

Solution Seeking Microbes

UNIT 5 RECAP

Unit 5 explored the idea that microbes could be the key to providing solutions to local and global problems. There is an important symbiotic relationship between the microbiome and the organisms they inhabit. There are many health benefits that these microbes provide for human health, and they are important in food production for both people and animals. While bacteria used in medicine have saved countless

numbers of lives, the overuse of these microbes can lead to antibiotic resistance, where they can become ineffective weapons against the diseases they are used to treat. By understanding the natural ways that microbes, such as bacteria, use to defend themselves against viruses, new biotechnological tools, such as CRISPR-Cas9 hold the power to change the way we fight against deadly pathogens and to treat or

prevent genetic diseases. As with any powerful biotechnological tool, there must be careful consideration and discussion as to how CRISPR technology should and should not be used to solve human and environmental problems. Microbes are not only beneficial to human health, but are also essential to the health of ecosystems, and have the potential to help control the spread of disease and reduce human impact on the changing climate.

INSPIRATION 1

We count on farmers for the food on our table. Though agriculture has advanced, many farmers still use synthetic fertilizers. While these ensure that crops can take in nitrogen and phosphorus, they contribute to climate change, poor soil health, and water pollution. Plants need nitrogen and symbiotic bacteria to “fix” nitrogen, turning it into a usable form. Companies are now developing biofertilizers that contain microbes that have beneficial cultures and nutrient solutions.

PROBLEM

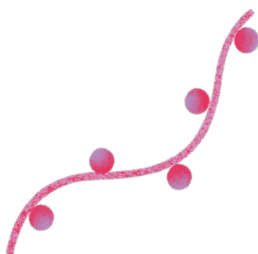
Is the use of microbes in agriculture a better method of producing the food we eat? How can we encourage farmers and large-scale agriculture to explore the use of biofertilizers over synthetic ones?

SOLUTION DESIGN DRIVING QUESTIONS

- What is the relationship between soil microbes and plants?
- Why do farmers use fertilizer in large-scale agriculture?
- What are the various types and categories of synthetic fertilizer?
- What are the costs versus the benefits of fertilizer use?
- What are biofertilizers and how do they work to encourage plant growth?
- Why would farmers not want to use biofertilizers?

RESOURCES

- [Understanding and Managing Soil Microbes | PennState Extension](#)
- [Why we must rethink the use of nitrogen fertilizers | International Institute for Sustainable Development](#)
- [Biofertilizers: An ecofriendly technology for nutrient recycling and environmental sustainability | PubMed Central | National Library of Medicine](#)
- [Researchers hope to develop biofertilizer using Utah plant bacteria | Utah Public Radio](#)
- [Rethinking Crop Nutrition in Times of Modern Microbiology: Innovative Biofertilizer Technologies | Frontier Media](#)
- [Helping plants and bacteria work together reduces fertilizer need, finds new study | Phys](#)
- [Nutrient producing microbes win over farmers but skeptics doubtful | MPR News | Minnesota Public Radio](#)



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INSPIRATION 2

The gut microbiome refers to the microbes in our intestinal tract helping us do such things as digesting our food, training our immune system to fight disease, and even stimulating the release of neurotransmitters in the nervous system. Before we're born, we have no microbes and must build our microbiome as we interact with the world. Did you know that many of the microbes we need can be found in tap water?

PROBLEM

How can we ensure that the water we drink helps to build and maintain a healthy gut microbiome?

SOLUTION DESIGN DRIVING QUESTIONS

What does a healthy gut microbiome look like?

How do we get beneficial microbes in our body?

What environmental factors contribute to the development of our gut microbiome?

What health problems are related to problems in the gut microbiome?

What is the connection between the water we drink and our gut microbiome?

How can drinking water negatively impact the gut microbiome?

Is there a connection between drinking water sources and gut microbiome-related health issues?

How can water treatment plants use biotechnology to identify the microbes in our drinking water and ensure that it includes the ones that we need for a healthy gut microbiome?

RESOURCES

[What Is Your Gut Microbiome? | Cleveland Clinic](#)

[The Microbiome | The Nutrition Source | Harvard T.H. Chan School of Public Health](#)

[Water Disinfection with Chlorine and Chloramine | Centers for Disease Control and Prevention](#)

[Drinking Water Source and Intake Are Associated with Distinct Gut Microbiota Signatures in US and UK Populations | NIH National Library of Medicine](#)

[Examining the effects of chlorinated drinking water on the gut microbiome | Berkeley Engineering](#)

[Changes in the Drinking Water Microbiome: Effects of Water Treatments Along the Flow of Two Drinking Water Treatment Plants in a Urbanized Area, Milan \(Italy\) | Frontiers in Microbiology](#)

[Tap water as a natural vehicle for microorganisms shaping the human gut microbiome | PMC](#)

[Characterization of the Microbiome at the World's Largest Potable Water Reuse Facility | Frontiers in Microbiology](#)

