

Biology & Human Rights: Short Segments Can Broaden Student Acceptance

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ABSTRACT

Human rights issues can be topics of conflict, resistance, and indifference; thus, these issues are seldom broached in traditional college STEM courses. In this article, I share process, content, and sources used to introduce college students to the biology of the singularity of race and the biology of sexual identity. One or two class meetings on the connections between biology and human rights were all that was necessary for students to recognize that science courses in fields such as human anatomy and physiology should address human rights issues; science courses can be used as venues to help explain human differences, and these discussions can be of personal significance and use to students.

Key Words: human rights; science and society; bioethics; anatomy; physiology; diversity; skin color; race; sexual identity; gender; civil rights.

○ Introduction

Carl Sagan wrote, “We have arranged things so that almost no one understands science and sooner or later the combustible mixture of ignorance and power is going to blow up in our faces” (Sagan & Druyan, 1997). There are a few topics that are partially or totally ignored in science courses yet need to be understood to help defuse the “combustible mixture”; two of these, race and sexual identity, are the topical focus of this paper. Race and sexual identity are grounded in biology; and, given their connections to the biological sciences, it is particularly important that these topics not be ignored in biology courses.

Historically, race and sexual identity are seldom discussed in science courses for a number of reasons, including their not being considered part of the curriculum; a lack of time; and the assumption that these are fraught topics associated

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with negative emotions, controversy, and occasional moral panic. For example, less than one-third of all college faculty include topics of diversity in their classes (Maruyama & Moreno, 2000), and the percentages for science faculty are much smaller (e.g., discussions on the subject of race are virtually absent in college biology courses; Morning, 2011; Donovan, 2015; Hubbard, 2017). Furthermore, a recent study found that racial achievement gaps were twice as large when STEM faculty believed that a student’s ability, based on race, is fixed, compared to STEM faculty who had an ability-growth mindset (Canning et al., 2019).

Previous studies have shown that short segments of scientific discourse and/or conversation can help overcome bias and prejudice (Broockman & Kalla, 2016; Truong et al., 2018). Knowing this, I wanted to test my hypothesis that as few as one or two college biology class meetings devoted to the scientific underpinnings of human rights could broaden the acceptance of human rights topics in science courses and enhance engagement within members of the class. The details presented here were applied in two college biology courses but could easily be adapted to high school instruction.

○ Course Setting

The subject content was presented in Human Anatomy and Physiology (A&P) I and II, a two-semester, upper-level biology course within the Department of Biological Sciences at Meredith College. The results reported here combine two consecutive years of the two-semester course. A total of 146 students were enrolled in A&P I, and 115 of those students continued on to A&P II. I was the instructor for the courses. “Race” was the topic for a single 50-minute class meeting in A&P I as part of the unit on

the integument (i.e., skin); and “sexual identity” was the topic for a single 50-minute class meeting as part of the unit on reproduction in A&P II.

Students participated in a “flipped classroom” that included “watch-read-think” activities that were to be completed prior to attending class. Students were assigned to *watch* a few short videos related to subject content; to *read* a concept narrative with supporting slides found in Brightspace, Meredith College’s cloud-based learning management system, and to *think* by forming written responses to several reflective statements or questions based on the videos and narratives. Class time included an instructor-led discussion of the major talking points followed by peer-group problem solving and reflection. Class concluded with the collection of written “think” responses and peer-group responses, a verbal summary of class-wide conclusions, and a short survey. Individual and group responses were not graded but were used to qualitatively assess whether student learning was incorporated into biology concepts that support equity.

○ Singularity of Race – Lesson Plan

Students were asked to watch the following videos before the class meeting:

- “Human Migration” (2 min., Wisdom Land, 2015), <https://www.bing.com/videos/search?q=human+migration+map&view=detail&mid=7009E9FCF4C8269933B27009E9FCF4C8269933B2&FORM=VRDGAR>
- “Race and Genetics” (11 min., TEDx Talks, 2016), <https://www.bing.com/videos/search?q=dr.+allen+gathman+you+tube+race+and+genetics&view=detail&mid=6726089EC54FE96DB55C6726089EC54FE96DB55C&FORM=VRDGAR>
- “The Biology of Skin Color” (18 min., HHMI Biointeractive, 2020), <https://www.biointeractive.org/classroom-resources/biology-skin-color>

Students were asked to read a narrative prior to our class meeting that included the major biological concepts associated with the singularity of race. A synopsis of the narrative with sources follows.

There is no biological evidence to suggest that there are any races or subspecies of humans, *Homo sapiens*; we are all too much alike (Ingman et al., 2000). Numerous scientific papers have been written that support the absence of correlation between DNA differences and racial identity (Azvolinsky, 2018); yet, even though there is no human trait that can define a race, skin color has been misused by society to classify people into races, and throughout history racial identity has been used extensively to deprive humans of their civil liberties.

Variations in skin color are an adaptation to the effects of too much or too little exposure of skin to sunlight due to the evolutionary loss of body hair as a result of selection pressures created by the effectiveness of evaporative cooling in humans (Jablonski & Chaplin, 2000; Jablonski, 2012). Too much solar radiation exposure can alter DNA base sequences in skin that can lead to skin cancer. Additionally, sunlight can destroy folate, one of the metabolically important B vitamins. Alternatively, too little sunlight can be problematic because ultraviolet-B radiation in sunlight is

a requirement for vitamin D synthesis by skin. Vitamin D is required for calcium absorption and specific immunocompetencies (Montoya et al., 2014).

Skin color is darkest where sunlight intensity is greatest, such as the low latitudes or high altitudes; and lightest where intensity is low, such as in higher latitudes (Jablonski & Chaplin, 2000; Jablonski, 2012; Tang & Barsh, 2017). Researchers have identified six genes within four genomic regions that are associated with skin color. The six genes are termed *SLC24A5*, *MFSD12*, *DDB1*, *TMEM138*, *OCA2*, and *HERC2*; and individual genes as well as combinations of genes are associated with the many variations of skin color (Lamason et al., 2005; Crawford et al., 2017; Gibbons, 2017; Adhikari et al., 2019).

With the use of evidence-based dialogue, we can help alleviate the harmful disparity between various ancestral groups of people; however, we need to be careful not to merge the concept of the singularity of race with the removal of social, cultural, health care, and ethnic differences between peoples of differing ancestries. To do so would deprive people of their ancestral identity, pride, heritage, health, and well-being (Yudell et al., 2016).

○ Sexual Identity – Lesson Plan

Students were asked to watch the following videos before the class meeting:

- “The Diversity of Sex, Gender, and Sexual Orientation” (18 min., Strong Medicine, 2017), https://www.youtube.com/watch?v=2yM_P6WdRJU
- “The Biology of Gender, from DNA to the Brain” (13 min., TED, 2019), <https://www.youtube.com/watch?v=HLEgiR1Fsd5>

Students were asked to read a narrative prior to our class meeting that included the major biological concepts associated with sexual identity. A synopsis of the narrative with sources follows.

Are there more than two sexes? According to the binary chromosome pattern, XX = female and XY = male, but if there are other sex chromosome combinations, or variations in cellular genetic interpretation, there must be more than two sexes as well as sexual orientations; and there are many. Understanding XX pairing that results in a female is relatively easy to grasp, but what is it about the Y chromosome that creates a male? Turns out, very little – only two genes on the entire Y chromosome are required, the *Sry* and the *Eif2s3y* genes – *Sry* for male sex determination in the developing embryo and *Eif2s3y* to drive sperm production (Capel, 2014; Yamauchi, 2014). If the *Sry* gene becomes attached to XX, the result is *XXSry* – one example of more than two sexes. If you did a chromosome analysis or karyotype of an *XXSry* individual, you would not see the *Sry* gene and would thus call the person a biological female, only to find that this person had the body form and genitalia of a male because the *Sry* gene triggered the development of a male, and therefore this person would likely self-identify as male (Capel, 2014).

XXSry is a good example of the very important gene-driven role that hormones play in sex differentiation and development of sexual maturity. Prior to birth and at puberty, variations of specific fetal, maternal, and/or developmental hormones can lead to dramatic anatomical and functional differences in males and females (Orpha.net, 2019).

Table 1. Average percentages of students in Human Anatomy and Physiology (A&P) I and II, during two academic years, who agreed to the survey statements at the beginning of the fall semester and at the end of the spring semester. For each value given, 100 minus the value is the percentage who did not agree or offered no opinion. Statistical comparisons of the two percentages for each statement were conducted through the use of two-sample tests of proportions. *P*-values <0.001 are listed as 0.000.

Statement	Percentage Who Agreed at Beginning of Fall Semester (N = 146)	Percentage Who Agreed at End of Spring Semester (N = 115)	<i>P</i> (χ^2_1 test statistic)
It is important to relate science courses to societal issues.	84% 122/146	100% 115/115	0.000 (20.8)
It is important to relate science courses to human rights.	70% 102/146	95% 109/115	0.000 (25.7)
It is important to relate A&P to societal issues.	62% 91/146	94% 108/115	0.000 (35.4)
It is important to relate A&P to human rights.	64% 93/146	94% 108/115	0.000 (33.1)
There should be more emphasis in science courses on societal issues such as human rights.	45% 66/146	86% 99/115	0.000 (46.2)
[On spring survey only:] A&P has given me information that may change my position or attitude on human rights or allows me to be more comfortable about entering into discussions on human rights.	NA	94% 108/115	NA

Biological imperatives of sexual orientation can also be a function of differential and developmental operatives; and from a biological point of view, science needs to contribute as much as possible to help alleviate the sociopolitical malady associated with gender dysphoria. There are two areas of recent scientific research that demonstrate the biological imperatives of sexual orientation: (1) the biological implications in people who are transgender, where brain anatomy and neural activity is linked to gender identity (Junger et al., 2014; Zubiaurre-Elorza et al., 2014; Harper, 2015; Smith et al., 2015; Guillamon et al., 2016; Muller et al., 2017; Burke, 2018; Kornei, 2018; Williams, 2018), and (2) the biological connections to gender in men who are gay (Hamner et al., 1993; Blanchard, 2004; Rahman, 2005; Stern, 2013; Kaiser, 2014; Servick, 2014; Balter, 2015; Ngun & Vilain, 2015; Sanders et al., 2015; Ganna, 2018; Price, 2018; Ganna et al., 2019). To summarize much of this research: sex, gender, and sexuality have continually evolved over millions of years to create a human reproductive-system genome that potentially contains thousands of bits of interactive DNA that is influenced by internal as well as environmental forces, and a large portion of this genome is important for the survival of our species. There may be choices as to how any one of us expresses our sexuality, or lack thereof, but sexual orientation is a biological imperative and is not a choice.

○ Analysis of a Single Session per Course in A&P I & II

I used a short survey to help me analyze the questions created by my hypothesis. Could the students in my A&P classes demonstrate

markedly improved perceived importance of including human rights topics in science courses, as well as enhanced engagement? An anonymous, single-blind survey was given during academic years 2015–16 and 2016–17 to the same cohort of students at the beginning of A&P I in the fall semester of each academic year and again in A&P II at the end of the spring semester of each academic year. The survey was approved by the Meredith College Institutional Review Board (IRB; file no. 937). All of the students enrolled in the classes took the survey in the fall and spring. A total of 146 students took the survey at the beginning of the fall semester, and 115 took the survey at the end of the spring semester. The results for each of the two academic years were comparable; responses to any of the survey statements varied from year to year by no more than 5%. The students could respond to the survey statements as follows: “Agree,” “Disagree,” or “Haven’t Thought About It / No Opinion.” Students were also given the opportunity to provide comments. Two-sample tests of proportions were used to evaluate whether the proportion of students that agreed at the beginning of the course differed from that at the end of the course (Table 1). Because the survey data were anonymous, individual responses at the beginning and end of the semester could not be paired.

Student perceptions on the importance of incorporating topics of social relevance in an A&P course, as well as in other science courses, changed during the span of the two courses, with significantly higher rates of agreement observed toward the end of the course sequence. The results of the first two questions suggest that, at the beginning of the course, 14% of students did not think “human rights” were societal issues. It is interesting that at the beginning of the academic year, many students did not think

A&P was a science course that should relate to societal issues/human rights; yet by the end of the course, 94% agreed that it should relate. The most dramatic shift in perception was the number of students who thought that science courses, in general, should include topics covering societal issues such as human rights – going from only 45% agreement in the fall to 86% agreement in the spring. It was gratifying to find, by the end of the A&P courses, that 94% of the students felt they had received information on human rights that was important and/or useful to them.

Typical student comments about the human rights information presented in these classes, as well as other comments, are listed below. There were no negative statements. Qualitatively, the comments spoke highly of the role of biology to advance equity through understanding and acceptance of human differences, and self-confidence to engage with others.

- “I would now be more comfortable talking about human rights knowing a lot of the science behind the rights.”
- “I now have information that I can share.”
- “My acceptance of the LGBTQ community has been increased.”
- “I now understand the science behind skin color.”
- “LGBTQ identity is grounded in science.”
- “I am more confident with my own differences.”
- “I now have factual information to justify my opinions.”
- “Thank you. I am now better able to support and argue for my ideas.”
- “There is a great deal of genetic and biological reasoning that I was not familiar with.”
- “Seeing the biological perspective on sexuality definitely opened my mind.”
- “This unit definitely made me think about the singularity of race.”
- “This lecture made me a lot more comfortable and confident when it comes to talking about these topics.”
- “My attitude towards human rights has been changed because of this new information.”
- “I feel comfortable and confident to defend these basic rights for all people of the world.”
- “I now think that science should play a huge role in human rights topics.”
- “There is a genetic basis for gender and sexuality.”
- “There is no justification to judge or treat someone differently just because they appear to be different.”
- “I have a better understanding, but would prefer not to get into a discussion about this.”
- “I enjoyed learning about biological imperatives.”
- “I am gay. Thank you so very much for this class.”

○ Future Directions

Further research is needed to determine whether these human rights concepts could be integrated into introductory biology

courses and produce similar results. In the fall semester of 2019, I presented these topics during a single 80-minute introductory biology class, Principles of Biology. A survey approved by the Meredith College IRB (file no. 1023) was administered at the end of the class meeting. The results were analogous to the A&P class surveys; however, with only 35 students in the class, no conclusive statistical analysis could be made. In early 2020, further research was stymied because all classes went totally online due to the COVID-19 pandemic; nevertheless, more data will be collected when on-site Principles of Biology instruction returns to campus. A rubric to evaluate individual and group responses will be collected at the end of each class meeting to further assess student learning in biology that supports equity. In addition, a control-comparison between A&P classes, and between Principles classes, that did not receive the instruction and classes that did, will be incorporated into the assessment process.

○ Conclusion

Within the classical sciences, including biology, human rights topics tend to be ignored. Human rights issues are societal and civil rights issues, and science can be an important ingredient in granting equality and respect to all of humanity. Those of us in science education need to overcome our fear of contentiousness; and, with the appropriate mixture of context, process, and reflection, in balance with content, we can and should include human rights topics in the disciplines that are the bulwarks of science. Evolution has resulted in only one human race with multiple genders, and our singular racial identity as well as our gender differences are not a choice, but run as deep as our DNA. One or two class meetings on the connections between science and human rights are all that is required for students to recognize that science courses should address human rights issues; science courses can be used as venues to help explain human differences and can be of personal significance and use to students.

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