Discovery and Invention: A Reflection on Representation in Science

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Abstract

Despite increased awareness of the lack of equity and inclusion in the STEMM classroom, lessons on DEI topics are treated as separate to the scientific curriculum being taught. Rarely are intentional reflections and conversations on the lack of representation integrated into the lessons themselves. This lesson, titled “Discovery and Invention”, was developed to guide students through an exploration of the history of a topic—in this case, fermentation—followed by reflections and discussion on the culture of science and how it highlights certain individuals over others. Reflections allow students to explore and discuss their own scientific self-identity and sense of belonging in science. This fermentation lesson was designed to be integrated into a unit introducing students to microbial ecosystems, but it can be adapted for other topics as well, to suit the instructor’s needs.

Learning Goals

Students will:
◊ know the history of fermentation or of a specific fermented product.
◊ understand how scientific culture can highlight certain individuals at the expense of others.

Learning Objectives

Students will be able to:
◊ describe the history of a fermented product.
◊ discuss how credit for discoveries is granted by both scientific culture and the wider public.
◊ reflect on their sense of scientific identity and belonging.

INTRODUCTION

Academic institutions have recently affirmed their commitment to equity, inclusion, and antiracism efforts in response to the widespread attention towards systemic racism following the murders of Breonna Taylor and George Floyd amid a global pandemic. Calls to increase the diversity of STEMM (Science, Technology, Engineering, Mathematics, and Medicine) classrooms, labs, and the workforce through inclusive pedagogy however, are not new (1–3). The lack of diversity at leadership levels in STEMM (department chairs, faculty, deans, university presidents) is due in part to funding disparities for Black, Indigenous, Latinx, and Asian scholars (4–6), a continued prevalence of hostile and unwelcoming climates (3, 7) and the twin myths of scientific objectivity and meritocracy stemming from the false narrative that the scientific process arose solely in Western Europe (8, 9). When students of color, particularly Black and Indigenous students, navigate these same hostile climates, they see little diversity in STEMM leadership and are fed a whitewashed narrative in their curricula that lacks representation; they fail to develop feelings of belonging in STEMM, which in turn affects their performance and retention in these fields (10–12). Science training environments led by predominantly white faculty that focus on Eurocentric curricula and histories also prevent white students and instructors from being challenged to recognize, reflect on, and commit to deconstructing these systemic issues.

Often, STEMM curricula and analyses on the history and culture of science are treated as separate endeavors that are seldom intentionally integrated. Inclusion, diversity, equity, and antiracism (IDEA) work is more commonly delegated to workshops that instructors and graduate students are expected to attend in order to implement inclusive teaching practices in the classroom. While these trainings may lead to more inclusive teaching approaches by individuals, they rarely lead to long-term improvements in classroom inclusion or redesigned curricula that integrate discussions on the culture of science. Additionally, undergraduate students are rarely invited to reflect on how the topics they are learning, and their history, relate to their own lived experiences. Inclusive pedagogy that fosters belonging requires that all students, regardless of race
or ethnic background, engage in discussions of racial equity and representation that are intentionally integrated into the very science topics they are learning (13–15). If we are to responsibly steward the investment that students of color have in their belonging in STEMM spaces, intentional reflection and curricular integration need to involve and empower people at all career stages, beginning in the classroom (15–17).

This lesson is inspired by Dr. Chanda Prescod-Weinstein’s call to action in her “Decolonizing Science” reading list (9), in which we are invited to reframe “the discourse around ‘diversity, equity, and inclusion...’ as a reclamation project for people of color.” As instructors, we must challenge our own and students’ assumptions around the history of science, who its key innovators have been, and the cultures they are a part of (9, 15). As such, this lesson integrates reflections on history, culture, and context into a larger unit about microbial ecosystems in a first-year seminar called Exploring Biology at the University of Wisconsin-Madison (18). Exploring Biology aims to help aspiring bioscience majors develop skills in scientific thinking and communication, as well as become familiar with the core concepts in biology (2). The course is designed around four units that each focus on a different biological topic, with students learning about core concepts and the process of science through examples that relate to each topic. The course is also designed to help students appreciate how science benefits from diverse perspectives and shows them how to make connections between the biosciences and society.

The lesson was implemented in a unit about microbial ecosystems that focused on the examples of fermenting kombucha and the gut microbiome to help students better understand three of the five core concepts: Pathways and Transformation of Energy and Matter (PTEM); Information Flow, Exchange, and Storage (IFES); Evolution (2). The unit on microbial ecosystems and the topic of fermentation were chosen for this lesson because these topics lend themselves to discussions on the history and culture of science. The fermentation of foods is a process that was discovered and refined by various cultures at different times throughout history. Despite this, it is mostly Louis Pasteur who is credited with the discovery and description of the mechanism of fermentation. Although fermentation is an ideal topic in which to integrate this lesson, it can be adapted to focus on any scientific discovery or discipline. The lesson guides students toward the recognition that science has a culture with its own biases and assumptions that affect perceptions of who is and is not involved in science. By doing individual research, answering reflection questions, and engaging in asynchronous and synchronous discussions in this lesson, students are able to analyze the history and culture of science and how it highlights and favors some groups over others. This analysis is followed by guided conversations on students’ sense of belonging in science.

**Intended Audience**

The intended audience for this lesson is undergraduate STEM students with a general knowledge (high school biology, as an example) of the subfield within which this lesson is integrated. While the lesson was developed for use in a unit on microbial ecosystems and fermentation in a first-year bioscience seminar in the US, it can be adapted for use with other topics that have been known to present the history of science from one particular culture’s perspective. For example, topics that may lend themselves well to integration of this lesson include genetics and its origins in eugenics; the attempted erasure of mathematics and astronomy’s development across cultures; and ecology and field biology’s ties to colonialism and devaluing of traditional ecological knowledge and practices in favor of the scientific method. This lesson can also be adapted for implementation with graduate students, delving into more detail on specific fields of interest in which the students are engaging.

**Required Learning Time**

This activity can be implemented within one week of an online course. It requires up to ninety minutes of asynchronous student work followed by a synchronous guided discussion of ten to thirty minutes.

**Prerequisite Student Knowledge**

Students should have general knowledge on how to determine the reliability of scientific sources and popular press articles, and how to cite them. Popular knowledge of fermented foods (or another topic, if the lesson is being adapted) is useful to inspire students in their research, though it is not required. It may also be helpful for students to have previously considered the importance of diversity and inclusion in STEMM, through this is not required. In our course, students had previously considered this in several other units, but did not have a strong background in IDEA topics. Students would also benefit from prior experience or well-established expectations for engaging in an online environment. This lesson was taught in the Fall of 2020 in a fully online course that included one 50-minute synchronous online meeting per week and multiple asynchronous activities and discussions completed through a learning management system. Prior to this lesson, students had participated in several activities that involved online discussion forums, so they were generally familiar with the format and expectations for participation. Note however, that the course is not typically taught in a fully online modality. The shift to online occurred due to the COVID-19 pandemic, so students did not have much prior experience with online learning.

**Prerequisite Teacher Knowledge**

Preparation for this lesson requires the instructor/facilitator has a basic knowledge of fermented foods (or whichever topic into which the lesson is being integrated). The instructor should make themself familiar with the topic of decolonizing STEMM by reading the popular press article by Dr. Chanda Prescod-Weinstein (9). The instructors should be able to facilitate group discussions with students. Helpful resources for facilitating group discussions around IDEA topics are in the Mentor Training for Biomedical Researchers curriculum from the Center for Improved Mentoring Experiences in Research (19), specifically the sections titled “Introduction to Facilitation” and “Addressing Equity and Inclusion.” In final preparation of this manuscript, FS also created a resource about discussions of IDEA topics for facilitators that includes considerations, strategies, and a glossary of terms (20).

**SCIENTIFIC TEACHING THEMES**

**Active Learning**

This lesson involves all three types of interaction that are widely cited as necessary for effective online learning (21,
Students engage actively with the material (learner-content interaction) through a self-directed web search (23) and individual reflection questions (24–26). Students engage with each other (learner-learner interaction) in a structured asynchronous online discussion forum (27–29), in which they synthesize and discuss the findings of their online search. Writing in online discussion forums aids student learning by providing a space for the development of community and online social presence in the remote learning environment. Finally, students engage in a synchronous wrap-up discussion in small groups of three to four students (30, 31) and a subsequent large group discussion facilitated by the instructor (learner-instructor interaction).

Assessment

Students are formatively assessed through their posts on the asynchronous online discussion forum, as well as on their engagement with at least one other post by their classmates (see rubric in Supporting File S2). Students receive feedback on their ideas and learning from their classmates through the online discussion forum (29), and from their classmates and instructor during the synchronous wrap-up discussion.

Inclusive Teaching

We incorporate the principles of inclusive teaching into this lesson in both content and design. Mainly, students choose their own fermented food to research, highlighting different cultures and their foods at different time periods moving away from the Eurocentric view of Louis Pasteur as the “father of fermentation” (14). Students respond to reflection questions individually and asynchronously, allowing each student to take as long as they need to reflect on discussion questions while working within a framework of suggested time. Participation in an asynchronous discussion board, as well as the requirement that students respond to at least one classmate’s post, encourages students to interact with each other. This engagement with other students results in greater exposure to different perspectives and experiences (14, 32). Finally, the activity guides students to reflect on how the lesson has affected their sense of scientific identity and belonging in the scientific community (11, 33, 34).

LESSON PLAN

The course in which this lesson was implemented enrolled approximately 130 students divided into discussion sections of 15–20 students, with students engaging in synchronous classes and in discussion forums in these smaller discussion section groups. The article describes the lesson as it was implemented in this context (Table 1), but offers modifications for other course modalities, topics, and audiences. The activity is largely asynchronous and includes one synchronous component.

This lesson was part of a unit that uses microbial fermentation to teach students about the core concepts of Pathways for Transformation of Energy and Matter (PTEM), Information Flow, Exchange, and Storage (IFES), and Evolution. Following activities that focus on the biology of fermentation, students individually research the history of a fermented product or the history of fermentation itself. They then asynchronously respond to discussion questions on a Learning Management System (LMS) discussion board, and finally, they participate in a synchronous wrap-up discussion in small groups to both discuss scientific belonging and identity and integrate what they’ve learned in this activity with the larger unit on microbial ecosystems as examples of PTEM, IFES, and Evolution.

Before the lesson, the instructor should familiarize themselves with and set up the LMS discussion board to provide detailed instructions and create online discussion groups. We made use of an LMS discussion board throughout the semester, and found smaller groups of around 15 to 20 students worked best to promote discussion (35). The instructor should also familiarize themselves with the learning objectives and individual discussion post questions to adapt if necessary. Finally, the instructor should review Supporting File S3 and any additional resources needed (19, 20) to prepare for the synchronous discussion.

An LMS page for the activity should provide background motivation for the activity as well as detailed instructions that guide students to complete the work asynchronously. The LMS page content used in our class is provided in Supporting File S1. The instructions introduce students to the idea that scientists, individually and in groups, bring their subjective experiences, worldviews, and biases into the process of doing science. The instructions then prompt students to either choose the process of fermentation or a specific fermented food or beverage and to briefly research its history:

“Search for the history of either the process of fermentation or of one specific fermented food/beverage. Some ideas for inspiration include: sourdough bread, beer, wine, kombucha, kimchi, kefir, cheese, yoghurt, or sauerkraut. Read the questions below to help focus your research. This should be a quick search and should not take you longer than 30 minutes.”

After researching, students individually answer four follow-up questions (see one example below and Supporting File S1 for all four) that are intended to help them (a) reflect on the process of scientific discovery/invention, (b) synthesize the history and background of their chosen fermented product, and (c) discuss the impact that popular ideas of scientific discovery have on inclusion:

“When we say someone discovered or invented something, who is highlighted and who is excluded? Are we prioritizing process, results, or individuals? Is this reflective of the reality of doing science?”

Students are not required to turn these answers in for credit. Next, students post a one hundred to two hundred and fifty word summary of their answers to the LMS discussion forum, focusing on what stood out to them the most or what they found most thought-provoking. In our course, students were given a week to engage in the discussion forum, both writing their initial post and responding to classmates; engaging with at least two other students was required as part of their grade (see rubric in Supporting File S2). Students were instructed to spend no more than a total of one and a half hours on the entire activity (doing the research, answering questions, posting their summary, and responding). The instructor monitors student responses in the discussion forum at least twice during the
week, responding to posts that have either not received student engagement, or to provide follow-up questions and comments to the points students raised in the virtual discussion. For example, the instructor might address misconceptions or biases that come up in student posts, or validate and reassure the feelings of students that express anxiety around having future contributions to science go unattributed:

“I can totally understand those feelings, and have at time felt them myself as well. This was one of the reasons why, as an undergrad, finding the right instructors, organizations, and support networks on campus was important. With their support, I came to feel not just included, but that I was exactly where I needed to be and that my contributions were important and appreciated.”

The synchronous session comes after the deadline for student contributions to the discussion board. At least ten minutes should be allocated for a follow-up discussion, but preferably more. The instructor introduces the discussion with the following prompt, while the discussion questions below are shared with the students on a PowerPoint slide:

“For our activity today, we wanted to revisit the ‘Discovery and Invention’ activity that you engaged with this week. We are going to head into breakout rooms and have a discussion around some reflection questions. We will spend XX minutes in small groups before returning to the main room. Be sure to designate one person from your group as the ‘reporter’ to share your groups’ thoughts when we come back to the main room. I will post the questions in the chat before we go into the breakout rooms.”

Then, students are assigned to small breakout rooms (three to four students each), with at least one instructor or assistant facilitator (e.g., undergraduate peer mentor or learning assistant) in each room. If additional facilitators are not available, the instructor can move between breakout rooms to monitor and facilitate discussion as needed.

The questions assigned to the students for synchronous discussion may include (see Supporting File S3 for all examples):

- What stood out to you most while doing this activity?
- How did this activity affect your feelings about belonging in science?

The instructor should select questions depending on what the instructor noticed was most salient in the asynchronous discussion forum and give students enough time to discuss in small groups. Following the small group discussions, a reporter from each group briefly summarizes discussion highlights to the larger group. The instructor also invites reactions from other students to encourage a more organic discussion, as opposed to having each group report out in turn. The instructor then wraps up the discussion with some final comments highlighting or responding to any insightful points made by the students, particularly ones relating to scientific identity or their sense of belonging in science. Students expressing concerns about their future contributions to science, for example, should be validated in those concerns and also encouraged to discuss strategies that recognize both inclusive environments and teams. They can also be provided examples (local and national/international) of successful scientists in their fields of interest with whom they share identities. They can be reminded of the importance that cultural identity, sense of belonging, and discussions of these topics are to the process of doing science.

When engaging in conversations around IDEA topics and systemic oppression, it is important for facilitators to keep in mind that students will have a wide range of experience with, prior exposure to, and openness to discussing these topics. Instructors should uplift the voices of students from underrepresented backgrounds who may be at greater risk for feeling a lack of scientific belonging. These students should feel safe and comfortable sharing their thoughts freely, while also not feeling pressure to do so; it is important that they do not feel expected to speak for an entire demographic (tokenization). During our implementations, instructors who were experienced and comfortable with facilitating these types of conversations were more likely to ad-lib in their facilitation, while others used the prompts provided (Supporting File S3). As noted in the Prerequisite Teacher Knowledge subsection, FS developed an additional resource for facilitating conversations around IDEA topics that facilitators may find useful (20).

TEACHING DISCUSSION

Effectiveness

The effectiveness of this lesson was evaluated by reviewing student feedback on a unit survey, student contributions to discussions, and instructor reflections. This was done as part of standard course evaluation with the goal of quality improvement and therefore falls outside of IRB review. The lesson was taught twice, which allowed instructors to reflect on the activity and apply changes for the second implementation. Here, we report on the effectiveness of the lesson as it was taught in the second iteration after some improvements had already been incorporated.

Learning Objective 1: Students will be able to describe the history of a fermented product.

Across four sections with 15–16 students each, students chose to research cheese, kefir, kombucha, sourdough, wine, beer, yoghurt, salami, sauerkraut, and even miso, which was not included in our list of suggestions in the activity instructions. By engaging with other students’ discussion posts, students were exposed to a variety of histories and information about fermented products. In most posts, students used phrases such as “it never occurred to me...” and “this activity made me realize...” before discussing the history of their chosen fermented product, demonstrating that students had acquired new knowledge about the fermented product they chose to research. All student responses described the history of the fermented product they chose to research or fermentation itself, accomplishing our first learning objective for this activity.

Learning Objective 2: Students will be able to discuss how credit for discoveries is granted by both scientific culture and the wider public.

A post-unit survey demonstrated that 85.7% of respondents either somewhat or strongly agreed with the statement, “the discovery and invention assignment helped me to understand
how biases in scientific culture can unequally highlight or erase those who contribute to scientific discoveries.” Related to this learning objective, students also made comments in their discussion posts on the cultures and individuals that are given credit for discoveries, such as the student comment below:

“When we say that something was discovered or invented, we really only focus on who made the concrete theory rather than anyone else that was involved. This needs to change, the process is just as important as the results and experiments are long and dedicated processes, these need to be acknowledged as well...I am able to see people’s contributions and what they gave to our community, and how we can further their ideas and use their information to better our knowledge.”

This student’s response captures their understanding of science as a collaborative process involving many individuals, and that sometimes credit is only given to one person. Though not every student’s response included this understanding, most of them did (~93% of students who completed the assignment). While we did not employ a full thematic analysis of student responses, we did notice student responses focusing on an appreciation of the culture or peoples leading to the fermented product, as well as expressing their fears about having their own discoveries and contributions go unattributed, as will be discussed below.

**Learning Objective 3: Students will be able to reflect on their sense of scientific identity and belonging.**

During our first implementation, we noticed that some students, particularly women, posted their fears of not receiving credit for their work in STEMM fields in the future:

“Since science is being represented as an individual job, that makes me feel like there are many people who aren’t being represented. I hope my contributions to science will be recognized, but this shows me that it wouldn’t be abnormal if they weren’t.”

The instructional team decided that allowing time for students to have a post-activity conversation was important, as activating students’ anxieties and fears was an unintended consequence of the asynchronous online discussion portion of the activity. Completion of this activity should not leave students with unaddressed insecurities related to their belonging in science. The follow-up discussion in a synchronous meeting was therefore added during our second implementation for students to feel more empowered. The discussion provided students strategies and community to drive change in training environments, as well as to recognize the “red flags” of unhealthy ones (36, 37), thereby better aligning with our learning objective.

**Possible Modifications**

**Content**

While developed around the topic of microbial fermentation, the “Discovery and Invention” activity can be modified for integration with other topics. For example, the instructor may ask students to research the origins of a field of study or its founders. Questions can be adjusted to probe students about the race and/or gender of those key figures or the cultures reported to be behind a field of study. More specifically, one could ask students to choose a Nobel Prize winner, and then follow up by asking students to find other figures who have done notable research in that field. This prompt could be used as a platform for a discussion of the demographic biases of Nobel Prizes. Dr. Prescod-Weinstein’s reading list (9) offers additional information on why it is important to deconstruct the preconception that the modern process of scientific inquiry is largely a product of white, western European men. Some of the suggested readings may be incorporated into an expanded lesson on this topic.

**Discussion Platform**

This lesson required students to comment on their peers’ discussion posts. While this was beneficial for exposing students to diverse ideas, several tactics should be considered to ensure useful discussions.

First, we recommend the instructor encourage students to write their initial post early in the week, in order to give time for fellow student responses. Second, to ensure useful dialog among the students, we now require that each student respond to at least two other students.

In some sections, our students only responded to the discussion questions, while in others, students summarized and synthesized their responses into a post, like the instructions asked. We therefore recommend that the instructor be very clear about the expectation to use the questions only as a guide for writing their discussion response. Alternatively, instructors who wish to review their students’ responses to each question can prompt students to post their direct responses, instead of writing a synthesis. However, this means students will not go through the higher-level process of synthesizing their responses into a summary for peer engagement. The instructor can use settings in the online discussion portal to limit students from viewing other responses until they have posted one of their own. Applying this setting to the discussion board prevents students from modeling their discussion posts too closely after their classmates’ and encourages a greater diversity of ideas. Finally, we recommend breaking students into small online discussion groups, even if the course is large. As mentioned earlier in the text, we found that having discussion forums for ~15 students as opposed to ~60 allowed for richer and more engaged conversations (35).

**Implementation and Instructional Modality**

This lesson can be modified to take longer than as originally implemented, and it can be modified for various course modalities. Given time constraints with our class format, we were only able to allocate ten minutes to the wrap-up synchronous discussion. Whether in an in-person classroom setting, or synchronous remote learning session, we recommend that a minimum of 20 minutes be set aside for this important follow-up conversation. Students also indicated in course surveys that they were spending more time with the assignments than was suggested in our instructions. For first-year undergraduates new to online research and finding credible resources, we recommend that the asynchronous activity instructions direct students to spend no more than 90 minutes on this activity (instead of the 60 we originally assigned). This change is reflected in the text above and in Supporting File S1. Students more familiar with online research may be able to complete the background research and write a discussion post in less time.
This lesson was developed and implemented for remote learning in the fall semester of 2020 due to the COVID-19 pandemic but could be easily adapted for an in-person course. One option is to assign the research and online discussion post as a pre-class assignment, similar to the way it was assigned as part of the asynchronous portion of our remote teaching. This should be relatively easy to implement using an online LMS that students are familiar with. Alternatively, if you are not incorporating an online LMS, or you believe your undergraduate students would benefit from collaborating on the first part of the assignment in person, the entire lesson can be planned as an in-person, synchronous activity. First, students are broken up into teams and instructed to research a particular topic or person. This requires a classroom where students have access to computers and internet. Then, students answer the discussion questions as a group; assigning one notetaker to record the answers and turn them in for a grade ensures that you as an instructor still benefit from the formative assessment piece of this assignment. After students complete the background research and initial discussion in groups or online, the instructor can facilitate a large group follow-up discussion in person, rather than in a synchronous remote context. This discussion can follow the same discussion prompts provided above for the synchronous online debrief.

Final Thoughts

It is our responsibility as instructors to incorporate reflections on history and context into our STEMM classrooms, not just as extra activities where time allows, but intentionally integrated into the curricula. Students must be given agency in these discussions, particularly when reflecting on their own sense of belonging within the fields being studied. Reflection and conversation among students and instructors alike are crucial if we are to change the demographics of our STEMM leadership and workforce to ones that more closely resemble the general population. Without intentional reflection that is integrated into our curricula, even our best of practices will lack context and fall short of driving significant cultural change to our STEMM training spaces (16). We owe it to ourselves and our students to make them a part of this process of deconstruction followed by reclamation (9). We hope that this activity will serve as both an example and a scaffold upon which to build more lessons and curricula.

SUPPORTING MATERIALS

- S1. Discovery and Invention – Student Instructions
- S2. Discovery and Invention – Rubric
- S3. Discovery and Invention – Facilitator Prompt

ACKNOWLEDGMENTS

This lesson was developed and taught as part of the WISCIENCE Scientific Teaching Fellows Program at the University of Wisconsin-Madison. This program trains graduate students and postdocs in the principles and practices of scientific teaching, and then they apply their training as instructors in the Exploring Biology disciplinary first-year seminar. The effectiveness of this lesson was evaluated as part of routine and ongoing course evaluation and with the goal of quality improvement. In consultation with the UW-Madison IRB, we determined that IRB review was not required for this project because it is characterized as program evaluation and does not constitute research (as defined by federal regulations under 45 CFR 46.102(d)). As such, use of direct de-identified quotes with consent from those quoted is permissible under the UW-Madison IRB guidelines.

We are grateful to the other Scientific Teaching Fellows, who provided invaluable insight during the development, implementation, and writing of this activity. We are also grateful to Dr. Amanda Butz for her guidance on evaluating lessons developed for Exploring Biology, and to the CourseSource reviewers and editorial staff who provided helpful comments that strengthened this manuscript. Finally, we recognize that UW-Madison stands on occupied Ho-Chunk land that has yet to be returned to its original tribal ownership and that there are currently no actionable plans from the university or state leadership to engage in reparations.

REFERENCES

Discovery and Invention: A Reflection on Representation in Science


*Please note that this series of comics we cited, while a potentially great resource for students, to our knowledge is not accessible via screen readers.
## Table 1. Teaching Timeline.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Estimated Time</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instructor Preparation</strong></td>
<td></td>
<td></td>
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<tr>
<td>Familiarization with activity</td>
<td>Read through the discussion questions and prompts.</td>
<td>15–30 minutes</td>
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</tr>
<tr>
<td>Adaptation and set up</td>
<td>Set up LMS discussion platform and adapt questions to specific topic, if needed.</td>
<td>As needed</td>
<td>See Supporting File S1.</td>
</tr>
<tr>
<td>Prepare facilitating</td>
<td>Review cited resources on facilitation and decolonization, antiracism in STEM.</td>
<td>As needed</td>
<td></td>
</tr>
<tr>
<td><strong>Asynchronous Activity and Discussion</strong></td>
<td>Students are introduced to the idea that scientists—individually and in groups—bring their biases into the process of doing science. They are told to choose either the process of fermentation or a specific fermented food or beverage and research its history.</td>
<td>45 minutes</td>
<td>Students may take longer to complete this part of their assignment. Adjust instructions, according to the students’ experience and comfort with online search engines and reliable sources.</td>
</tr>
<tr>
<td>Questions and discussion</td>
<td>Students are given four questions regarding scientific discovery and then are instructed to make a summary post of their answers on an LMS discussion board. Students are expected to respond to at least two other students’ prompts as part of the assignment.</td>
<td>45 minutes</td>
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<tr>
<td><strong>Follow-Up Discussion</strong></td>
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<tr>
<td>Small group wrap-up discussions (3–4 students)</td>
<td>Students are put into breakout rooms to discuss reflection prompts.</td>
<td>10–20 minutes</td>
<td>See Supporting File S3.</td>
</tr>
<tr>
<td>Large-group wrap-up discussion</td>
<td>Participants from each group report out, with space for students from other groups to react or respond.</td>
<td>10–20 minutes</td>
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