

Lesson 1 Outline

Lesson Part	Activity description/Teacher does	Students do
Formal/Informal Assessment of Prior Learning or Preassessment (Sequence start)	<p>A few days before beginning this lesson, the teacher asks the students the following questions:</p> <p>What is a protein? What are their repeating units called?</p> <p>What is an enzyme?</p>	The students are to answer the questions on a piece of notebook paper and hand it in.

Title	Sucrase Enzyme Lab Inquiry	
Standard	<p>EALR 9-11 LS1F All of the functions of the cell are based on chemical reactions. Food molecules are broken down to provide the energy and the chemical constituents needed to synthesize other molecules. Breakdown and synthesis are made possible by proteins called enzymes. Some of these enzymes enable the cell to store energy in special chemicals, such as ATP, that are needed to drive the many other chemical reactions in a cell.</p> <p>NGSS HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</p>	
Central Focus (CF)	Explain the purpose of enzymes in our bodies, and justify with evidence that you know how they work, and how are they regulated.	
Learning Target (LT)	<p>Students will observe what sucrase does to sucrose (table sugar).</p> <p>Students will be able to describe the phenomenon of sucrase breaking down sucrose.</p>	
Instruction Inquiry Preview Review	<p>The teacher will introduce the lab, and describe some pieces that must be clarified. One example includes levels on the hotplate necessary for a “warm” water bath, versus settings for boiling water. Another example is to show them how to mix the contents of the test tubes well, so the reaction can take place properly.</p> <p>The teacher then directs the students to go into the lab area with goggles, and begin to follow the procedure at the lab station.</p> <p>I have included the lab handout below in this lesson.</p>	<p>The students will be listening and taking notes on the clarifications.</p> <p>The students go into the lab area with their goggles on and begin the lab. They will fill out the first empty column in the table given on the lab handout.</p>
Informal Assessment	<p>As the students are doing the lab, the teacher will go around and ask the students questions in their lab groups. Some questions include:</p> <p>“In Step 3, why are we adding water to test tubes 2 and 4?” (if they have trouble answering, follow up with “Are we controlling for something?”)</p> <p>“In this lab, exact measurements aren’t as important. Why might that be?”</p>	The students will try to answer the questions as best they can while the group is doing the lab.
Practice Activity Support	In the lab, there is a wait time of 20 minutes. During this time, the teacher will be going over a few things in the lab. The teacher will perform direct instruction on the structures of sucrose and starch.	The students will take notes.

Informal Assessment	<p>The teacher will also ask some review questions as they have worked with Benedict's solution before, and have learned the differences between monosaccharides, disaccharides, and polysaccharides. These questions may ask:</p> <p>"Where do you see starch in your every day life?" "Where do you see sucrose in your everyday life?" "What kind of saccharide is sucrose? Do you know any other types of disaccharides?" "What monosaccharides make up sucrose?" "What is an indicator?" "What does Benedict's solution indicate for? What happens that would indicate it is indicating?"</p> <p>They have seen all of these questions before, so I am trying to jog their memory.</p>	<p>Students will answer the questions and look through their old notes. They learned this in the previous semester, so they will be connecting old information to new.</p>
Practice Activity Support	<p>After the 20 minutes are up, the teacher will have the students go back and finish the lab.</p>	<p>The students will finish the lab. They will record the data they see in the table given on the lab handout.</p>
Closure Assessment of Student Voice	<p>The teacher will again be asking the students questions, not saying whether the students are correct or not. Questions may include:</p> <p>"What does the color change/lack of color change seem to indicate?" "What might be happening to the sucrose in the various test tubes? What might be happening to the starch?"</p> <p>The teacher asks the students to consider the questions that night and come back the next day prepared to answer a few more and look at the class data.</p>	<p>The students will give their best answers to the questions, and will think about them over night.</p>

Lesson 2 Outline

Lesson Part	Activity description/Teacher does	Students do
Title	Lab Data analysis and Conclusion	
Standard	<p>EALR 9-11 LS1F All of the functions of the cell are based on chemical reactions. Food molecules are broken down to provide the energy and the chemical constituents needed to synthesize other molecules. Breakdown and synthesis are made possible by proteins called enzymes. Some of these enzymes enable the cell to store energy in special chemicals, such as ATP, that are needed to drive the many other chemical reactions in a cell.</p> <p>EALR 9-12 INQB Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.</p> <p>EALR 9-12 INQC Conclusions must be logical, based on evidence, and consistent with prior established knowledge.</p> <p>NGSS HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</p>	
Central Focus (CF)	Explain the purpose of enzymes in our bodies, and justify with evidence that you know how they work, and how are they regulated.	
Learning Target (LT)	<p>The students will be able to analyze data and use it to describe what is happening to sucrose on a molecular level.</p> <p>The students understand how to write a scientific conclusion using a “Statement, Evidence, Explanation” format.</p> <p>The students will synthesize a conclusion based on data they obtained in the lab.</p>	
Instruction Inquiry Preview Review	<p>The teacher gives the students the learning targets for the day and has the students rephrase them in their own words for their partners.</p> <p>The teacher has the students put their data on the board in a large chart so everyone can see it.</p> <p>The teacher then asks several leading questions to have the students walk through what they are seeing.</p> <p>These questions will include the following:</p> <p>“What information are we trying to get from this lab? If you were a scientist, what would you use this lab to find out?”</p> <p>“Which test tubes does Benedict’s solution seem to affect? Is there anything different about them?”</p>	<p>The students see the learning targets and attempt to say them in their own words.</p> <p>The students write their data from the previous day on the board in the chart</p> <p>The students will attempt to answer these questions. Some questions will be answered in small groups first before they come back and describe what</p>

	<p>“Is there a correlation between where we see a reaction with Benedict’s solution and where we have added sucrose?”</p> <p>“Are there any outliers in the data? Where do we see trends that don’t fit with what we know about our lab?”</p>	they have talked about. Other questions will be answered only in class discussion.
Informal Assessment	The teacher will listen to the class as they discuss the questions, and attempt to ascertain their level of understanding.	The students will discuss some with their groups, and some with the class as a whole.
Practice Activity Support	<p>If the students are not fully comprehending the learning objectives, the teacher will ask them a few more questions, and lead them further, until most to all of the students seem to understand. These may include:</p> <p>“In test tube 3, was there a color change? What was in that test tube that made it different from test tubes 1 and 2?”</p> <p>The teacher will also remind them what Benedict’s solution indicates for, as well as what sucrose would look like if the two monosaccharides separated.</p>	The students will answer these questions as well, and attempt to understand what is happening.
Informal Assessment	The teacher will again attempt to ascertain if the students are understanding what they are seeing in the test tubes	The students are attempting to describe what is happening in the test tubes using the class’s data.
Practice Activity Support	<p>The teacher will then go through the conclusion rubric. The rubric is attached to this document below.</p> <p>The teacher will give the students examples of conclusions in a PowerPoint with pieces missing, so they can see what they need to watch out for. Examples include a conclusion that just starts off with data without giving a statement in response to the lab purpose question. Another example will show a conclusion that only gives one data point as opposed to a range of data.</p>	<p>The student will take notes on what a good conclusion looks like.</p> <p>The students will try to guess what is missing from the conclusions on the PowerPoint slide using the rubric to guide their responses.</p>
Closure Assessment of Student Voice	The teacher will give the students their homework assignment for the weekend, which will involve writing a conclusion based on the provided rubric.	The students will write a conclusion for their lab based on the class data and their own data using the rubric provided.

Lesson 3 Outline

Lesson Part	Activity description/Teacher does	Students do
Title	Enzymes and How They Work	
Standard	<p>EALR 9-11 LS1F All of the functions of the cell are based on chemical reactions. Food molecules are broken down to provide the energy and the chemical constituents needed to synthesize other molecules. Breakdown and synthesis are made possible by proteins called enzymes. Some of these enzymes enable the cell to store energy in special chemicals, such as ATP, that are needed to drive the many other chemical reactions in a cell.</p> <p>NGSS HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</p>	
Central Focus (CF)	Explain the purpose of enzymes in our bodies, and justify with evidence that you know how they work, and how are they regulated.	
Learning Target (LT)	<p>Define enzyme and give at least 2 examples of enzymes.</p> <p>Explain the specificity an enzyme to their substrates, and justify this with two real world examples.</p>	
Instruction Inquiry Preview Review	<p>The teacher will show the students the learning targets and have them try to write them in their notes in their own words, and then ask a few of the students to share their responses.</p> <p>The teacher will give all of the students a single staple and a small piece of scrap paper. They will then be tasked with stapling the paper, folding the staple, then unfolding the staple and unstapling the paper. This will all be done with their fingers.</p> <p>The teacher will then take a few volunteers to come up front and race the teacher in stapling three staples into a piece of paper, and unstapling them as well. The one who does it the fastest will win. However, during the race, the teacher will use a stapler, and a staple remover to do the same work much faster then the students can.</p>	<p>Students will write the learning targets in their words and then a few of them will share theirs with the class.</p> <p>Students will attempt to staple their piece of paper with their fingers and then unstaple it as well.</p> <p>The students racing the teacher will attempt to staple and unstaple the paper with their fingers.</p>
Informal Assessment	<p>The teacher will then ask the students questions like: “How was I able to beat you three so easily in our race?” “Were our goals different or the same?”</p> <p>The teacher will describe to the students that the task was the same and the result was the same for both the students and the teacher, but the teacher was able to do it a lot faster with the aid of the stapler.</p>	<p>The students will respond that the teacher used a stapler (and most likely that he cheated). They will respond to the other questions as well.</p> <p>The students will take note of the difference in rate.</p>

<p>Practice Activity Support</p>	<p>The teacher will then describe to the class that the stapler is a model called “Staple-ase”; a model for an enzyme. The teacher will give them the definition of an enzyme, and how it acts as a catalyst for reactions. The teacher will also define catalyst as something that increases the rate of a reaction without being a reactant or a product in the reaction.</p> <p>The teacher will the do some direct instruction on other terms associated with enzymes using a PowerPoint slideshow. These terms that are defined include:</p> <p>Substrate Active site Specificity of an enzyme’s active site</p> <p>For high achieving students, I include an image and video of DNA replication to show the class all of the different enzymes that are involved. This gets a bit more complicated for the average student, and so none of them have to memorize the enzymes of DNA replication. But the high-achieving students will be able to connect this to when they learned about DNA Replication and give them more detail into the process, while the rest of the class may just see it as another example of enzymes which is all they need to get out of it for the unit. For the student who is an English language learner, I made sure to include pointing out the different parts of the Staple-ase model, like the substrate and the Active site, so she can not only read about it and hear about it, but see a model to show these concepts.</p>	<p>The students will take notes during this section.</p> <p>The students take notes on these different definitions.</p>
<p>Informal Assessment</p>	<p>The teacher will then ask the students to take the example of the staple-ase model, and compare it to what they saw in the lab in the previous lessons.</p> <p>As the class goes through the above definitions, the teacher will have the students answer questions about them and gauge how well they understand the material. For example, the teacher will ask things like:</p> <p>“What is the substrate in our ‘staple-ase’ example?”</p> <p>“What is the substrate in our sucrose lab?”</p> <p>“What would be the active site on ‘staple-ase’?”</p> <p>“Knowing what you know of the structure of sucrose, what might the active site of sucrose look like?”</p>	<p>The students will try to make the connection of how staple-ase and the staple remover called “unstaple-ase” work to sucrose in the previous lessons’ lab.</p> <p>The students will answer some of the questions first in pairs, and then with the whole class. They will answer some of the questions only as a whole-class discussion where I will call on various people to answer, only giving them a concrete answer when multiple people have received a chance to speak.</p>

<p>Practice Activity Support</p>	<p>The teacher will have a class discussion about another example: Lactase. He will have the students talk with a partner and then with the class on the following questions:</p> <p>“Lactose intolerance is a condition in which a person can’t break down the sugar lactose. What kind of enzyme problem might these people be having? Could they take something to help them break down lactose?”</p>	<p>The students will answer the questions with their partners first and then come together for a class discussion on the questions to the left.</p>
<p>Closure Assessment of Student Voice</p>	<p>The teacher will also as the students do a Think, Pair, Share on the following questions concerning their learning on the learning objectives. But for the “Think” part, the teacher will have the students answer the questions on a piece of paper and turn it in as an exit ticket:</p> <p>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?</p>	<p>The students will answer the questions using the Think, Pair, Share model, but the students will write their “think” part on a separate piece of paper and turn it in before they go as an exit ticket.</p>

Lesson 4 Outline

Lesson Part	Activity description/Teacher does	Students do
Title		
Standard	<p>EALR 9-11 LS1F All of the functions of the cell are based on chemical reactions. Food molecules are broken down to provide the energy and the chemical constituents needed to synthesize other molecules. Breakdown and synthesis are made possible by proteins called enzymes. Some of these enzymes enable the cell to store energy in special chemicals, such as ATP, that are needed to drive the many other chemical reactions in a cell.</p> <p>NGSS HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.</p>	
Central Focus (CF)	Explain the purpose of enzymes in our bodies, and justify with evidence that you know how they work, and how are they regulated.	
Learning Target (LT)	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.	
Instruction Inquiry Preview Review	<p>The teacher will first review what they learned about enzymes the previous day with a few questions such as:</p> <p>“What is an enzyme?” “Explain the specificity of sucrose to sucrase as best you can.”</p> <p>The teacher will introduce the students to 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.</p> <p>The teacher will then introduce an idea of our body as a recycle plant and factory all in one. The teacher will then ask them to answer the following questions:</p> <p>“When you throw a bottle into the recycle, will you see that same bottle in the store next week? Why or why not?”</p> <p>The teacher will then go into a discussion of what they think happens to that bottle.</p>	<p>The students will look through their notes from the previous day and attempt to answer the questions.</p> <p>Students will discuss with a partner what they think the learning targets mean.</p> <p>The students will try to answer the questions and then give what they think happens to a plastic bottle.</p>
Informal Assessment	<p>The teacher will then ask the students to connect this idea of a recycling plant and factory to our bodies. The teacher will ask them questions like:</p> <p>“When we eat broccoli, can we use the broccoli DNA as it is? Would that give us broccoli parts? What would we need to do with the broccoli DNA to then be able to use it to build our own DNA?”</p> <p>The teacher will have the students answer this question in a</p>	The students will struggle through these questions in a pair/share model as the teacher walks around.

	pair/share model, while walking around the room to see what they are thinking and discussing.	
Practice Activity Support	The teacher will then give a lecture via PowerPoint on what a macromolecule is, that it is a large molecule made of many smaller repeating unit molecules. The lecture will then go into the 4 main macromolecules and the usable parts our bodies can break them into: nucleic acids → nucleotides lipids → fatty acids proteins → amino acids carbohydrates → simple sugars	The students will take notes on this section.
Informal Assessment	The teacher will have the students talk about what they know of each one so as to correct any misconceptions early.	The students will talk about what they know of each of the different types of macromolecules.
Practice Activity Support	The teacher is asking the students where they think each of the macromolecules can be found. The teacher will then talk about where the students can find each of the macromolecules in their diet in PowerPoint slide show.	The students will give where they think they can get the different macromolecules in the food they eat, and then will take notes on the sources given in the slide show.
Closure Assessment of Student Voice	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 learned about the different kinds of macromolecules, and what they learned of enzymes the previous day. This should connect the various lessons together a bit better for the students.	The students will discuss in small groups of two or three what happened in the sucrose lab using the vocabulary and knowledge they learned about macromolecules and enzymes. They will then share with the class in a share/pair model.

Lesson 5 Outline

Lesson Part	Activity description/Teacher does	Students do
Title	Enzyme Wrap-Up	
Standard	<p>EALR 9-11 LS1F All of the functions of the cell are based on chemical reactions. Food molecules are broken down to provide the energy and the chemical constituents needed to synthesize other molecules. Breakdown and synthesis are made possible by proteins called enzymes. Some of these enzymes enable the cell to store energy in special chemicals, such as ATP, that are needed to drive the many other chemical reactions in a cell.</p> <p>9-11 LS1G Cells use the DNA that forms their genes to encode enzymes and other proteins that allow a cell to grow and divide to produce more cells, and to respond to the environment. Explain that regulation of cell functions can occur by changing the activity of proteins within cells and/or by changing whether and how often particular genes are expressed.</p> <p>NGSS HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</p>	
Central Focus (CF)	Explain the purpose of enzymes in our bodies, and justify with evidence that you know how they work, and how are they regulated.	
Learning Target (LT)	<p>Students will be able to: Explain that living things regulate cellular functions by changing the activity of proteins within cells. Give two examples of how living things can regulate protein activity in response to their environment.</p>	
Instruction Inquiry Preview Review	<p>First the teacher will do a small review and discuss the idea of the body as a combination recycling plant and factory.</p> <p>The teacher will show the learning targets on the screen, and have the students write the learning targets for the day in their notes. A few of them will then share with the class.</p> <p>The teacher will show a clip from "I Love Lucy" showing a candy factory. http://www.youtube.com/watch?v=0YGF5R9i53A</p> <p>The teacher will ask the students what Lucy and Ethel could have done in the clip to be able to keep up with the candy coming down the conveyer belt. The teacher will then have the students discuss how this could relate to our bodies as a machine, and how our enzymes can be regulated to do better. Do the option discussed for Lucy and Ethel apply to our machinery as well? What are some ways you might think enzymes could be regulated?</p>	<p>Students will ask any questions they have from the previous day.</p> <p>Students will see the learning targets and write them down in their notebooks. Then a few of them will share theirs with the class.</p> <p>Students will watch the short clip.</p> <p>The students will discuss what they think in answer to the questions.</p>

	(5-10 minutes)	
Informal Assessment	The teacher will listen to the students' responses and gauge whether the students understand or not.	The students will discuss with the teacher what they think Lucy and Ethel could have done.
Practice Activity Support	The teacher will go through some direct instruction with PowerPoint slide show. The teacher will go over the two main types of enzyme regulation (changing amounts, and changing efficiency) and give a good example of each. The example for changing the amount of an enzyme is hemoglobin (this is shown in the practice activity later in the lesson), and the example for changing the efficiency of an enzyme is insulin and glucagon. (10 minutes)	The students will take notes on the slides.
Informal Assessment	During the lecture, the teacher will ask the students periodically if they have questions and if they are following the lesson thus far.	Students will answer if they have questions, or if they understand what is being taught.
Practice Activity Support	The teacher will then give the students a practice problem to go over with their partners. This will ask the students how they think their bodies could adapt to increasing altitude after the students are given some information about hemoglobin and how it carries O ₂ in the blood stream (5 minutes)	The students will think about the question and try and come up with an answer with their partners.
Closure Assessment of Student Voice	The teacher will have the class discuss what they thought in their partner groups. The teacher will lead them to the correct answer. (5 minutes) The teacher will then give the students their Unit Review worksheets to work on for the remainder of the period. This is attached to the bottom of this lesson.	The class will discuss as a whole what they think the body could do. The students will work on their review worksheets for the rest of the period.
Formal Assessment or Postassessment (Sequence end)	The students will be getting a pen and paper assessment to finish out this unit. The test will be given two days from this lesson to give them time to review the unit's material. The test is below the content review.	The students will be doing a pencil and paper test where they will be tested on the unit's material.