

March 30, 2021

To: Committee Members, NAS/BOSE Call to Action for Science Education
From: Andy Zucker, Ed.D., Penny Noyce, M.D., & Cary Sneider, Ph.D.
Re: Comments for members of the committee and the public

We appreciate the opportunity to provide comments to the committee. As science educators with decades of experience leading state and national projects, we have studied and written about improving K-12 science education, especially the role of science education standards. Dr. Zucker was the keynote speaker at the 125th annual meeting of the Science Teaching Association of New York State in 2020. Dr. Noyce is a past member of the Massachusetts Board of Elementary and Secondary Education. Dr. Sneider was a lead author of the *Next Generation Science Standards*. In 2020 Zucker and Noyce published a popular, free curriculum unit for science classes called Resisting Scientific Misinformation.

The challenges

What are the two biggest challenges that need to be addressed? Testimony for the committee on March 24 identified multiple priorities, making the committee's task a tough balancing act. At the top of our list is this: **Science education in schools should help students make decisions about science-related personal and societal issues.** This goal is not widely recognized as a national or state priority, which is strange because there is great interest in civic education, which [keeps growing](#). **A second key challenge is students' diminishing interest in science as they move through school.** According to NAEP, for example, in 2015 fewer than 60% of American high school seniors enrolled in *any* science class, and half of those reported they enrolled only because they had to. Too many students lose interest in science as it is now taught.

Few people in the United States are scientists, yet all of us make choices about health and diet for ourselves and our families, and we all purchase products that claim, with variable accuracy, to be based on scientific research. American citizens vote for candidates and ballot initiatives, contribute to political campaigns, run for office, manage town meetings and legislatures, pass laws and issue regulations, and create spending priorities. Science education ought to help students think about issues, questions, and decisions that they face both now and in the future. This means decisions about college and careers but also decisions related to their personal and civic lives that can and should be informed by science. Because such decisions are rarely based entirely on science, students (who include future politicians and policymakers) need practice applying values and balancing costs, competing interests, benefits, and tradeoffs as they make decisions that have a scientific component. This kind of practice may help mitigate our society's current tendency to polarize rigidly over complex issues. Students also need to learn how to guard against misinformation. Practice judging the quality of allegedly scientific information, through whatever media it may come, including advertising and social media, can help hone students' ability to resist misinformation of all sorts. At present, schools provide students with little practice making judgments related to scientific issues.

Preparation for college and careers is the sole explicit goal of most science education, but [one-third of all high school graduates](#) never enroll in college, and many students will work in careers that have nothing to do with science or technology. Meanwhile, even many college graduates struggle to apply scientific thinking to personal or civic decisions. In our view, the *Next Generation Science Standards* (NGSS) should be revised to strengthen preparation for daily life.

The NGSS has many strengths, including a focus on "scientific practices" as well as disciplinary core ideas (content), and placing a priority on teaching about climate change. Although the NGSS includes the idea that science, technology and engineering profoundly influence society and the environment, the authors did not include it as a core idea, a decision we lament. We believe this idea should be elevated, with a focus on such issues as public health and the role of science in government affairs. As examples of what is missing, we would like to see the NGSS prioritize teaching about public health, vaccines, immunity, the CDC, the FDA, the EPA, the IPCC, and how to judge the quality of sources of information about science. Since it is a model for most states, we recommend broadening the NGSS to more clearly connect science to one's own life and to other people's lives, which should be essential goals for all students, whether or not they eventually pursue a science career. We hope the report of your committee will include this recommendation.

Proposed messages to policymakers

We advocate that policymakers promptly and clearly identify preparing students for civic life as a major goal for science education, in addition to preparing students for college and careers. Massachusetts, one of the highest-performing states on NAEP’s science assessment, already does so. The Massachusetts Vision for STE Education identifies three important goals: civic participation, college preparation, and career readiness. The state’s STE Vision notes the importance of “leveraging multiple relevant societal contexts from STE,” and one of its Guiding Principle states that, “An STE curriculum that is carefully designed around engaging, relevant, real-world interdisciplinary questions increases student motivation, intellectual engagement, and sense making.”

Similarly, the National Science Teaching Association issued a three-page [Position Statement](#) in 2016 advocating teaching science “in the context of societal and personal issues.” The National Association of Biology Teachers believes that [excellent biology teachers](#) “follow an integrated approach by incorporating other subjects, technology, society, and ethics.” People are interested in themselves and others, as well as phenomena. In 2020 alone the three NSTA K-12 teacher journals published more than 50 articles about teaching science in societal or personal contexts. These articles were more popular than others, and received more than 12,000 views online. As one example, an excellent article in *Science Scope* describes a science unit for middle school students about the lead pollution problems in Flint, Michigan, which especially affected low-income families of color.

In short, teachers already know that teaching science in the context of societal and personal issues is important, despite the fact that the NGSS and most state science education standards do not make that clear. State tests, teacher professional development opportunities, and model lessons based on the NGSS or state equivalents also do not place a priority on teaching science in the context of societal and personal issues. They should. Eventually, the NGSS should be revised to include a focus on personal and societal contexts, although that seems unlikely to happen soon.

In the near term, we recommend that state and local policymakers prioritize teaching science in the context of societal and personal issues. The NGSS describes minimum expectations, and is not a curriculum. More science lessons can and should include personal and societal issues, and more states should adopt a broader vision for STE education.

Whether connected to the NGSS or not, it would be helpful to see an effort focusing on personal and societal issues that identifies what is important to teach, at what grade level. About half of adults in 2018 did not know that antibiotics won’t kill viruses. That topic would be straightforward to teach even in elementary schools, but is not in the standards. Similarly, it would not be hard to teach students in the middle grades what a number of science-related agencies like the CDC and the EPA do, and how they reach decisions. All students should have these opportunities.

Middle school is also an ideal time to begin teaching students healthy skepticism about statements made in popular media. Such instruction makes a difference. E.g., in [one experiment](#) researchers found that explaining the flawed arguments used by climate change deniers “fully neutralized the polarizing effect of misinformation.” That calls for science instruction about how advertisers, and others, can try to mislead people—material that is easily available but is not included in the NGSS, *per se*.

It is more challenging, but also vital, to teach some science in personal and societal contexts in a way that considers costs, benefits, tradeoffs, and values. Which vaccinations should be required by law, for whom, and why? Should humans be cloned? What are the tradeoffs when buying an electric or hybrid car, or voting for a state ballot initiative about clean energy? There are dozens if not hundreds of relevant, tested lessons. **We recommend that science teacher preparation programs include components that help more teachers manage class discussions about science-related issues with multiple right answers and multiple points of view consistent with scientific evidence.**

Changing the emphasis of science education in this way will come naturally to some teachers, but not to others, which is why support for such changes is vital. Such support could come from national statements, state standards, teacher preparation programs, learning materials used in schools, encouragement of interdisciplinary and team teaching, and new reward structures for teachers, among others. If the nation can successfully achieve this change of emphasis, students will be more interested in science than at present, and they will become more [scientifically literate](#).