

TITLE: Curriculum Intervention for Anti-Racism in Introductory Biology

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ABSTRACT:

Science faculty and departments have the responsibility to engage in equity-based interventions to create a culture of inclusive diversity that acknowledges social systems and identities and leverages student community cultural wealth to support all students interested in pursuing science and to avoid perpetuating inequities. STEM equity efforts can be targeted at curriculum modifications to STEM courses to meaningfully integrate connections between science, social structures, and racial inequity. Our project “Impact of Anti-Racist Practices in Gateway Biology Courses” aimed to develop and pilot a model for curriculum intervention in undergraduate biology that meaningfully integrates historical and contemporary connections between science, social structures, and racial inequity. A team of undergraduate Biology instructors from various institutional and geographical contexts designed course-specific teaching materials to explicitly address equity-related issues in science practices and applications that connect to their specific course topics. Data will be collected to examine the extent to which the course modifications implemented in introductory biology influence student learning and attitudes toward science and towards the intersection of science with social issues and inequities. Lesson plans and instructor guides will be prepared for publication to disseminate the curricular framework and materials for implementation by other college educators interested in the approach.

PROPOSAL:

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**1. Theoretical framework and need. How does the activity intentionally seek to foster a learning environment that welcomes and engages all students?**

Because of embedded racist cultures and structures in higher education in the U.S., students who belong to excluded ethnic and racial groups (PEERs) leave science at disproportionately high rates compared to white students, despite PEERs’ initial high interest in science and intention to major in science fields (Asai, 2020). Institutions must move beyond numerical comparisons of compositional diversity and deficit mindsets that explain disparate outcomes for minoritized students (Bensimon 2005) to examine how personal and social factors influence the STEM education experiences of their students and how programmatic and instructional approaches can be modified to better take these into account (Williams 2011).

Science faculty and departments have the responsibility to engage in equity-based interventions to create a culture of inclusive diversity that supports and retains all students interested in pursuing science and avoids perpetuating inequities (Asai, 2020). An important aspect of this culture change is to first acknowledge that Western Science is a traditionally exclusionary arena accessible mostly to white men. Because this demographic group has dominated scientific research labs and their discoveries, the interpretation of phenomena has been filtered by their own social positioning. Several historical examples demonstrate this, including the eugenics movement (Ramsden 2003), the perpetuation of race science (Saini 2019), and whiteness being the assumed human reference point for most psychological studies (Henrich et al. 2010). Second, we must acknowledge that scientific findings are typically communicated among the educated elite, and when science is communicated to wider society, it is done in a way that contributes to the perception of the scientific community being elitist and tone-deaf (Resnik and Elliott 2016). Science has thus preserved inequitable systems of power that inadvertently perpetuate environmental, social, and health injustices.

Most STEM faculty in the United States are trained to view science as purely empirical and apolitical and to simply “teach the facts.” They are rarely trained to acknowledge, let alone discuss how to mitigate, the inequities present in scientific practice or to emphasize the power that science has to be a driver of societal change toward equity. This pedagogical philosophy often leads to science classroom environments, pedagogy, and curricula that do not focus on making connections among students or connections between course content and the students’ lives. In turn, this can result in a sense of exclusion, especially for PEERs who do not see themselves represented in the dominant culture of science or higher education.

Our project “Impact of Anti-Racist Practices in Gateway Biology Courses,” funded by the 2021 Spencer Foundation Racial Equity Special Grants Program, aimed to develop and pilot a curriculum intervention model for undergraduate biology that meaningfully integrates historical and contemporary connections between science, social structures, and racial inequity into required courses for science majors. Leveraging the tenet of “humanization” and community of wealth from the ‘emancipatory pedagogy framework, we envisioned that the implementation of the developed curricular modules will help students see increased connection to each other and to our social contexts and understand why evidence of our shared humanity is important for STEM majors. This incorporation of STEM-focused civic engagement through exploration of human and social dimensions of biology promotes a culture of care (Nouri and Sajjadi, 2014). Students are prompted to explore how their own socializations, awareness and acknowledgement of racial inequities intersect with their experiences and career goals. Curricular interventions that explore the subjective nature of science and exclusionary science practices can help to dismantle systems of privilege and power by positioning students to be fully engaged agents of change during and after receiving their degrees.

## **2. Methodology. What is the activity? Proposals emphasizing practice should describe the strategy for implementation in the classroom and for assessment of student outcomes.**

Our proposal emphasizes the pedagogical practice of designing and implementing our curriculum reform model in introductory biology classrooms and plans for assessment of student outcomes.

### ***Development of Curriculum Overlay Model for Introductory Biology:***

A team of undergraduate Biology instructors from various institutional and geographical contexts met bi-monthly during AY2021 to discuss what anti-racist and equity-focused content and practices look like in undergraduate introductory biology. Through these conversations, a two-part ‘guiding principle’ for the curricular reform model was created: (1) Western science is believed to be objective and purely evidence-based. However scientific practices and conclusions are influenced by *who* does the practicing and the sociocultural norms and lenses that the scientists bring to the scientific questions, data interpretation, and actions taken with the findings and (2) Scientific practice that attends to human biases, historical and present-day inequities, and societal distribution of power can be used as a force to address social problems for the benefit of all humans. This principle guided us to create curriculum modules that oriented the biology content to considerations of historical and social context and underlying influences of privilege and power in an inequitable society. Through this lens, instructors aimed to create opportunities for their students to connect the scientific content to their present-day life and their goals for their future self.

### ***Curriculum Design and Implementation and Assessment:***

Starting in Fall 2022, implementation of the curricular intervention in introductory biology courses taught by the project team members began. The specific curriculum interventions differed based on each instructor and course context, but each instructor created and followed a general “Implementation plan” with the following elements:

#### Syllabus Adjustments:

All collaborating instructors incorporated inclusive syllabus statements for their courses that communicate a value of diversity and inclusion and a commitment of respect and care for students (Fuentes et al. 2021). Additionally, all collaborating instructors incorporated at least one equity-related core learning objective into their list of content learning objectives, to emphasize the importance of exploration of the intersections between biology, human endeavors, social systems, and racial inequity as a critical component of the course. Examples include “*Students will be able to evaluate the connection between biology, power, racial inequity and social justice*” and “*Students will be able to use course knowledge to develop one or more strategies to reduce care or service disparities that result from racially-driven power imbalances.*”

#### First-Week Relationship-Building:

To ensure a clear emphasis on humanism from the first week of the course, collaborating instructors each incorporated an introductory “student voice” reflection tool to get to know students in authentic ways. Examples include an equity-focused course info-sheet (Killpack & Melon 2020), a personal essay (example Keil 2008) or a values-affirmation activity (Jordt et al 2017). This intervention aimed to promote interpersonal connections and connections to students’ social contexts, and communicate a culture of care and acknowledgement of community cultural wealth.

#### Equity-Focused Modules:

Each team member then designed and implemented at least three “equity-focused activities” to integrate biology content with instances of racial inequity or social issues or solutions. Some examples include analysis of case studies of ecotoxicology and environmental injustice, race-related systemic health disparities, comparison of indigenous and Western

science, and long-term impacts of redlining on ecosystem services. These activities varied in length, topic, and approach to suit the instructors' specific contexts. In some course contexts these were thematically-linked across the course and activities in other contexts each addressed separate themes. This course design aimed to allow introductory students to explore the human and social dimensions of biology through an anti-racist lens and prompted them to explore how their own socializations, awareness and acknowledgement of racial inequities intersect with their experiences and career goals. These curricular interventions aimed to enhance humanization of science, enhance student awareness, and empower them to see how science can be used to effect change. To assess student outcomes from participating in the activities, data was collected following each equity-focused activity using a standard prompt: *"Write a short reflection (100 words or about ~3-5 sentences) on what you learned from this activity and/or why you think it is important. Does it connect to your lived experience in some way? Please explain."*

#### Pre-and Post-Course Reflections:

As part of the curricular intervention, students will complete a pre- and post-course reflection to probe students' awareness and views of the intersections of science, social issues, racism, and their personal experiences: *"In what ways can scientific practice be useful to improve society? Describe one or more specific examples in your response (100 words or about ~3-5 sentences)"* During the final week of class, collaborating instructors will disseminate an additional course evaluation prompt to allow students to appraise influential aspects of the course and reflect on their science paths, and to probe development of cultural humility and awareness of equity issues: *How has this course experience led you to think differently about yourself and/or your path to a career in science?*

### **3. Analysis. What are the results of the activity? This section may include qualitative, quantitative or mixed methods evidence, and might include case study analysis, statistical analyses, and/or assessment results describing student outcomes.**

Anonymized data from the survey instruments and reflections assignments will be collected by the research program run by Dr. Bryan Dewsbury. This research program conducts mixed methods research exploring the social context of science teaching and learning. Centralizing the data analysis process here reduces any bias potentially associated with collaborating instructors analyzing data from their own institution. Written reflections will be qualitatively coded by two technicians using a Critical Race Theory Narrative analysis as a guide for the thematic coding process. This framing will allow us to extract the ways in which students interpret the intersections of race and power in their own lived experiences. This will be used to compare student data pre- and post-course and to explore what aspects of the course activities led students to change attitudes and viewpoints. Technicians will calculate inter-rater reliability to ensure that there is agreement with the coding scheme before completing the data set. If appropriate, codes will be codified into themes. Themes will then be used to develop a narrative of how students in all courses reflected on race and power both before and after the course was administered.

#### **4. Implications. Based upon the presented work, what recommendations can be offered to the NABT community on how to improve inclusion in STEM classrooms and promote culturally relevant pedagogies?**

Through this collaborative, multi-institutional initiative, we will pilot a curriculum model that prioritizes and integrates incorporation of aspects of anti-racism and an exploration of racial inequity into the study of biology. Each collaborating instructor will develop and tailor their curricular interventions to their specific course context. This initiative will result in a diverse set of curricular examples that can serve as a ‘proof of principle’ for the model and its impact on students. Because our model will be implemented in a variety of contexts, it has the potential to transform traditional undergraduate biology course content by adopting a focus on racial equity, with the ultimate goal of lowering barriers for such curricular implementation by other science faculty nationwide. A team of undergraduate Biology instructors from various institutional and geographical contexts designed course-specific teaching materials and assessments for their teaching contexts that explicitly address equity-related issues in science practice that connect to their specific course topics. The project goal is to examine the extent to which the course modifications implemented in introductory biology influence student learning and attitudes toward science and towards the intersection of science with social issues and inequities. Data from student pre-post course reflections, as well reflections following curricular modules, will be analyzed using qualitative coding and data analysis. Additionally, lesson plans and instructor guides will be prepared for publication to disseminate the curricular framework and materials for implementation by other college educators interested in the approach.

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