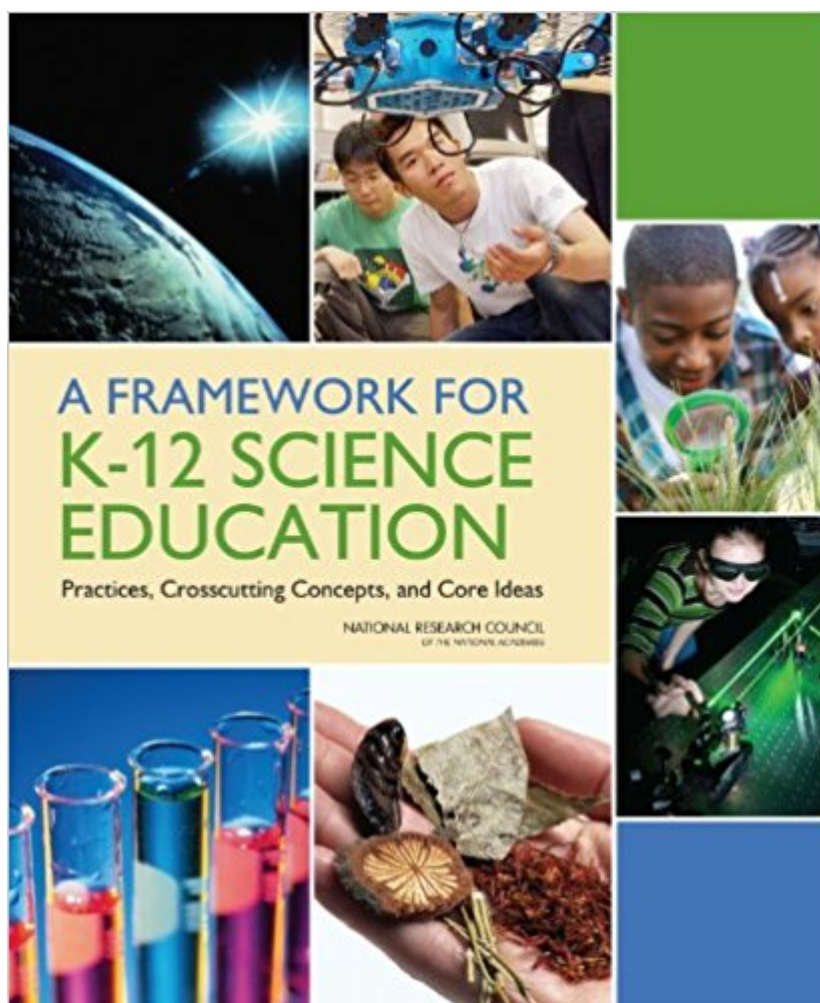


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# A Framework For K-12 Science Education: Practices, Crosscutting Concepts, And Core Ideas



## Synopsis

Science, engineering, and technology permeate nearly every facet of modern life and hold the key to solving many of humanity's most pressing current and future challenges. The United States' position in the global economy is declining, in part because U.S. workers lack fundamental knowledge in these fields. To address the critical issues of U.S. competitiveness and to better prepare the workforce, A Framework for K-12 Science Education proposes a new approach to K-12 science education that will capture students' interest and provide them with the necessary foundational knowledge in the field. A Framework for K-12 Science Education outlines a broad set of expectations for students in science and engineering in grades K-12. These expectations will inform the development of new standards for K-12 science education and, subsequently, revisions to curriculum, instruction, assessment, and professional development for educators. This book identifies three dimensions that convey the core ideas and practices around which science and engineering education in these grades should be built. These three dimensions are: crosscutting concepts that unify the study of science through their common application across science and engineering; scientific and engineering practices; and disciplinary core ideas in the physical sciences, life sciences, and earth and space sciences and for engineering, technology, and the applications of science. The overarching goal is for all high school graduates to have sufficient knowledge of science and engineering to engage in public discussions on science-related issues, be careful consumers of scientific and technical information, and enter the careers of their choice. A Framework for K-12 Science Education is the first step in a process that can inform state-level decisions and achieve a research-grounded basis for improving science instruction and learning across the country. The book will guide standards developers, teachers, curriculum designers, assessment developers, state and district science administrators, and educators who teach science in informal environments.

## Book Information

Paperback: 400 pages

Publisher: National Academies Press (March 28, 2012)

Language: English

ISBN-10: 0309217423

ISBN-13: 978-0309217422

Product Dimensions: 1 x 8.2 x 10 inches

Shipping Weight: 2.6 pounds (View shipping rates and policies)

Average Customer Review: 4.2 out of 5 stars 21 customer reviews

Best Sellers Rank: #59,513 in Books (See Top 100 in Books) #65 in [Books > Science & Math > Science for Kids](#) #90 in [Books > Education & Teaching > Schools & Teaching > Instruction Methods > Science & Technology](#) #100 in [Books > Education & Teaching > Schools & Teaching > Education Theory > Research](#)

## Customer Reviews

The Framework is the basis for the "Next Generation Science Standards" (NGSS) which Michigan's State Board of Education will consider some time in 2014. I serve on that board and wanted to understand the NGSS, so I obtained the Framework and read through it. Like many professional education treatises, it is not an easy read, having the excitement of your automobile manual, with portions of great usefulness buried amid the tedious, the obscure, and the redundant. This latter is partly because the volume was authored by a committee, a committee that qualifies much, but assumes much. Everything is footnoted, but the pages upon pages of references raise their own questions about assumptions, for one can cite many studies that share the assumptions you share but don't actually prove the point. The Framework proposes less content but deeper understanding of science concepts ("big ideas" in my words), a theme I have encountered in education literature for 40 years. Apparently nobody has gotten it right in all that time, and this framework is explicit at times, informing us that even those who have majored in science in college probably don't have the understanding of science necessary to understand science. This implies a whole change of system, how we teach kids on every level, how we prepare teachers, how we test kids, professional development, etc. At the same time, the exact sequence of concepts that ought be taught, and in what grades, is still in need of research. This is the Framework's greatest weakness. It suffers from the hype that dominates so much of educational policy discussion, not that prose is emotional, but that what is called for is simply unrealistic. How can we adopt standards if the majority of teachers don't understand science, even those who majored in it in college? Where will we find people to implement changes so sweeping? Where is the continuity with what has been taught here-to-fore? My concern with standards is for the lower 50% achieving students. Such sweeping changes in instructional standards will leave the lower-performing students (who often have lower performing teachers) in the lurch. Higher performing students will come out all right even if their education in K-12 is lacking in something (other than math & reading skills). We may not have scored well on the international tests, but that didn't stop us from inventing the internet. A useful aspect of the Framework is the suggestion of "cross-cutting concepts" like systems balance, or conservation of

matter & energy, which pertain to many different fields like geology, biology, meteorology. These tend to be abstract and the Framework's suggestions for K-3 and 4-5 standards are suitably modest. Their suggestions for 6-8 seem suitable for that level, as well. But I need to look at the NGSS to see if too much abstraction is assumed for the younger grades (My first look at NGSS gave me the impression that they were, hence my reading of the "Framework"). Like much writing in similar fields, there is an injection of political correctness. Tests and or methods are said to have bias for one group (males/females, black/white, Anglo/Hispanic, etc.) over another, despite the admission earlier that learning science is a cultural change. It is ludicrous to hold science as a value, then claim there can be a value-neutral way of teaching it. One of the few really lame suggestions (and this is not at all characteristic of the book as a whole) is the suggestion that science be related to ethnic groups' experience and values, like the Native American feel for ecology. This romantic and inaccurate stereotype is a sign of political sensibilities intruding into science education policy. Integrating core ideas with cross-cutting concepts constitutes 2 of three legs that the Framework's proposals rest on. The third is "practices." These are investigations, the survival of the "hands-on activities" which were assumed to be the core of science teaching until it turned out that reading and math skills were more important for scoring well on summative and achievement tests. Shame on us for ever thinking that we could teach science apart from reading and math! These practices are imported from ELA (English/language arts) curricula- argumentation from evidence, reading for information, conveying your findings to others, logical reasoning. And I would hasten to add, measuring. Using rulers, balances, thermometers, etc. are great activities with real benefit to the K-5 crowd. Evolution deserves special attention, particularly as it is used in the Framework in different senses. Sometimes it is synonymous with "development," particularly when describing physical changes (how the planets came to be). It is used in the Darwinian sense as one of the core ideas to explain the diversity and unity of living things. I believe the concept must be taught/learned in K-12 science, like the germ theory, but I do not believe that it pulls all things together (neither does the germ theory explain all disease), and there are problems with it that need to be acknowledged, like design, as even the staunchest advocates of evolution acknowledge. Related to this is that all scientific theories are "provisional" to some extent; Stephen Hawking's "Short History of Space and Time" reveals that the two theories that explain the physical world- relativity and quantum mechanics- are inconsistent with each other. (It was Hawking's stated desire to come up with a grand theory to reconcile them). To conclude: there is much of value in the proposals, particularly the engineering concepts added, then compared and contrasted with science concepts. The implicit acknowledgement that reading and math skills are indispensable for science

instruction (which could have been made more explicit for a stronger framework) are a real advance. The acknowledgement that models as well as experiments and observation are the stuff of science, not merely a "scientific method" is well-taken. But the discontinuity with what has gone before in science understanding and instruction makes this Framework less helpful than it might be.

The one and only review so far is very misleading so I wanted to clarify that this book is hugely useful because it IS THE Framework for science education now. It is updated from the 90's which was the last time the scientific and education community set out the content and skills K-12 students should know. This framework is the foundation for the Next Generation Science Standards' writers which are working on the final draft of the standards due out in March 2013. To understand the Next Generation Science Standards, one must understand the Framework laid out in this document first. It provides the background and research for the creation of the Framework as well as the content and skills students should know by grade 12. I hope this helps a bit!

Great

You can find this information online and download it for free. Yet, it is helpful to have this as a resource.

This is the definitive, easy-to read text explaining the principles, rationale, and underlying research behind the Next Generation Science Standards and efforts at improving modern K-12 science education in the U.S. and elsewhere.

I had to have this book for my trip to Austin to discuss the possibility of using this for the state standards. It was easy to understand and add to for the purpose of the national standard draft meeting.

I purchased this book for an education course I am taking. I found it useful; however, my hesitation to buy it came from the "always-changing" standards.

This guide lets the teacher (future) find information that will give continuity to a science classroom from Kindergarten to middle school to high school. This connected idea will be of great value, especially as more and more of the country adopts the Core Values recommended by the

government.

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