Unit 7.3 Metabolic Reactions

Content Area: **Science**
Course(s): **Science 7**
Time Period: **Marking Period 3**
Length: **MP3**
Status: **Published**

Essential Questions

Unit Question How do things inside our bodies work together to make us feel the way we do?

Lesson 1 What is going on inside M'Kenna's body that is making her feel the way she does?

Lesson 2 Can we see anything inside M'Kenna that looks different?

Lesson 3 Why do molecules in the small intestine seem like they are disappearing?

Lesson 4 What happens to food molecules as they move through the small intestine and large intestine?

Lesson 5 Why do large food molecules, like some complex carbohydrates, seem to disappear in the digestive system?

Lesson 6 What happens to the different substances in food as it travels through the digestive system?

Lesson 7 What is the function of the digestive system, and how is M'Kenna's digestive system different?

Lesson 8 What does the surface of M'Kenna's small intestine look like up close compared with a healthy one?

Lesson 9 How can a problem in one body system cause problems in other systems?

Lesson 10 Why is M'Kenna losing so much weight?

Lesson 11 What happens to matter when it is burned?

Lesson 12 Does this chemical reaction to burn food happen inside our bodies?

Lesson 13 How does a healthy body use food for energy and growth, and how is M'Kenna's body functioning differently?

Lesson 14 Do all animals do chemical reactions to get energy from food like humans?

Lesson 15 What questions on our Driving Question Board can we now answer?

Big Ideas

Unit Summary

This unit on metabolic reactions in the human body starts out with students exploring a real case study of a

middle-school girl named M'Kenna, who reported some alarming symptoms to her doctor. Her symptoms included an inability to concentrate, headaches, stomach issues when she eats, and a lack of energy for everyday activities and sports that she used to play regularly. She also reported noticeable weight loss over the past few months, in spite of consuming what appeared to be a healthy diet. Her case sparks questions and ideas for investigations around trying to figure out which pathways and processes in M'Kenna's body might be functioning differently than a healthy system and why.

Students investigate data specific to M'Kenna's case in the form of doctor's notes, endoscopy images and reports, growth charts, and micrographs. They also draw from their results from laboratory experiments on the chemical changes involving the processing of food and from digital interactives to explore how food is transported, transformed, stored, and used across different body systems in all people. Through this work of figuring out what is causing M'Kenna's symptoms, the class discovers what happens to the food we eat after it enters our bodies and how M'Kenna's different symptoms are connected.

Enduring Understandings

This unit builds toward the following NGSS Performance Expectations (PEs):

- MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
- MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- MS-LS1-7: Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
- MS-PS1-1: Develop models to describe the atomic composition of simple molecules and extended structures.*

- MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.*

Disciplinary Core Ideas

LS1.A Structure and Function

- In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

LS1.B Growth and Development of Organisms

- The growth of an animal is controlled by genetic factors,* food intake, and interactions with other organisms, and each species has a typical adult size range.

LS1.C Organization for Matter and Energy Flow in Organisms

- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.

PS3.D Energy in Processes and Everyday Life

- Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.

*There is a slash through the pieces of the DCIs that are not developed in this unit. In the OpenSciEd Scope and Sequence, students will develop an understanding of genetic factors in the OpenSciEd Unit 8.5, how plants do chemical reactions to obtain and store energy in the subsequent OpenSciEd Unit 7.4, and interactions with other organisms in the ecosystem dynamics in OpenSciEd Unit 7.5.

In addition, this unit introduces the concept of food as fuel and lays the groundwork for future units in which students figure out that both food and other sources of fuels are sources of matter and sources of energy, drawing connections between chemical reactions that transfer and convert energy in living and nonliving systems. This connects to the idea identified on page 196 of Framework for K–12 Science Education (National Research Council, 2012): “By middle school, a more precise idea of energy—for example, the understanding that food or fuel undergoes a chemical reaction with oxygen that releases stored energy—can emerge.”

Crosscutting Concepts

- Systems & System Models
- Structure & Function

Science and Engineering Practices

- Developing & Using Models
- Analyzing & Interpreting Data
- Engaging in Argument from Evidence

Cross-Curricular Integration

Integration Area: Math

MS-PS4-1 Use mathematical representation to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

MS-PS-4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Activity:

In this lab rotation, students continue to create models that explain phenomena (SP2). In addition, students utilize the Crosscutting Concept of Patterns, using graphs to identify patterns and relationships between variables such as frequency and wavelength.

However, one new aspect that we begin to discuss is the mathematical representation of what a wave looks like (MP4). On the first day, students are introduced to the idea of how a wave can be graphed in a coordinate plane on a Displacement vs. Time/Distance plot. In this lab, students have to create graphs that demonstrate general relationships of both transverse and longitudinal waves in order to develop their mathematical and conceptual thinking (SP5). On the second day of instruction, students are introduced to graphing a wave based on specific numbers instead of general relationships and begin manipulating the graphs of waves to demonstrate a proportional understanding of wave relationships.

Integration Area: Language Arts

W.IW.7.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

A. Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information, using text structures (e.g., definition, classification, comparison/contrast, cause/effect, etc.) and text features (e.g., headings, graphics, and multimedia) when useful to aid in comprehension.

B. Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.

C. Use appropriate transitions to create cohesion and clarify the relationships among ideas and concepts.

D. Use precise language and domain/ grade-level- specific vocabulary to inform about or explain the topic.

E. Establish and maintain a formal style academic style, approach, and form.

F. Provide a concluding statement or section (e.g., sentence, part of a paragraph, paragraph, or multiple paragraphs) that follows the flow of ideas, reflects back on the topic, and supports the information or explanation presented.

RL.CI.7.2. Determine a theme in a literary text (e.g., stories, plays or poetry) and explain how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

RI.CI.7.2. Determine a central idea in an informational text and explain how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

Activity:

Sound & Light: A.) What is infrared light? In an explanatory essay that uses facts, details and examples from a variety of credible sources, explain how infrared light can be useful to humans providing at least 3 examples. B.) Cell phones have become an integral part of daily life for a majority of people. They are very useful but may pose some physical dangers to users. Are cell phones dangerous? Based on your research, compose an argument that defends your opinion on this issue. Use at least three pieces of evidence collected

from your research and the Socratic Seminar to support your claim. Be sure to identify the specific sources for the underlying research.

Integration Area: Pre-Algebra

Chapter 6: Rates, Ratios and Proportions

7.RP.A.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction* $^{1/2}/_{1/4}$ *miles per hour, equivalently 2 miles per hour*.

7.RP.A.3 Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

Chapter 11/7: Multi-step Equations and Inequalities

7.EE.A.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation*.

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Chapter 4/5: Proportional Relationships/Graphs

7.RP.A.2 Recognize and represent proportional relationships between quantities.

CSDT Technology Integration

8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.

8.1.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

Activity:

Students will watch a video on amplitude and its relation to energy. The students will complete an activity on

the interactions of amplitude, frequency, and wavelength (internet based interactive). The students will then complete questions related to amplitude and its energy in a wave.

Lab

Lab: Exploring Metabolic Reactions

Objective:

Students will explore the concept of metabolic reactions by observing and analyzing how yeast metabolizes sugar.

Reflective Questions:

1. What did you observe happening to the balloon, and why do you think it happened?
2. How does this experiment illustrate a metabolic reaction?
3. What are some real-world examples of metabolic reactions in living organisms?

Assessment:

- Have students write a short paragraph explaining the metabolic process observed in the experiment.
- Include a drawing showing how the yeast metabolized the sugar and the effect on the balloon.

https://drive.google.com/drive/folders/1eL_NAEz-pKPMQ6oi9CsmG6Z5Iowqez2Q?usp=drive_link

Resources

Scientific Inquiry

MS-PS4-1 *Properties of Waves*, Slinky Lab
MS-PS4-2 *Waves Interaction Stations*
MS-PS4-3 *How Does a Cell Phone Work?*