Are All Bacteria in Food Harmful?

High School, Life Science

Task Overview

Because certain types of bacteria can make humans sick, many people believe that having bacteria in food is always harmful. Throughout this task, students will gradually analyze new sources of data to revise working explanations of whether all bacteria are harmful for humans or if some bacteria can be used to prevent food from spoiling. First, students explore the food ecosystems of two samples of yogurt with different bacteria to figure out which types are harmful and then explore the environmental conditions that allow harmful and less harmful bacteria to thrive. Next, students investigate how the presence of a bacteria called *lactobacillus* can actually prevent harmful bacteria from forming on food, which they use to construct a final argument about how bacteria can actually be beneficial to humans by making food safer.

Next Generation Science Standards

Three-Dimensional Claim

Evaluate the impact of new data on a working explanation to construct an argument for how the population of one species can affect the carrying capacity of another species in the same ecosystem by changing environmental conditions.

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

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems (HS)
- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem (HS-LS2-1).

Science and Engineering Practices

Analyzing and Interpreting Data (HS)
- Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.

Engaging in Argument from Evidence (HS)
- Construct, ~~use, and/or present~~ an ~~oral and~~ written argument ~~or counter-arguments~~ based on data and evidence.

Crosscutting Concepts

Cause and Effect (HS)
- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Helpful Prior Knowledge

Food can be thought of as an ecosystem. Bacteria, of many types, are the primary living organisms interacting in food ecosystems. Some food bacteria are safe for humans to eat while others are harmful. When bacteria consume sugars in the food, they release waste products that can be neutral, beneficial, or harmful. Harmful bacteria, for example, produce toxic waste products, which make us sick when they are in our digestive system.

One bacteria that is safe for humans to consume is *lactobacillus.* When *lactobacillus* feeds on sugars in food, it produces lactic acid and carbon dioxide through a process called lacto-fermentation. Lactic acid and carbon dioxide reduce the pH in food ecosystems so that harmful bacteria (that spoil food and make people sick) have a hard time growing in the ecosystem. *Lactobacillus* can continue to survive in the low pH (acidic) food ecosystems it helps create. Therefore, humans are able to use the unique characteristics of *lactobacillus* to help keep harmful bacteria out of food without any negative impacts to our digestive systems. Sometimes humans even add *lactobacillus* starters to food to encourage growth. This makes the food ecosystem unfavorable for other harmful bacteria to grow and can increase the shelf life of food.

Collaborations