Framework Vision for Science Education and Implications for *Next Generation Science Standards*

Background

The *Next Generation Science Standards* (NGSS) are a set of science education standards being developed based on a vision for science education established by *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, published by the National Research Council in 2012. Publication of the framework was the first of a two-step process to produce a set of *Next Generation Science Standards* for voluntary adoption by the states. The NGSS are currently being developed by a team of writers including researchers, education policy specialists, scientists, and classroom teachers. The development is being coordinated by Achieve and 26 lead states.

The first draft of the NGSS was released to the public for comment in May 2012. The writing team is currently responding to the comments of the public and expert groups that reviewed the draft. Another public review is currently scheduled for late fall with the final standards expected in 2013. These standards describe student performances at the intersection of the three dimensions of science described in the framework, and they are designed to provide assessable performance expectations for all students.

Understanding the framework and NGSS is essential to implement meaningful changes in science teaching and learning. The potential for the framework's vision to be fully realized hinges largely on the quality of the NGSS and practitioners' understanding of the intersection of the three dimensions of science described in the framework. The framework's vision takes into account two major goals for K–12 science education: (1) educating all students in science and engineering and (2) providing the foundational knowledge for those who will become the scientists, engineers, technologists, and technicians of the future. The framework principally concerns itself with the first task: what all students should know in preparation for their individual lives and for their roles as citizens in this technology-rich and scientifically complex world (NRC, 2012).

The framework is designed to help realize a vision for science and engineering education in which students, over multiple years of school, actively engage in science and engineering practices, utilizing crosscutting concepts and core ideas to make sense of scientific phenomena. Instruction that focuses student learning on the three dimensions may be accomplished in a number of ways, but what should be clear is that separating the doing of science from the knowing of science, as many current state standards imply, is not consistent with the framework's vision.

Models of professional development and implementation of instruction provide teachers with meaningful ways to understand and use the three dimensions of science as described in the framework. The Utah Partnership for Effective Science Teaching and Learning uses a model built on this concept to provide teachers with the tools for effective instruction at the intersection of the three dimensions. During the past four years, this partnership has provided teachers with instructional models for using the crosscutting concepts, disciplinary core ideas, and science and engineering practices. The models help elementary teachers make sense of the science needed to understand core ideas specific to matter, energy, and forces. Reducing the ideas down to a few core ideas that have utility across all of science helps teachers improve instruction. When students develop a deeper understanding of a few core ideas, they are able to make sense of novel phenomena. Focusing on core ideas requires eliminating ideas that are not central to the development of science understanding. Core ideas should be both foundational in terms of connections to many related scientific concepts and have the potential for sustained exploration at increasingly sophisticated levels across grades (NRC, 2007).

Students are able to make sense of scientific phenomena when they are able to develop causal relationships, supported by evidence, of observed phenomena in defined systems. The crosscutting concepts organize a set of familiar touchstones for students to use in their sense making and evidence gathering. Students utilize these crosscutting concepts in the process of gathering and using evidence for the science and engineering practices. The practices engage students in gathering and using information from investigations and other sources, developing and using models, constructing explanations and communicating arguments that support these explanations.

Insights into the vision of the three dimensions of science described in the framework, the implications for the NGSS, as well as the professional development that will lead to successful implementation of the vision for science education are critical for the education system to make changes consistent with the framework. The ongoing discussion specific to implementing the NGSS and the implications for professional development, STEM education, and instructional materials is necessary but not sufficient. Models of classroom instruction will be necessary to move the vision forward, and teachers need to embrace the proposed changes for science education. Successful implementation requires coherence of all the components of the education system working in logical ways to support the new vision.

References

National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Washington, DC: The National Academies Press.

National Research Council. (2007). *Taking Science to School: Learning and Teaching Science in Grades K 8.* Committee on Science Learning, Kindergarten Through Eighth Grade. Richard A. Duschl, Heidi A. Schweingruber, and Andrew W. Shouse, Editors. Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

For More Information

The framework is available to download at: http://www.nap.edu/catalog.php?record_id=13165
Information about the NGSS is available at: http://www.nextgenscience.org/
Taking Science to School is available at: http://www.nap.edu/catalog.php?record_id=11625