions like “How was I able to beat you three so easily in our race?”, “Were our goals different or the same?”, “What in the sucrase lab is represented by the staple and paper in our lab?”, and “What is comparable to sucrase in our staple-ase model?” This will allow me to monitor how they can take a real occurrence they can see, and start to talk about the stapler as a scientist does an enzyme. With these questions, I will try to see if the students will be able to make the jump from the inquiry model to the real thing, or if they need some more connections to be made between the two. Examples of how formal assessments will provide direct evidence for me and my students to monitor their understanding of science concepts and the phenomenon, the nature of science, and the application of scientific practices through inquiry throughout the learning segment can be seen in the both of the two formal assessments in the unit. The first is the lab conclusion. This will help me monitor my students’ progress of science concepts and the phenomenon, the nature of science, and the application of scientific practices through inquiry because in writing the conclusion, they are following the conclusion

rubric from past “Biology End of Course” exams which has them give a range of data (nature of science and needing multiple trials and controls) and scientific explanations with explanatory language (showing inquiry based understanding of concepts and the real life phenomenon of sucrose be broken down by sucrase).

### **5b. Adapting lessons**

I am teaching an honors section, so the only students in my class with IEPs or 504s are two students diagnosed with an illness that causes them to miss classes. Their 504 plans allow them extra time for turning in work and for retaking tests if they weren't prepared enough for the test when they took it originally. I designed two separate tests with similar questions so the students can retake the tests when they feel more confident. These two students will also be allowed extra time to seek help and ask questions as well as to finish writing their lab conclusions. My student who is an English language learner is fairly advanced in her English, so my mentor teacher says she can handle the normal test, given the provision she can ask more questions. If she doesn't understand something, I will let her ask more questions than the average student during the test as long as they are clarification questions. There are also high achieving students in my classroom. For these students, I include an extra credit question (number 5 on the assessment in the Assessments document under the Lesson 5 section) that has the students try to use what they know about human enzyme regulation, and apply it to an alien species with an enzyme called “Steam-ase”. While the idea of an enzyme that splits a water molecule into H<sub>2</sub> and O<sub>2</sub> inside a living organism seems a bit far-fetched, I think it will work well enough to get my students thinking about enzyme regulation in a new way. This is an attempt to bring out a higher level of Blooms taxonomy and let them try to answer an application question. I didn't give any special considerations for the high achieving students or the girl who is an English language learner on the lab conclusion. This is because I was trying to prepare them for what to expect on their Biology End of Course (EoC) exam. Because the Biology EoC is a standardized test, I had them all use the same rubric so as to best mimic the expectations for writing a conclusion on the Biology EoC.

### **5c. Student reflection (Washington state only)**

I tried to elicit student voice in most, if not all, of my lesson plans to help both me and the students gauge where they are relative to the learning targets. This usually involved having the students try to discuss the learning targets with a partner or the class, or translate the learning targets into their own words. An example of this was in Lesson 4, where it states “The teacher will introduce the students with their learning targets for the day, and have the students discuss with their partners what they think the learning targets mean. The teacher will walk around the room listening to discussions to see what the students are saying.” This will allow me to walk around the room and either get a general idea of how the class as a whole is doing, or be able to target a few groups who may need a bit more help in understanding the learning targets, or who have had a history of needing help understanding the learning targets in the past. In Lesson 3, I will directly ask the students to comment not on the learning targets, but to assess how they thought they did learning the learning targets. I will ask this at the end of the lesson, and have the students do a think, pair, share except that I will have the students write their thoughts down on a piece of paper and turn it in so I can take a look at them. This will allow the students to get a chance to take a look at their own learning, and allow me to assess some student voice responses and see how they think they are doing in the class.

### **5d. Strategies to promote student self-assessment (Washington state only)**

In Lesson 3, I have the students do a think, pair, share, using the following questions as a guide: “How well did you do learning the objectives today?,” “If you were tested on them today, how do you think you would do?,” “Were you able to stay focused?,” “What could you or I have done differently that would have helped you learn better?” This will allow the student a very deliberate chance to look at their learning at the end of Lesson 3. However there are several other chances for students to monitor their own learning throughout the 5 lessons. One example is in lesson 4, which states “the teacher will then have the students discuss what happened in the lab from the previous lessons (Lessons 1 and 2) using the new information they have about the different kinds of macromolecules, and what they learned of enzymes the previous day” (Lesson 4, p. 2). This process of getting the students to connect what they just learned in Lesson 4 to what they did in Lesson 1 and the data they analyzed in Lesson 2 will force them to evaluate on some level how well they learned the material in the earlier lessons so as to use the new information to further what they learned then.