More Cheese, Please

High School, Life Science

Task Overview

In this task, students use models and data to explain why lactose intolerant people experience lots of gas, bloating and diarrhea when they eat certain dairy products. Students explore models comparing the digestive systems of lactose-tolerant and lactose-intolerant people to see how specialized parts of the systems affect how they are able to process dairy products. They then annotate the comparative models to explain why only lactose intolerant people experience these painful symptoms. At the end of the task, students examine new data to recommend what types of dairy products lactose intolerant people might eat to cause less painful symptoms.

Next Generation Science Standards

Three-Dimensional Claim

Use models and data to explain how parts of a body system interact, including matter flows within and between body systems, to perform essential functions of life.

This task is intended to elicit student learning of the following **NGSS elements** for each of the three dimensions:

Disciplinary Core Ideas

LS1.A: Structure & Function (HS)

- Systems of specialized cells within organisms help perform essential functions of life (HS-LS1-1).
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level (HS-LS1-2).

Science and Engineering Practices

Developing and Using Models (HS)

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.

Analyzing and Interpreting Data (HS)

- Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.

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Crosscutting Concepts

Systems and System Models (HS)

- Models (e.g., physical~~, mathematical, computer~~ models) can be used to simulate systems and interactions—including ~~energy~~, matter~~, and information~~ flows—within and between systems at different scales.

Helpful Prior Knowledge

The human body is a system made of many smaller systems. Those smaller systems are made of multiple parts (organs) that are made of tissues. Those tissues are made of cells with specialized functions. The digestive system has cells with specific digestion-related functions. One key example is the intestinal epithelial cell, which lines the small intestine. This kind of cell produces lactase, an enzyme that breaks down the two-unit sugar lactose into smaller digestible sugars called galactose and glucose. These cells have small finger-like projections called villi that help absorb these nutrients from the small intestine into the bloodstream.

Some individuals have a natural difference in their digestive processes, including producing decreased amounts of the enzyme, lactase. This is often referred to as lactose intolerance. Because of this decreased amount of lactase in the small intestine, more lactose passes from the small intestine into the large intestine without being broken down into glucose and galactose. When lactose enters the large intestine, it is consumed by bacteria in a process called bacterial fermentation which produces gas as a byproduct. This is what can lead to uncomfortable digestive symptoms, such as gas, bloating, and diarrhea. These symptoms happen more often when eating dairy products that have a higher lactose content, like milk.

When introducing the task, students can watch a video (*Original Source: Lactose Intolerance by Nucleus Medical Media on YouTube*) if they would first like a review of the digestive system.

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Collaborations

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