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SYMPOSIUM

Incorporating Sex-Diverse and Gender-Inclusive Perspectives in Higher Education Biology Courses

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Synopsis Inclusive teaching is teaching in a way that reaches all students in the classroom; this is beneficial for everyone, particularly for those with minoritized identities. Instructors play a critical role in scaffolding how students are exposed to and learn science content in the classroom. In this manuscript, we discuss how biology instructors can make their classrooms more inclusive with regard to sex and gender diversity content. Many topics in biology are based on androcentric, heteronormative, and oppressive framing, even though those lenses are more reflective of our own history and culture than they are of the diversity we see in nature. Here, we summarize information presented in the SICB 2024 workshop titled "Incorporating sex diversity and gender inclusivity in biology undergraduate classrooms" and provide instructors with (a) rationale for why inclusive teaching matters, (b) guidance on how to challenge unscientific views and make their curricula more sex diverse and gender inclusive, and (c) practical and easy-to-implement strategies for discussing "contentious" topics in the classroom. Incorporation of this material will be beneficial for students, for science and medicine, and for accurately representing the diversity found across the tree of life.

Introduction

Recent calls-to-action have highlighted the need for inclusive pedagogies within undergraduate classrooms (Dewsbury and Brame 2019; Hales 2020; Harris et al. 2020; Zemenick et al. 2022; Costello et al. 2024). Mounting evidence supports the idea that an inclusive learning environment can aid in closing the attrition gap between students who belong to historically and/or currently marginalized and disenfranchised groups (i.e., racial, sexual, and/or gender minorities) and their non-minoritized (white, cisgender, heterosexual) counterparts, as attrition is often attributed to lacking a sense of belonging in science, technology, engineering, and mathematics (STEM) classrooms rather than an inability to comprehend the course content (Dewsbury and Brame 2019).

Such findings have resulted in discourse among academics on broadly applicable best practices for incorporating inclusive perspectives while teaching diverse student populations (Hales 2020; Harris et al. 2020). Course content within the biological sciences is often particularly vulnerable to biases, microaggressions, and alienation, depending on how the material is delivered to the students (Hales 2020), as much of the content relates to people, including issues that pertain to student's personal identities (Casper et al. 2022; Packer and Lambert 2022; Lewis and Sharpe 2023). Additionally, many topics in biology are based on an-

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drocentric, heteronormative, and oppressive framing, even though those lenses are more reflective of our own history and culture than they are of the diversity we see in nature (Nelson 2017; Hayssen 2020; Kamath et al. 2022; Lewis and Sharpe 2023; Subramaniam and Bartlett 2023; Baker and Hayssen in review). For example, material covered in an introductory undergraduate genetics course may relate directly or indirectly to students' identities, such as race or ethnicity, disability status, sexual orientation, or gender identity (Hales 2020). As such, Hales (2020) has tailored a guide for how to signal inclusivity on these topics within a genetics classroom. However, to the best of our knowledge, no guides currently exist for best practices in covering sexual diversity and gender inclusivity in an undergraduate biology classroom.

Instructors in undergraduate biology classes may be hesitant to discuss sexual and gender diversity or integrate related topics into their course content due to the belief that these issues are too controversial, politicized, unrelated to course content, unimportant, and/or beyond their personal scope of expertise (Casper et al. 2022; Sharpe et al. 2023). These concerns are understandable within a disciplinary culture that posits science and science education as an identity-neutral and apolitical enterprise; however, contexts purported to be identity-neutral implicitly normalize and enshrine dominant identities, which carry the privilege of being viewed as apolitical and unmarked (Casper et al. 2022; Fitzgerald-Russell and Kowalske 2022; Leyva et al. 2022). When instructors try to remain neutral by not engaging with issues of sex, gender, and sexuality diversity in their curricula and pedagogy, their attempts at neutrality or non-engagement tacitly enforce a "hidden curriculum," which has been described by Phillip Jackson as "the unwritten institutional demands for conformity" (qtd in Zook 2017). In this context, this "hidden curriculum" includes a variety of implicit and explicit messages that suggest only content that conforms to a socially normative, cisheterosexual, endosex (i.e., not intersex; a person born with sex characteristics that fit normative expectations of male and female bodies) paradigm can be considered legitimate biological knowledge (Bazzul and Sykes 2011; Junkala et al. 2022; Aivelo et al. 2022).

Much of the existing research on teaching sex, gender, and sexuality diversity in biology classes has focused on (a) human-oriented content, (b) presentation of a supposedly universal sex binary, (c) projection of human gender stereotypes onto non-human organisms, and (d) promotion of monogamous, heterosexual reproduction as the superior strategy across non-human organisms, but this framing can increase misconceptions about biodiversity and foment binary and cisheterosexist social perspectives in biology students (Casper et al. 2022; Sharpe et al. 2023; Subramaniam and Bartlett 2023). Such an approach can also decrease the quality of instruction and the opportunity for authentic understanding of multiple organisms, including plants, fungi, and various vertebrates, that utilize alternate sex and reproductive strategies that cannot easily or accurately be mapped onto a binary, cisheteronormative, anthropocentric life history (Casper et al. 2022; Subramaniam and Bartlett 2023). Of particular relevance to this concept are former US laws on and criminalization of homosexuality (see Lawrence v Texas 2003). The basis for much of our legal rationale for criminalizing homosexuality comes from St. Thomas Aquinas, Plato, and others, who stated that same-sex sexual behavior is a crime against nature, is "unnatural," or is an abomination (see the summary of historical context in Pope 1997). This belief that queerness is inherently unnatural and un-biological is both pervasive and influential, meaning that there is no "neutral" pedagogical option, and not acknowledging and directly challenging such beliefs can serve to tacitly uphold them. Additionally, historic and current opposition to LGBTQIA+, particularly transgender, individuals relies heavily on pseudoscientific rhetoric and eugenic rationale (Lewis and Sharpe 2023), and many recent legislative efforts to remove or restrict access to books dealing with LGBTQIA+ information have been recently proposed (Rosenthal 2024). Thus, by not teaching about what is known about the vast sex diversity found in nature and across the tree of life, we are doing our students a disservice.

Lastly, teaching in an exclusionary, sex binary way can also reduce feelings of belonging and increase attrition for queer, trans, and intersex biology students, fail to prepare future medical professionals for the human biodiversity they will encounter, and underserve all students within the current political context that increasingly features appeals to the scientific validity of a biological sex binary to justify oppression of LGBTQIA+ individuals (Casper et al. 2022; Lewis and Sharpe 2023; Sharpe et al. 2023). We want to note that it should not matter if queerness is reflected in beyond-human biodiversity or not, as all individuals deserve human rights and the freedom to exist and express their identities—full stop. However, given the historical context of legislation and the focus on biological data in research and classrooms, we want to highlight the impact of teaching (and researching) about natural sex (and gender) diversity across taxa, as this can influence societal views and policy. Relatedly, *Nature* recently published (May 1, 2024) an article collection titled *Sex and Gender in Science* to highlight the necessity and challenges of studying sex and gender in sci-

ence and medicine, and earlier this year (March 14, 2024), *Cell* published a focus issue on sex and gender that emphasized gender equality issues in academic science, the complexity of sex-related variables, and the problematic history of sex research (Cell 2024). As instructors in higher education, we are perhaps our students' first exposure to this content, and by teaching them about the vast diversity of sex and sexuality in nature, we can play a critical role in empowering them to contextualize and critique arguments. Discussions of beyond-human biodiversity are important to disrupt and contradict common misconceptions about universal heteronormative binaries and should be understood as a compliment to, rather than a replacement of, equity and inclusion work uplifting the diversity of human identities.

Teaching about variation and diversity in sex expression can be low-hanging fruit for botanists/plant scientists given the significant presence of what one might call "non-normative" reproductive strategies in plants. This includes the dominance among plants of the cosexual sex system (historically referred to as hermaphroditic or bisexual), in which all plants in a given species bear so-called "perfect" flowers with the capacity to perform both male (sperm production) and female (egg production) sexual function—and, in many cases, the ability to self-fertilize. On this background of cosexuality, however, just about every imaginable combination has evolved (typically numerous times independently) across the plant kingdom—including dioecious species in which individual plants are either unisexually male or unisexually female but never both (see Renner 2014), plastic species in which individuals shift effortlessly from one sexual system to another over the course of a growing season or their lifetimes (e.g., Doust and Cavers 1982; McDonnell et al. 2019; Blake-Mahmud and Struwe 2020), species in which unisexual individuals can (even briefly) find themselves occasionally expressing as the opposite sex (e.g., Martine 2023), and species that appear morphologically to be one sex form but perform functionally as another (e.g., Anderson and Symon 1989).

Students' perception of plants as being far removed from humans and other animals, while often bemoaned by botanical educators, can be an advantage when introducing "controversial" topics like the beyond binary nature of sex (or even the concept of evolution, itself) simply because what happens in plants is perceived as largely non-threatening with regard to human identity and social mores. Likewise, the common touch points that many people already have with plants (like food, gardens, cut flowers, houseplants, representation in art, and textiles) can easily be approached by instructors through the lens of plant reproductive biology—and create interdisciplinary teaching opportunities (e.g., Martine et al. 2024) with rich prospects for exploring the variation and diversity in sexual expression one encounters every day by interacting with and living alongside plants.

Introducing concepts related to sexuality by citing non-animal systems can and should achieve more than just a recognition that, say, "plants are weird." Rather, this approach fosters an understanding that diverse sex-related strategies are part and parcel of the development of life on Earth—and can be used as an example of the commonalities among all organismal groups as they face the shared challenges commensurate with living on the same planet. Establishing the magnitude of "non-normative" sexual variation in plants can thus function as part of a scaffolding approach in which additional examples are introduced. Diverse approaches to sexuality among animals might, instead of appearing exceptional, be recognized as part of a continuum. There are many vertebrate examples of sex variation which can be used to further help students conceptualize this continuum, including environmental sex determination strategies in some reptiles (Krueger and Janzen 2022), fishes that change from a reproductive adult of one sex to a reproductive adult of another sex (Nagahama et al. 2021), and observations of same-sex sexual behavior in hundreds of animal species (Bailey and Zuk 2009; Roughgarden 2013; Monk et al. 2019).

Of relevance to broader society, many students who are enrolled in biology degree programs are seeking positions within healthcare settings. Current medical school curricula are notoriously non-inclusive, particularly around trans healthcare both in the United States and globally (Hana et al. 2021; Dubin et al. 2018). For example, US medical schools reported a median of 5 h of course-time (inter-quartile range 3–8 h) dedicated to LGBTQIA+-related content, though many schools reported that they did not teach these topics at all during the pre-clinical and/or clinical years (Obedin-Maliver et al. 2011; but see examples of programs with successful curricular interventions in O'Leary and Kunkel 2021). Additionally, the majority of medical students surveyed ranked their school's incorporation of LGBTQIA+ content into their curriculum as being "fair or worse," did not feel comfortable discussing topics related to gender transitioning and gender-affirming surgery, and felt unprepared to obtain a comprehensive sexual history and counsel patients belonging to the LGBTQIA+ community (O'Leary and Kunkel 2021). Intersex content in medical curricula is often either relegated under the umbrella of LGBTQIA+ health training or is taught with outdated, pathologizing terminology, although an intentionally patient-centered, trauma-informed approach to intersex education has been proposed and

piloted (Endres et al. 2022). Inclusion of these topics is urgently needed as LGBTQIA+ patients face stigma, bias, and health disparities in medicine (Liu et al. 2022; Malta 2023; Hatzenbuehler et al. 2024), and LGBTQIA+ medical students and physicians also face stigma and discrimination from peers and patients (Dimant et al. 2019; Freeman and Keuroghlian 2022).

Research underscores the critical significance of addressing mental health concerns among LGBTQIA+ students due to their heightened vulnerability to adverse outcomes stemming from societal stigma, microaggressions, and other stressors (Hatzenbuehler 2009; Poteat et al. 2011; Kulick et al. 2017; Lipson et al. 2019). Evidence suggests that integrating LGBTQIA+-inclusive content and language into biology curricula not only promotes academic success but also contributes to a sense of belonging and psychological safety for LGBTQIA+ students, enhancing their overall mental health outcomes (Bry 2017; Ostovich and Case 2018). Interventions aimed at fostering inclusive spaces and affirming identities have been shown to positively impact the mental health outcomes of LGBTQIA+ students, emphasizing the importance of holistic approaches to support their well-being (Butterfield et al. 2018; Toomey et al. 2018). Thus, the incorporation of sex-diverse and gender-inclusive teaching is a real, pressing need.

University instructors are viewed by students as purveyors of knowledge wielding substantial epistemological authority (Casper et al. 2022), and STEM course content such as textbooks is typically presented and received as "final science" or "statements of fact" rather than reflecting a snapshot of the ongoing and dynamic process of scientific inquiry (Aivelo et al. 2022). Concerningly, most biology textbooks do not embrace the natural diversity of sex and gender and instead: promote ideas of sex and gender essentialism, are overly simplified, and/or conflate sex with gender (Donovan et al. 2024; Dunk et al. 2024). As biology is uniquely situated as both a STEM discipline (in which course materials are typically presented as "final science" rather than opportunities for critical inquiry) and a subject that directly touches on aspects of human diversity and identity (including those which may be visibly or invisibly embodied by students), opportunities to enforce or challenge the normative "hidden curriculum" surrounding sex, gender, and sexuality are present in not only course content but also in classroom management and response to student inquiry (Casper et al. 2022; Lewis and Sharpe 2023; Sharpe et al. 2023). As discussed in the below vignette, "*Setting the stage for an inclusive and productive classroom*," proactively establishing an inclusive classroom environment in which affirmed names and pronouns are respected and used is an important step for supporting transgender and gender non-conforming students and rejecting the attitude summed up by Bryant as "this space is for the science; that stuff belongs outside of work" (Bryant 2023). Course content may provide unexpected and impactful opportunities to address questions or misconceptions students may hold related to, for example, cultural discourses on the heritability of LGBTQIA+ identities (Casper et al. 2022). Preparing for how to handle questions, comments, and misconceptions related to social identities such as sex, gender, and sexuality is a key strategy for developing a responsive and inclusive classroom. As explained in the below vignette "*Handling hot button topics*," being well informed on these issues can facilitate effective responses to hot button topics in the classroom, but being prepared to answer appropriately when the topic or question is beyond one's scope of knowledge is equally important for maintaining a supportive environment.

Manuscript focus and goals

This paper was developed as the result of a workshop held at the 2024 Society for Integrative and Comparative Biology (SICB) meeting in Seattle, Washington, and presents some issues around inclusivity and best practices specifically aimed at biology courses, especially those that include human-relevant content. These courses are particularly problematic, as when human data are involved, it is impossible to disentangle the material from societal contexts. Further, content is based on accepted "norms" about human bodies (Zemenick et al. 2022), leaving students open to reflecting on how the course content relates to themselves and their own bodies. Perhaps reflecting the historical disconnect between inclusivity and teaching human-focused courses, students who belong to gender- and sexual-minority groups are less likely to complete degrees in STEM than their peers who do not belong to these groups (Zemenick et al. 2022). Introductory biology and human anatomy and physiology courses are often seen as challenging, gate-keeper courses with high attrition rates (Britson 2022; Hatfield et al. 2022). To this end, courses that are taught from a perspective that does not include sexual diversity and gender inclusivity may widen the attrition gap.

The goals of this manuscript are to (1) capture the information presented in the SICB 2024 workshop titled "*Incorporating sex diversity and gender inclusivity in biology undergraduate classrooms*" and (2) provide instructors with information on how to make their curricula more sex diverse and gender inclusive. After interacting with this article, readers should know or be able to:

(1) Describe why inclusive teaching is important.
(2) List several strategies for how to create a culture or norm of inclusion in their classroom.
(3) Practice different ways of calmly and effectively dealing with hot-button situations or discussions in the classroom.
(4) Explain at least one concrete way to incorporate sex-diverse and gender-inclusive language into pedagogical materials.

Setting the stage for an inclusive and productive classroom

Creating an inclusive classroom/classroom management

A. Kelsey Lewis

Creating an inclusive classroom is one of the first steps in the journey to a sex-diverse and gender-inclusive biology classroom. All instructors, regardless of course subject matter, need a basic understanding of gender grammar (Trans Student Educational Resources [TSER] "Gender Grammar") and gender pronoun usage (TSER "Gender Pronouns"). Research on trans college students determined that individually and as a community, trans students can face violence, fear, and hatred (Pusch 2005; Rankin et al. 2010; Beemyn and Rankin 2011; summarized in Nicolazzo 2017). Colleges and universities have a responsibility to make campuses safe, inclusive, welcoming spaces for lesbian, gay, bisexual, transgender, queer, intersex, and asexual (LGBTQIA+) students, and setting up a safe, inclusive, and welcoming classroom is one component of many that are necessary. STEM instructors often fail to recognize the relevance of gender, sex, and sexuality to their classroom environments (see above), which can be frustrating and hurtful to LGBTQIA+ students (Cooper and Brownell 2017; Casper et al. 2022). Cooper et al. (2020) proposed fourteen recommendations, divided into five subsections, for creating a more inclusive environment for LGBTQIA+ individuals in academic biology. One of these subsections is "Create opportunities for people to describe who they are and avoid assuming people's identities, names, and pronouns." This subsection offers three recommendations: We need to foster safe environments for individuals to reveal their LGBTQIA+ identities; we cannot assume an individual's gender or partner choice; and we must create opportunities where individuals may choose to share how they are referred to, specifically their names and pronouns (Cooper et al. 2020).

Their additional suggestions centered on utilizing LGBTQIA+ language appropriately, championing the LGBTQIA+ community, establishing an inclusive biology classroom environment, and conducting biology education research with LGBTQIA+ inclusivity in mind. Jaekel and Holmes (2019) proposed a practical model for training college faculty on how to support trans students in the classroom, but found in their workshops for faculty and teaching assistants that educators can be resistant to gender-inclusive teaching strategies. While some educators may struggle with learning gender-inclusive teaching strategies, these strategies may benefit more students than ever before, as 5.1% of adults in the United States under 30 years old (ages 18–29) identify as transgender and/or nonbinary, compared with 1.6% of those are 30–49, and 0.3% of those 50 and older (Brown 2022).

One of the most fundamental aspects of a classroom is simply listening to and speaking to each other. An engaged, active-learning classroom involves communication among and between students and with the instructor(s). Depending on the methods of active learning, this can necessitate knowing how those in the classroom like to be referred to. For example, in a classroom setting where students may be working in pairs or small groups often, or a smaller classroom where students will be engaged in discussion or learning activities together regularly, it is important for students to know how to refer to each other, in addition to the instructor(s) knowing the students. While pronoun sharing, often referred to as a "pronoun go-round" has become more common in biology classrooms over the last several years, the manner of doing so, as well as potential performativity of the act, have been debated (Manion 2018; Spade 2018). The intentions behind pronoun go-rounds—to know how to refer to each other respectfully and ensure that all present feel included and valued—are critical to an inclusive classroom. However, forcing all present to share their pronouns can unintentionally force an individual into choosing between outing themselves or sharing pronouns they are not comfortable with and feeling dysphoric (Xiao 2020). Furthermore, pronoun go-rounds can place someone who is gender-questioning in a difficult position. One way to initiate pronoun go-rounds in the classroom is to ask students to introduce themselves with their names and pronouns if they feel comfortable, although this often results in few students sharing their pronouns along with their name. Rather than simply offering the opportunity to share pronouns, instructors can frame how-we-refer-to-each-other as part of a community agreement in the classroom: We agree as a community to refer to people the way that they have asked to be referred to. This means that if someone shares pronouns in addition to their name, then we use their name and those pronouns, and if someone has not shared pronouns, then we do not use pronouns to refer to that person, only that person's name. This community agreement framing intends to highlight the intention,

knowing how to respectfully refer to each other, while reminding those present that if we do not know a person's pronouns, we can simply use that person's name. A method that allows the students to introduce themselves to the instructor(s), without sharing publicly, is a digital or paper survey, such as on a notecard (Cooper et al. 2020; Smith 2021; NYU). Asking for a students' information including name and pronunciation, pronouns, and whether these may be used in class, along with major, career goals, and/or other introductory questions can prevent a student from being deadnamed (i.e., calling a student their birth name when they no longer use that name), while also ensuring not to out a student to their classmates (Smith 2021). Additional methods may include utilizing paper table/desk tents (NYU), which provide an ongoing reminder for both students and instructor(s) how each person wishes to be referred to. MacNamara et al. (2017) found that a gender pronoun activity in a sociology class setting led to greater empathy for transgender individuals and a greater recognition that misgendering is a serious issue. At institutions with a preferred name policy, instructors might include information on how to have their names updated in the system in the syllabus and remind the class of this information when introducing these topics in the classroom. In cases where such policies are not readily available, instructors can set aside a mechanism for students to provide their used name. This procedure will allow trans students the opportunity to focus on learning without the anxiety associated with being deadnamed in the classroom, an important opportunity for students who may not have an updated name on the course roster.

It's in the syllabus!—the syllabus as a tool for inclusive teaching

Breanna N. Harris

Syllabi are often viewed as required, boilerplate documents that serve as a contract between professor and student. Many times, professors do not like writing them as they feel like legal documents, and students do not like reading them. However, there are many benefits to syllabi, a major one being they are often a student's first introduction to and experience with an instructor and with the course topic (Harnish and Bridges 2011). The syllabus sets the tone and the norms for the course and can shape student learning experiences (Roberts 2016). Historically within STEM disciplines, field norms contain authoritative, objectivist (i.e., science seeks the truth and laws of nature and by using the scientific method there is no bias; social and cultural positionality do not influence objective truths in data), androcentric, misogynistic, and racist messaging and framing (Nelson 2017; Kamath et al. 2022; also see above). Thus, these same themes often appear in syllabi and in framing of course materials. However, there is an increasing interest in addressing these assumptions in biology (e.g., Kamath et al. 2022; Lewis and Sharpe 2023) and in making syllabi more inclusive generally (Umbach and Wawrzynski 2005; Chandar et al. 2023) and within biology courses (Gin et al. 2021).

The concept of inclusive teaching is vast and can be approached and defined in multiple ways. This is particularly true in the case of teaching with intersectionality in mind. For example, Harris et al. (2020) discuss universal design for learning framing, trauma-informed teaching, culturally responsive teaching, mindset management, and focusing on equity in course design and access. We encourage readers to engage with that paper for these topics as it has several excellent examples and scenarios. In an excellent review paper, Dewsbury and Brame (2019), provide an interactive webpage with resources on multiple aspects of inclusive teaching, including the importance of climate and how pedagogical choices can shape the sense of belonging. Here, we will focus on how the syllabus can be structured to enhance inclusivity, primarily by setting norms and fostering a sense of belonging.

Just as the term inclusive teaching can have multiple interpretations, so too can inclusive syllabi. At Texas Tech University (TTU), I attended a year-long program (Institute of Inclusive Excellence), and one task was to overhaul one of our syllabi to be more inclusive. The TTU Teaching, Learning, and Professional Development Center (TLPDC) maintains a website (https://www.depts.ttu.edu/tlpdc/Creating_an_Inclusive_Syllabus.php) with very useful resources on inclusive syllabi, including a document containing 7 areas to consider (1. Tone and frame, 2. Learning goals and objectives, 3. Learner-centered framework, 4. Content selection, 5. Learning activities and assessments, 6. General statements and policies, and 7. Visual, organizational, and clarity). Some aspects of inclusive syllabi are relatively easy to incorporate (e.g., organization, flow, word tone, and font or color choices), whereas others can be more challenging and take more investment (e.g., incorporation of anti-racist, feminist, or counternormative content; design and implementation of inclusive activities and assessments). In addition to practical challenges, in locations where diversity, equity, and inclusion (DEI) initiatives have been legally banned or restricted, teaching inclusively comes with fear and uncertainty. For example, in Texas, Senate Bill 17 was signed on June 17, 2023, and as of January 1, 2024 the bill bans DEI offices, divisions, units, or university-sponsored initiatives; prohibits the use of any DEI materials or contexts in hiring or admissions; and prevents trainings, programs, or activities related to race, color, ethnicity, gender identity, or sexual ori-

entation (sadly, as a result, the Insitute of Inclusive Excellent program has been discontinued). As of writing this manuscript, a total of 11 states have signed anti-DEI bills into law (North Dakota, Idaho, Wyoming, Tennessee, North Carolina, Texas, Florida, Indiana, Alabama, North Carolina, Kansas, and Utah; the Chronicle of Higher Ed maintains an anti-DEI bill tracker; Chronicle staff 2024), most of them prohibiting DEI in hiring. These regulations often do not focus on classroom instruction (for example, Texas SB 17 says the subsections of the bill do not apply to academic course instruction; however, see discussions around Florida's "Don't Say Gay" bill), but even so, the norm and culture those laws create can make instructors fearful of pushback. Thus, it can feel challenging to add inclusive information—particularly information that challenges misogynistic, racist, heteronormative, cisnormative, and exclusionary views—in a written course document. However, the syllabus can actually be an excellent place to counteract those views and can serve as a protective mechanism. Often, arbitration of teaching complaints relies heavily on the syllabus (e.g., did the instructor and course material follow the syllabus and stated learning outcomes? Were grading policies followed? etc.). If the syllabus sets the norm for inclusion and provides a strong rationale for doing so, the course goals and expectations are clear to all.

In this section, I highlight four ways in which instructors can provide strong rationale for making syllabi inclusive: (1) learning outcomes; (2) university mission statements, strategies, and/or values; (3) scientific and medical organizations; and (4) primary literature. After the TLPDC program, I overhauled my syllabi in many domains and now use a Frequently Asked Questions framework for my document (Loepp 2019). My syllabus sections (questions) include the below, and several of these sections allow me to incorporate background and rationale for inclusive teaching strategies.

i. Who is teaching?
ii. When and where do we meet?
iii. What do I need?
iv. Why is this topic important?
v. What will I get from this class? Learning outcomes and their assessment.
vi. What are we doing in this class, and how do I earn points?
vii. How do course content and structure relate to the "real world"? [*Course Topic*] and society.
viii. Do I have to come to class? Attendance and make-up policies.
ix. What are the expectations for this classroom?
x. How do I contact you? What if I need help or have questions?
xi. What will be in all my syllabi? University syllabus statements.
xii. Help! I'm feeling overwhelmed. What can I do?
xiii. Um, I have a lot of questions about college, being a student, internships, careers, research, etc.—What can I do?

Given the contentious political and cultural environment that many are facing in higher education at this time, my focus for this vignette is on rationale and justification for why we need to teach inclusively, and this will not be a how-to on creating inclusive syllabi overall. For more information on other aspects of building inclusive syllabi and assignments, please see the TTU TLPDC website, Dewsbury and Brame (2019), Harris et al. (2020), and other cited sources.

Learning outcomes

Learning outcomes are "the knowledge, skills, attitudes, and habits of mind that students have and take with them when they successfully complete a course or a program" (Suskie 2009). Crafting learning outcomes is a form of backwards design (Handelsman et al. 2007), where instructors think about their overall course goals and framing before they create their content. For Introductory Biology and Anatomy and Physiology courses, many of the learning outcomes are fairly standard (e.g., see Human Anatomy and Physiology Society 2023 [HAPS] Learning Outcomes; NSF Vision and Change 2012), and several good papers describing what undergraduate biology or pre-medical students should know exist (Core Principles in A and P, Michael et al. 2009; BioCore Guide based on NSF Vision and Change, Brownell et al. 2014; GenBio-MAPS, Couch et al. 2019; Phys-MAPS, Semsar et al. 2019). In addition to content-specific learning outcomes, it is also common to include aspects of career preparation, critical and metacognitive thinking, teamwork, and communication skills. For pre-health students, knowing the cellular and mechanistic details of health and disease is absolutely important. However, medical professionals treat humans, that is—they treat people, not just walking embodiments of textbook information; we are all not just bags of cells. People are complex, multifaceted beings whose health and behavior are indisputably impacted by biology but also by social, cultural, and political views, and by policy decisions (see Wear et al. 2017; Matathia and Tello 2020; Nieblas-Bedolla et al. 2020; Vyas et al. 2020; Chin 2021; Golden et al. 2021; Hahn 2021; Sudai et al. 2022; Frost and Meyer 2023). In 2023, the American Medical Association (AMA 2023) released a list of the top 10 ethical issues medical students should be taught, number 7 was addressing inequities in healthcare and number, 10 was making de-

Box 1: Broad learning outcomes

- Describe how the material learned in this course is relevant to our daily lives and give examples of how [course topics] are relevant for societal concerns.
- Combine collaborative effort, critical thinking skills, and clinically relevant and career-oriented knowledge to solve course-related problems.
- Describe how (explicit, unintentional, and/or structural) bias has influenced, and continues to influence, the fields of medicine and science.
- Understand the importance of science, empirical research, experimental design, and data collection. Discuss these tenets of science and discuss how historical, cultural, and social views impact the way in which science is done.
- Work together with a team of people to locate and apply relevant content knowledge and collectively determine answers.
- Practice metacognitive skills ("thinking about thinking")

cisions when professional and personal values diverge. Thus, the human and interactive side of medicine is incredibly important. Lastly, teamwork and communication are important in most (all?) jobs, but are exceptionally important in healthcare, both among professionals and between professionals and patients (Lerner et al. 2009; Fong Ha and Longnecker 2010; Ranjan et al. 2015). So, in addition to context-specific learning outcomes, instructors can incorporate human-centered goals. For examples of broader learning outcomes for use in an inclusive syllabus see Box 1.

University mission or values statement

Traditionally, instructors are employed within institutions of higher education. Each of these institutions has their own ethos and culture, including the guiding documents of the university mission, values, student handbook, and possibly a strategic plan or vision. By using verbiage or goals from the university mission within the syllabus and/or the learning outcomes, instructors can align the course with the institutional goals and values. For example, Texas Tech University has a University Strategic Plan—Texas Tech University A Foundation for the Next Century: A Pathway to 2025. This plan has three major strategic priorities: *1. Educate and empower a diverse student body*, 2. *Enable innovative research and creative activities*, and 3. *Transform lives and communities through strategic outreach and engaged scholarship.* Each of these strategic priorities has subgoals and specific strategies to accomplish those goals. Additionally, the Texas Tech University Mission Statement is "*As a public research university, Texas Tech advances knowledge through innovative and creative teaching, research and scholarship. The university is dedicated to student success by preparing learners to be ethical leaders for a diverse and globally competitive workforce. The university is committed to enhancing the cultural and economic development of the state, nation and world.*" Thus, both documents provide context and framing for inclusive teaching practices and can be cited in the syllabus.

(Inter)National science and professional organizations

Just as each institution has its own values and goals, so too do our educational and scientific organizations. The majority are ardent supporters of inclusive and holistic educational curricula and of tackling bias in science and medicine. Table 1 is an example of several organizations and relevant policies that may be useful for syllabus design, especially for courses that train pre-health students and/or cover human content. By referencing these statements or linking to them within the syllabus document, instructors can provide the career preparatory rationale for the inclusion of diverse gender and sex concepts. I include several of the links in my *How does course content and structure relate to the "real world"* section of the syllabus; I am happy to share my syllabi upon request.

Primary literature and resources

Lastly, a vast body of literature on inclusive teaching and effective educational practices exists within the field of discipline-based educational research (DBER). Of particular relevance to this manuscript is the DBER orga-

Table 1: List of sex and gender inclusive policies and statements from national and international scientific and professional organizations

Policy # or title	Policy, unit, or office description	Link
National Institutes of Health (NIH) (US, federal)		
UNITE	The UNITE initiative focuses on three primary domains—health disparities/minority health research (HD/MH), internal NIH workforce, and external biomedical and behavioral research workforce—that intersect and enable greater transparency, accountability, and communications across NIH and the biomedical and behavioral research community	https://www.nih.gov/ending-structural-racism/unite
NOT-OD-15-102	Sex as a biological variable	https://grants.nih.gov/grants/guide/notice-files/not-od-15-102.html
NOT-OD-18-014	Inclusion of women and minorities in clinical research	https://grants.nih.gov/policy/inclusion/women-and-minorities.htm
Established 1990	Office of Research on Women's Health; primers on sex vs. gender and other info	https://orwh.od.nih.gov/sex-gender
Established 2015	Office of Sexual and Gender Minority Research; have a strategic plan with good info	https://dpcpsi.nih.gov/sgmro
National Science Foundation (NSF) (US, federal)		
2022–2026 strategic plan	Core values: "NSF's strength is scientific leadership. We value diversity and inclusion, demonstrate integrity and excellence in our devotion to public service, and prioritize innovation and collaboration in our support of the work of the scientific community and of each other." Vision: "A nation that leads the world in science and engineering research and innovation, to the benefit of all, without barriers to participation." One pillar of the vision: ensuring accessibility and inclusivity	https://www.nsf.gov/news/special_reports/strategic_plan/
National Science Board (NSB) (US, federal; governing body of NSF)		
Vision 2030	Report for what the United States must do to remain world innovators in science and engineering. One pillar is talent, and increased recruitment and retention of a diverse workforce is a major goal, as is an inclusive culture	https://www.nsf.gov/nsb/NSBActivities/vision-2030.jsp
World Health Organization (WHO) and World Health Assembly (Global)		
WHA67.15	Strengthening the role of the health system in addressing violence, in particular against women and girls, and against children	https://iris.who.int/handle/10665/252276
WHO/FCH/GWH/08.1	Strategy for integrating gender analysis and actions into the work of WHO	https://www.who.int/publications/i/item/WHO-FCH-GWH-08.1
Published manual	Gender mainstreaming for health managers: a practical approach	https://iris.who.int/handle/10665/44044
Centers for Disease Control (CDC) (US, federal)		
National Center for HIV, Viral Hepatitis, STD, and TB Prevention; Statement	Collecting sexual orientation and gender identity information. Addressing the health needs of people who are lesbian, gay, bisexual, or transgender (LGBT) is a key part of HIV, Viral Hepatitis, STD, and TB prevention	https://www.cdc.gov/nchs/nhis/sexual_orientation/background.htm
US Department of Health and Human Services (DHHS) (US, federal)		
Healthy people 2030	Health Equity in Healthy People 2030′ "Eliminate health disparities, achieve health equity, and attain health literacy to improve the health and well-being of all"	https://health.gov/healthypeople/priority-areas/health-equity-healthy-people-2030
Healthy people 2030	Increase the number of states, territories, and DC that include sexual orientation and gender identity questions in the BRFSS—LGBT-03	https://health.gov/healthypeople (enter LGBT-number into search bar)
Healthy people 2030	Increase the number of national surveys that collect data on transgender populations—LGBT-02	
Healthy people 2030	Increase the number of national surveys that collect data on lesbian, gay, and bisexual populations—LGBT-01	

Table 1: Continued

Policy # or title	Policy, unit, or office description	Link
Healthy people 2030	Increase the number of states, territories, and DC that use the standard module on sexual orientation and gender identity in the BRFSS—LGBT-04	
Healthy people 2030	Reduce bullying of transgender students—LGBT-D01	
Healthy people 2030	Reduce bullying of lesbian, gay, or bisexual high school students—LGBT-05	
United Nations (UN) (Global)		
A/HRC/RES/41/18	Mandate of the Independent Expert on protection against violence and discrimination based on sexual orientation and gender identity	www.ohchr.org/en/sexual-orientation-and-gender-identity/resolutions-sexual-orientation-gender-identity-and-sex-characteristics (weblink provides a list of all the below)
A/HRC/RES/40/5	Elimination of discrimination against women and girls in sport	
A/HRC/RES/32/2	Protection against violence and discrimination based on sexual orientation and gender identity	
A/HRC/RES/17/19 and A/HRC/RES/27/32	Human Rights Council Resolution—human rights, sexual orientation and gender identity	
Statement—april, 2020	COVID-19: targeted actions needed to protect LGBTI people amid pandemic—Bachelet	https://www.ohchr.org/en/press-releases/2020/04/covid-19-targeted-actions-needed-protect-lgbti-people-amid-pandemic-bachelet?LangID=E&NewsID=25807
American Medical Association (AMA) (USA)		
D-135.997	Environmental Contributors to Disease and Advocating for Environmental Justice	https://policysearch.ama-assn.org/policyfinder (enter policy number in search bar)
D-350.984	Reducing Discrimination in the Practice of Medicine and Health Care Education	
H-65.973	Health Care Disparities in Same-Sex Partner Households	
D-295.963	Continued Support for Diversity in Medical Education	
H-295.897	Enhancing the cultural competence of physicians	
D-200.972	Encouraging LGBTQ + Representation in Medicine	
H-160.991	Health Care Needs of Lesbian, Gay, Bisexual, Transgender, and Queer Populations	
H-295.878	Eliminating Health Disparities—Promoting Awareness and Education of Sexual Orientation and Gender Identity Health Issues in Medical Education	
D-295.312	Medical Spectrum of Gender	
H-65.967	Conforming Sex and Gender Designation on Government IDs and Other Documents	
H-65.976	Nondiscriminatory Policy for the Health Care Needs of LGBTQ Populations	
H-65.942	Supporting the Use of Gender-Neutral Language	
H-460.891	Mitigating Gender Bias in Medical Research	
D-100.968	Gender Identity Inclusion and Accountability in REMS	
H-65.962	Affirming the Medical Spectrum of Gender	
H-65.959	Opposing Mandated Reporting of People Who Question Their Gender Identity	
H-60.898	Opposing the Censorship of Sexuality and Gender Identity Discussions in Public Schools	
H-315.967	Promoting Inclusive Gender, Sex, and Sexual Orientation Options on Medical Documentation	
H-65.957	Preventing Anti-Transgender Violence	
H-170.968	Sexuality Education, Sexual Violence Prevention, Abstinence, and Distribution of Condoms in Schools	

Table 1: Continued

Policy # or title	Policy, unit, or office description	Link
H-160.991	Health Care Needs of Lesbian, Gay, Bisexual, Transgender and Queer Populations LGBTQI+ and ally caucus	
D-515.978	Ban Conversion Therapy	
2022 brief	Issue brief—sexual orientation and gender identity change efforts (so-called "conversion therapy")	https://www.ama-assn.org/system/files/conversion-therapy-issue-brief.pdf
2019 brief	Issue brief—health insurance coverage for gender affirming care of transgender patients	https://www.ama-assn.org/system/files/2019-03/transgender-coverage-issue-brief.pdf
2018 brief	Issue brief—transgender individuals' access to public facilities	https://www.ama-assn.org/system/files/2019-03/transgender-public-facilities-issue-brief.pdf
2023 brief	Issue brief—best practices for sex and gender diversity in medical education	https://www.ama-assn.org/system/files/cme-issue-brief-sex-gender-medical-education.pdf
GLMA: Health Professionals Advancing LGBTQ + Equality (formerly Gay and Lesbian Medical Association) (International)		
070-95-108-18	Protection from Discrimination in Healthcare for Transgender People; Recommendation that Clinicians Follow the WPATH standards of care	https://www.memberleap.com/news_archive_headlines.php?org_id=GLMA&snc=969947#969947
099-97-114-23	Position on Sexual Orientation and Gender Identity Change Efforts	https://www.memberleap.com/news_archive_headlines.php?org_id=GLMA&snc=969947#969947
See their website for a full list of position statements and advocacy efforts		
Endocrine Society (International)		
Policy priority	Protecting access to care for women and transgender patients	https://www.endocrine.org/advocacy/priorities-and-positions
2023 Scientific Statement	Addressing research gaps in LGBTQiA care	https://endocrinenews.endocrine.org/endocrine-societys-new-scientific-statement-identifies-research-gaps-in-pediatric-lgbtqia-care/
2020 Position Statement	Transgender health	https://www.endocrine.org/advocacy/position-statements/transgender-health
National Academies of Science, Engineering, and Medicine (NASEM) (USA)		
Collaboration with NIH SGMRO	Sexual and Gender Minority Measurement & Data Guide and interactive webpage	https://dpcpsi.nih.gov/sgmro/measurement-and-data/2022-NASEM-report
Consensus report, 2020	Understanding the Well-Being of LGBTQI+ Populations	https://nap.nationalacademies.org/catalog/25877/understanding-the-well-being-of-lgbtqi-populations
Consensus report, 2022	Measuring Sex, Gender Identity, and Sexual Orientation	https://nap.nationalacademies.org/catalog/26424/measuring-sex-gender-identity-and-sexual-orientation
Consensus report, 2011	The Health of Lesbian, Gay, Bisexual, and Transgender People	https://nap.nationalacademies.org/catalog/13128/the-health-of-lesbian-gay-bisexual-and-transgender-people-building
Society of Health and Physical Educators (SHAPE) (USA)		
National Sex Education Standards, 2020	K-12 core content and skills, 2nd edition. Created with Future of Sex Education (FOSE) and Sexuality Information and Education Council of the United States (SIECUS)	https://www.shapeamerica.org/Common/Uploaded%20files/uploads/2021/standards/National-Sex-Education-Standards.pdf
American College of Obstetricians and Gynecologists (ACOG) (USA)		
2024 policy priority	LGBTQIA and Gender Diverse Individuals	https://www.acog.org/advocacy/policy-priorities/lgbtqia-and-gender-diverse-individuals
2024 policy priority	Health Care and Support for Transgender and Gender Diverse Adolescents	https://www.acog.org/advocacy/policy-priorities/lgbtqia-and-gender-diverse-individuals/health-care-and-support-for-transgender-and-gender-diverse-adolescents
Committee Opinion 823	Health Care for Transgender and Gender Diverse Individuals	https://www.acog.org/-/media/project/acog/acogorg/clinical/files/committee-opinion/articles/2021/03/health-care-for-transgender-and-gender-diverse-individuals.pdf
American Physiological Society (APS) (USA)		

Table 1: Continued

Policy # or title	Policy, unit, or office description	Link
Interest group	Sex/Gender Research Interest Group, goal: to promote the importance of better understanding the impact of sex and gender on physiology	https://www.physiology.org/community/aps-communities/interest-groups/Sex-Gender-Research?SSO=Y
American Psychological Association (APA) (USA)		
Policy statement	Resolution on Supporting Sexual/Gender Diverse Children and Adolescents in Schools	https://www.apa.org/pi/lgbt/resources/policy/gender-diverse-children
Statement, 2023	Opposing conversion therapy—APA joins 28 organizations in call to end conversion therapy in the United States.	https://www.apaservices.org/advocacy/news/opposing-conversion-therapy
Statement, 2023	Urging congress to protect access to gender-affirming care for transgender youth—APA services joins over 60 organizations to preserve the right of transgender youth to access gender-affirming care	https://www.apaservices.org/advocacy/news/gender-affirming-care-transgender-youth
American Academy of Pediatrics (AAP) (USA)		
Policy statement 2018	AAP Policy Statement Urges Support and Care of Transgender and Gender-Diverse Children and Adolescents	https://www.aap.org/en/news-room/news-releases/aap/2018/aap-policy-statement-urges-support-and-care-of-transgender-and-gender-diverse-children-and-adolescents/
American Public Health Association (APHA) (USA)		
Caucuses	LGBTQ Health Caucus	https://www.apha.org/apha-communities/caucuses/lgbtq-health-caucus
American Nurses Association (ANA) (USA)		
Policy statement 2018	ANA Position Statement: Nursing Advocacy for LGBTQ+ Populations	https://ojin.nursingworld.org/table-of-contents/volume-24-2019/number-1-january-2019/ana-position-statement-advocacy-for-lgbtq/
American Academy of Nursing (AAN) (USA)		
Policy statement 2018	Policy brief: Protecting vulnerable LGBTQ youth and advocating for ethical health care	https://www.nursingoutlook.org/article/S0029-6554(18)30494–9/fulltext

nization Society for the Advancement of Biology Education Research (SABER). SABER has resources online, including a whole series of recorded research talks under the broad topic of *Striving toward inclusion in academic biology*; they also have special interest groups, including one on LGBTQiA+ inclusive teaching. Additionally, for anatomy and physiology-focused pedagogical literature, the journal *Advances in Physiology Education* has some excellent publications. For general biology courses, the journal *CBE-Life Science Education* is a wonderful source. One specific paper by Sensoy and DiAngelo (2014) has some useful tips for how we all can approach difficult conversations and learn new (and sometimes uncomfortable) information (see Sensoy and DiAngelo 2014, 8, reproduced in Box 2 below); these tips can be added to the syllabus as a template and guide to help students and instructors. In addition, several publications specifically address sex diversity and gender-inclusive topics in biology and medicine and referencing relevant literature in the syllabus and/or assigning select options as class reading can be useful (see Table 2 for some of those papers). Table 2 is also an excellent resource for instructors who want to learn more and enhance their own knowledge base.

For up-to-date information on medical education and discourse, the *Journal of American Medical Association (JAMA)*, the *New England Journal of Medicine (NEJM)*, the *Lancet*, the *American Medical Association Journal of Ethics* (Virtual Mentor website), as well as the *National Academies* Podcasts, Hidden Brain (podcast), RadioLab (podcast—example episodes: *The Seagulls; Born this way?, UnErased series, Gonads series; G series*), This American Life (podcast, e.g., *81 words*), History UnErased (podcast; UnErasing LGBTQ History and Identities), Scene On Radio (podcast; MEN series), and Nature Podcast (episodes: *Stick to the Science: When Science Gets Political; Sex and Gender Discussions Don't Need to Be Toxic*) all have good information and can make excellent supplemental reading or listening assignments. The RadioLab podcasts *The Seagulls* (2023) and *Born This Way* (2023) provide rich context and discussion about what is "natural" and does it and should it matter. Additionally, recent journal collections are relevant to the discussions of data, power, sex, gender, sexuality, and

Box 2: Course Goals & Discussion Starters

Goals

- Strive for intellectual humility. Be willing to grapple with challenging ideas.
- Differentiate between opinion—which everyone has—and informed knowledge, which comes from sustained experience, study, and practice. Hold your opinions lightly and with humility.
- Let go of personal anecdotal evidence and look at broader group-level patterns.
- Notice your own defensive reactions and attempt to use these reactions as entry points for gaining deeper self-knowledge, rather than as a rationale for closing off.
- Recognize how your own social positionality (e.g., race, class, gender, sexuality, ability, socioeconomic status, etc.) informs your perspectives and reactions to your instructor and those whose work you study in the course.
- Identify where your learning edge is and push it. For example, whenever you think, I already know this, ask yourself, *How can I take this deeper*? Or *How am I applying in practice what I already know*?

Discussion Starters (for students or instructors)

- From my experience/perspective as [identity], . . .
- This is what I understand you to be saying:. . . . Is that accurate?
- I've been wondering about how we are using [term] in this discussion . . .
- How would you respond to [X] from a social justice framework?
- Given the reality of inequitable power, would it be better if . . . ?
- This perspective is new to me, but I'm wondering if it is accurate to say that . . . ?
- I am having a "yeah, but" moment. Can you help me work through it?
- I'm not sure if this will make any sense, but . . .
- Can you help me understand whether what I'm thinking right now might be problematic?
- The author is arguing that only [e.g., men can be sexist]. Can you help me understand that?

Above created by Sensoy & DiAngelo and can be found in Sensoy & DiAngelo, 2014, pg 8.

policy: (1) *Nature*—Sex and Gender in Science (2024; https://www.nature.com/immersive/sex-and-gender-in-science/index.html), (2) *Cell*—Focus on Sex and Gender (2024; volume 187, Issue 6; https://www.cell.com/news-do/cell-sex-gender-focus-issue), (3) *American Naturalist*—Nature, Data, and Power (2022, volume 200, issue 1), (4) *Scientific American*—Sex and Gender (https://www.scientificamerican.com/sex-and-gender/), and (5) *Science*—Science, Sex, and Gender (2023, podcast series and write up; https://www.science.org/content/blog-post/new-podcast-series-examines-intersections-science-sex-and-gender).

Handling hot button topics

Breanna N. Harris

Often, instructors can feel vulnerable or nervous when teaching "controversial" or hot-button topics in the classroom. Various topics in biology courses could be considered "controversial," including sex diversity and gender inclusivity. Even with extensive backing in the scientific literature and the support from multiple (inter)national science and professional organizations, teaching about sex diversity and gender inclusivity can bring about difficult conversations. We encourage educators to embrace those difficult discussions in a productive way, as challenging ourselves and exploring outside our comfort zone is critical for learning and growth. The first step to setting the tone of the classroom and modeling how information will be tackled is via the syllabus (see above), but what are some strategies for in-the-moment discussions? Below I list three non-mutually exclusive strategies for the classroom. I was made aware of these options by attending workshops on hot-button topics and dealing with microaggressions, led by Erika Brooks-Hurst and Dr. Alec Cattell, at the Teaching Learning and Professional Development Center (TLPDC) at TTU. The TLPDC has an online collection of handouts and resources (https://www.depts.ttu.edu/tlpdc/Resources_Thoughtful_Conversations.php) as well as a YouTube channel with recorded sessions (https://www.youtube.com/channel/UCWsOMbKUk9aCyDn4iO-nZeA)—I encourage readers to engage with those sources.

Strategy 1—stop, think, and/or write

This strategy can be used to start a new topic, to dig deeper into a topic, or can be a good pause or break

Table 2: List of publications addressing sex diversity and gender inclusivity in biological and medical education and research

Authors and year	Title	Scope
Ahnesjö et al. (2020)	*Considering gender-biased assumptions in evolutionary biology*	Evolutionary biology
Alexander et al. (2024)	*Increasing LGBTQ + inclusion and competency in wildlife sciences: intersections of sociocultural, structural, and historic barriers to inclusion*	Wildlife biology
Bagemihl (1999)	Biological exuberance: animal homosexuality and natural diversity	Biology (book)
Bailey and Zuk (2009)	*Same-sex sexual behavior and evolution*	Evolutionary biology
Bartz et al. (2020)	*Clinical advances in sex- and gender-informed medicine to improve the health of all*	Medicine
Bird et al. (2022)	*Teaching reproduction, gender and sexuality: broad, multidisciplinary and nuanced*	Reproduction
Casper et al. (2022)	*"It's completely erasure": A qualitative exploration of experiences of transgender, nonbinary, gender nonconforming, and questioning students in biology courses*	Biology and pedagogy
Casto et al. (2022)	*Teaching about sex and gender in neuroscience: more than meets the" XY"*	Neuroscience
Cooper et al. (2020)	*Fourteen recommendations to create a more inclusive environment for LGBTQ + individuals in academic biology*	Biology and pedagogy
Cotner and Wassenberg (2020)	*The evolution and biology of sex*	Biology; open-source textbook
de Vries and Lehtonen (2023)	*Sex-specific assumptions and their importance in models of sexual selection*	Evolutionary biology
Donovan et al. (2024)	*Sex and gender essentialism in textbooks*	Biology
DuBois and Shattuck-Heidorn (2021)	*Challenging the binary: gender/sex and the bio-logics of normalcy*	Anthropology; humans
Hayssen (2020)	*Misconceptions about conception and other fallacies: historical bias in reproductive biology*	Biology; reproduction
Hayssen and Orr (2020)	*Introduction to "Reproduction: The female perspective from an integrative and comparative framework"*	Biology; reproduction
Jewett Rifkin and Garson (2023)	*Sex by design: a new account of animal sexes*	Biology
Lewis and Sharp (2023)	*Sex, science, and society: reckonings and responsibilities for biologists*	Biology
Maloy et al. (2022)	*Factors influencing retention of transgender and gender nonconforming students in undergraduate STEM majors*	Biology students and pedagogy
Malta (2023)	*LGBTQ + health: tackling potential health-care professionals' bias*	Medicine
Massa et al. (2023)	*Deconstructing sex: strategies for undoing binary thinking in neuroendocrinology and behavior*	Hormones and behavior
Mauvais-Jarvis et al. (2020)	*Sex and gender: modifiers of health, disease, and medicine*	Medicine
McLaughlin et al. (2023)	*Multivariate models of animal sex: breaking binaries leads to a better understanding of ecology and evolution*	Ecology and Evolutionary biology
Mercer-Mapstone et al. (2021)	*Breaking the binary: teaching inclusive conceptions of sex and gender in undergraduate science*	Biology students and pedagogy
Monk et al. (2019)	*An alternative hypothesis for the evolution of same-sex sexual behaviour in animals*	Evolutionary biology
Moreira et al. (2023)	*Importance of survey demographic questions to foster inclusion in medicine and research and reduce health inequities for LGBTQIA2S1 individuals*	Medicine
Montanez (2017)	*Visualizing sex as a spectrum*	Biology
Nelson (2017)	*Biology and feminism*	Biology; philosophy (Book)
O'Leary and Kunkel (2021)	*Restructuring LGBTQ curriculum in medical schools*	Medicine
Packer and Lambert (2022)	*What's gender got to do with it? Dismantling the human hierarchies in evolutionary biology and environmental toxicology for scientific and social progress*	Evolutionary biology; Toxicology
Pregnall et al. (2021)	*A call for LGBTQ content in graduate medical education program requirements*	Medicine
Regula (2021)	*Times and terms: teaching anatomy that is inclusive and respectful of LGBTQ patients*	Medicine and A&P
Ridgeway and Saperstein (2024)	*Diversifying gender categories and the sex/gender system*	Society and science
Roughgarden (2013)	*Evolution's rainbow: diversity, gender, and sexuality in nature and people*	Biology (book)
Sensoy and DiAngelo (2014)	*Respect differences? Challenging the common guidelines in social justice education*	Pedagogy (see pg 8 for a list of goals)
Sharpe et al. (2023)	*Sex and biology: broader impacts beyond the binary*	Biology
Simha et al. (2024)	*When the window is a mirror: how do dominant theories limit our understanding of nature?*	Biology

Table 2: Continued

Authors and year	Title	Scope
Smiley et al. (2024)	*Sex diversity in the 21st century: concepts, frameworks, and approaches for the future of neuroendocrinology*	Hormones and behavior
Spaulding and Fuselier (2023)	*Images of nonhuman animals in animal behaviour textbooks communicate an androcentric view of reproductive-related behaviours*	Animal behavior
Spaulding (2021)	*The peacock in the room: confronting the hidden curriculum of androcentrism and gender bias in undergraduate biology education*	Biology and pedagogy
Subramaniapillai et al. (2023)	*Sex and gender in health research: intersectionality matters*	Medicine
Sun (2019)	*Stop using phony science to justify transphobia*	Biology
Sudai et al. (2022)	*Law, policy, biology, and sex: critical issues for researchers*	Biology; research
Toman (2019)	*Navigating medical culture and LGBTQ identity*	Medicine
Ulrich (2024)	*Practicing medicine in the culture wars—gender-affirming care and the battles over clinical autonomy*	Medicine
Velocci (2024)	*The history of sex research: is "sex" a useful category*	Biology
Warkentin (2021)	*Queering herpetology: on human perspectives and the study of diverse animals*	Biology
Williams et al. (2023)	*Considering hormones as sex- and gender-related factors in biomedical research: challenging false dichotomies and embracing complexity*	Medicine
Zemenick et al. (2022)	*Six principles for embracing gender and sexual diversity in postsecondary biology classrooms*	Biology and pedagogy

when an unexpected controversial topic arises in class discussion. Stop and/or write exercises can also be useful when the class discussion needs a break or if you as the instructor are asked something important or critical that you do not know.

Students can be given one of several prompts before the unit or discussion and be asked to think quietly and then write out their response or ideas. Encouraging the classroom to stop, think, and/or write before discussion is a powerful tool and can allow everyone to gather their thoughts and overcome initial urges to respond with pure emotion. These mini-essays or in-class writing assignments can be kept private for student-only use, or they could be turned in for instructor review. Instructors may also use polling programs (e.g., Top Hat or other internet-based clicker programs) to gather anonymous student feedback and questions. The questions could be either addressed in class or used to make content for the next class period. Possible prompts include:

- What do you know about this topic already? What information are you bringing to class with you?
- Where have you learned or heard about this topic before? What was the framing of the topic in those contexts?
- Does this topic bring up strong feelings or emotions for you? If so, that is okay! Write those feelings down and try to think of why this topic conjured a strong response.
- Go back to our course learning outcomes in the syllabus, how does this topic relate the goals of our course? Why might it be important to address this topic within the context of our course content?
- What questions do you have about this topic?
- If you are uncomfortable and feeling defensive, pause. Before you speak, stop, reflect, and think. Jot down what you're feeling and see if you can identify your cognitive and emotional responses to topics that you feel strongly about.

Strategy 2—content at the front

When we teach about topics that may generate tough discussion or controversy, we tend to prepare our content accordingly and do plenty of background education before bringing topics to class. Sometimes, however, organic discussions of difficult material arise outside of our course schedule or planned activities. When this occurs, one may feel anxious, but bringing all discussions back to course content and purpose can help ease anxieties. For example, as the instructor, we can model our critical thinking and assessment skills by asking relevant questions or prompts, such as:

- Let us take a step back and frame how the topic is related to our unit/a reading/lecture and/or a theory.
- Based on what we have learned in this course so far, how would the topic fit with x that we have previously discussed?
- That is an interesting question/comment and is something we tend to hear on the new/social media, what experimental design and respective data would we need to address that comment/question? How could the knowledge obtained from such a study add to our knowledge of course topics? Students could then be asked to pair up to design a study to address the question/comment.

- It sounds like you are making a neat/creative connection with a real-world topic and our course material, could you reframe your question/comment in a way that better aligns it with our course?

Instructors may want to pair these questions with options from Stop, Think, and/or Write. If the syllabus was built with the inclusion of the recommendations from Sensoy and DiAngelo (2014), the instructor can easily refer back to those prompts in the moment. These prompts can, of course, still be used even if they are not in the syllabus.

Or, perhaps the topic is not something that can adequately be discussed in class, perhaps time will not permit a deviation from schedule; maybe students are too passionate or bordering on angry; maybe the instructor does not have adequate background knowledge at this time. These are all okay outcomes, and it is perfectly acceptable to acknowledge and wait until a later time for answers/discussion. It is always okay to not have the answer for every question or scenario. For example, below are a few potential phrases to acknowledge and wait.

- I do not have that knowledge off the top of my head, so I am hesitant to answer your question at this moment. What I would want to know is X, Y, and Z, and I will look up some credible, peer-reviewed studies on that topic and let you all know what I find (or whatever outcome seems reasonable for the situation, perhaps students are tasked with finding relevant information to share at the start of the next class period or via a short assignment).
- We are all getting quite involved at the moment, and I think we should step back from this discussion. This is not to downplay the importance of the topic, the data, or anyone's responses. But I think it is in the best interest of our educational environment to take a breather.
- This is a good question/interesting question/important topic/relevant topic, and I would like to discuss it with you, but I honestly do not have the background information I would want to discuss it competently at this time. Nor do we have the class time to give it proper attention right now. I want to make sure I am coming from a place of knowledge so let us circle back to this topic later.
- I can see you are very passionate about this topic, and I respect your enthusiasm. However, here and now is not a good time for this discussion (or we are getting too deep/too off-topic/too whatever). Why do not you come to my office hours, and we can chat about this more fully at that time. I want to make sure we can have a productive conversation.

Strategy 3—pick a communication framework

In addition to the above strategies, the below are excellent examples of how to frame discussions and how to address controversial statements or microaggressions that may arise in the classroom. Each of these three frameworks provided helpful scaffolding for hot button topic discussions and can help prevent freezing in the face of challenging questions. For additional helpful language, visit the University of Michigan Center for Research on Learning and Teaching website (https://crlt.umich.edu/resources-1), specifically their *Hot Moments Handout*; *Intervention Strategies Worksheet Student-Student Microaggressions*; *Responding to Disrespect Worksheet*. Two specific frameworks, Open The Front Door (adapted from Learning Forum 2016 and Souza et al. 2016) and ACTION (Souza 2017; 2018) are described below. Additionally, instructors may also want to reference handouts by Oakland University (https://www.oakland.edu/Assets/Oakland/cetl/files-and-documents/TeachingTips/2016/HotMomentsTT.pdf), California State University, Northridge (Arend and Joseph 2015; https://www.csun.edu/sites/default/files/OpenTheFrontDoor.pdf), the TTU TLPDC (linked above), or the Derek Bok Center for Teaching and Learning at Harvard (https://eloncdn.blob.core.windows.net/eu3/sites/126/2017/04/Managing-Hot-Moments-in-the-Classroom-Harvard_University.pdf) as they provide example scenarios and additional information about these frameworks.

Open The Front Door

This communication technique helps participants reframe the conversation content in a more positive way. For an example of a scenario with answers, see Arend and Joseph (2015).

i. Observe (O): concrete, factual, and observable (not evaluative).
ii. Think (T): thoughts based on observation (yours and/or theirs).
iii. Feel (F): emotions, "I feel (emotion)."
iv. Desire (D): specific requests or inquiries about desired outcome.

ACTION framework

The basis of the ACTION framework was originally proposed by Cheung and colleagues (Cheung et al. 2016) as a way to deal with microaggressions in the classroom. We have successfully used this framework,

Box 3: Take ACTION

1. **A**sk clarifying questions to assist with understanding intentions.
   "I want to make sure that I understand what you were saying. Were you saying that…?"

2. **C**ome from curiosity, not judgment
   Listen actively and openly to their response.
   - If they disagree with your paraphrase and clarify a different meaning, you could end the conversation. If you suspect they are trying to "cover their tracks," you may consider making a statement about the initial comment to encourage learning. "*I'm glad to hear I misunderstood you, because, as you know, such comments can be…*"
   - If they agree with your paraphrase, explore their intent behind making the comment. "*Can you tell me what you were you hoping to communicate with that comment?*" "*Can you please help me understand what you meant by that?*"

3. **T**ell what you observed as problematic in a factual manner
   "*I noticed that…..*"

4. **I**mpact exploration: ask for, and/or state, the potential impact of such a statement or action on others
   "What do you think people think when they hear that type of comment?"
   "As you know, everything speaks. What message do you think such a comment sends?"
   "What impact do you think that comment could have on …"

5. **O**wn your own thoughts and feelings around the impact
   "When I hear your comment, I think/feel…"
   "Many people might take that comment to mean…"
   "In my experience, that comment can perpetuate negative stereotypes and assumptions about… I would like to think that is not your intent."

6. **N**ext steps: Request appropriate action be taken
   "Our class is a learning community, and such comments make it difficult for us to focus on learning because people feel offended. So, I am going to ask you to refrain from stating your thoughts in that manner in the future. Can you do that please?"
   "I encourage you to revisit your view on X as we discuss these issues more in class."
   "I'd appreciate it if you'd consider using a different term because it is inconsistent with our course agreement regarding X…"

Above created by T. Souza and can be found verbatim in Souza, 2018.

and we wanted to make others aware. Full credit to Souza (2017, 2018) and colleagues (Souza et al. 2016; Cheung et al. 2016) for developing this framework shown in Box 3.

After a difficult class discussion or topic instructors may want to revisit the Stop, Think, and/or Write strategy to reflect. Some helpful prompts for this integration can be found in the resources above or by using *The Four Fs of Active Reviewing* (Greenaway et al. 2015). This process allows for reflection and critical thinking and can be very useful in a variety of settings. Examples of the Fs (facts, findings, feelings, and future) are shown below and come from a handout prepared by Arend and Joseph (2015), based on the work of Souza and The Learning Forum (2016).

- What happened in our class today? (facts).
- What was hard about our discussion? (findings).
- What was good about our discussion? (findings).
- What feelings emerged for you, and why? (feelings).
- What did you learn about yourself or others in today's discussion? (findings/future).
- How can you use what you learned today in the future? (future).

In summary, there are multiple tools and strategies available for managing hot topics in the classroom. We encourage readers to practice these strategies and find some that are comfortable and relevant to their own classroom dynamics. These strategies can be used well-beyond the classroom to help students learn how to

process new information, engage with difficult material, and practice their critical thinking—all of which are major goals of higher education.

Summary

The need for inclusive pedagogies in the biological sciences is pressing. We hope the importance of proactive preparation (e.g., backward design and inclusive syllabus construction) as well as some of the specific conversational tools reviewed above will serve as inspiration and a starting point for fostering an inclusive classroom, even in cases where students may respond in unexpected ways. Recognizing that communication (including that of course material) encompasses practical, emotional, and social dimensions, educators must navigate these conversations adeptly to facilitate meaningful connections (Duhigg 2024). Although we cannot include all possible solutions and course design options here, especially as more research is happening in teaching and supporting diverse student populations in STEM, several key areas are worth highlighting. First: know the background of your content and understand how what we teach is relevant to our social world. Second: stay informed and gain comfort with TSER "Gender Grammar" such that when terms are used you have a working vocabulary that will allow you to properly discuss or at least understand nuanced conversations that may come up; read the literature (Table 2 is a great place to start). Third: use your syllabus to establish course content, and norms for the classroom and link these to professional development (goals) of your students as well as institutional mission statements. Fourth: be prepared to moderate your classroom like a boss! by preparing activities (stop, think, and/or write) and statements ("I respect your passion. However, let's circle back to this at another time when we can all take a bit of time to reflect [ex. on the writing you just did]") to diffuse heated moments, get back on track, and remind students of an established code of conduct (respect) of the classroom. A quote from Duhigg (2024; below) is useful for approaching tough classroom discussions as thinking about the perspective from which students are asking questions and our perspective for answering is incredibly salient.

> "Whenever we speak, we're actually participating in one of three conversations: practical (What's this really about?), emotional (How do we feel?), and social (Who are we?). If you don't know what kind of conversation you're having, connection is hard." (Duhigg 2024)

Changing the way we teach is hard (see Harris et al. 2020), but we challenge instructors to commit to making small, incremental changes to build more inclusive classrooms and curricula. We know this can sometimes feel overwhelming, especially given the various demands on our time and the vast amount of pedagogical literature available; however, we can build on what others have done and do not need to start from scratch. Given our positionality as scholars trained in the sciences/biology, many of us were never exposed to the history of science, (feminist) philosophy, or the content presented in this manuscript. There are entire fields devoted to studying these issues, and biologists are rarely going to be wholly trained in both science and science studies, but looking outside STEM disciplines to inform our teaching and research will only improve our science. Readers can start with the resources provided here (e.g., see Table 2) and work to engage with scholars and scholarship from gender studies, critical race theory, queer theory, postcolonial studies, history of science, and science and technology studies (see Martin 1991; Harding 1993; Fujimura 2006; Cipolla et al. 2018; Disch and Hawkesworth 2018; Fausto-Sterling 2020; Jordan-Young and Karkazis 2022; Kamath et al. 2022; Velocci 2024). This will take effort, as teaching inclusively is not easily done (DiAngelo and Sensoy 2010; Lombardi et al. 2011)—it is much more than a syllabus statement of support or including a reading by a nonbinary author. But the effort is worth the investment as doing so will not only be good for all students and our communities, but it is better, more accurate science. Lastly, teaching in a sex and gender inclusive way can quite literally impact lives, as trans and gender nonconforming individuals continue to face bias, stigma, and violence from those in power, and the status quo of biology scholarship and pedagogy contributes to these outcomes (Sudai et al. 2022).

The importance of considering these topics before the semester starts will enable instructors to start off classes with multiple avenues of connecting inclusive teaching to course content, a supportive syllabus, and some phrases for dealing with possible hot-button topics. As we build our courses, it is crucial to provide students with relevant inclusive content and to consider subtle ways to signal support to *all* students, in particular by seeking to better understand those from historically or currently marginalized groups. The benefits of a well-considered course design include enhanced student learning, a greater sense of belonging, and lower attrition. This also promotes greater scientific knowledge production and communication, and greater empathy, thus leading to a more well-versed and respectful workforce.

Author contributions

All authors contributed to the writing and reviewing of this manuscript; A.K.L. wrote section "Creating an

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Conflict of interest

These authors have no formal "conflicts" to declare, although they acknowledge that positionality is, in fact, always a conflict in its own way.

Data availability

No empirical data were used in the writing of this document, and there are no supplementary files. Links to all referenced and helpful webpages are listed within the document.

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