Title: ***Increasing inclusion & competency in STEM: Understanding LGBTQ+ history, barriers, and heteronormativity***

Authors: Nathan B. Alexander[1], Douglas Knutson[2,3], Loren Lynch[1], Madeleine Spellman[4], Michael Rivera[5], Leslie K. Morrow[6,7], Maxine Scherz[4,8], Thea E. Clarkberg[4], Lucas T. Allen-Custodio[9], Kae Fountain[9], Isaac Klimasmith[1], Emmett M. Smith[4], Jaime J. Coon[4,8]

1 Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign, Urbana, IL, USA

2 School of Community Health Sciences, Counseling and Counseling Psychology, Oklahoma State University, Stillwater, OK, USA

3 Diversity and Rural Advocacy Group, Oklahoma State University, Stillwater, OK, USA

4 Department of Biology, Earlham College, Richmond, IN, USA

5 Program in Ecology, Evolution, and Conservation Biology, University of Illinois at Urbana-Champaign, Urbana, IL

6 Lesbian, Gay, Bisexual, and Transgender Resource Center, University of Illinois at Urbana-Champaign, Urbana, IL, USA

7 Department of Education Policy, Organization and Leadership, University of Illinois Urbana-Champaign, Urbana, IL, US

8 Department of Environmental Sustainability, Earlham College, Richmond, IN, USA

9 Humboldt State University, Arcata, CA, USA

Abstract

Lesbian, gay, bisexual, trans, queer, and other marginalized gender and sexual identities (LGBTQ+) face unique barriers to participation in the sciences rooted in cis-heteronormativity and heterosexism. We need to expand conversations on LGBTQ+ advocacy in science beyond personal beliefs and actions, and toward the recognition of structural and societal barriers to participation. In this paper, we review how structural deficits and heteronormativity serve as barriers to LGBTQ+ inclusion, well-being, and participation in science. To ground this conversation in a shared understanding of LGBTQ+ oppression and liberation movements, we highlight important historic events that aid in understanding current issues, including the historic and ongoing role of science in the lives and rights of LGBTQ+ people.

1. Introduction

Recently, scholars in science, technology, engineering, and mathematics (STEM) fields have started to acknowledge exclusive and oppressive practices and have provided preliminary recommendations for creating more welcoming, inclusive, and diverse STEM education and practice spaces [1–4], including in the biological sciences [5,6]. Emerging recommendations are broad and include individual behavioral adjustments as well as necessary systemic and structural changes [6–8]. To expand on this growing body of literature, we focus on LGBTQ+ identities and explore in detail barriers to creating inclusive biology fields and fields within STEM at large.

Although there is increasing discussion of LGBTQ+ representation and inclusion in STEM, recommendations have focused on simple steps to increase inclusivity, including highlighting similarities between LGBTQ+ and heterosexual researchers despite acknowledging lack of inclusion [9]. The recommendations have focused largely on individual action, including correct pronoun use and nonbinary gender options [5,10]. These initial resources and actions are a start for signaling inclusion through personal actions, yet fall short of acknowledging systemic injustices such as housing and medical access, variable experiences dependent on specific LGBTQ+ identities, and the lag associated with advocacy in structured organizations.

As people with LGBTQ+ identities have historically been omitted from classroom settings [11], teachers are often ill prepared to engage with LGBTQ+ topics [12]. By providing a brief history, we not only place LGBTQ+ people back within our historic understanding, but also contextualize current issues facing the LGBTQ+ community. We describe existing systemic barriers to basic needs such as housing and medical care to show continuing issues faced by the LGBTQ+ community, with special attention paid to how those barriers impact people working in science [e.g., 13]. We also discuss how LGBTQ+ identities persist in heterosexist [14] and

cis-heternormative [15,16] cultures, with added stressors and compartmentalization navigating being 'out' [17]. All of these factors ultimately impact retention and success in STEM (**Figure 1)** [3,18,19].

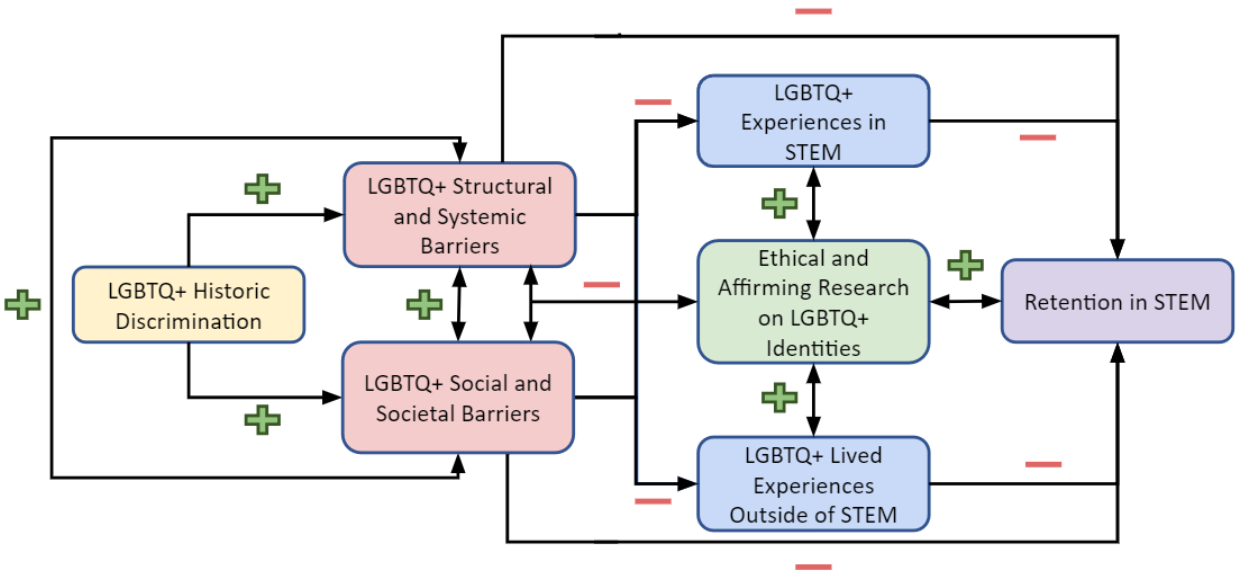

Figure 1-LGBTQ+ historic discrimination has increased contemporary structural, systemic, and societal barriers for LGBTQ+ people, which has lead to negative LGBTQ+ experiences in STEM and lived experiences outside of STEM. These barriers also increase the difficulty of conducting ethical and affirming research on LGBTQ+ identities, negatively impacting retention in STEM. Structural and societal barriers create positive feedback loops where structural barriers increase social stigma and social stigma increases anti-LGBTQ+ legislation and policies. However, LGBTQ+ research done in ethical and affirming methodology can increase retention, and may decrease discriminatory perceptions and systems. Furthermore, lived experiences of LGBTQ+ people can inform research, which, in turn, can improve lived experiences.

The biological sciences are among these STEM fields that require reform to increase LGBTQ+ inclusion [20]. For one, LGBTQ+ people face significant barriers to academic practice in biological fields [21,22][21]Many college Biology instructors fear coming out to their students [17], despite the potential mentorship benefits for biology students [23]. [21]have a complicated history interacting, including, and researching LGBTQ+ identities [20,24,25].

Box 1. The diverse positionalties from which the author team approached this paper, adapted from Coon et al. (2022).

We are a group of scholars from diverse disciplines and backgrounds with an interest in making applied ecology more inclusive. Our author list includes those with nonbinary, transfeminine, transgender man, genderfuck, gender nonconforming, lesbian, gay, bisexual, and queer perspectives. Our author list also includes identities such as Black, Latino, white, immigrant, Jewish, disabled, and able-bodied, and we are in our 20s or 30s.

We also include authors who are undergraduate researchers or undergraduate research mentors at predominantly undergraduate institutions (PUIs), as well as several individuals working at large state universities in positions such as graduate student, counseling psychologist, and activist-scholar. Many of us have been involved in local LGBTQ+ nonprofits and activism.

Here, we hope to provide a resource for biology educators, mentors, and LGBTQ+ students and researchers and provide a resource for individuals working towards diversity, equity, and inclusion in STEM. We start by providing a brief history of LGBTQ+ oppression, resilience, and advancement, acknowledge the complicated history science has with LGBTQ+ identities, and discuss systemic and social barriers experienced by LGBTQ+ people. Then we discuss how these broader issues impact LGBTQ+ individuals in STEM. We hope that this paper informs and roots advocacy in appropriate contexts moving biology and STEM fields towards a better, more inclusive future.

1. A brief LGBTQ+ history

To understand contemporary barriers of LGBTQ+ people working in science, we must examine how oppression is rooted in historic anti-LGBTQ+ policies and discrimination (**Figure 2**). This means looking to LGBTQ+ history, which is often omitted [12], and considered unimportant in science [26]. Describing LGBTQ+ history is challenging, because what we do know can be incomplete due to criminalization or erasure of LGBTQ+ identities [27,28]. Thus, we attempt to approach this topic with humility, understanding we cannot do justice to vibrant, context-specific, multicultural LGBTQ+ histories. Although a full account is beyond our scope, here we highlight a few western historical moments that contextualize current barriers faced by LGBTQ+ people in science specifically and society generally.

Temporality of Terminology

LGBTQ+ terminology has shifted over time, making it challenging to frame historic movements. For instance, “homosexual” was popularized by sexologists in the 19th century, and “gay” became an alternative in the early 1900s, becoming popular by the 1970s. During the 1950s-1980s, trans people were commonly referred to as “transsexuals” and “transvestites,”

which refer respectively to people seeking medical transition and to people who cross dress. However, these terms were created not by trans people, but rather by cisgender medical professionals [29]. The term “lesbian” also appeared in the 1960s and 1970s, with “queer” appearing in the 1990s, and “LGBT” in the later 1990s and 2000s. By the 2010s, expansive inclusion and naming of identities became popularized [30], and “Sexual and Gender Minorities (SGM)” is gaining traction. There are also shifts in pejorative terms, with some reclaimed within the LGBTQ+ community and even rejoining mainstream vernacular (e.g., “queer”). These discussions are anything but semantic, as it’s important to highlight that modern day identities are historically represented despite contemporary terms not being historically used. In an effort to be as inclusive as possible, we use the acronym LGBTQ+ throughout this paper.

World War II

We begin with World War II, an era marked by genocide and violence towards multiple minoritized identities, with lasting impacts on LGBTQ+ policies and research. One early act by Nazis was the destruction of Jewish sexologist Magnus Hirschfield’s library, where extensive research on sexuality and gender identity was conducted [31]. Nazis also expanded upon anti-gay laws, specifically Paragraph 175 [32], increasing persecution of homosexuals [31]. Nazis sent gay people to concentration camps for ‘re-education’ [33], but also targeted lesbian people, defining them as “anti-social” or “political enemies” [34]. Within the concentration camps, gay people were marked with a pink-triangle and were used for unethical scientific research and labor [31–33], and lesbian people were classified with a black triangle [34]. Nazis kept LGBTQ+ and Jewish individuals at the bottom of prisoner hierarchies [31]. LGBTQ+ individuals were often isolated from other prisoners, with higher rates of both suicide and Nazi-sanctioned rape [32,34]. Anti-LGBTQ+ sentiment in this era was not limited to the Nazi regime. The United States passed a law in 1952 to exclude “homosexual” people, including concentration camp survivors, from entering the country [31]. LGBTQ+ survivors were at risk of re-imprisonment, so did not disclose concentration camp experiences after the end of World War II [28].

The Lavender Scare

In the U.S. post-World War II, LGBTQ+ identities were often conflated with communism and sexual deviance [30,35,36] under Executive Order 10450. The Miller Sexual Psychopath Law of 1948 was one of the first legislative pieces to confuse pedophilia with homosexuality, an inaccurate comparison that still harms LGBTQ+ individuals to this day [30,36]. Along with the rise of McCarthyism of the 1950s came the moral panic, the Lavender Scare, in which both legislation and bureaucratic policies banned LGBTQ+ individuals from working in the federal government, including scientific positions [35].

The Lavender Scare involved invasive interrogation, blackmailing, and dismissal of gay and lesbian workers, who were thought to be dangerous, deviant, and allied with communism [35,36]. The United States globalized this policy by pushing allies to adopt similar policies [36]. This federal ban predominantly impacted white LGBTQ+ individuals, as racial discrimination already prevented Black, indigenous, and People of Color (BIPOC) LGBTQ+ individuals from serving in government roles [35]. Although the exact numbers are difficult to trace, the Lavender Scare resulted in an estimated five to tens of thousands of lesbians and gay men losing their jobs and lasted until 1975 when the Civil Service Commission removed homosexuality from the morality clause [30,36].

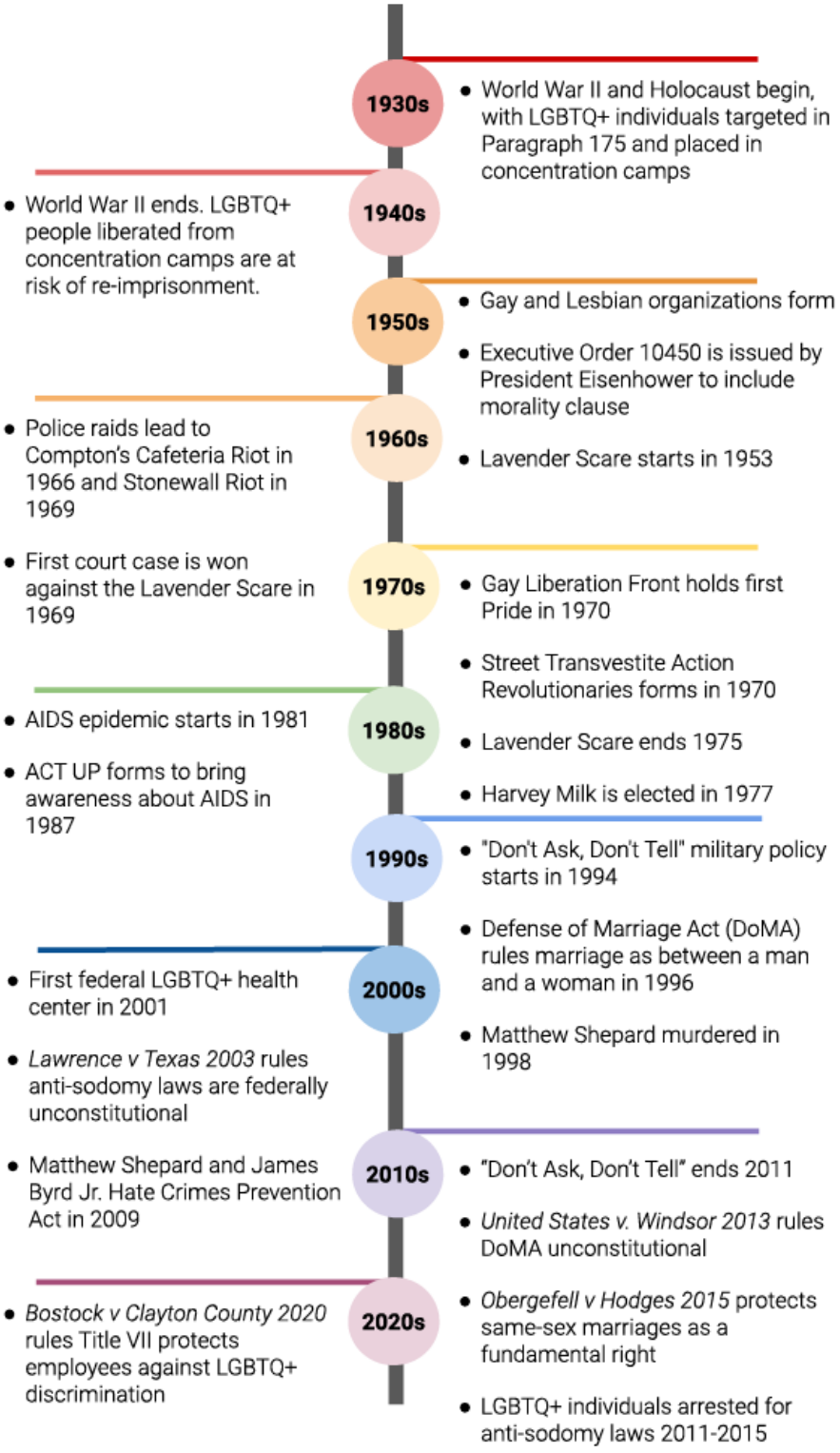

Figure 2. Timeline of important eras, events, and court cases impacting the LGBTQ+ community with a focus on the United States from 1935-2020.

LGBTQ+ Liberation Groups Form Amid Discrimination

Concurrent with the Lavender Scare, the police and FBI escalated their targeting of LGBTQ+ people [30,36]. During this time, lesbian and gay groups like the Mattachine Society and Daughters of Bilitis formed as liberation groups [37,38]. The Mattachine Society had strong protocols to protect members from the government, including registering the organization under the names of heterosexual women [30]. The Daughters of Bilitis also began as a secret society, becoming a group that focused on increasing community, advancing responsible research, and removing homosexuality from the penal code [30].

Both were predominantly white, in part because racial differences meant that individuals experienced homophobia in significantly different ways [38]. The Mattachine Society shifted focus to lobbying and the courts due to the advocacy of Frank Kameny, an astronomer who lost his job in the Lavender Scare [36,39]. This was reflected in the courts in 1969, when Clifford Norton, a NASA employee who was fired for homosexual activity, won a court case against the government [36].

Trans movements were also advancing, with the 1960s publication of *Transvestia*, the first trans magazine [37]. Expression of trans identity was illegal at this time, and many trans people were at risk, not only because cross-dressing was a crime, but also because often trans people had no other source of income besides survival sex work [40,41]**.** In this climate, seeds of trans resistance began to grow. The first widely documented instance of trans resistance to police violence was in San Francisco in 1966, at Compton's Cafeteria [29]. The riot at Compton's Cafeteria began with police arresting people for cross-dressing. Gay and trans patrons responded in solidarity by striking back at police, smashing windows, and preventing arrests [29]. Although this riot was unsuccessful in securing long-term changes, it marked the beginning of a forceful, working class, and queer resistance to police violence [27].

The Stonewall Riots

These liberation movements, in the context of increased policing and societal alienation, laid the groundwork for the Stonewall Riots in 1969. The Stonewall Inn, where the riots occurred, was like many gay bars at the time – Mafia-owned and private [27]. The Stonewall would experience police raids, leading to intrusive anatomical searches of trans women and cis-men in drag [27]. During a police raid on June 27, 1969 [27], the arrest of 3-5 transwomen and drag queens incited riots [27] with a butch, biracial drag-king lesbian, Storme DeLarvarie, initiating the protest[42].

The patrons forced the police to seek refuge within the barand 3 days of violent, yet joyous, protests ensued [27]. These riots were not covered by mainstream media outlets, but, from local coverage, "swishes'' and "sissies'' were instrumental in protecting targeted people and

maintaining a jovial atmosphere through “camp,” including singing, dancing, and jibes towards police [27]. Importantly, this history positions transwomen, effeminate people, and butch lesbians, all of whom break from heteronormative gender presentation, at the center of LGBTQ+ liberation. The Stonewall Riots inspired the establishment of the first Pride celebration as an annual commemorative event.

Post Stonewall Liberation Efforts

Post Stonewall, there was a divergence between the gay/lesbian and trans communities, with friction between the two. The gay movement tried to distance itself from the trans movement due to the pathologization of trans identities, prioritizing political movements for LGB identities [27,37]. Trans liberation groups included the Street Transvestite Action Revolutionaries (STAR) founded and supported by BIPOC trans activists Sylvia Rivera and Bubbles Rose Marie, and Marsha P. Johnson [27]. STAR focused on mutual-aid and solidarity-based support amongst sex workers, providing lodging, food, and protection to youth [43].

The lesbian and gay movements often were not intersectional (sensu Crenshaw 1989). Black women, especially Black trans women, were particularly excluded, experiencing both racism and sexism [27]. The growing LGB civil rights movement resulted in the election of the first openly gay man, Harvey Milk, to the San Francisco Board of Supervisors in 1977 , who increased acceptance by encouraging people to come out and supporting inclusive policies, before he was assassinated in 1978 [44].

HIV and AIDS

LGBTQ+ liberation and rights movements were tragically interrupted by the HIV/AIDS (originally termed gay cancer and Gay-Related Immune Deficiency) crisis of the 1980s and 1990s [37,45]. The AIDs crisis reached a peak in 1995, with more than 10,000 annual deaths of men who have sex with men, although this peak is likely due to increased surveillance and documentation efforts [46]. The US government purposefully ignored this disease under President Reagan [45]. In response, organizations like ACT UP formed. ACT UP used the pink triangle from World War II concentration camps as its symbol, adopting the slogan “Silence = Death”[28], referencing genocide due to government (in)action and the incredible loss of life. Since HIV/AIDS was largely associated with gay men, it conflated homosexuality with the disease, perpetuating stigma [37].

Ongoing Legal Protections and Progress

AIDS became more manageable with medications in the 90s and 2000s [37], but violence and discrimination still excluded LGBTQ+ individuals from many parts of society. LGBTQ+ identities only became protected under hate crime laws in 2009 with the Matthew Shepard and James Byrd Jr. Hate Crimes Prevention Act, named after Matthew Shepard, a gay man who was beaten, tortured, and killed near Laramie, WY in 1998, and James Byrd Jr., a Black man who was tortured and lynched by white supremacists in Jasper, Texas. Exclusionary policies included legal

discrimination in employment based on sexual orientation and gender identity. One example of this is “Don’t Ask, Don’t Tell,” a Clinton-era military policy that barred LGBT people from openly serving in the military from 1993-2011.

Although the 2010s saw some LGBTQ+ movements achieving mainstream support, a majority of these focused on conformist gains rather than holistic LGBTQ+ community protection and inclusion [47–49]. Furthermore, protections were and still are often piece-meal and based on state legislatures. For example, Illinois abolished its anti-sodomy law in 1962, yet federal courts did not rule anti-sodomy laws unconstitutional until 2003 in *Lawrence v. Texas*, and 16 states still have codified anti-sodomy laws, with individuals being charged with sodomy as recently as 2015, including arrests for sodomy by police stings 2011-2013 with at least 12 men arrested [50–52]. Same-sex marriage was similar, with a state-by-state approach to legalization after The Defense of Marriage Act (1996) was ruled unconstitutional in *United States v Windsor* (2013).

The state-legislative push is an ongoing pattern for both rights-movements and discriminatory laws. For instance, efforts to ban conversion therapy are proceeding state-by-state, and is still legal in 22 states (LGBTMap.org). There has also been a mounting backlash to the increasing rights and social acceptance of LGBTQ+ people, especially trans people. As of March 20, 2022, there have been 238 anti-LGBTQ+ bills filed across the USA, 154 of which target trans people, especially trans youth [53]. Bills banning trans children from participating in school sports, bills requiring teachers to report trans kids to their parents, and bills outright banning trans healthcare for minors have exploded in state legislatures [53]. This state-legislature patchwork highlights the importance of local advocacy efforts, and the deficiency of current federal protections.

Summary

LGBTQ+ history still has heterogeneous lasting effects in the United States, including within academia. Inclusive policies are not ubiquitous, and LGBTQ+ researchers continue to navigate harmful policies and laws. Despite institutions or departments wanting to be inclusive, there may be anti-LGBTQ+ legislation or inadequate protections for LGBTQ+ students or researchers. Due to our history and current legislation, LGBTQ+ identities are inherently political. Although legislation and policy create non-uniform issues with access and inclusion between states, there’s further conflict created by systemic issues directly impacting LGBTQ+ identities as well.

2. Systemic and Structural Barriers lead to Exclusion

Housing

Students continue to face increasing housing insecurity, homelessness, and food insecurity [54], negatively impacting academic success [55]. Disownment, lack of family support, continued

(and lasting) effects of structural inequality [56], and negative experiences in schools [57], are systemic, financial, and emotional barriers that all limit LGBTQ+ access to academia. Although national statistics on LGBTQ+ homelessness are limited, one national survey found around one-third of trans participants reported experiencing homelessness at one point in their lifetime [58]. Lack of access to shelter services and housing create additional difficulties (Friedman et al. 2013, Grant et al. 2011, [59], especially for trans women of color [60].

Rates of homelessness in LGBTQ+ populations appear to be on the rise such that, between 2016 and 2020 the number of trans adults experiencing homelessness rose 88% and the number without shelter rose 113% (or 63% of the homeless trans population as compared to 49% unsheltered homeless cisgender people) increasing vulnerability to a wide range of mental and physical health issues [61]. Sexual orientation data related to homelessness is less prevalent, as it's not a recorded demographic statistic for U.S. Department of Housing and Urban Development, but estimates for LGBTQ+ adult homelessness ranges from 9-30% [62], and pathways into homelessness may directly or indirectly be due to sexual orientation and/or gender identity [56].

Healthcare

Along with systemic housing and food insecurity, LGBTQ+ healthcare also lags behind that of cis-heterosexual healthcare, especially in rural areas of the US [63–65], Adequate healthcare access is a priority area for LGBTQ+ issues [65]. Trans and nonbinary people in particular report negative experiences with health care providers [63], increasing avoidance of services and exacerbating mental health concerns [e.g., 66]. Medical schools and workplace training do not prepare students to work with LGBTQ+ [67,68] or BIPOC [69–71] clients adequately, creating further disparities for BIPOC LGBTQ+ clients [72–74] Many medical students are likely relying on self-education for LGBTQ+ competency [75], or medical professionals may claim LGBTQ+ proficiency through false equivalency with other minoritized identities [68].

Furthermore, insurance often does not cover LGBTQ+ needs to the same extent as it covers for cis-heterosexual individuals [68], particularly as some affirming medical care is considered cosmetic by insurance companies [65,76,77]. There is also difficulty in accessing insurance when there is gender-specific coverage (e.g. coverage of cancer screenings), or gender-affirming care is considered cosmetic [e.g., mastectomies, breast augmentation, hair grafts, voice therapy, etc.; ,76,77]. Even LGBTQ+ organizations, like the Human Rights Campaign, may not adequately assess comprehensive trans healthcare policies [76], requiring an added burden navigating insurance and healthcare for trans and nonbinary individuals.

These barriers are present within university and college systems as well. LGBTQ+ students disproportionately use university healthcare resources but also report discrimination and poor

health service based on LGBTQ+ identities at 4.5 times the rate of cis-heterosexual students [78]. There is a pervasive lack of supportive systems, especially for trans individuals, nonbinary individuals, and women [78,79]. Inclusive provisioning of base-necessities needs to be structurally addressed and understood [68,78,79] to increase inclusion within the biological sciences and academia broadly. Scholars and LGBTQ+ people themselves continue to advocate for a move toward an affirming model in spaces across the academic landscape (i.e., housing, medical services, mental health, and so on) to counteract the barriers and discrimination that LGBTQ+ students face [7,80].

3. Social and Cultural Barriers lead to Exclusion

The impacts of cis-heteronormative expectations on LGBTQ+ individuals

In addition to structural and systemic barriers in place for LGBTQ+ individuals, there are further socio-cultural considerations. Just as we persist in a cis-hetero-patriarchy [81], our social constructs are often based on heteronormativity [15], cisnormativity [16], and heterosexism [14], to the detriment of LGBTQ+ individuals. Heteronormativity confers societal power and privilege to the exclusion of LGBTQ+ individuals [15]. With both heteronormativity and heterosexism intertwined with colonialism and racism [14,82], LGBTQ+ discrimination is correlated with discrimination based on sex and race [3,14] and includes the erasure and oppression of Indigenous concepts of gender [82]. When individuals deviate from these compulsory ideals, they may face discrimination and assault [14,15,26,83]. LGBTQ+ identities create a unique onus on individuals to find their community, identity, and culture, rather than being born into and raised within LGBTQ+ culture.

In addition to external risks due to divergence from cis-hetero-normativity and heterosexism, there are also personal impacts on LGBTQ+ individuals. For example, there is often increased anxiety if someone is worried of being 'outed,' and individuals may internalize expectations of heteronormativity, causing added stress [14]. Furthermore, bisexual individuals may experience increased depression and anxiety, as bisexual individuals often experience isolation and feel unwelcomed by lesbian and gay communities, yet experience homophobia and heterosexism from heterosexual individuals [14,84]. Also, the amount of privilege someone has socially is correlated to how well someone conforms or adheres to heteronormative expectations [14]. This is one reason why intentional acts of pushing back against heteronormativity and celebrating LGBTQ+ identities is meaningful, as it disrupts social systems of privilege [14].

These systems operate at a societal level, but are persistent in STEM and academia as well. There is often an urge to separate identity from the workplace [1], but fundamentally we cannot separate LGBTQ+ identities from ourselves [18]. Education systems become microcosms

where social dynamics are exacerbated and heteronormativity is reinforced [15,18,49,85]. Out individuals in STEM face more discrimination and stigma than individuals that are not out [2,26].

Academic success and persistence

Housing and healthcare can both increase costs for LGBTQ+ students, impacting overall initial access to academia, and heteronormativity and heterosexism can increase socio-cultural barriers. However, even once within educational institutions, struggles due to LGBTQ+ identities still persist. First, academia does not just persist within a patriarchy, but within a cis-hetero-patriarchy which interacts with different LGBTQ+ identities in different manners [81,86]. Gay men, regardless of race, tend to receive more bachelors degrees, with this attributed to compensating from increased ostracization and victimization, forming the "Best Little Boy in the World" hypothesis, a form of resilience [81]. However, women that behave more masculine tend to receive "bad girl penalties" form school authorities, with Black lesbians particularly excluded from bachelor degrees [81]. Trans individuals also face barriers, with around half not being out, and 17% withdrawing from schools due to negative treatment [58]. Structural and social systems are changing rapidly, so the experiences of LGBTQ+ individuals are dependent on age as well, and cohort-based research is needed to better understand LGBTQ+ academic success and trends [81].

Graduate school adds further stressors, with close to 50% of graduate students reporting experiencing psychological distress during their graduate studies. However, the levels of distress are even higher for LGBTQ+ graduate students [7,87]. In addition to the high pressure, performance-based environment of graduate school, LGBTQ+ people must navigate a wide range of structural, interpersonal, and individual stressors that negatively impact health such as discrimination, erasure, lack of access to affirming health care, restrictive cultural norms, and difficulty accessing resources [7]. Overall, LGBTQ+ individuals, particularly trans and gender non-conforming individuals, experience increased difficulty in accessing housing and healthcare, impacting mental health and ability to access academia.

4. LGBTQ+ identities in STEM

Decisions to be Out in STEM

Heteronormativity and heterosexism create dangerous environments and fraught internal conflicts for LGBTQ+ individuals to navigate within the biological sciences and STEM at large. Due to 'norms of impersonality' in STEM, being out can be considered too personal for the workplace [1,17]. Discussing LGBTQ+ identities leads to exclusion and discomfort in science departments, and can damage LGBTQ+ scientists' careers [2,3,17]. Out individuals are more

likely to consider leaving STEM fields due to increased discrimination and victimization, risks that are worse in rural areas [2,88–90]. This can lead to compartmentalization where LGBTQ+ scientists separate their LGBTQ+ identities from their professional science identities [48]. This may be particularly strong in locations where LGBTQ+ identities are criminalized or face social stigmatization [91]. This forced invisibility of identities can lead to the alienation of LGBTQ+ individuals who do not see LGBTQ+ representation within their scientific instructors and mentors [1].

However there are benefits to being out in STEM as well. In addition to benefits of representation for LGBTQ+ students, being out as an LGBTQ+ scientist is linked to increased academic productivity in some contexts [19], and has mental health benefits [90,92]. Navigating these costs and benefits related to being "out" and context-specific risks may lead to increased mental burden on LGBTQ+ biologists and scientists. LGBTQ+ scientists can be caught between feeling responsible for being out to their students and mentees, while simultaneously navigating workplace hostility [93,94].

LGBTQ+ experiences and retention in STEM

LGBTQ+ individuals in science experience 30% more harassment than cisgender, heterosexual colleagues, in addition to having access to fewer resources, worrying more about repercussions of reporting negative work environments, experiencing professional devaluation, and feeling like they do not fit in with colleagues [95]. The issue of 'fit', a nebulous criteria often used to rank candidates applying to academic positions, can exclude LGBTQ+ individuals from jobs. This is especially salient for queer and trans people of color and those who do not get to choose whether they are out as LGBTQ+ due to societal norms and assumptions about gendered appearances [96–98].

The result of these patterns of exclusion is a lack of retention of LGBTQ+ students in science [96]. Among undergraduate students who entered college intending to complete a degree in STEM, students belonging to a sexual minority were 7% less likely to still be in a STEM major after four years despite LGBTQ+ students engaging in undergraduate research 8.3% more than straight students [99]. LGBTQ+ people remain underrepresented in science fields [1,100,101]. A survey of undergraduate students at 18 research universities found that only 40% of queer students majored in STEM fields compared to about 47% of students who identified as straight [101]. This trend continues as LGBTQ+ people move into the workforce. In 2013, a survey of people working for STEM-related federal agencies found that only 2.8% of respondents identified as LGBT compared to 3.4% of the general population [100].

Trans people are impacted especially strongly by these disparities, with trans students being 15% less likely to pursue STEM degree than their cisgender peers [101]. There is also a stronger

impact on gay men than on women. For example, one study found that men in same-sex partnerships were 12% less likely to have a degree in STEM than men in different-sex partnerships [102] despite the fact that gay men are 18.8% more likely to earn a bachelor's degree than straight men [81]. Women in same-sex and different-sex relationships were equally likely to earn a bachelor's degree in a STEM field [102].

Importantly, finding a position in an inclusive organization or college is not a simple solution to problems LGBTQ+ scientists face. For one, invisibility and erasure are common even at welcoming scientific environments, with LGBTQ+ scientists not featured in classes because LGBTQ+ identities are not seen as salient to science [26] and historically difficult to identify [28]. Furthermore, LGBTQ+ scientists, even those who are out in more welcoming environments, can still feel pressure to self-censor aspects of their LGBTQ+ identities and assimilate into heteronormative expectations [93]. Second, looking for more inclusive employers can be limited by a lack of financial resources. Many conservative or religious schools, which are common higher education workplaces in many regions of the U.S., remain unwelcoming or dangerous for LGBTQ+ faculty and students. LGBTQ+ faculty have been not hired, fired, or dismissed for violating morality clauses [103] as recently as 2020, when an ecologist was forced to resign due to marrying a same-sex partner [104].

5. Science and research on LGBTQ+ identities

Scientific research and clinical theory surrounding LGBTQ+ identities require thoughtfulness, diligence, and self-reflection. It may be hard to maintain objectivity when reading studies that focus on LGBTQ+ people, but it is a vital part of detecting the insights and bias that may show up in LGBTQ+ past, present, and future research. Accurate interpretation of research is further complicated because not all studies of LGBTQ+ people are conducted with scientific rigor and may even jeopardize the well-being and safety of LGBTQ+ people. However, well-designed studies share a few common characteristics that make them easier to detect.

Valid and reliable studies of LGBTQ+ people are conducted with appropriate consultation, representation, and/or input from the LGBTQ+ community. Dependable results consistently indicate that LGBTQ+ people benefit from inclusion, affirmation, and protection from discrimination and marginalization. When studies of LGBTQ+ people detect issues faced by community members (e.g., elevated depression, anxiety, and suicidal ideation), they provide appropriate context for elevated distress and can propose interventions that may reduce distress and increase resilience in LGBTQ+ populations.

By contrast, poorly-designed research and clinical practices are often constructed in bad faith as they atempt to justify discrimination and marginalization of LGBTQ+ people. Biased studies have the potential to harm members of the LGBTQ+ community and be misused by bad actors [105].

For this reason, biologists and other scientists must consider the social and political implications of their research or clinical practice recommendations, and understand the complex and ongoing history of LGBTQ+ oppression that continues to be falsely justified through poorly constructed or even malevolent studies.

Bias in Scientific Foundations

Science has long regarded sexual and gender minorities as topics of research, with early studies treating non-cis-hetero peoples as aberrant or diseased [105]. Inherent in this approach is the incorrect assumption that deviations from heterosexism are a result of physiological, biological, or cultural abnormalities [106,107]. This led homosexuality to be described as a disorder in the first Diagnostic and Systamatic Manual of Mental Disorders [DSM; 108], which was used to justify laws that barred LGBTQ+ people from any number of occupations and encouraged inhumane and barbaric efforts to "cure" same sex behaviors [109].

In addition, the medicalization and misunderstanding of gender and sex has resulted in genital surgery on intersex children to fit binary concepts of phenotypes and chromosomes [110], altering their body and understanding of self before they can consent or even have concepts of gender and sex [111]. Surgeries on intersex infants currently occur, but are being contested, with bioethical arguments focusing on waiting until a patient can provide consent [111].

Biological and Psychological Sciences

In addition to clinical understanding of LGBTQ+ identities, psychological and biological research on LGBTQ+ people became a focal point for a small pool of researchers in the 1950s. Studies from this time showed that same-sex sex behavior was more widespread that previously believed in humans [112,113] and non-human animals [114]. The "gay gene", first proposed in 1993, hypothesized a genetic cause for same-sex behavior. The assumption of biological determinism that comes along with this hypothesis carries complicated implications within the LGBTQ+ community.

Biological determinism is the belief that people's social identities are predicated on biology or genetics, and has been used to subjugate marginalized identities, including LGBTQ+ people [115,116]. As genetic and genomic research has increased, there are continuing misinterpretations of genetics relating to social standing, race [115], sex, and gender [117]. For instance, genome-wide association studies continue to infer causal relationships between genetics and same-sex phenotypes [116] despite the studies being correlative in methodology, and only finding weak correlations [118].

Researchers need to consider the complexity inherent in studying the role of biology in LGBTQ+ identities. Although establishing a biological basis for LGBTQ+ identities may support inclusive policies [119], it also poses risks both by creating scientific gate-keeping of identities, where genetic metrics must be met to establish identity. Or, if a genetic explanation is not found, it may inadvertently support arguments that sexual orientation and gender identity are "preferences" or "choices." Importantly, biological explanations do not decrease internalized homonegativity [120]. Some LGBTQ+ people worry that genetic ties to LGBTQ+ identities may lead to eugenics or limited access to medical care, but others may view genetic inquiry as possibly affirming or increasing access to affirming medical care [121,122]. There are also implications for cis-heterosexual individuals, with accepting cis-heterosexual individuals often believing that LGBTQ+ identities are biological or genetic, yet biological arguments do not decrease negative perceptions of LGBTQ+ people in cis-heterosexual people who already are negatively biased towards LGBTQ+ identities [123].

Towards inclusion and considerations in research

It was only after extensive challenges by LGBTQ+ activists and scientists that the American Psychiatric Association took efforts to reverse course [124], with homosexuality being removed from the Diagnostic and Statistical Manual (DSM) as a diagnosis in 1973 [125]. However, change was slower to come for trans people, with clinical terminology changing from gender identity disorder for children and transexualism for adults under DSM III in 1973, to solely gender identity disorder under DSM IV in 1994, and gender dysphoria in 2013 to decrease stigma [125,126]. Currently, gender dysphoria is included in the DSM V, and is considered a less stigmatizing disorder, though people and activists continue to debate the appropriateness of gender dysphoria diagnosis [125,127–129]

The media also has a role to play in the public's understanding of the scientific basis of LGBTQ+ identities. For instance, media outlets have published debates on the legitimacy of LGBTQ+ identities that are often rooted in biological essentialism [130]. Additionally, the controversy of the gay gene or genetic correlations to homosexuality has dominated scientific news reporting sites since the 1990s, and has become common rhetoric despite the lack of scientific support [121]. Research has found that increased exposure to lay articles and news coverage that promote biological determinism about sex-differences increases prejudice against trans individuals [117]. Studies with very small, biased samples with major flaws have received a significant amount of media attention [131]. Such research can be twisted to fit narratives about the "unnaturalness" of LGBTQ+ individuals by groups like the Family Research Council or trans-exclusionary radical feminists (TERFs, aka "gender critical feminists") that revert to biological essentialism arguments [130]. Researchers need to consider how their research may be (mis)represented.

Given the troubled history of LGBTQ+ research, the production of biased research, and the skew perpetuated by the media, it is imperative that scientists and practitioners develop research literacy that reaches beyond their own specialization or scientific discipline. When scientists, researchers, and other professionals become too siloed and/or fall behind on current research findings, they run the risk of perpetuating damaging biases that further marginalize LGBTQ+ people across STEM disciplines [132]. In particular, we would like to caution researchers against relying on biological determinism as the primary argument for inclusion and recommend working with LGBTQ+ communities to conduct high-quality research. Shifts toward greater inclusion and affirmation of LGBTQ+ identities is reflected in other clinical and research fields that focus on the effects of stigma on LGBTQ+ communities and methods to alleviate rather than uphold stigma [108]. Rigorously conducted research on LGBTQ+ people is incredibly important, as data on LGBTQ+ individuals lags behind other marginalized identities, making it difficult to provide adequate care or resources.

6. Lack of data on LGBTQ+ Identities

The lack of attention and information on LGBTQ+ homelessness [62], medical care [133], and history [33], is continued in the lack of understanding about LGBTQ+ identities and experiences in science [1], particularly for trans and gender non-conforming people in higher education [7]. For instance, the National Science Foundation does not track LGBTQ+ identities [134], despite LGBTQ+ advocacy for demographic inclusion [1,95] and known benefits of data collection [2,3,95].

In STEM, more attention has been given to the role of gender in harassment, focusing on the different experiences of men and women from a binary perspective [2,135]. A better understanding of the presence and experiences of LGBTQ+ people in STEM is limited by research on LGBTQ+ identities in higher education and in science that has largely focused on undergraduates, with less information available about graduate students, faculty, and other professional scientists [134,136]. Data are also lacking about the presence and experiences of BIPOC and disabled people in science, identities which intersect with LGBTQ+ identities and are severely under-represented in STEM and data [1,48]. This lack of data collection is due to the common view that LGBTQ+ identities are non-consequential [137], or that studies on LGBTQ+ identities may lead to harassment of the researcher themself [138].

We first recommend that institutions and researchers should collect data. Data on collection on marginalized identities in STEM through climate and other surveys should include LGBTQ+ identities and follow ethical guides such as the Vanderbilt University Survey guide [139] for LGBTQ+ people [2,3]. Although small sample size may lead to aggregation [131], disaggregation of both identity and discipline data allows better understanding of identity-specific experiences

in different STEM contexts, especially since we know that LGBTQ+ experiences vary between disciplines such as the life sciences and engineering [26,136,140,141]. We also recommend institutions reference the growing and valuable findings from qualitative social science, where experiences of marginalized identities in science can be contextualized within broader narratives and systems [1]. We cannot address disparities if we do not know who exists in science, and not including LGBTQ+ identities in our studies leads to further erasure and marginalization.

7. Conclusion

In order to reduce barriers in Biology and STEM at large for LGBTQ+ people, we need to have advocacy for structural change and social inclusion rooted in historic context. Here, we hope to provide an introduction to systemic and social barriers for LGBTQ+ people in biological fields, emphasizing the impacts of historic and ongoing disenfranchisement in STEM. Understanding contemporary issues through the lens of history allows us to note changing landscapes and address long term as well as novel issues in an adaptive framework for inclusion. Younger generations are identifying more with LGBTQ+ identities [142], with barriers for LGBTQ+ individuals impacting a growing population. Understanding LGTBQ+ history frames this increased identification as correlating with increasingly affirming policies, laws, and societal acceptance [142].

Despite increasing protections, LGBTQ+ individuals still experience discrimination. Steps towards inclusion within STEM fields have focused predominantly on individual changes to increase inclusion [e.g., 5,10]. These steps, including things such as allowing people to provide pronouns, passively signaling inclusion through stickers, and using inclusive language, are easily enacted and are a great starting point, but there are structural and systemic issues that also need to be addressed within STEM and society at large. Through incorporating small steps towards change and framing the steps in a larger framework, we hope to emphasize the recommendations towards inclusion by other papers [e.g., 5,10], but we encourage people to be aware of LGBTQ+ exclusion and discrimination within a broader framework and advocate for policy, structural, and societal reform.

We recommend advocating for institutional change to include focusing on increased financial support, housing, and physical and mental health resources as part of LGBTQ+ advocacy. We hope to support and provide a resource to the many people currently working to increase inclusion within institutions, classrooms, and biological fields, with a specific focus to add context to current and ongoing advocacy efforts. Through building on current and ongoing recommendations and practices, we can expand advocacy to be comprehensive

community-based and institutional to create a more inclusive STEM future rooted in LGBTQ+ history.

Acknowledgements

We would like to thank the LGBTQ community, elders, those that paved the way, and the current and ongoing advocacy efforts in STEM. We would like to thank J. Carden for reviewing the LGBTQ+ history section and his lifelong advocacy, and J. Adams for reviewing the LGBTQ+ history and systemic and structural barriers sections.

References

1. Freeman J. Measuring and Resolving LGBTQ Disparities in STEM. Policy Insights Behav Brain Sci. 2020;7: 141–148. doi:10.1177/2372732220943232

2. Patridge EV, Barthelemy RS, Rankin SR. Factors impacting the academic climate for LGBQ STEM faculty. J Women Minorities Sci Eng. 2014;20: 75–98. doi:10.1615/jwomenminorscieneng.2014007429

3. Yoder JB, Mattheis A. Queer in STEM: Workplace Experiences Reported in a National Survey of LGBTQA Individuals in Science, Technology, Engineering, and Mathematics Careers. J Homosexual. 2015;63: 1–27. doi:10.1080/00918369.2015.1078632

4. Unsay JD. LGBTQ+ in STEM: Visibility and Beyond. Chem European J. 2020;26: 8670–8675. doi:10.1002/chem.202002474

5. Cooper KM, Auerbach AJJ, Bader JD, Beadles-Bohling AS, Brashears JA, Cline E, et al. Fourteen Recommendations to Create a More Inclusive Environment for LGBTQ+ Individuals in Academic Biology. Cbe Life Sci Educ. 2020;19: es6. doi:10.1187/cbe.20-04-0062

6. Halsey SJ, Strickland LR, Scott-Richardson M, Perrin-Stowe T, Massenburg L. Elevate, don't assimilate, to revolutionize the experience of scientists who are Black, Indigenous and people of colour. Nat Ecol Evol. 2020;4: 1291–1293. doi:10.1038/s41559-020-01297-9

7. Knutson D, Matsuno E, Goldbach C, Hashtpari H, Smith NG. Advocating for transgender and nonbinary affirmative spaces in graduate education. High Educ. 2022;83: 461–479. doi:10.1007/s10734-020-00673-5

8. Schell CJ, Guy C, Shelton DS, Campbell-Staton SC, Sealey BA, Lee DN, et al. Recreating Wakanda by promoting Black excellence in ecology and evolution. Nat Ecol Evol. 2020;4: 1285–1287. doi:10.1038/s41559-020-1266-7

9. Blooms T. I am one of you - A gay wildlife biologist's perspective on our profession. The Wildlife Professional. 2019; 34–35.

10. Miles C. 3 Simple Steps to Create a More Inclusive Work Space for Our LGBTQ+

Community. Fisheries. 2021;46: 537–538. doi:10.1002/fsh.10677

11. Dodge AM, Crutcher PA. Inclusive Classrooms for LGBTQ Students: Using Linked Text Sets to Challenge the Hegemonic “Single Story.” J Adolesc Adult Lit. 2015;59: 95–105. doi:10.1002/jaal.433

12. Maguth BM, Taylor N. Bringing LGBTQ Topics into the Social Studies Classroom. Soc Stud. 2013;105: 23–28. doi:10.1080/00377996.2013.788471

13. Coon JJ, Alexander NB, M E, Smith, Spellman M, Klimasmith I, et al. Queering Applied Ecology: Best practices for LGBTQ+ inclusion in fieldwork for individuals, mentors, and institutions. 2022.

14. Knutson D, Goldbach C, Kler S. Heterosexism. In: Goldberg AE, Beemyn G, editors. The SAGE Encyclopedia of Trans Studies. SAGE Publications, Inc; 2021. pp. 380–383. doi:10.4135/9781544393858.n130

15. Goldbach C, Knutson D, Kler S. Heteronormativity. The SAGE Encyclopedia of Trans Studies. SAGE Publications, Inc; 2021. pp. 377–379. doi:10.4135/9781544393858

16. Berger I, Ansara YG. Cisnormativity. In: Goldberg AE, Beemyn G, editors. The SAGE Encyclopedia of Trans Studies. SAGE Publications, Inc.; 2021. pp. 122–125. doi:https://dx.doi.org/10.4135/9781544393858.n45

17. Cooper KM, Brownell SE, Gormally C. Coming out to the class: Identifying factors that influence college biology instructor decisions about revealing their LGBQ identities in class. J Women Minorities Sci Eng. 2019;25: 261–282. doi:10.1615/jwomenminorscieneng.2019026085

18. Hughes BE, Kothari S. Don’t Be Too Political: Depoliticization, Sexual Orientation, and Undergraduate STEM Major Persistence. J Homosexual. 2021; 1–28. doi:10.1080/00918369.2021.1996101

19. Nelson J, Mattheis A, Yoder JB. Nondisclosure of queer identities is associated with reduced scholarly publication rates. Plos One. 2022;17: e0263728. doi:10.1371/journal.pone.0263728

20. Boustani K, Taylor KA. Navigating LGBTQ+ discrimination in academia: where do we go from here? Biochem. 2020;42: 16–20. doi:10.1042/bio20200024

21. Wanelik KM, Griffin JS, Head ML, Ingleby FC, Lewis Z. Breaking barriers? Ethnicity and socioeconomic background impact on early career progression in the fields of ecology and evolution. Ecol Evol. 2020;10: 6870–6880. doi:10.1002/ece3.6423

22. Atchison CJ. Challenges of fieldwork for LGBTQ+ scientists. Nat Hum Behav. 2021;5: 1462–1462. doi:10.1038/s41562-021-01205-6

23. Busch CA, Supriya K, Cooper KM, Brownell SE. Unveiling Concealable Stigmatized Identities in Class: The Impact of an Instructor Revealing Her LGBTQ+ Identity to Students in a

Large-Enrollment Biology Course. Cbe Life Sci Educ. 2022;21: ar37. doi:10.1187/cbe.21-06-0162

24. Weber S. What's wrong with be(com)ing queer? Biological determinism as discursive queer hegemony. Sexualities. 2012;15: 679–701. doi:10.1177/1363460712446275

25. Field S, Rajewski A. Challenges facing LGBTQ+ early-career scientists and how to engage in changing the status quo. Plant Cell. 2021;33: koab094-. doi:10.1093/plcell/koab094

26. Mattheis A, Arellano DC-RD, Yoder JB. A Model of Queer STEM Identity in the Workplace. J Homosexual. 2019;67: 1–25. doi:10.1080/00918369.2019.1610632

27. Stein M. The Stonewall Riots, A Documentary History. New York, NY: NYU Press.; 2020. doi:10.18574/9781479808519-001

28. Jensen EN. The Pink Triangle and Political Consciousness: Gays, Lesbians, and the Memory of Nazi Persecution. J Hist Sexuality. 2002;11: 319–349. doi:10.1353/sex.2002.0008

29. Irving D. Normalized Transgressions: Legitimizing the Transsexual Body as Productive. Radical Hist Rev. 2008;2008: 38–59. doi:10.1215/01636545-2007-021

30. Faderman L. The Gay Revolution: The Story of the Struggle. New York, NY: Simon & Schuster; 2015.

31. Haeberle EJ. Swastika, pink triangle and yellow star—the destruction of sexology and the persecution of homosexuals in Nazi Germany. J Sex Res. 1981;17: 270–287. doi:10.1080/00224498109551120

32. Cuerda-Galindo E, López-Muñoz F, Krischel M, Ley A. Study of deaths by suicide of homosexual prisoners in Nazi Sachsenhausen concentration camp. Plos One. 2017;12: e0176007. doi:10.1371/journal.pone.0176007

33. Lautmann R. Categorization in Concentration Camps as a Collective Fate: J Homosexual. 1990;19: 67–88. doi:10.1300/j082v19n01_04

34. Crowder HE. Lesbians under National Socialism: Legal Indifference, Real Oppression. Usurj Univ Sask Undergrad Res J. 2018;4. doi:10.32396/usurj.v4i2.308

35. Shibusawa N. The Lavender Scare and Empire: Rethinking Cold War Antigay Politics*. Diplomatic Hist. 2012;36: 723–752. doi:10.1111/j.1467-7709.2012.01052.x

36. Johnson D. The Lavender Scare: The Cold War Persecution of Gays and Lesbians in the Federal Government, Johnson. Chicago, IL: University of Chicago Press; 2004.

37. Martos AJ, Wilson PA, Meyer IH. Lesbian, gay, bisexual, and transgender (LGBT) health services in the United States: Origins, evolution, and contemporary landscape. Plos One. 2017;12: e0180544. doi:10.1371/journal.pone.0180544

38. Peacock KW. Race, the Homosexual, and the Mattachine Society of Washington,

1961–1970. J Hist Sexuality. 2016;25: 267–296. doi:10.7560/jhs25203

39. Stenhoff M. From astronomy to activism. Astron Geophys. 2020;61: 5.31-5.33. doi:10.1093/astrogeo/ataa073

40. Nadal KL, Davidoff KC, MA WF-D. Transgender Women and the Sex Work Industry: Roots in Systemic, Institutional, and Interpersonal Discrimination. J Trauma Dissociatio. 2014;15: 169–183. doi:10.1080/15299732.2014.867572

41. Kattari SK, Begun S. On the Margins of Marginalized: Transgender Homelessness and Survival Sex. Affil. 2016;32: 92–103. doi:10.1177/0886109916651904

42. Schares EM. Witnessing the Archive: Stormé DeLarverie and Queer performance historicity*. Text Perform Q. 2020;40: 1–18. doi:10.1080/10462937.2020.1807045

43. Shepard B. From Community Organization to Direct Services: The Street Trans Action Revolutionaries to Sylvia Rivera Law Project. J Soc Serv Res. 2013;39: 95–114. doi:10.1080/01488376.2012.727669

44. Milk H, Black J, Morris C, Robinson F. An Archive of Hope: Harvey Milk's Speeches and Writings. Berkeley, CA: University of California Press; 2013.

45. Francis DP. Deadly AIDS policy failure by the highest levels of the US government: A personal look back 30 years later for lessons to respond better to future epidemics. J Public Health Pol. 2012;33: 290–300. doi:10.1057/jphp.2012.14

46. CDC. Epidemiology of HIV/AIDS 1981-2005. 2001 [cited 1 May 2022]. Available: https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5521a2.htm

47. Daum CW. Social Equity, Homonormativity, and Equality: An Intersectional Critique of the Administration of Marriage Equality and Opportunities for LGBTQ Social Justice. Administrative Theory Praxis. 2019;42: 1–18. doi:10.1080/10841806.2019.1659044

48. Friedensen RE, Kimball E, Vaccaro A, Miller RA, Forester R. Queer science: Temporality and futurity for queer students in STEM. Time Soc. 2021;30: 332–354. doi:10.1177/0961463x211008138

49. Kokozos M, Gonzalez M. Critical Inclusion: Disrupting LGBTQ Normative Frameworks in School Contexts. Equity Excell Educ. 2020;53: 1–14. doi:10.1080/10665684.2020.1764881

50. Compton J. American Men Are Still Being Arrested for Sodomy. In: The Advocate [Internet]. 23 May 2016 [cited 15 May 2022]. Available: https://www.advocate.com/crime/2016/5/23/american-men-are-still-being-arrested-sodomy

51. McKinney M. Arrest on unconstitutional sodomy law prompts Baton Rouge police chief to send memo to all officers | Crime/Police | theadvocate.com. In: The Advocate [Internet]. 16 Feb 2015 [cited 15 May 2022]. Available: https://www.theadvocate.com/baton_rouge/news/crime_police/article_ce56e834-d61d-50bd-894

d-bd664428e56d.html

52. Grindley L. Sheriff Claims He Didn't Know Anti-Sodomy Laws Weren't Valid Anymore. In: The Advocate [Internet]. 29 Jul 2013 [cited 15 May 2022]. Available: https://www.advocate.com/crime/2013/07/29/sheriff-claims-he-didnt-know-anti-sodomy-laws-werent-valid-anymore

53. Lavietes M, Ramos E. Nearly 240 anti-LGBTQ bills filed in 2022 so far, most of them targeting trans people. In: NBC News [Internet]. 20 Mar 2022 [cited 30 May 2022]. Available: https://www.nbcnews.com/nbc-out/out-politics-and-policy/nearly-240-anti-lgbtq-bills-filed-2022-far-targeting-trans-people-rcna20418

54. Broton KM. A review of estimates of housing insecurity and homelessness among students in U.S. higher education. J Soc Distress Homel. 2019;29: 1–14. doi:10.1080/10530789.2020.1677009

55. Hallett RE, Freas A. Community College Students' Experiences with Homelessness and Housing Insecurity. Community Coll J Res Pract. 2017;42: 1–16. doi:10.1080/10668926.2017.1356764

56. Ecker J, Aubry T, Sylvestre J. Pathways Into Homelessness Among LGBTQ2S Adults. J Homosexual. 2019;67: 1625–1643. doi:10.1080/00918369.2019.1600902

57. Bidell MP. Is There an Emotional Cost of Completing High School? Ecological Factors and Psychological Distress Among LGBT Homeless Youth. J Homosexual. 2014;61: 366–381. doi:10.1080/00918369.2013.842426

58. James S, Herman J, Rankin S, Keisling M, Mottet L, Anafi M. The Report of the 2015 U.S. Transgender Survey. Washington DC; 2016.

59. Kattari SK, Whitfield DL, Walls NE, Langenderfer-Magruder L, Ramos D. Policing Gender Through Housing and Employment Discrimination: Comparison of Discrimination Experiences of Transgender and Cisgender LGBQ Individuals. J Soc Soc Work Res. 2016;7: 427–447. doi:10.1086/686920

60. Abramovich A. Understanding How Policy and Culture Create Oppressive Conditions for LGBTQ2S Youth in the Shelter System. J Homosexual. 2016;64: 1484–1501. doi:10.1080/00918369.2016.1244449

61. Transgender Homeless Adults & Unsheltered Homelessness: What the Data Tell Us. Washington, DC: National Alliance to End Homelessness; 2020. Available: https://endhomelessness.org/wp-content/uploads/2020/07/Trans-Homelessness-Brief-July-2020.pdf

62. Ecker J, Aubry T, Sylvestre J. A Review of the Literature on LGBTQ Adults Who Experience Homelessness. J Homosexual. 2017;66: 297–323. doi:10.1080/00918369.2017.1413277

63. Jennings L, Barcelos C, McWilliams C, Malecki K. Inequalities in lesbian, gay, bisexual, and

transgender (LGBT) health and health care access and utilization in Wisconsin. Prev Medicine Reports. 2019;14: 100864. doi:10.1016/j.pmedr.2019.100864

64. Koch JM, Knutson D. Transgender Clients in Rural Areas and Small Towns. J Rural Ment Heal. 2016;40: 154–163. doi:10.1037/rmh0000056

65. Ramsey ZS, Davidov DM, Levy CB, Abildso CG. An etic view of LGBTQ healthcare: Barriers to access according to healthcare providers and researchers. J Gay Lesbian Soc Serv. 2022; 1–19. doi:10.1080/10538720.2022.2042452

66. Knutson D, Koch JM, Arthur T, Mitchell TA, Martyr MA. “Trans broken arm”: Health care stories from transgender people in rural areas. Journal of Research on Women and Gender. 2016;7: 30-46.

67. Goldhammer H, Maston ED, Kissock LA, Davis JA, Keuroghlian AS. National Findings from an LGBT Healthcare Organizational Needs Assessment. Lgbt Health. 2018;5: 461–468. doi:10.1089/lgbt.2018.0118

68. Table B, Tronstad LD, Kearns K. ‘Anything is helpful’: examining tensions and barriers towards a more LGBT-inclusive healthcare organization in the United States. J Appl Commun Res. 2021; 1–20. doi:10.1080/00909882.2021.1991582

69. Blanchard AK, Blanchard JC, Suah A, Dade A, Burnett A, McDade W. Reflect and Reset: Black Academic Voices Call the Graduate Medical Education Community to Action. Acad Medicine J Assoc Am Medical Coll. 2022;Publish Ahead of Print. doi:10.1097/acm.0000000000004664

70. Shahriar AA, Prasad K, Casty K, Rahman ZI, Westerhaus M, Satin DJ. Race and Gender Differences in Medical Student Perspectives on Social Determinants of Health Education: A Single-Institution Survey Study. Adv Medical Educ Pract. 2021;12: 587–595. doi:10.2147/amep.s300447

71. White-Means S, Dong Z, Hufstader M, Brown LT. Cultural competency, race, and skin tone bias among pharmacy, nursing, and medical students: implications for addressing health disparities. Medical Care Res Rev Mcrr. 2009;66: 436–55. doi:10.1177/1077558709333995

72. Casanova-Perez R, Apodaca C, Bascom E, Mohanraj D, Lane C, Vidyarthi D, et al. Broken down by bias: Healthcare biases experienced by BIPOC and LGBTQ+ patients. Amia Annu Symposium Proc Amia Symposium. 2021;2021: 275–284.

73. Kum S. Gay, gray, black, and blue: An examination of some of the challenges faced by older LGBTQ people of color. J Gay Lesbian Ment Heal. 2017;21: 00–00. doi:10.1080/19359705.2017.1320742

74. Malebranche DJ, Peterson JL, Fullilove RE, Stackhouse RW. Race and sexual identity: perceptions about medical culture and healthcare among Black men who have sex with men. J Natl Med Assoc. 2004;96: 97–107.

75. Nowaskie DZ, Patel AU. How much is needed? Patient exposure and curricular education on medical students' LGBT cultural competency. Bmc Med Educ. 2020;20: 490. doi:10.1186/s12909-020-02381-1

76. Kirkland A, Talesh S, Perone AK. Transition Coverage and Clarity in Self-Insured Corporate Health Insurance Benefit Plans. Transgender Heal. 2021;6: 207–216. doi:10.1089/trgh.2020.0067

77. Scheim AI, Baker KE, Restar AJ, Sell RL. Health and Health Care Among Transgender Adults in the United States. Annu Rev Publ Health. 2021;43: 1–21. doi:10.1146/annurev-publhealth-052620-100313

78. Reeves B, Rojas-Guyler L, Brown J, Bennett K, Bennett S. Attitudes toward health care needs and utilization of a university health center among LGBT and non-LGBT college students. J Am Coll Health. 2021; 1–9. doi:10.1080/07448481.2021.1898400

79. Haskett ME, Kotter-Grühn D, Majumder S. Prevalence and Correlates of Food Insecurity and Homelessness Among University Students. J Coll Student Dev. 2020;61: 109–114. doi:10.1353/csd.2020.0007

80. Knutson D, Martyr MA, Mitchell TA, Arthur T, Koch JM. Recommendations from Transgender Healthcare Consumers in Rural Areas. Transgender Heal. 2018;3: 109–117. doi:10.1089/trgh.2017.0052

81. Mittleman J. Intersecting the Academic Gender Gap: The Education of Lesbian, Gay, and Bisexual America. Am Sociol Rev. 2022; 000312242210757. doi:10.1177/00031224221075776

82. Robinson M. Two-Spirit Identity in a Time of Gender Fluidity. J Homosexual. 2019;67: 1–16. doi:10.1080/00918369.2019.1613853

83. Anderson SM. Gender Matters: The Perceived Role of Gender Expression in Discrimination Against Cisgender and Transgender LGBQ Individuals. Psychol Women Quart. 2020;44: 323–341. doi:10.1177/0361684320929354

84. Ross LE, Salway T, Tarasoff LA, MacKay JM, Hawkins BW, Fehr CP. Prevalence of Depression and Anxiety Among Bisexual People Compared to Gay, Lesbian, and Heterosexual Individuals:A Systematic Review and Meta-Analysis. J Sex Res. 2017;55: 1–22. doi:10.1080/00224499.2017.1387755

85. Steck AK, Perry D. Challenging Heteronormativity: Creating a Safe and Inclusive Environment for LGBTQ Students. J Sch Violence. 2017;17: 227–243. doi:10.1080/15388220.2017.1308255

86. Maloy J, Kwapisz MB, Hughes BE. Factors Influencing Retention of Transgender and Gender Nonconforming Students in Undergraduate STEM Majors. Cbe Life Sci Educ. 2022;21: ar13. doi:10.1187/cbe.21-05-0136

87. Hyun JK, Quinn BC, Madon T, Lustig S. Graduate Student Mental Health: Needs

Assessment and Utilization of Counseling Services. J Coll Student Dev. 2006;47: 247–266. doi:10.1353/csd.2006.0030

88. Hughes J, Rogerson M, Barton J, Bragg R. Age and connection to nature: when is engagement critical? Front Ecol Environ. 2019;17: 265–269. doi:10.1002/fee.2035

89. Gibney E. Discrimination drives LGBT+ scientists to think about quitting. Nature. 2019;571: 16–17. doi:10.1038/d41586-019-02013-9

90. Kosciw JG, Palmer NA, Kull RM. Reflecting Resiliency: Openness About Sexual Orientation and/or Gender Identity and Its Relationship to Well-Being and Educational Outcomes for LGBT Students. Am J Commun Psychol. 2015;55: 167–178. doi:10.1007/s10464-014-9642-6

91. Pettorelli N, Barlow J, Cadotte MW, Lucas K, Newton E, Nuñez MA, et al. Applied ecologists in a landscape of fear. J Appl Ecol. 2019;56: 1034–1039. doi:10.1111/1365-2664.13382

92. Fletcher L, Everly BA. Perceived lesbian, gay, bisexual, and transgender (LGBT) supportive practices and the life satisfaction of LGBT employees: The roles of disclosure, authenticity at work, and identity centrality. J Occup Organ Psych. 2021;94: 485–508. doi:10.1111/joop.12336

93. Horswell M. Conceiving a space for compassionate engagement with LGBT+ university lecturers around professional identity. 22nd EGU General Assembly. 2020. doi:10.5194/egusphere-egu2020-17929

94. Toynton R. ‘Invisible other’ Understanding safe spaces for queer learners and teachers in adult education. Stud Educ Adults. 2016;38: 178–194. doi:10.1080/02660830.2006.11661532

95. Cech EA, Waidzunas TJ. Systemic inequalities for LGBTQ professionals in STEM. Sci Adv. 2021;7: eabe0933. doi:10.1126/sciadv.abe0933

96. Freeman J. LGBTQ scientists are still left out. Nature. 2018;559: 27–28. doi:10.1038/d41586-018-05587-y

97. Endo R. Retaining and Supporting Faculty Who Are Black, Indigenous, and People of Color: The Promise of a Multi-Leveled Mentoring-Partnership Model. Multicultural Perspectives. 2020;22: 169–177. doi:10.1080/15210960.2020.1845178

98. Harris JC, Nicolazzo Z. Navigating the academic borderlands as multiracial and trans* faculty members. Crit Stud Educ. 2017;61: 1–16. doi:10.1080/17508487.2017.1356340

99. Hughes BE. Coming out in STEM: Factors affecting retention of sexual minority STEM students. Sci Adv. 2018;4: eaao6373. doi:10.1126/sciadv.aao6373

100. Cech EA, Pham MV. Queer in STEM Organizations: Workplace Disadvantages for LGBT Employees in STEM Related Federal Agencies. Soc Sci. 2017;6: 12. doi:10.3390/socsci6010012

101. Greathouse M, BrckaLorenz A, Hoban M, Huesman R, Rankin S, Stolzenberg EB.

Queer-spectrum and trans-spectrum student experiences in American higher education: the analyses of national survey findings. Tyler Clementi Foundation & Rutgers University; 2018. Available: https://doi.org/doi:10.7282/t3-44fh-3b16

102. Sansone D, Carpenter CS. Turing's children: Representation of sexual minorities in STEM. Plos One. 2020;15: e0241596. doi:10.1371/journal.pone.0241596

103. Stoltzfus K. Same-Sex Hiring Policies Polarize Some Christian Colleges. In: The Chronicle of Higher Education [Internet]. 6 Oct 2015 [cited 11 May 2022]. Available: https://www.chronicle.com/article/same-sex-hiring-policies-polarize-some-christian-colleges/

104. Lori M. Malone University Is Rightfully on Worst Colleges for LGBTQ Youth List. In: The Advocate [Internet]. 2021 [cited 26 Mar 2022]. Available: https://www.advocate.com/commentary/2021/10/29/malone-university-rightfully-worst-colleges-lgbtq-youth-list

105. Mohr JM. Oppression by Scientific Method: The Use of Science to "Other" Sexual Minorities. Journal of Hate Studies. 2008;7.

106. Carpenter E. Homogenic love, and its place in a free society. Labour Press Society. 1894.

107. Ulrich K. The Riddle of" Man-Manly" Love: The Pioneering Work on Male Homosexuality. 1994.

108. Drescher J. Out of DSM: Depathologizing Homosexuality. Behav Sci. 2015;5: 565–575. doi:10.3390/bs5040565

109. Jenkins D, Johnston LB. Unethical Treatment of Gay and Lesbian People with Conversion Therapy. Fam Soc J Contemp Soc Serv. 2004;85: 557–561. doi:10.1177/104438940408500414

110. Minto CL, Liao L-M, Woodhouse CR, Ransley PG, Creighton SM. The effect of clitoral surgery on sexual outcome in individuals who have intersex conditions with ambiguous genitalia: a cross-sectional study. Lancet. 2003;361: 1252–1257. doi:10.1016/s0140-6736(03)12980-7

111. Behrens KG. A principled ethical approach to intersex paediatric surgeries. Bmc Med Ethics. 2020;21: 108. doi:10.1186/s12910-020-00550-x

112. Kinsey A, Pomeroy W, Martin C, Gebhard P. Sexual Behavior in the Human Female. 1953;139: 217.

113. Kinsey A, Pomeroy W, Martin C. Sexual Behavior in the Human Male. 1948;215: 593.

114. Ford C, Beach F. Patterns of Sexual Behavior. J Amer Med Assoc. 1951;146: 1543–1543.

115. Graves JL. Great Is Their Sin: Biological Determinism in the Age of Genomics. Ann Am Acad Political Soc Sci. 2015;661: 24–50. doi:10.1177/0002716215586558

116. Shen H, Feldman MW. Diversity and its causes: Lewontin on racism, biological

determinism and the adaptationist programme. Philosophical Transactions Royal Soc B. 2022;377: 20200417. doi:10.1098/rstb.2020.0417

117. Ching BH-H, Xu JT. The Effects of Gender Neuroessentialism on Transprejudice: An Experimental Study. Sex Roles. 2018;78: 228–241. doi:10.1007/s11199-017-0786-3

118. Ganna A, Verweij KJH, Nivard MG, Maier R, Wedow R, Busch AS, et al. Large-scale GWAS reveals insights into the genetic architecture of same-sex sexual behavior. Science. 2019;365. doi:10.1126/science.aat7693

119. Mills MC. How do genes affect same-sex behavior? Science. 2019;365: 869–870. doi:10.1126/science.aay2726

120. Morandini JS, Blaszczynski A, Ross MW, Costa DSJ, Dar-Nimrod I. Essentialist Beliefs, Sexual Identity Uncertainty, Internalized Homonegativity and Psychological Wellbeing in Gay Men. J Couns Psychol. 2015;62: 413–424. doi:10.1037/cou0000072

121. O'Riordan K. The Life of the Gay Gene: From Hypothetical Genetic Marker to Social Reality. J Sex Res. 2012;49: 362–368. doi:10.1080/00224499.2012.663420

122. Rajkovic A, Cirino AL, Berro T, Koeller DR, Zayhowski K. Transgender and gender-diverse (TGD) individuals' perspectives on research seeking genetic variants associated with TGD identities: a qualitative study. J Community Genetics. 2022;13: 31–48. doi:10.1007/s12687-021-00554-z

123. Mitchell RW, Dezarn L. Does Knowing Why Someone is Gay Influence Tolerance? Genetic, Environmental, Choice, and "Reparative" Explanations. Sex Cult. 2014;18: 994–1009. doi:10.1007/s12119-014-9233-6

124. Conger J. Proceedings of the American Psychological Association, Incorporated, for the year 1974: Minutes of the annual meeting of the cousin of representatives. American Psychologist. 1975;30: 620–651.

125. Daley A, Mulé NJ. LGBTQs and the DSM-5: A Critical Queer Response. J Homosexual. 2014;61: 1288–1312. doi:10.1080/00918369.2014.926766

126. Diagnostic and Statistical Manual of Mental Disorders, DSM-5. American Psychiatric Association; 2013.

127. Dewey JM, Gesbeck MM. (Dys) Functional Diagnosing. Humanit Soc. 2017;41: 37–72. doi:10.1177/0160597615604651

128. Schulz SL. The Informed Consent Model of Transgender Care: An Alternative to the Diagnosis of Gender Dysphoria. J Humanist Psychol. 2018;58: 72–92. doi:10.1177/0022167817745217

129. Spade D. Resisting Medicine. Berkeley Women's Law Journal. 2003;18: 15–37.

130. Pearce R, Erikainen S, Vincent B. TERF wars: An introduction. Sociol Rev. 2020;68:

677–698. doi:10.1177/0038026120934713

131. Ganna A, Verweij KJH, Nivard MG, Maier R, Wedow R, Busch AS, et al. Response to Comment on “Large-scale GWAS reveals insights into the genetic architecture of same-sex sexual behavior.” Science. 2021;371. doi:10.1126/science.aba5693

132. Coon JJ, Alexander NB. Retract Now. 12 Nov 2021. Available: https://docs.google.com/document/d/1oAAlUzQYQT8IldXLKWzRqz3B-BP-rXvwhYvdDJ1YSvo/edit

133. Frey JD, Poudrier G, Thomson JE, Hazen A. A Historical Review of Gender-Affirming Medicine: Focus on Genital Reconstruction Surgery. J Sex Medicine. 2017;14: 991–1002. doi:10.1016/j.jsxm.2017.06.007

134. Clancy KBH, Nelson RG, Rutherford JN, Hinde K. Survey of Academic Field Experiences (SAFE): Trainees Report Harassment and Assault. Plos One. 2014;9: e102172. doi:10.1371/journal.pone.0102172

135. Renn KA. LGBT and Queer Research in Higher Education: The State and Status of the Field. Educ Researcher. 2010;39: 132–141. doi:10.3102/0013189x10362579

136. Miller RA, Downey M. Examining the STEM Climate for Queer Students with Disabilities, Journal of Postsecondary Education and Disability. Journal of Postsecondary Education and Disability. 2020;33: 169–181.

137. Stein J, Appel M. How to deal with researcher harassment in the social sciences. Nat Hum Behav. 2021;5: 178–180. doi:10.1038/s41562-020-01011-6

138. Jimenez MF, Laverty TM, Bombaci SP, Wilkins K, Bennett DE, Pejchar L. Underrepresented faculty play a disproportionate role in advancing diversity and inclusion. Nat Ecol Evol. 2019;3: 1030–1033. doi:10.1038/s41559-019-0911-5

139. How to Ask About Sexuality/Gender. Lesbian, Gay, Bisexual, Transgender, Queer, and Intersex Life: Vanderbilt University; 2022. Available: https://www.vanderbilt.edu/lgbtqi/resources/how-to-ask-about-sexuality-gender

140. Cech EA, Waidzunas TJ. Navigating the heteronormativity of engineering: the experiences of lesbian, gay, and bisexual students. Eng Stud. 2011;3: 1–24. doi:10.1080/19378629.2010.545065

141. Linley JL, Renn KA, Woodford MR. Examining the ecological systems of LGBTQ STEM majors. J Women Minorities Sci Eng. 2018;24: 1–16. doi:10.1615/jwomenminorscieneng.2017018836

142. Jones JM. LGBT identification rises to 5.6% in latest US estimate. Gallup News. 2021. Available: https://news.gallup.com/poll/329708/lgbt-identification-rises-latest-estimate.aspx