Leveraging Panel Discussions to Promote Positive Representation, Develop Science Identity, and Shift Stereotypes

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Abstract

The overrepresentation of cis straight white male scientists in examples used in Biology curriculum makes it difficult for students with other axes of diversity (race/ethnicity, gender, sexuality, first-generation college-going, socioeconomic status, disability, etc.) to develop their own science identity and sense of belonging. This, in turn, has been shown to have negative impacts on student retention and graduation rates. Previous data from other groups have shown that the use of written Scientist Spotlights shifts students from stereotypical descriptions of scientists to non-stereotypical descriptions. To address the lack of positive representation of scientists from diverse backgrounds, we have created a lesson to bring Scientist Spotlights to life. In this lesson, students get to interact with scientists from diverse backgrounds in either an in-person or synchronous online format. Pre- and post-assessment questions ask students to reflect on what they know about the types of people who do science. By learning about the panelists’ personal and scientific backgrounds, students become increasingly aware that people from any background can do science. This knowledge is expected to help build their own science identity and sense of belonging in the scientific community.


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Learning Goals

Students will:

◊ discover biology careers and explore biology career pathways through discussion and question and answer sessions with various scientists on the panel.
◊ identify resources with detailed information on different careers and career paths of interest.
◊ develop their sense of belonging to the scientific community.

Learning Objectives

Students will be able to:

◊ access and utilize multiple resources for information about specific careers and career pathways.
◊ recognize that it is understandable and acceptable to not have in mind a desired pathway while still in school.
◊ perceive a sense of belonging to the scientific community.
◊ connect science to their home communities (e.g., people from the same social backgrounds/identities).

INTRODUCTION

It is well documented that women and Persons Excluded because of Ethnicity or Race (PEERs) are under-represented in STEM disciplines due to multiple failures in STEM, including issues with both recruitment and retention (1, 2). As such, significant efforts are being made to improve inclusion in undergraduate science classrooms, with a particular focus on building science identity and a sense of belonging in STEM (3). The BioSLAM (4) project at SF State University represents a significant effort to ground our laboratory curriculum in equity and inclusion. To do this, we sought to (i) ensure positive representation of diverse scientists and communities in the curriculum, (ii) foster community between students, (iii) connect science to student communities and (iv) center student voices, thus expanding students’ views about what types of people can do science and the relationship between science and society (5–7).

Scientist Spotlights are short assignments that feature the accomplishments and career paths of scientists from diverse backgrounds. After reading about the featured scientists, students are asked to reflect on several metacognitive questions, one of which is “What do these articles tell you about the types of people who do science?” (8). Evidence has been published showing the positive representation of diverse scientists via the Scientist Spotlight assignment shifted students’ ability to describe scientists in non-stereotypical ways and made scientists seem more relatable to students (8). Additionally, students who shifted to less
stereotypical descriptions of scientists also earned significantly better grades in the course (8). Importantly, these shifts are connected to science identity and sense of belonging (5–7, 9–12).

Subsequent work by Aranda et al. demonstrates that over half of the scientists remembered by students were graduate students or post-docs, suggesting that highlighting near peer scientists had a particularly high impact on undergraduate students in the classroom (13). The Scientist Spotlights intervention along with the observed importance of near peer role models served as the inspiration for the activity described in this article, an adaptation of Scientist Spotlights from a written exercise to a live virtual panel featuring graduate student, professional, and faculty scientists from different backgrounds.

In the exercise described here, Scientist Spotlights were brought to life by inviting panelists with diverse backgrounds to share their paths into science with students in the class. Although the panel described here was run remotely, it could easily be adapted to a face-to-face format. In advance of the panel, students filled out a pre-assessment designed to garner their opinions about what types of people do science. During the panel, panelists were encouraged to share about their (often winding) path into science as well as their science with students. They were also asked to talk about their lived experience and any obstacles they may have overcome on their way to becoming a scientist. Students are then allowed to ask any questions that they might have. As with the Scientist Spotlights, the magic is in the metacognitive question that students answer after the panel: What do the stories of these panelists tell you about the types of people who do science?

**Intended Audience**

Although this particular activity was piloted with undergraduate students enrolled in an Introductory Biology lab, it could be applied to any course, major, or student grade level (high school, undergraduate, graduate, etc.).

**Required Learning Time**

The Scientist Spotlight Panel requires 15–30 min in the class period preceding the panel and 1–3 hours for the panel. Pre- and post-assessment surveys (<20 min each) are done outside of class.

**Prerequisite Student Knowledge**

This scientist panel lesson is intended to give high school, undergraduate, and graduate biology students an opportunity to learn more about the science and scientists around them by generating, discussing, and asking their own questions. Students need not have any prior knowledge.

**Prerequisite Teacher Knowledge**

To prepare for this activity, instructors should read the following two papers on Scientist Spotlights:


To promote the positive representation of diverse scientists, the instructor should also have the ability to identify and recruit scientists from diverse backgrounds to serve on the panel. If the class is being taught in a university setting, this can be as simple as reaching out to graduate students in the discipline as well as faculty and scientific staff members in the department. The instructor can also reach out to STEM societies for students of color at your institution (e.g., Society for the Advancement of Chicano/a and Native American Scientists [SACNAS]). By using a virtual format, the instructor can also reach out to colleagues at different institutions. In addition to having panelists with diverse backgrounds, it is recommended to have panelists who represent a range of disciplines and career paths. Instructors who do not have well developed networks of scientists from diverse backgrounds may find the following links useful:

- 100 inspiring Hispanic/Latinx scientists in America
- 100 inspiring Black scientists in America
- Dr. Lydia Jennings’ 50 Inspirational Indigenous Scientists
- 500 Queer Scientists

Additionally, instructors may consider using their social media networks to identify panelists. A sample social media post is below:

> Are you a Biologist (grad student, professional or faculty) from a background that is typically under-represented in STEM (BIPOC, LGBTQ, first-generation, low-income history, disabled, etc.)? Are you committed to diversifying the scientific workforce?

If so, please consider helping out my [course name] class at [university name] by serving on an in-person/virtual career panel. Graduate students, Biology professionals, and faculty members are invited to participate. The panel will require minimal preparation and is expected to take [number] hours and will be held from [time] on [date]. In addition to having the opportunity to impact the lives of some amazing students, all panelists will receive a parking permit (if in person) and are invited to join me for coffee/tea (my treat) after the panel. If interested, please reach out to me at [email address] by [date].

While we acknowledge that the time and effort that we are requesting from panelists add to their service burden, which is likely already higher than colleagues from majority backgrounds (14), we also understand that mentoring diverse students can have positive psychosocial impacts for the mentor...
(15). If you have the resources to compensate panelists, we certainly recommend that you do so. But, if you don’t, please don’t let this prevent you from asking. Other possible ways that this service can benefit the mentor is by adding to their outreach portfolio and providing networking opportunities (e.g., coffee after the panel) so that the experience advances their professional careers. Lastly, if asking panelists to come to campus in person, it is a courtesy to provide parking permits or transit vouchers as possible.

**SCIENTIFIC TEACHING THEMES**

**Active Learning**

This activity includes multiple methods to actively engage students in their own learning. By including students in the process of developing questions for panelists, we **center student voices** by having students reflect and build on prior knowledge. We also give students agency by having them establish their own ground rules for the panel. The group discussions at the beginning of the panel offer students the opportunity to interact in small groups while the full class Q&A at the end of the panel offers students the opportunity to participate in large group discussions. Lastly, the pre- and post-assessment questions are designed to help students exercise their metacognitive skills.

**Assessment**

From very young ages, student stereotypes of scientists affect development of their science identity and sense of belonging in STEM (5–7, 9–12, 16). Feeling out of alignment with stereotypical descriptions hinders academic achievement via stereotype threat (17). The pre-assessment engages students in reflecting on what kinds of people do science while **centering student voices** through collecting their questions for the panelists. This metacognitive work is essential to the process (8, 18–21). The first two pre-assessment questions are from published reports on Scientist Spotlights (8, 13).

1. Please REFLECT on the statement below. Choose and WRITE the number and phrase that reflects your level of agreement. Then, WRITE 200 or more words about your reflections on this statement and your level of agreement.

   “I know of one of more important scientists to whom I can personally relate.”
   1) Strongly disagree, 2) Disagree, 3) Agree, 4) Strongly agree, DK) Don’t know

2. Please REFLECT and WRITE 200 or more words about the following prompt:

   “Based on what you know now, describe the types of people who do science. If possible, refer to specific scientists and what they tell you about the types of people who do science.”

3. **REFLECT** on the question below and then WRITE 100 or more words to answer the question.

   “What career(s) are you most interested in and why?”

4. **REFLECT** on what questions you might have for a panel of scientists who have chosen a range of careers in STEM. WRITE at least 2 questions that you have for the panelists.

To further **center student voices**, the instructor should make a list of the student questions from the pre-assessment and share them with the students in the class in a survey format that will allow the students to rank which questions they are most interested in having the panelists answer.

After the panel session, students should be asked the following questions as a post-assessment: (8, 13).

1. Please **REFLECT** on the statement below. Choose and WRITE the number and phrase that reflects your level of agreement. Then, WRITE 200 or more words about your reflections on this statement and your level of agreement.

   “I know of one of more important scientists to whom I can personally relate.”
   1) Strongly disagree, 2) Disagree, 3) Agree, 4) Strongly agree, DK) Don’t know

2. Please **REFLECT** and WRITE 200 or more words about the following prompt:

   “Based on what you know now, describe the types of people who do science. If possible, refer to specific scientists and what they tell you about the types of people who do science.”

3. **REFLECT** on what you learned about different career paths. Then, WRITE 100 words or more about two things you learned from this panel.

4. **REFLECT** on additional questions that have emerged for you after listening to the panelists. Then, WRITE two additional questions that have emerged as a result of the panel.

By asking the first two questions in both the pre- and post-assessments, the instructor/host can highlight and compare their ideas before and after the panel and reaffirm the shift to non-stereotypical descriptions of scientists and that anyone can become a scientist. The data can be shared with students so that they can reflect on shifts that may have occurred across the entire class.

**Inclusive Teaching**

An underlying objective of the panel activity is the development of a scientific identity. As this lesson is designed for undergraduates in introductory biology, most students are assumed to be new to university or at least new to the biology major. All too often, students leave STEM majors when they lack a sense of belonging (22). As their sense of belonging in an academic context is crucial to their continued motivation, academic achievement, and well-being, it is important to use positive “instructor talk” throughout the lab (23). “Instructor talk” is loosely defined as everything that the instructor says that...
it not directly related to the course content and is divided into several categories including (i) Building the Instructor/Student Relationship, (ii) Establishing Classroom Culture, (iii) Explaining Pedagogical Choices, (iv) Sharing Personal Experiences, and (v) Unmasking Science (23).

To ensure positive representation of diverse scientists in this exercise, the panel should be comprised of people who come from diverse backgrounds across multiple axes of diversity (race/ethnicity, gender, sexuality, first-generation college-going, socioeconomic status, disability, etc.). It is important that the panelists are relatable to the students and willing to engage the students in personal conversations about their path to becoming a scientist. This will allow students to form their own scientific identity and begin to view themselves and their student colleagues as scientists.

**LESSON PLAN**

**Pre-Panel Preparation**

The overall flow of the lesson planning and implementation is outlined in Table 1 and Figure 1.

The advance preparation includes identifying, recruiting, and communicating with panelists, surveying students, generating questions for the panelists, and if needed, setting up a link for the virtual panel. The instructor should identify and recruit panelists for the lesson several weeks, if not months, in advance. It would be great if the instructor recruited panelists that reflect the diversity in their classroom. To learn more about the diversity in their own classroom, the instructor could deploy a “More about you” survey (24). In addition to recruiting panelists, the instructor needs to launch a survey and facilitate an in-class discussion about the questions for the panelists. The survey will ask students to reflect on their ideas about careers and what questions they might have for the panelists. The instructor can also seed the conversation about questions with some examples such as:

- What obstacles did you encounter and overcome en route to becoming a scientist?
- How did you navigate the bumps in your career?
- Did you have a mentor and if so, how did this mentor help you attain your goals?
- What gave you the confidence to know that you could become a scientist?
- How did you know that science was the path for you?
- What is one piece of wisdom that you would like to share with aspiring scientists today?

The survey will also contain pre-assessment questions for the students about what kinds of people do science (see assessment plan above). To prepare the panelists for the panel session, the instructor should describe the student population in the class and the required time commitment for the lesson. The instructor should also obtain one introductory slide from each panelist that explains a bit about who the panelist is personally and scientifically (see Supporting File S1 for a template PowerPoint slide).

It is also advised to share the names of the panelists (names, roles, institutions, and area of expertise) at the end of the previous class. Doing this beforehand will allow the students time for self-reflection about their current and future career goals and ideas. Any ground rules for the panel session should also be discussed ahead of time (such as whether students in a virtual setting need to have their cameras on during the panel discussion).

**Panelist Introductions**

After welcoming the students and attendees to the lab, take the first five minutes to set an open and personal tone for the panel. Following a short introduction to the lesson, there should be 10 to 15 minutes allotted for online breakout rooms or small group discussions to foster community between students and panelists. The small groups should include students and at least one panelist. Potential conversation starters in the small groups could be to describe (i) two important things to know about who they are and what they value or (ii) current career goals. These small group discussions at the start of class foster community between students and create a warm and inclusive environment for all students in the class. We also like to offer up appreciation for students being so personable during these discussions.

After the small group discussions, the focus is then turned to the panelists. The panelists will be asked to introduce themselves to everyone without going in depth about their science. The introduction slide that they have prepared will be projected at the same time.

They should be prompted to explain who they were and who they are now as a scientist and any pertinent education or career path and work they are comfortable sharing. These introductions should last no more than five minutes and should be similar in manner to how an instructor would introduce
themselves to their class at the start of the semester or quarter. It is important to the students and attendees that the panelists can introduce and speak on their research and experiences concisely using language that can be understood by introductory biology students. These scientific introductions should last no more than five minutes per panelist.

Panelist Q&A Session
This part of the class is for the Q&A session. The first questions to be asked will be those that were pre-submitted and ranked by the entire class. Students should be assigned to ask the prepared questions. If there is any time at the end, then the floor can be opened for additional questions.

Resources
The instructor should leave approximately two minutes at the end of class to share a list of online education and career resources for the students. This list should be broad and cover a multitude of fields and disciplines. Examples of resources could include links to writing application materials, handouts about upcoming career or research opportunities, and locations of resources on campus to ask further questions or get more information. With the permission of the panelists, the instructor can also share their contact information with the students.

This lesson is structured for one entire lab class period (2–3 hours) and does not require any physical materials. It can be conducted fully in person, fully online, or in a hybrid format (with the students in person and the panelists online). Although the in-person format offers a personal touch, online meetings offer the advantage of bringing in panelists from further afield. Having students in person (with no computer) and panelists online would make it challenging for panelists to interact with students in small groups though. If this lesson is done online (Zoom, Microsoft Teams, etc.), the instructor should ensure that all students and panelists have access to the link beforehand.

TEACHING DISCUSSION

Our Experience Teaching a Large Introductory Biology Lecture Class Led to the Development of the Panel Discussion Described Here
We are faculty with multiple axes of diversity who teach at a minority-serving institution. When over 300 students in our Introductory Biology lecture class were asked to name 10 scientists, the vast majority were white men such as Albert Einstein. When we asked them how many of them had included even a single woman on their list, very few hands went up. When we asked about BIPOC scientists, there were even fewer hands. We then asked how many of them had included the faculty teaching the course (two BIPOC men and one queer woman) on their list; there was a collective groan from the class. We learned that none of the students had included one of their colleagues even though they are all budding scientists. This exercise provided us with anecdotal evidence that students often fail to explicitly connect the fact that they know real people (not just people in books) who are scientists with diverse backgrounds. Experiences such as these led us to see the tremendous need to explicitly connect students to scientists with diverse backgrounds and to develop the panel described in this manuscript.

Reactions to the Lesson
Our students, many of whom are from backgrounds typically under-represented in the sciences, shared a high level of enthusiasm about the panel. Our impression was that the students felt very comfortable asking questions of the panelists, including questions that were not directly related to science. During the panel, many of the panelists described the long and curvy road leading to their current careers as well as the obstacles they faced along the way. In post-class surveys, students shared that this was highly reassuring and that they felt less worried about not knowing what they wanted to be in the future or what education or career path they want to pursue. This realization allowed our students to grow their science identity.

We also found that our students responded especially well to near-peer panelists. While the older more established scientists were an important part of the panel, the students really related to the graduate student scientists. This makes finding panelists from diverse backgrounds even easier!

Challenges
One of the biggest challenges we encountered during the virtual panel was getting students to turn their videos on. We used so-called “instructor talk” to gently persuade students to utilize their cameras for this online lesson.

Future Considerations
Data collection should be a priority for whoever utilizes this lesson. As previously mentioned, the assignment of metacognitive reflections before and after class will help them to understand that people from diverse backgrounds with varied paths can do science. As such, students start to see themselves as being scientists. In addition, student responses also allow the instructor to understand and act on the diverse education and career ideas of their students in terms of creating a dialogue or teacher talk, providing additional resources and network connections, or in the development of future lessons.

When we taught this lab at San Francisco State University, we combined two lab sections (with identical meeting times), which meant that there were roughly 50 students in the audience. This way, one of the two instructors was available to lead the panel session while the second instructor served as one of the panelists.

As previously stated, the construction of the panel is crucial to the effectiveness of this lesson. It is critical to assemble a diverse panel of scientists who represent varied backgrounds and careers. Hearing from scientists who share demographics and/or life experiences should promote the formation of student science identity.

Another consideration that might prove beneficial to the students and the idea of scientific identity is to allow the students to pick the panel. Planning must go into the research and selection into potential panelists well in advance of the panel and lesson to allow students to both learn about the
potential panelists and then to express their desire on which panelists they would like to hear from.

One last consideration for the instructor is to host the panel and lesson later into the semester or quarter. This should have allowed the students to get more comfortable with their classroom, environment, and community. This, in turn, can allow students to be more open to asking questions and in the case of a virtual or online class, having cameras on.

**SUPPORTING MATERIALS**

- S1. Panel Discussion – Panelist Slide Template

**ACKNOWLEDGMENTS**

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Table 1. Breakdown of the lesson plan. This table outlines the lesson’s activities as they relate to the panelists and students.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Estimated Time</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panelists</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify panelists</td>
<td>Identify panelists who represent diverse backgrounds to invite</td>
<td>30 min</td>
<td>Try to include multiple axes of diversity in your panel</td>
</tr>
<tr>
<td>Invite panelists</td>
<td>Email panelists to invite them to your class</td>
<td>20 min</td>
<td>Let them know the goal of the panel and provide them with date, time, and format (virtual or in person). You should also consider garnering their permission to record the panel, especially if held in a virtual format</td>
</tr>
<tr>
<td>Send calendar invites and instructions to panelists</td>
<td>Send calendar invites and provide instructions about the slides that panelists are asked to prepare for the class</td>
<td>20 min</td>
<td>The two slides that they should prepare are (i) a personal introduction that contains a description of their path to becoming a scientist and (ii) a scientific introduction</td>
</tr>
<tr>
<td>Panel discussion</td>
<td></td>
<td>1–3 hr</td>
<td></td>
</tr>
<tr>
<td>Follow-up with panelists</td>
<td>Send thank you notes to panelists</td>
<td>20 min</td>
<td>You might also think about sharing post-assessment data with them so that they can see the impact that their time had</td>
</tr>
<tr>
<td><strong>Students</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-assessment</td>
<td>Have students complete the pre-assessment online outside of class time</td>
<td>20 min</td>
<td>The pre-assessment should be administered roughly two class periods before the panel discussion</td>
</tr>
<tr>
<td>Solicit ideas for questions</td>
<td>Solicit student ideas for questions to ask the panelists</td>
<td>5 min</td>
<td>This can be done at the same time as the preassessment</td>
</tr>
<tr>
<td>Rank questions for panelists</td>
<td>Have students rank the compiled questions that students created on their own</td>
<td>15 min in class 5 min outside of class</td>
<td>In the class period preceding the panel, students should be encouraged to discuss which questions they see as being the most important (perhaps using think-pair-shares or in small groups). Then, outside of class, students should be asked to rank the questions using survey software such as Qualtrics, Google Forms, or SurveyMonkey</td>
</tr>
<tr>
<td>Panel discussion</td>
<td>In class session with panelists from diverse backgrounds, who describe their career paths and their science</td>
<td>1–3 hr</td>
<td>Panelists should be primed to discuss any obstacles they have face and how they approached them</td>
</tr>
<tr>
<td>Post-assessment</td>
<td>Have students complete the post-assessment online outside of class time</td>
<td>20 min</td>
<td>This should be assigned immediately after the panel discussion</td>
</tr>
<tr>
<td>Class discussion</td>
<td>In the class period following the panel, students should be invited to share what they learned about the types of people who do science</td>
<td>30 min</td>
<td>This discussion would be best in the next class period after the panel</td>
</tr>
</tbody>
</table>
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REFERENCES