Standard #: SC.912.L.18.11

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Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, and their effect on enzyme activity.

General Information

Subject Area: Science

Grade: 912

Body of Knowledge: Life Science

Idea: Level 2: Basic Application of Skills & Concepts

Standard: Matter and Energy Transformations -
A. All living things are composed of four basic categories of macromolecules and share the same basic needs for life.

B. Living organisms acquire the energy they need for life processes through various metabolic pathways (primarily photosynthesis and cellular respiration).

C. Chemical reactions in living things follow basic rules of chemistry and are usually regulated by enzymes.

D. The unique chemical properties of carbon and water make life on Earth possible.

Date Adopted or Revised: 02/08

Content Complexity Rating: Level 2: Basic Application of Skills & Concepts - More Information

Date of Last Rating: 05/08

Status: State Board Approved

Related Courses

Course Number	Course Title
2000350:	Anatomy and Physiology (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000360:	Anatomy and Physiology Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000310:	Biology 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000320:	Biology 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000330:	Biology 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 - 2022 (current), 2022 and beyond)
2000430:	Biology Technology (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
3027010:	Biotechnology 1 (Specifically in versions: 2015 and beyond (current))
3027020:	Biotechnology 2 (Specifically in versions: 2015 and beyond (current))
2000370:	Botany (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003360:	Chemistry 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002490:	Forensic Sciences 2 (Specifically in versions: 2014 - 2015, 2015 - 2017, 2017 - 2022 (current), 2022 and beyond)
2000440:	Genetics Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002420:	Integrated Science 2 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002430:	Integrated Science 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002440:	Integrated Science 3 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002450:	Integrated Science 3 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000800:	Florida's Preinternational Baccalaureate Biology 1 (Specifically in versions: 2014 - 2015, 2015 and beyond (current))
7920015:	Access Biology 1 (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 and beyond (current))
2000315:	Biology 1 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000520:	Bioscience 3 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002425:	Integrated Science 2 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2020 (course terminated))
2002445:	Integrated Science 3 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2020 (course terminated))

Related Access Points

Access Points Number	Access Points Title
SC.912.L.18.In.6:	Recognize that enzymes break down food molecules during the digestive process.
SC.912.L.18.Su.5:	Recognize that food is broken down in digestion (use of enzymes).
SC.912.L.18.Pa.4:	Recognize that saliva helps people eat when they chew.

Related Resources

Lesson Plans

Name	Description
Enzymes: The Greatest Biological Catalysts:	This lesson focuses on the role of enzymes as biological catalysts. The resource contains a lab that demonstrates enzyme reactions and a worksheet with activities for the students to select from.
Enzymes in Action 5E Lesson:	Students will predict, investigate, observe, and report on the effects that pH, concentration, and temperature have on catalase enzyme reactions. Students will conduct an experiment in which they will alter the pH, concentration, and temperature of the environment in which catalase enzyme reactions are taking place. Students will be able to describe how changes in these environmental conditions affect the action of the enzymes in living things.
Enzyme Kinetics Inquiry:	In this lesson, students work from lower to higher levels of scientific inquiry while studying enzyme kinetics in a practical, student-centered, flipped-classroom process. In addition to reviewing the importance of enzymes to biological systems and examining the factors that influence their activity, this is a good lesson to practice the scientific method, from replication of pre-designed experiments to asking questions, designing investigations, collecting and analyzing data, sharing findings, and engaging in peer review. Designed for higher-level classes, this lesson can be modified, simplified, or shortened for regular and honors classes.
Easy Enzymes:	In this lesson, students will learn how important enzymes are by functioning as a catalyst in most all biological processes. In learning about the functions of enzymes, they will also see how they are related to things they come across in everyday life. Students will observe the breakdown of hydrogen peroxide by catalase from potatoes.
Enzymes, Eggs, and Active Sites - Factors that Affect their Activity:	This lesson will demonstrate enzyme-substrate complex and how they work in a biochemical reaction. It will also introduce factors that effect the rate of enzyme activity. Students will be asked to model enzymes and how they work in a biochemical reaction by interacting with an egg as the reactant/substrate and producing a fried egg over easy. Students will be asked a series of questions along the way and later will work in small groups to come up with their own model of a short biochemical pathway (1-2 steps) and identify the enzymes involved in the process. The model or process they choose should come from their every day experiences.
Why Do Apples Turn Brown?:	Students design an experiment to determine the effects of pH and temperature on enzyme activity in apples.
Enzymes Help Us Digest Food:	Students learn about enzyme function, enzyme specificity, and the molecular basis for lactose intolerance.

Original Student Tutorial

Name	Description
Enzymes are the Stuff of Life:	At any instant in your life, millions and millions of enzymes are hard at work in your body as well as all around you making your life easier! By the end of this tutorial you should be able to describe how enzymes speed up most biochemical reactions as well as identify the various factors that affect enzyme activity like pH and temperature.

Perspectives Video: Experts

Name	Description
Enzymes and Energy:	Learn how enzymes play a key role in regulation of cellular energy and metabolism. Download the CPALMS Perspectives video student note taking guide.
Knot Theory Entangled in Cellular Biology:	This FSU professor describes how knot theory and cellular biology are intertwined. Researchers are still trying to determine how enzyme bridges are able to un-knot long strands of DNA to mitigate potential cell destruction. Download the CPALMS Perspectives video student note taking guide.

Tutorials

Name	Description
Enzyme Action in the Body:	This tutorial presents an animation of the way that the enzyme sucrase catalyses sucrose into its components, glucose and fructose. This occurs in the small intestine of the human body.
The Role of Vitamins in Human Nutrition:	This tutorial will help you to understand the role that vitamins play in human nutrition. Vitamins interact with enzymes to allow them to function more effectively. Though vitamins are not consumed in metabolism, they are vital for the process of metabolism to occur. This challenging tutorial addresses the concept at a high level of complexity.
Activation Energy-Kickstarting Chemical Reactions:	Chemical reactions are constantly happening in your body -- even at this very moment. But what catalyzes these important reactions? This short video explains how enzymes assist the process, while providing a light-hearted way to remember how activation energy works.

Unit/Lesson Sequence

Name	Description
Enzyme Reactions:	This video shows an enzyme reaction lab. The teacher demonstrates how the enzyme, catalase, reacts with hydrogen peroxide (a substrate found in cells). The teacher first demonstrates a normal enzyme reaction. He or she then goes on to show how manipulating temperature and pH will affect the reaction of an enzyme.

Student Resources

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