Biology textbooks do not provide students with comprehensive view of science of sex and gender, say professors

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The teaching of science has long generated controversy in the United States—from evolution in the early 20th century to climate change

today. Debates have also often emerged around how textbooks teach concepts related to social groups, and in particular whether they gloss over complex realities in ways that may mislead students in providing scientific instruction.

In an effort to investigate this matter, a team of researchers examined how biology textbooks in the U.S. instruct students about sex and gender. Its findings showed that these concepts are frequently described in ways that are at odds with scientific research.

The study, which appears in the journal *Science*, raises questions about the accuracy of high school biology curricula and offers a roadmap for their reform in ways that reflect scientific knowledge.

"The findings serve as a call to action—it is important that the high school biology curriculum is revised so that it reflects accurate scientific knowledge rather than misguided assumptions that may foster gender stereotyping and discrimination," says Andrei Cimpian, a professor in the Department in the Psychology at New York University and one of the paper's senior authors.

The study, which also included researchers from BSCS Science Learning and the University of Texas at Austin, examined whether textbooks communicated "essentialism" about sex and gender. Essentialism is a widespread, but scientifically inaccurate, view rooted in the idea that there is a genetic "essence" that makes women and men the way they are. Because of their assumed distinct genetic essences, women and men are also assumed to be discrete, non-overlapping groups—not just in terms of reproductive anatomy, but also in terms of their psychology and behavior.

The research published in *Science* set out to characterize how textbooks describe sex, which is a complex set of biological features related to

reproduction, and gender, which is a socially constructed interpretation of the biological phenomenon of sex. The scientific consensus is that sex and gender are distinct phenomena and that both are inconsistent with the essentialist view that is common among the general public.

Its analysis of six textbooks—published between 2009 and 2016 and used in an estimated two-thirds of high school introductory biology classes across the U.S.—found that none of the textbooks differentiated between the concepts of sex and gender, despite the clear distinction made between them in the scientific literature.

In addition, consistent with the idea that textbooks communicate essentialist views to students, more paragraphs described people of the same sex or gender as uniform rather than different from each other—whereas in reality differences are the norm. Women differ from each other substantially—in physical traits, personality, and preferences—as do men.

The studied textbooks also suggested that variation in one or more genes inherited through the sex chromosomes was the most plausible explanation for variation within and between gender or sex groups—overlooking the key role of environmental factors and instead reinforcing the mistaken notion of a genetic "essence."

"Overall, the ways in which textbooks described sex and gender are more consistent with essentialism than with the scientific consensus on these topics," explains Catherine Riegle-Crumb, a professor in the College of Education at the University of Texas at Austin and one of the paper's senior authors.

Prior research has found that essentialist assumptions have a range of negative consequences, including gender stereotyping, the dehumanization of women, and support for gender discriminatory

practices. The embedding of these assumptions in biology textbooks, then, raises concerns that students are learning about phenomena in ways not backed by science.

"Our study suggests that the material that adolescents are exposed to in school textbooks might itself—even if unintentionally—be a source of essentialist ideas," says Brian Donovan, a senior research scientist at BSCS Science Learning, a nonprofit organization in Colorado Springs, and one of the paper's senior authors.

"It's not unusual for textbooks to discuss ideas that were considered accurate earlier in the history of science and are now known to be incomplete. But essentialism is not a scientific model—it's an overly simplistic lay view that is at odds with the scientific consensus on sex and gender," adds Donovan. "It should have no place in the biology curriculum."

More information: Brian M. Donovan et al, Sex and gender essentialism in textbooks, *Science* (2024). DOI: 10.1126/science.adi1188 . www.science.org/doi/10.1126/science.adi1188

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