Tips & Tools
DOI: https://doi.org/10.1128/jmbe.v22i1.2119

JMBE Journal of Microbiology & Biology Education

A Food Microbiology Classroom Activity to Draw Connections between Microbes and Students' Lives‡

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INTRODUCTION

Research shows that making personal connections to course content enhances learning and retention (1, 2). One way to foster personal and cultural connections to microbiology is through food (3–5). This is accomplished here with an in-class, fermented food activity and discussion with an end-of-course "microbe lunch."

Fermented foods have been prepared for millennia, and every society around the world has traditional fermented foods and/or beverages that are identified with that culture. The first evidence of intentionally prepared fermented food comes from around 7000 BC, when the Babylonians created beer (6). Many cultures developed other fermented foods and beverages which are still prepared today. Commercial fermentation products found in the dairy, wine, beer, meat, and vegetable sectors have sparked renewed interest in fermentation (7–10). Food companies are exploring the diversity of flavors, textures, and nutritional benefits microbial fermentation may add to their products (11). With the growing DIY community, companies are selling starter cultures for a variety of foods and beverages (11). In the scientific community, new sequencing technologies are helping scientists better understand interactions between microbial species and the important roles each play in commercial fermentation processes (11).

Because of the rich history of food fermentation around the world, fermented foods are also an excellent opportunity to engage students and the general public in appreciation of the microbial world and to raise awareness of our common connections through food (12). The growing availability of authentic fermented foods has made it easier to introduce students to this rich variety of fermented foods and beverages. This article describes ways to include microbes and food in classes and outreach. It discusses how this strategy is used to raise awareness and appreciation of human diversity and to encourage students to share and celebrate their own cultural identity.

PROCEDURE

General microbiology at Missouri S&T enrolls 40 to 50 students, mostly biology and engineering majors. Food microbiology is introduced with the section on microbial metabolism and fermentation pathways. A clicker case study on the production of soy sauce is used to introduce real-world applications before introducing the assignment (13).

Students are asked to investigate one fermented food and learn how the food is connected to a particular culture or society (see supplemental materials for specific prompt). They identify the type(s) of organism(s) involved in the fermentation (if known), the fermentation products, and how the products contribute to the characteristics of the food. Students are instructed to bring something connected to the fermented food to the next class (image, list of ingredients, or a physical item) and to be prepared to share information with the class.

During the next class period, students share and discuss their information in small groups and then share a summary of the group conversation with the entire class. Students are encouraged to share their experiences with specific foods (e.g., have they tried it through family, travel, or general interest). Discussion of the societal origins of the fermentation process is encouraged to understand the value of processes such as preservation or flavoring. Not all students are comfortable speaking in class, so students also post their fermented foods to a course discussion board, where each student is required to comment on the foods posted by other students. Students are reminded that while it is alright to not like certain foods, it is important to be respectful of the cultural norms of others.

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Received: 26 February 2020, Accepted: 22 December 2020, Published: 29 January 2021
‡Supplemental materials available at http://asmscience.org/jmbe

During the last week of the course, students are invited to a microbe lunch to sample some of the foods they have learned about. They are encouraged to bring friends to share what they have been studying. A table of foods used for the microbe lunch is included in the supplemental materials along with photographs from the class. The list includes foods and beverages with microbe-derived additives, such as aspartame or high-fructose corn syrup as sweeteners, to raise awareness of the lesser-known roles of microbial activities. Foods and beverages such as chocolate, coffee, and tea show that microbes can be involved in the processing of the food even though they are not present in the final product. Peanuts and soybeans represent the role of soil microbes in symbiotic nitrogen fixation with leguminous plants.

The learning objective of this activity is for students to explain the different roles of microbes in food production. This has been assessed through grading of discussion board posts and comments, short essays on exams, online quizzes, or preparation of one-page infographics describing each food. The infographics are displayed during the microbe lunch event.

Variations on the microbe lunch have been used to introduce food microbiology in different contexts. The American Society for Microbiology has included the microbiology of food as part of their exhibit for the USA Science and Engineering Festival (14). Visitors to the exhibit are invited to select from a variety of food products and identify which foods have a connection to microorganisms. One of the authors (DJW) uses similar activities in K–12 schools and community outreach events. The goal is to initiate engaging conversation between scientists and the general public.

Safety issues

All foods used in this activity are purchased from grocery and health food stores. Any food items, particularly foods that participants may not have experienced in the past, carry the potential risk of allergic reactions. Participants are instructed ahead of time to be conscious of potential food allergies, dietary restrictions, and food sensitivities. As much as possible, students are provided descriptions of all ingredients for the foods served so they can make informed choices. All sampling is voluntary, and participants should not be coerced into trying foods. Variations of the activity could include students bringing samples or even making their own foods. Instructors should check with campus rules regarding the use of food in the classroom before making such assignments. They should also be aware that assigning students to provide food may create a burden for some students.

CONCLUSION

The Microbe Lunch is a great way to celebrate the end of the semester and provides an opportunity for students to experience the foods they have been learning about and to share those lessons with others. Students are encouraged to bring friends, and the instructor invites faculty, staff, and administrators from across campus. Microbe Lunch has been held every semester for over 20 years, and former students, their friends, and campus colleagues regularly ask about when the lunch will be held. In open-ended, end-of-course surveys, students frequently reference Microbe Lunch as the most impactful lesson on the ubiquitous nature of microbes.

SUPPLEMENTAL MATERIALS

Appendix 1: List of microbial foods and beverages.
Appendix 2: Classroom assignment, discussion board prompt, and foods served during the Microbe Lunch

ACKNOWLEDGMENTS

The authors declare that they have no conflicts of interest.

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