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## **Surprised by co-creation; building equality, diversity and inclusion (EDI) in the physiology curriculum with undergraduate students**

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## PERSPECTIVES

## Surprised by cocreation: building equality, diversity, and inclusion in the physiology curriculum with undergraduate students

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## INTRODUCTION

As public-facing global institutions, modern universities are subject to equality legislation (locally the United Kingdom Equality Act; Ref. 1) and the need to represent an increasingly diverse student body. For effective education, this broad cohort needs to see itself represented both in the curriculum and in the very structures of the university (2). It is with this in mind that staff in the Centre for Biomedical Sciences Education in Queen's University Belfast recruited three students from diverse backgrounds to codesign aspects of the Undergraduate Physiology Curriculum for Medicine and Health and Life Sciences (MHLS) degrees. As part of a 6-week summer internship, our students set out to identify gaps in the physiology curriculum regarding those with protected characteristics as described by the UK Equality Act 2010 (race, sex, gender reassignment, marriage or civil partnership, pregnancy and maternity, religion and belief, disability, and sexual orientation; Ref. 1). Our aim was to incorporate Equality, Diversity, and Inclusion (EDI) principles to create a learning environment that celebrates people's differences and represents individual students. Themes that developed over the 6-week period of the internship were recognizing oneself in the curriculum, cultural humility, and intersectionality.

## SELF-RECOGNITION IN THE CURRICULUM

It is crucial to have a focus in the curriculum on representing all kinds of identities (2). It has become more recognized that the standard 70-kg man (physiological man) mentioned in the fundamental physiology texts (3) does not represent the populations of the world with diverse race, genetics, height, sex, gender, weight, sexuality, age, and life experiences. This is something that has become increasingly problematic for researchers and subjects (4, 5), for students, and for the discipline at large (6). Put simply, it also means that students who are taught using data attributed to the standard 70-kg man may not recognize themselves in the curriculum. Simple changes can improve engagement and learning and help develop future health care workers who not only have become more invested in an authentic curriculum but also learn to see individuals rather than numbers or averages.

## CULTURAL HUMILITY AND INTERSECTIONALITY

Cultural humility can be defined as a process of self-reflection and exploration outside of one's culture to gain interpersonal understanding and awareness of others' experiences. It is fundamentally an acknowledgment that we can never be an expert on anyone else's lived experience (7). Our students, coming, as they do, from different backgrounds identifying with many of the protected characteristics, have been a huge resource in allowing us to identify gaps in the curricula and apply their broader life experiences and more contemporary perspectives to the material that they use for learning. Through cocreation with an awareness of EDI, we highlight the importance of leaving this view of what is "normal" in historical textbooks and encourage students to look beyond the averages and focus on the individual.

Taking this a step further, intersectionality (a term first used in 1989 and applied to race and gender; Ref. 8) is a critical concept that recognizes how individuals hold multiple identities and face unique challenges at the intersections of those identities. The concept of intersectionality has since been adopted more widely in campaigns for equity and gets away from the critique of EDI as putting people in silos with convenient labels. Intersectionality is especially needed in the physiology classroom because it encourages more precise and authentic descriptions of populations and avoids classifying them within broad boxes. Female reproductive physiology is an excellent example. It is crucial to recognize the differences within a woman's ethnic background, age, and socioeconomic status (SES), as each has the potential to overlap and play a role in an individual's health status. Race can significantly influence female serum sex hormone levels and menopausal clinical symptoms (9). By including this intersectionality in the curriculum we aim to move beyond a "one size fits all" mindset, thus being more authentic and scientifically valid.

## SOME EXAMPLES: STEPS IN THE RIGHT DIRECTION

The following are examples of simple changes that can be implemented to increase cultural humility, intersectionality and self-recognition in the curriculum.

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## Pre-Lab Declaration

Taking inspiration from a Lesson on Reproductive Physiology (available in the Human Physiology Collection in Lt Kuracloud from ADInstruments; Ref. 10), we worked to create a disclaimer (Fig. 1) with the aim of enhancing students' awareness of the appropriate language to use when dealing with potentially sensitive information, for example, with regard to sex and gender. Initially written with the intention of being included in lung function practical classes for all MHLS students, it defines genotypic sex (referring to an individual's chromosomes) and phenotypic sex (derived by gonads, hormones, and reproductive anatomy) and describes how they may not match the individual's gender identity throughout life. To be more inclusive of those not represented by simplified, dimorphic language (male/female), this disclaimer can be used to ensure that students understand why specific details are necessary in a clinical setting, i.e., preventing comparisons

to incorrect reference ranges and thus misdiagnosis. By dealing with sensitive topics openly in the laboratory setting, students will begin to develop professionalism and respect toward potentially triggering topics. Similar disclaimers could potentially be used to highlight other protected characteristics, e.g., effects of religious fasting in relation to plasma glucose concentrations, making each individual student feel seen in the curriculum. The only limit is the creativity of the writer, and these practical guides could be considered live, developing documents.

## Female Health and Contraception

Focusing more on female health in the curriculum not only improves female health care but can reduce student anxiety, particularly with regard to unplanned pregnancy. It is estimated that worldwide 151 million women of reproductive age used oral contraceptives in 2019; however, 162.9 million

## Pre-lab considerations

**The following practical was co-designed with Human Biology and Biomedical Sciences students in QUB with the aim of incorporating Equality, Diversity and Inclusion (EDI) in Physiology class activities to create a learning environment that celebrates people's differences and represents individual students.**

The physiology of the pulmonary system will be assessed in this class, and students will learn to perform lung function tests and interpret results. Within the context of respiratory physiology, the subject's phenotypic sex during development and maturation of the lungs is important to ensure accurate comparisons to normal ranges.

An individual's chromosomes (e.g., XX, XY, X, XXY) determines their Genotypic sex, which generally determines Phenotypic sex (outward appearance). When considering sexual phenotype we often focus on gonads (ovaries or testes), hormones, internal reproductive anatomy and external genitalia however phenotypic sex differences also exist in the lungs.

Phenotypic sex will often be designated in binary (dimorphic) forms at birth (male vs female); phenotypic sex assigned/observed at birth may not always align with the individual's gender identity throughout their life, nor accurately represent their genetic makeup.

While the language of this lab aims to be inclusive of all forms of sexual and gender identities, for medical/diagnostic accuracy in calculating normal ranges, when 'sex' is utilized it refers to the phenotypic sex governing the development and maturation of the lungs and thoracic cavity dimensions which are historically aligned with dimorphic sex assigned/observed at birth and hormones present during puberty. It is fully acknowledged that more research is required to expand our understanding of lung parameter differences associated with, for example, transgender treatments (eg gender affirming treatments pre- and post- puberty and chest binding) and genotypic variation (eg XXY vs XX).

There is no requirement for any subject to disclose their genotypic or phenotypic sex or any medical treatments that you are undergoing in the course of this class however if anyone wishes to explore these topics either specifically or generally we ask that, as with any medical information, you approach this discussion professionally and confidentially in a sensitive, inclusive and respectful manner.

**Figure 1.** Pre-lab declaration inspired by a Lesson on Reproductive Physiology by ADInstruments (Lt Kuracloud; Ref. 10). This statement is designed to introduce inclusive concepts in the practical class, allowing students to understand why patient-specific details are necessary in a clinical setting while encouraging development of cultural humility regarding sex and gender.

women still had unmet contraceptive needs (11). It is also reported that users of combined oral contraceptives have two to nine times higher risk of venous thromboembolisms compared to nonusers. By including information regarding contraceptives in the physiology curriculum regarding reproduction but also hemostasis, some students in the classroom may have unmet needs resolved, some may have their anxiety around using contraception alleviated, some will understand their risks better, but all will be able to comprehend the role that estrogen has in increasing factors involved in blood clotting, thus understanding physiology better (12).

### Hematology: Race and Transgender Inclusion

With regard to hematological disorders the stigma of sickle cell disease (SCD) in some populations significantly impacts health outcomes. Ninety percent of the world's population of SCD patients live in Nigeria, India, or the Democratic Republic of Congo, where 2% of the population suffer from the condition (13). The consistent portrayal, however, of SCD as a “black” disease by the media (despite Hispanics in the United States population showing a higher mortality rate to SCD than Black patients; Refs. 14, 15) has affected public attitudes and perceptions. Many have perceived the condition as cultural; some believe that Black people are genetically deficient or that the disease is unique to the Black race. Multilayered social stigma affects patients themselves as well as health care providers, some of whom struggle with advising SCD patients in a racially appropriate/sensitive manner, leading to poorer health outcomes (14). Intertwining the discussion of race, disease epidemiology, genetics, and social impact into the physiology curriculum helps mitigate harmful stereotypes. This intersectionality has the potential not only to change attitudes but ultimately to improve treatment and patient outcomes.

In terms of learning opportunities for students, in-class discussions around amenorrhea in cis-females, amenorrhea as a result of cross-sex hormone therapy, and amenorrhea in menopause are very important but are often neglected in favor of “normal physiological” hormone cycles. When we add in the hematological consequences of amenorrhea, the need for these discussions becomes even more paramount. Although menopausal changes are becoming more visible in curricula and students may make the intellectual leap to hematological outcomes of menopause in cis-females, the consequences of transgender treatments are not often spoken of, possibly because the research in this area is relatively new (16, 17). Including questions exploring the possible consequences of cross-sex therapy in hematology classes allows transgender students to feel included in the dialogue, stimulates cis-gender students to consider how trans-gender experiences of clinical diagnosis may be different from theirs, and benefits all students by highlighting the intersection of endocrinology and hematology.

### SOME CONCLUSIONS

The conclusions of the internship are best captured by a line from the students' summary document; “By understanding how each other's lives have shaped each of us, we

began a journey to uncover the beauty in things learned from alternative perspectives.” We, as seasoned educators, were surprised at the maturity, professionalism, and authentic passion of the student investigators. Their ability to look beyond their own perspectives and challenge themselves was truly inspirational. The project served mainly to inform us that decolonization is a huge task, whose surface we barely scratched. Notwithstanding this, in 6 weeks, our student cocreators achieved significant changes in our curriculum. We would highly recommend that every teaching department (not just physiology) simply ask their students what topics they want to investigate to increase representation and recognition within the curriculum while providing space for them to explore their own and each other's diverse life experiences. Student cocreators are an essential but hitherto underutilized university resource.

### DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

### AUTHOR CONTRIBUTIONS

M.K.M., J.V., N.N., D.K., A.A., and S.M.R. conceived and designed research; J.V., N.N., and D.K. performed experiments; J.V., N.N., and D.K. analyzed data; M.K.M., J.V., N.N., D.K., and S.M.R. interpreted results of experiments; M.K.M. and J.V. prepared figures; M.K.M., J.V., N.N., and D.K. drafted manuscript; M.K.M., A.A., and S.M.R. edited and revised manuscript; M.K.M., J.V., N.N., D.K., A.A., and S.M.R. approved final version of manuscript.

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