CONNECTICUT NEXT GENERATION SCIENCE STANDARDS (NGSS-CT)

NEXT GENERATION SCIENCE STANDARDS
For States, By States

A TOOLKIT FOR LOCAL SCHOOL BOARDS

A New Vision for Science Education

Children are naturally curious about the world. While many adults recall learning science by reading about it in a textbook or listening to a teacher's explanation, we now know how to engage learners in more meaningful, lasting and exciting science learning.

By dramatically changing the way science is taught and learned, the Next Generation Science Standards (NGSS), adopted by Connecticut in November 2015, are designed to raise interest, participation and achievement for all students. This introductory video explains the design principles and key features of NGSS. This fact sheet summarizes the need for and development of NGSS.

Decades of research have resulted in increased understanding of how to engage diverse learners so that knowledge is retained and built upon for a lifetime. Our nation's leading scientists and science educators were convened by the National Academies of Science in 2012 to synthesize this research and recommend improvements to U.S. science education. These are reported in the Framework for K–12 Science Education (National Research Council, 2012). Among the envisioned improvements is a more authentic approach to scientific inquiry, the discovery process practiced by scientists that is more flexible and iterative than the scientific method taught in schools. This poster highlights new NGSS approaches that aim to involve all students in figuring out explanations based on critical analysis of evidence. To summarize, an NGSS learning approach teaches students to think on their own and in collaboration with others.

NGSS are aligned with contemporary expectations for college-level science courses. Beginning in 2012, the College Board redesigned Advanced Placement exams in STEM subjects (e.g., biology, chemistry, physics, computer science) to emphasize the use of science practices to reason with evidence (see summary of AP STEM advances). To help states and districts reform their science programs to better prepare more students for success in college-level science, the College Board in 2009 published College Board Standards for College Success: Science for grades 6–12.

By making science learning more like the way scientists work, more relevant to the real world and to students' experiences, the NGSS can better inspire and prepare many more students for advanced studies, careers and citizenship.

Striving for Excellence and Equity

NGSS will compel school districts to make many systemic improvements to curriculum design, teaching and assessment practices, and instructional materials. These changes will take considerable time, commitment and resources. The reward for sustained and coordinated reform is that by the end of 12th grade, many more Connecticut students will:

- appreciate the creative and dynamic **nature of scientific discovery**;
- be **critical consumers of scientific and technological information** related to their everyday lives;
- learn to **think critically**, **analyze information** and apply knowledge to **solve complex problems**;
- be inspired and enabled to **continue to learn about science outside school**; and
- have the **skills to enter careers** of their choice, including (but not limited to) careers in science, engineering, and technology.

Innovative Changes

Perhaps the most significant change in NGSS is that students are expected to show evidence of their learning by using science and engineering practices to gradually piece together explanations from evidence. Simply knowing facts is not sufficient. See example below that contrasts student expectations in a current NGSS Performance Expectation with a previous Connecticut science standard:

2004 Connecticut Science Standards	2015 Next Generation Science Standards
Describe the effects of the strengths of pushes and pulls on the motion of objects.	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Major features of NGSS:

- Three-dimensional learning: Students use all three dimensions of science — the science and engineering practices; crosscutting concepts and disciplinary core ideas — to make sense of phenomena they experience in their lives and/or to design solutions to authentic problems. In other words, science knowledge is learned and demonstrated through science and engineering practices and applied in a context that is relevant and interesting to students.
- Real-world context: NGSS shifts the outcome of instruction from explaining science to using science to explain real world phenomena. Students use knowledge they develop over time to (a) explain an observable event or situation; and (b) to engineer solutions to problems. For example, instead of simply learning about the topics of photosynthesis and mitosis, students are engaged in building evidence-based explanatory ideas that help them figure out the phenomenon of how a tree grows. In this video, a leading NGSS contributor explains how phenomena shift the focus of science learning to making sense of observable events. This STEM Teaching Tool explains the central role of phenomena in NGSS teaching and learning.
- Engineering design is integrated within K–12 science curriculum for all students at all grades.
- Complements Connecticut Core Standards for English language arts and mathematics. NGSS make explicit interdisciplinary connections among the sciences, language arts and mathematics. Among the NGSS science and engineering practices are those that call for reading, writing, speaking, listening, computing and analyzing data. These present exciting opportunities for students to use reading, writing and mathematics skills to support their science investigations.

Student Learning in an NGSS Classroom

This chart highlights some of the key differences between a traditional science classroom and an NGSS classroom. Students in elementary NGSS classrooms will gradually develop and use these science and engineering practices to construct their own scientific explanations of phenomena. Secondary students will build on elementary school foundations and deepen their use of these science and engineering practices for grades 6–12.

High-quality curriculum materials and daily lessons will involve students in using the practices to develop, use and refine their ideas, and not simply explain the science to the students.

Key Messages for Local School Boards

Expect NGSS reforms to take several years of planned, coordinated efforts to transform curriculum, teaching practices, instructional materials and assessments.

- Commit to high-quality, sustained professional development for all teachers and school leaders. Professional learning should focus on three-dimensional teaching practices. Lessons Learned from the NGSS Early Implementer Districts: Professional Learning summarizes the professional learning successes and challenges experienced by several California school districts.
- Commit to a long-term process for upgrading existing curriculum and instructional materials. Engage only those with deep understanding of NGSS approaches in a planned process of modifying existing materials. Lessons Learned from the NGSS Early Implementer Districts: Instructional Materials summarizes the successes and challenges faced by several California school districts. This short course can guide your district's NGSS curriculum adaptation process.
- Explore variety in middle and high school course design. NGSS standards for Grades 6 to 12 can be grouped in a variety of ways to create courses to interest and excite diverse students. Besides general courses in life science, physical science and Earth/space science, high-interest courses such as environmental science, genetics, or meteorology can be NGSS-aligned by selecting appropriate NGSS standards. NGSS appendix K provides models of several ways to organize standards into a coherent grades 6–12 course sequence. This Accelerated Model Course Pathways document, developed by Achieve, shows the standards overlaps between AP science curricula and NGSS.
- Delay purchasing textbooks, kits or learning units until they've been reviewed for fidelity to NGSS core principles, either by Achieve's EQuIP Peer Review Panel: Science or by a district-level committee trained in using the EQuIP Rubric for Science Units and Lessons. Presently, few commercially available instructional materials reflect the NGSS vision of three-dimensional learning. In the interim, concentrate first on ensuring teachers and administrators participate in high-quality professional learning focused on three-dimensional instructional approaches. Then apply newly acquired pedagogy to modify existing teaching materials.
- Revise district, school and classroom assessment tools to reflect integration of content, practice and crosscutting themes. Most information useful for adjusting instruction is obtained from locally developed assessments administered by teachers and schools. (See Links to Detailed Information for sample three-dimensional assessment tasks for classroom use). In 2019, state science assessments will change to measure NGSS Performance Expectations. The Comprehensive Student Assessment Portal provides information about the development of NGSS science assessments. This NGSS transition timeline shows the years when CMT and CAPT Science will be phased out and new NGSS-aligned assessments will be introduced.

Resources for Local School Boards

Standards interact with many other aspects of the educational system — such as curricula, assessments, instructional materials, professional development, instructional leadership, budgets and communication. Faithful implementation of NGSS standards will require examining each of these and planning changes. Merely swapping out one set of standards for another will not achieve desired goals.

In this video, the director of the Board on Science Education at the National Research Council, offers school district leaders general advice for successful NGSS implementation. Refer to the National Research Council's Guide to Implementing the Next Generation Science Standards for more information.

Achieve Inc., the nonprofit education advocacy organization that coordinated NGSS development, enlisted the expertise of district leaders nationwide to compile specific, practical guidance and tools for impactful NGSS implementation:

- The NGSS District Implementation Workbook is a tool to help district leaders create or revise a plan to improve science education outcomes using NGSS as a springboard. The workbook proposes components of a comprehensive plan and offers a process for assessing and improving the outcomes of the existing science education program.
- The District Transition Guide outlines a set of indicators of successful NGSS implementation at the district level. This tool is useful for monitoring the district's progress towards the science education goals it has articulated.

The Connecticut State Department of Education will offer a one-day **District Transition Planning Workshop** for district vertical teams in 2018.

Equalizing learning opportunities is a prominent principle of next generation science. District policies should ensure that all students in every grade have access to coherent, coordinated K–12 science curriculum and instruction. This journal article speaks to student diversity and equity in NGSS and points to appendix D Case Studies to illustrate how NGSS can improve interest and achievement for diverse learner groups – from gifted to learning disabled.

Links to Detailed Information

- Next Generation Science Standards
- Framework for K–12 Science Education
- Connecticut Core Standards for English Language Arts and Mathematics
- Sample Classroom Assessment Tasks