# The Kansas Next Generation Science Standard Review Committee

## Report and Recommendation

## to the

## Kansas State Board of Education

**14 May 2013**

## The Kansas Next Generation Science Standards Review Committee Members

The Kansas Next Generation Science Standards Review Committee provided input on multiple releases of draft version of the Next Generation Science Standards (NGSS). The committee met both face-to-face and virtually from September of 2011 through April 2013. Members of the Committee volunteered their time to assure that the NGSS reflect the needs and desires of Kansas. The Committee Chairs thank members of the Kansas Next Generation Science Standards Review Committee for their efforts during this process.

| Last Name: | First Name: | Institution/Company name: |
|---|---|---|
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| Angel | Stephen | Washburn University |
| Atkins | Susan | USD 368 Cottonwood Elementary/Sunflower Elementary |
| Benz | James | USD 202 Turner |
| Bixby | Jared | Sunset Zoo; Flint Hills Discovery Center |
| Blake | Mindy | USD 379 Clay Center Community Middle School |
| Bollier | Barbara | Representative, State of Kansas |
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| Cleavinger | Laurie | University of Kansas |
| Cobble | Teresa | USD 259 Wichita Public School |
| Cooper | Jennifer | USD 475 Franklin Elementary |
| Coover | Donald | SEK Genetics |
| Culbertson | Chris | Kansas State University |
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| Dennis | Dave | Kansas State Board of Education |
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| Downey | Laura | KACEE |
| Elder | Rob | Seaboard Farms |
| Ellis | James | University of Kansas |
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| Griffith | George | USD 208 Trego County Schools |
| Hall | Kris | USD 217 Rolla Schools |
| Harmon | Marcel | M.E. Group |
| Harrington | John | Kansas State University |
| Harrison | Trey | USD 375 Circle High School |
| Hart | Stacey | USD 389 Eureka Jr/Sr High |
| Hawks | Anne | USD 497 Lawrence Public Schools |
| Hennessey-Springe | Margaret | Kansas Children's Discovery Center |
| Hillis | Maureen | USD 437 Auburn-Washburn |
| Jarboe | Mark | USD 450 Shawnee Heights High School |
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| Neugebauer | Charlotte | USD 259 Gammon Elementary |
| Perkins | Doug | NuStar Energy, L.P. |
| Piva | Michell | USD 503 Parsons District Schools |
| Popp | John | USD 428 Great Bend High School |
| Powell | Judy | USD 462 Central Elementary |
| Ptacek | Pesha | USD 306 Southeast of Saline Schools |
| Ratzel | Marsha | USD 229 Leawood Middle School |
| Sanders | Christine | USD 458 Basehor-Linwood School District |
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| Swanson | Laura | USD 259 Wichita Public Schools |
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| Troyer | Joyce | USD 378 Riley County Schools |
| Tschauder | Sarah | USD 409 Atchison High School |
| Wellman | Bruce | USD 233 Olathe Northwest High School |
| Wolken | Virginia | USD 101 ERIE HIGH CHARTER SCHOOL |
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## Executive Summary

The Kansas Next Generation Science Standards Review Committee recommends the April 2013 release of the Next Generation Science Standards be adopted as the Kansas science standards. The organization, emphasis, and structure of the NGSS reflect the evidence-based recommendations on teaching and learning in the sciences based on the research since the last major effort to produce comprehensive science standards dating back as far as twenty years ago (i.e. *Benchmarks for Science Literacy* (Project 2061, 1993) and the *National Science Education Standards* (NRC, 1996)). The consensus view of the Kansas NGSS review team is simple - these are a significant improvement over our current standards and have the potential to improve the science and engineering knowledge and skills of Kansas students.

On July 19, 2011, *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (NRC, 2012)* was released. It was a critical first step of rebuilding a foundation for science education compiling the most current research on science and scientific learning and identifying the science and engineering topics all K–12 students should know. A consortium of twenty-six states, facilitated by Achieve and the National Academy of Sciences, developed the K-12 Next Generation Science Standards (NGSS). The NGSS have undergone numerous reviews and revisions based on input from the Kansas Next Generation Science Standards Review Committee, and similar committees in the twenty-six lead States, and two national public comment periods. The final draft of the NGSS was released in April 2013 for states to consider for adoption.

The *Framework* recognizes that science and engineering are major intellectual enterprises that improve people's lives. However, many of the challenges facing our students in the future, such as environmental, energy, and health issues, require a deeply informed knowledge in the underlying science and engineering factors. The *Framework* lays out a vision for K-12 education with students actively engaging in scientific and engineering practices while applying the crosscutting concepts that will deepen their understanding of the core ideas of all the academic fields of science and engineering. By the end of the 12$^{th}$ grade, students should be critical consumers of scientific information related to their everyday lives. This will allow them to continue to learn and use science throughout their lives, whether it is in college or in a career (NRC, 2012).

The *Framework* reflects the need for greater coherence in science education. It was the guide for the authors of the NGSS to accomplish three main goals:

1. Develop and promote the concept that learning is a developmental progression;
2. Narrow the focus to a limited number of core ideas in science and engineering within and across the disciplines;
3. Integrate knowledge and practice in science and engineering learning experiences.

It is important, however, to remember that the NGSS are not intended to define course structures, curriculum, or lesson plans. The NGSS were written as expectations for what all students should know and be able to do in science and engineering, but it does not limit instruction. District

curriculum, especially in elective courses, should push beyond these standards to address the needs of their best and brightest students and community. The standards maintain a sharp focus on the things that cannot be overlooked in our expectations for *every* student. The NGSS emphasize what is essential and provide the tools and core knowledge needed to succeed, whether in a post-secondary classroom or career.

The Kansas Next Generation Science Standards Review Committee provided meaningful and significant input into the development of the NGSS from September 2011 through the April 2013 release. The committee included sixty Kansas citizens ranging from elementary education, secondary education (6-12), post-secondary education, informal science educators (e.g. zoo educators, children's science museum educators), business and industry, and representation from the Kansas State Board of Education. In addition to this group, that actively reviewed four confidential drafts of NGSS, many others in Kansas participated in shaping these standards. During the final public review (January 2013), over 4,200 unique IP addresses from Kansas accessed the NGSS. This was the thirteenth highest total (among all fifty States and the District of Columbia) in number of responses and if adjusted as a proportion of population, Kansas ranked sixth in number of responses. Many Kansans not only reviewed the standards, but also provided comments on the NGSS.

Though other States were involved in the standards development process and they and others will be adopting NGSS for their State Science Standards, Kansans played a central role in shaping these standards and should rest assured that this is very much a Kansas document (refer to *Appendix A: Kansas Influence on the NGSS*). Working with other states in this process did not "dilute" the Kansas effort, rather it what Kansas brought to the table and produced a better set of standards than Kansas could produce independently.

Respectfully Submitted on Behalf of the Kansas NGSS Review Committee,

| | | |
|---|---|---|
| Paul Adams | Mary Cerny | John Popp |
| Anschutz Professor of Education<br>Professor of Physics | Elementary School Specialist | Curriculum Director |
| Fort Hays State University | Salina Public Schools | Great Bend Public Schools |

Co-chairs of the Kansas Next Generation Science Standards Review Team

## Need for the Next Generation Science Standards

In Kansas, the Next Generation Science Standards (NGSS) have arrived at a critical juncture in Kansas standards adoption. The current Kansas State Science Education Standards are due for revision in 2014. As a lead state Kansas played a significant role in shaping these standards, with the backing of the National Research Council and the other lead states. The NGSS have been reviewed and revised based on input from Kansas, and reflect the rigor, coherence, and cohesiveness that will serve as the basis for developing STEM (science, technology, engineering, and mathematics) curriculum for this century. The need for the advancement of science and STEM education in Kansas schools is appropriate given the current needs of our society and world. "*A compelling case can … be made that understanding science and engineering, now more than ever, is essential for every American citizen. Science, engineering, and the technologies they influence permeate every aspect of modern life"*(NRC, 2012). In our ever-changing world, if we stay the same, we will fall hopelessly behind. Kansas students must be capable of meeting the needs of an increasingly technical and scientific work force to compete for jobs on the world stage.

In the wake of *No Child Left Behind (NCLB)*, students have become more adept at passing tests and regurgitating information, but not necessarily better at critically thinking and working through difficult problems. NCLB's increased emphasis on mathematics and reading, has forced many schools and systems to de-emphasize the teaching of other critical areas, such as science. There is a great need to establish science as equally important to mathematics and reading.

The Kansas College and Career Readiness Standards (KCCRS) have raised the bar for students in English Language Arts (ELA) and mathematics and more recently in Social Studies, History, and Government. The KCCRS empower us to change the education paradigm by challenging students to think deeper, to analyze, to create, and to justify their thoughts and actions. Students learn to research and develop logical arguments with evidence to support their position. The older model of just knowing "reading, writing, and arithmetic" is gone; we live in an age when information is ubiquitous and Kansas needs students who have the ability to solve problems, can think from a multidisciplinary perspective, can communicate and articulate their thought processes, can support their positions from evidence, and can use technology. This push should be reflected in science education. The NGSS have been written with the new KCCRS Standards in mind, tying every skill and standard to the KCCRS, and demonstrating how these are interwoven and complementary to one other. ELA and mathematics have always been important, but find additional relevance and application in the sciences: the "why" for mathematics is provided through science, meaningful application of ELA by communicating science ideas through the written and spoken word provides real and significant practice with these career-essential skills. By entwining KCCRS and STEM, students will experience a coherent school curriculum with the potential to maximize their learning. In order to address the performance expectations that define the NGSS, students will engage in high-level in-depth investigations and have meaningful dialogue through productive discourse, all while incorporating these science

and engineering practices with content. This engagement in science and engineering practices blended with content has been clearly demonstrated to not only increase student engagement in science, but also to increase their retention of content (NRC, 2006). The NGSS are not alone in this blending of content and practice as the redesign of the science Advanced Placement courses, the 2015 PISA (The Program for International Student Assessment (PISA) is an international assessment that measures 15-year-old students' reading, mathematics, and science literacy); Vision and Change in Undergraduate Biology and A New Biology for the 21st Century (two recent post-secondary science initiatives); and the Scientific Foundations for Future Physicians have all headed in this direction based on the research demonstrating its effectiveness. The NGSS does not ask less of our students; it asks more.

As Kansas continues to implement the Kansas College and Career Ready Standards, the NGSS will align with and invigorate that initiative. The career and college demands placed on students exiting high school necessitates a demanding science curriculum to prepare students for that transition from high school to the world of work or college. Adopting the standards is an investment in the intellectual capital of Kansas.

## Motivation for Adopting the NGSS as the Kansas Science Standards

### *The College and Career Readiness Imperative*

At the core of the NGSS is the vision that science competency unlocks the goal of all students becoming college- and career-ready upon graduation from high school and/or college. Kansas students have typically tested at or above average on a variety of measures of science competency. In 2011, the Kansas average score on the eighth grade National Assessment of Educational Progress (NAEP) was a 156—five points above the national average. In 2012, Kansas students taking the ACT scored an average of a 21.7, which continues a trend of at least the last five years of the Kansas science average being either at or just under a point better than the national average (20.9 in 2012). However, although an average of 21.7 is above the national average, only 35% of Kansas students that take the ACT reach ACT's college ready benchmark for science of a 24 on the science section (ACT, 2012). We can, and should, do better. Adoption of the NGSS as the new Kansas Science Standards, implemented with fidelity to the NGSS, has the potential to improve the performance of Kansas students on national comparisons, as it would better align instruction with evidence-based research on effective science teaching and learning. **Table 1 A Definition of College and Career Readiness in Science** operationally defines what we should expect to see in Kansas graduates.

**Table 1: A Definition of College and Career Readiness in Science[1]**

College- and Career-Ready Students can demonstrate evidence of:

- Applying a blend of Science and Engineering Practices, Crosscutting Concepts and Disciplinary Core Ideas (DCIs) to make sense of the world and approach problems not previously encountered by the student, new situations, new phenomena, and new information;
- Self-directed planning, monitoring, and evaluation;
- Flexible application of knowledge across various disciplines through the continual exploration of Science and Engineering Practices, Crosscutting Concepts and DCIs;

- Employing valid and reliable research strategies; and
- Exhibiting evidence of the effective transfer of mathematics and disciplinary literacy skills to science.

This working definition of college and career readiness in science is based on the following assumptions:

- As indicated in *A Framework for K-12 Science Education*, students are expected to operate at the nexus of the three dimensions of science: 1) Science and Engineering Practice; 2) Crosscutting Concepts; and 3) DCIs.
- The learning expectations are equivalent for college and career preparation.
- A student is ready to enter and succeed in coursework beyond high school in science and technical subjects that leads to a degree or credential. This includes the military and credentialing that can occur during the high school experience such as credentialing programs, dual enrollment programs and advanced placement courses.

[1]Source: NGSS, Appendix C

### *The Kansas Economy*

*Business leaders in Kansas have sounded an alarm. They cannot find the science, technology, engineering and mathematics (STEM) talent they need to stay competitive. Students' lagging performance in K–12 is a critical reason why* (Change the Equation, 2012a).

The workforce for the 21st Century demands an increased proficiency in science, technology, engineering and mathematics (STEM) in all fields (Achieve, 2013). During the mid- to late 2000s recession, postings for STEM jobs outnumbered the STEM unemployed (Change the Equation, 2012b). In the most recent recession Kansas's demand for STEM skills remained high (see **Figure 1**) with a ratio of two jobs for every one unemployed person. Even when the United States fills STEM jobs, businesses rely heavily on foreign-born workers to fill these positions. In the last 60 years the percentage of foreign-born workers filling STEM positions has more than doubled from 7 percent in 1950 to 17 percent in 2008 (Carnevale, Smith, & Melton, 2011).

As Kansas builds its workforce in bioscience, energy, aviation, agriculture, telecommunications, and transportation, citizens will be needed with core science skills. It is imperative that the Kansas education sector produce skilled high school and college graduates to fill the workforce needs of the state. Potential employers need individuals who can communicate clearly, solve problems, analyze situations, and know how to learn. Adoption of the NGSS will force the development of curriculum that will build these skills and knowledge through the learning and application of science and engineering practices, disciplinary core idea, and crosscutting concepts.

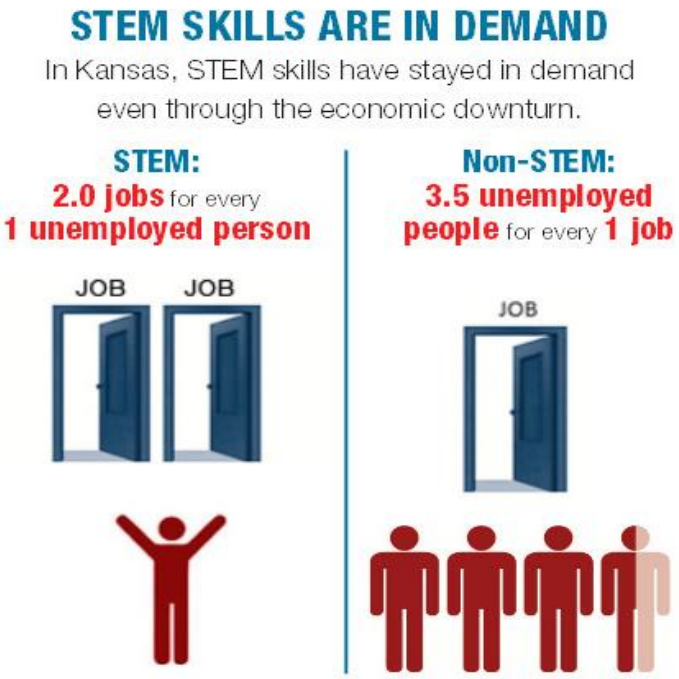


**Figure 1. Kansas STEM Skill Demand. (Image Source: Change the Equation, 2012a)**

### *Competition*

If Kansas is to compete nationally and internationally for new business and industry it must develop its intellectual capital; the changing requirements for careers are a global phenomenon. As a state, Kansas has a history of being innovative and creative, with a work ethic second to none; however, without the raw talent needed for STEM related industries and business we cannot compete. Our current system of science education and standards only prepare us to be just above average in knowing science facts; we fail on students being able to perform in the STEM disciplines. This will not support growth in STEM related industries.

Will adopting standards with greater rigor that are defined by demonstrative skills improve student abilities and Kansas competitiveness? Kansas has already made the first step by the adoption of the Kansas College and Career Ready Standards for Mathematics. While not causal, the emphasis Kansas has placed on mathematics education in the last few years appears to have had a positive effect on student performance in mathematics as illustrated in **Figure 2**. The assessments being developed for the KCCRS have the potential to raise the bar on student performance to prepare them for careers or college after high school. Adopting the NGSS with its challenging standards appears to have the potential to raise student performance in science as a component of STEM.

## Students have improved in math

Since 2003, eighth graders in Kansas have made gains on the National Assessment of Educational Progress (NAEP), also known as "the nation's report card." Yet many still have far to go to reach a score of 299, NAEP's cutoff for "Proficient" performance.

**8th Grade NAEP scale scores, 2003 & 2011**

| | NAEP Scale Score | | Change Since 2003 | |
|---|---|---|---|---|
| | 2003 | 2011 | KS | Most Improved State |
| All | 284 | 290 | +5 | +17 (DC) |
| Low Income | 270 | 276 | +6 | +19 (MA) |
| White | 290 | 295 | +5 | +17 (HI) |
| Black | 252 | 269 | +17 | +19 (NJ) |
| Hispanic | 263 | 274 | +11 | +24 (AR) |

*Totals may not sum due to rounding errors.*

**Figure 2: Kansas Improvement in 8th Grade Mathematics Measures. (Image Source: Change the Equation, 2012a)**

### *Equity*

*True scientific literacy has historically been the province of more privileged students — something reserved for the "gifted" rather than a requirement for all. We cannot close the college and career readiness gap without giving every student the opportunity to build his or her skills in scientific practices — practices that will apply both in and beyond STEM fields. White men still dominate the science and engineering workforce, accounting for 55 percent of those in science and engineering occupations. White women make up 18 percent of those employed in science and engineering occupations. Black men and women comprise just 3 percent of the scientists and engineers in science and engineering occupations; Hispanic men and women comprise just 4 percent (National Science Foundation, 2011)* (Achieve, 2013).

In Kansas we have struggled in developing science and mathematics literacy in all students as can be seen in **Figure 3** and **Figure 4**. Up to now, those who either a) came from more affluent backgrounds, b) had more family support and/or better home environments, and/or c) who have a natural ability for science/math are all more likely to receive additional help/encouragement outside of school and supplement the existing weaknesses in public school science/mathematics. With the adoption of the NGSS the need to go outside the public schools for adequate science and engineering education should be greatly reduced as the rigor and vision embodied in the NGSS will focus on preparing all students for college and career readiness. The Next Generation Science Standards *Appendix D: All Standards, All Students* describes in detail how the NGSS were designed and meticulously reviewed to promote science for all learners.

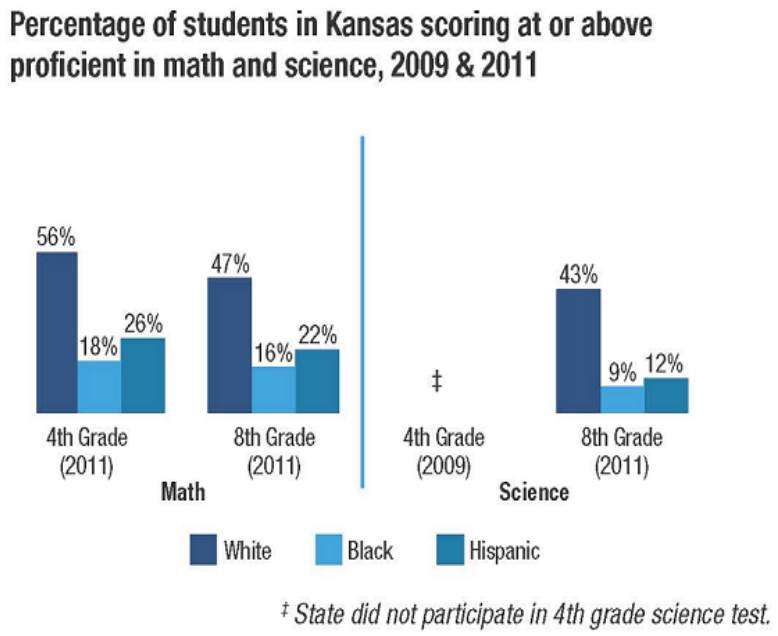


**Figure 3. Percentage of Students in Kansas scoring at or above proficient in math and science, 2009&2011 disaggregated by ethnicity. (Image Source: Change the Equation, 2012a)**

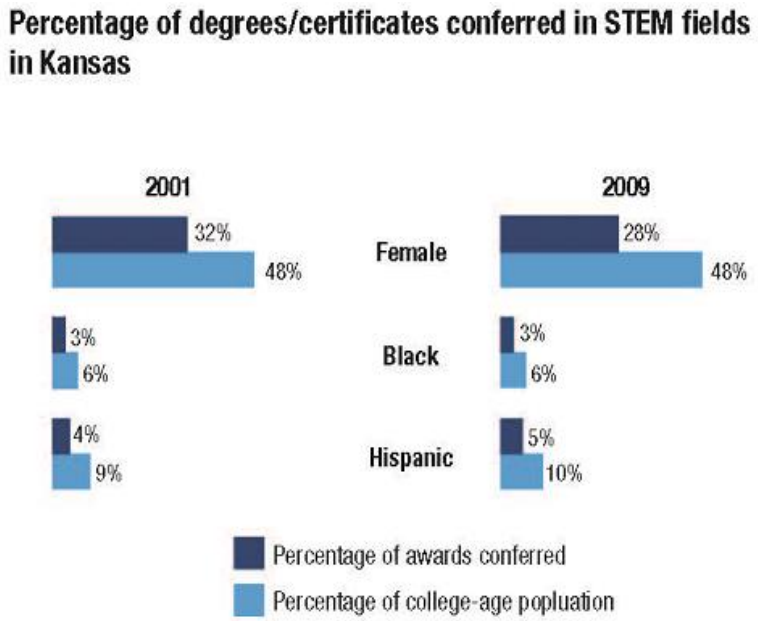


**Figure 4. Percentage of degrees/certificates conferred in STEM fields in Kansas disaggregated by gender and ethnicity. (Image Source: Change the Equation, 2012a)**

### *Informed Citizenry*

*Science — and therefore science education — is central to the lives of all Americans, preparing them to be informed citizens in a democracy and knowledgeable consumers in a world fueled by innovations in science and technology* (Achieve, 2013).

To be science literate means teaching science and STEM in our schools. In 2008 Kansas spent only 1.8 hours a week teaching science in grades 1-4 (see **Figure 5**). Compounding this lack of science education is a dearth of challenging mathematics and science courses (see **Figure 6**). While the NGSS is not a panacea for the failure of science education to prepare all citizens, adopting the NGSS with its renewed emphasis on performance expectations and science and engineering practices that are seamless with the KCCRS hold great promise to improve science and STEM education of all or our citizens by leveraging cross-disciplinary connections, increasing the time spent on science and STEM and providing the background knowledge and skills requisite for challenging courses.

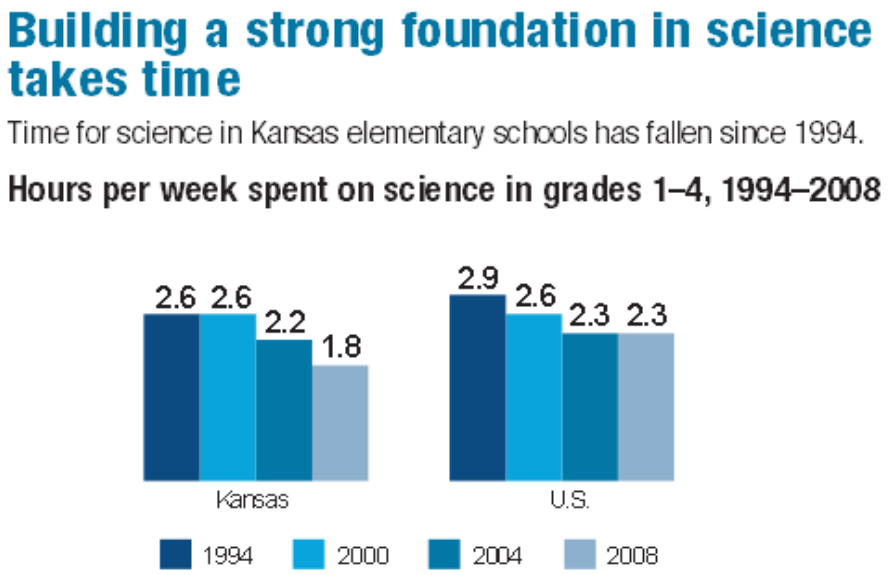


**Figure 5. Time spent on science instruction grade 1-4. (Image Source: Change the Equation, 2012a)**

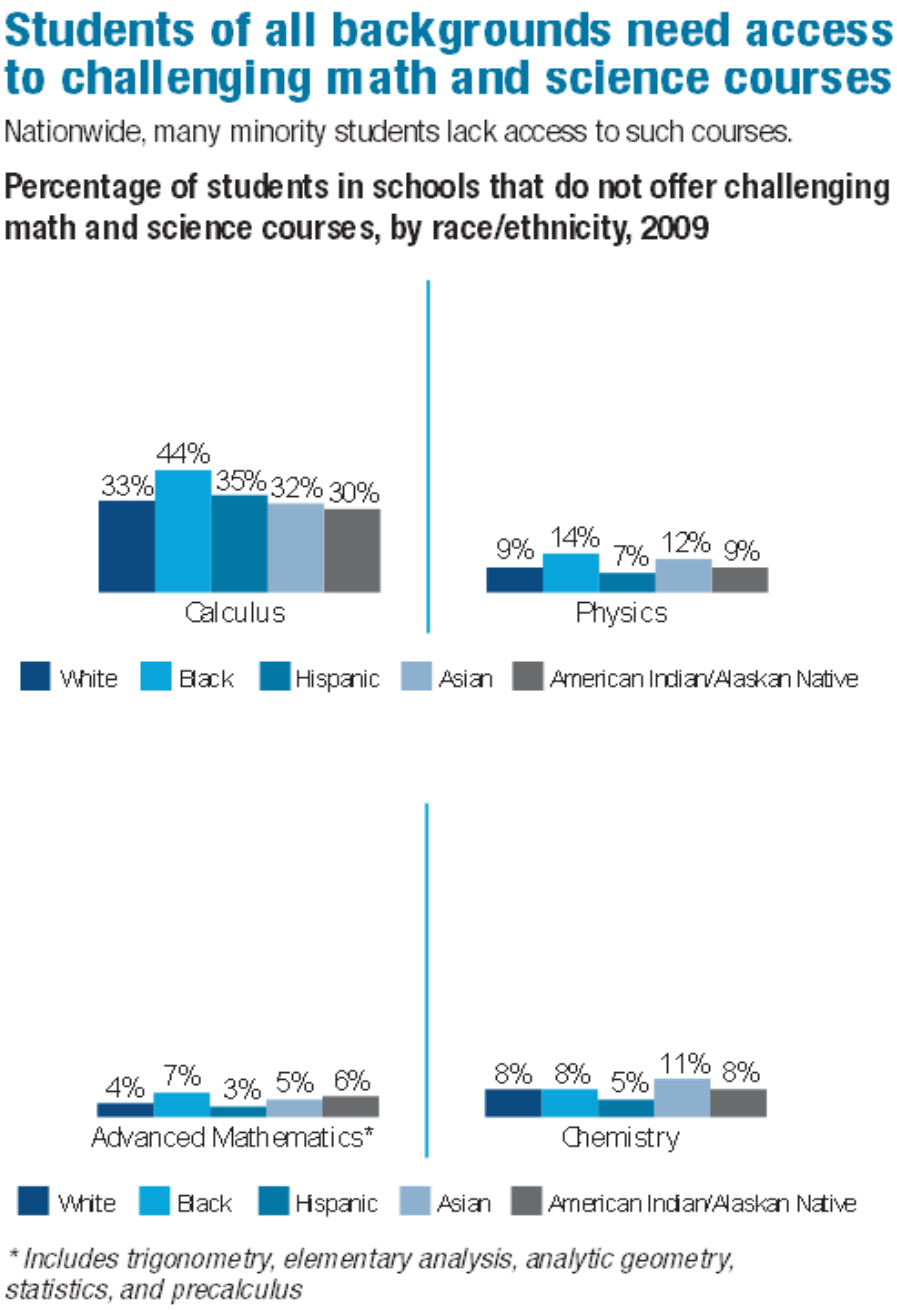


**Figure 6. Percentage of challenging mathematics and science courses taken by students nationally. (Image Source: Change the Equation, 2012a)**

## What will change?

The adoption of the NGSS is not change for the sake of change. Our understanding of science teaching and learning has changed due to research, such as that identified in *How People Learn Science and Mathematics* (NRC, 2000) or *America's Lab Report: Investigations in High School Science* (NRC, 2006). Our current standards do not reflect this research base base. But what will we see as the NGSS are translated into curriculum and lessons that bundle the standards into teachable units? Table 2 summarizes the vision.

### TABLE 2: An Introduction to the NGSS[2]

The overarching shift demanded by the NGSS is a change in the meaning of scientific proficiency. Students will demonstrate their proficiency in science not by recalling specific facts but by engaging in actual scientific practices that demonstrate the ability to apply scientific concepts and ideas in any context. Effective science teaching and learning comes from the combination of engaging in Disciplinary Core Ideas through Science and Engineering Practices, frequently in the context of Crosscutting Concepts. As such, the NGSS are organized around three dimensions:

- **Disciplinary Core Ideas** that are acquired by students through an overall K–12 learning progression and can be taught at increasing levels of depth and complexity over time.
- **Science and Engineering Practices,** like developing and using models or analyzing and interpreting data, are critical to scientific inquiry in any content area. These are not teaching strategies; they are a necessary student outcome to show proficiency in science.
- **Crosscutting Concepts,** like patterns and cause and effect, provide the connective tissue between sciences. These concepts are found throughout all scientific disciplines and will be continually revisited and built on through the exploration of core content.

At their core, the NGSS are defined and set apart by their focus on the blending of these three dimensions and the coherence between them. A student who can demonstrate understanding of these three dimensions as portrayed as performance expectations is literate in science.

How is this different from current science expectations in Kansas?

- **K–12 science education should reflect the interconnected nature of science as it is practiced and experienced in the real world.** Current Kansas standards express the three dimensions as separate entities, leading to their separation in both instruction and assessment. The NGSS expectations for both students and teachers are that they will engage at the nexus of these three dimensions, applying practices to content knowledge and making use of Crosscutting Concepts to do so.
- **The NGSS are student performance expectations — NOT curriculum.** The Disciplinary Core Ideas themselves form a progression of knowledge for students that are clearly laid out in the NGSS, but the Science and Engineering Practices and Crosscutting Concepts should not be limited to specific time periods of instruction. Rather, educators and students should

return to the Science and Engineering Practices and Crosscutting Concepts again and again, applying them to every Disciplinary Core Idea so that content knowledge progression is accompanied by skill development in the application of scientific practices and concepts. Simply said, the NGSS form the basis for student performance. Curriculum materials are state and local decisions that will encompass the order and day-to-day instructional needs to prepare students for the performances.

- **The science concepts in the NGSS build coherently from kindergarten through grade 12.** The focus on a few Disciplinary Core Ideas is a key aspect of a coherent science education. Historically, science education has been taught as a set of disjointed and isolated facts. The NGSS provide a more coherent progression aimed at overall scientific literacy, with instruction focused on a smaller set of ideas, while keeping an eye on what the students should have already learned and what they will learn at the next level. These progressions for each grade band assume that the student has learned the necessary previous material.

- **The NGSS focus on deeper understanding of content as well as application of content.** Within the Disciplinary Core Ideas, the focus of the NGSS is on conceptual understanding — not just the facts. Facts and details are important evidence, but can no longer be the sole focus of instruction. *A Framework for K-12 Science Education* casts this shift in terms of the difference between novices and experts: "Experts understand the core principle and theoretical constructs of their field, and they use them to make sense of new information or tackle novel problems. Novices, in contrast, tend to hold disconnected and even contradictory bits of knowledge as isolated facts and struggle to find a way to organize and integrate them." The NGSS aim to make students experts rather than novices.

- **Science and engineering are integrated in science education from kindergarten through grade 12.** Unlike the traditional science disciplines, engineering has not routinely been included in Kansas science standards, curricula, or assessments, or as a component of the education of new science teachers. The NGSS integrate engineering into the structure of science education by raising engineering design to the same level as scientific inquiry in classroom instruction and by giving core ideas of engineering and technology the same status as those in other major science disciplines.

- **The NGSS make explicit connections to the CCR (English language arts and mathematics).** The release of the NGSS comes as Kansas is implementing the CCR. This creates an opportunity for science to be part of a child's comprehensive education. The NGSS take into account the content and performance expectations of the CCR to ensure a symbiotic pace of learning in all content areas and specifically refer to related standards in the CCR.

[2] Source: Achieve, 2013.

## What are the implications for Kansas Schools?

The NGSS are a product of both research and an understanding of best practices across states. Once Kansas districts understand the difference between our current standards and the NGSS and the conceptual shifts demanded, they can prioritize the curriculum changes for their districts and articulate why these priorities will make the most difference for their students. **Table 3** provides shifts in the science curriculum and questions that Kansas districts may want to consider if the NGSS are adopted as the Kansas Science Standards

**TABLE 3: Implications of NGSS Conceptual Shifts for Educators and Students**[3]

| **Shift** | **Questions To Consider** |
|---|---|
| K–12 science education reflects the real-world interconnections in science. | • What do our current science standards require with respect to this shift (i.e., what is our baseline)?<br>• Do our current science standards require students to demonstrate understanding by applying specific scientific practices and crosscutting concepts to core content knowledge and its acquisition?<br>• Do our science educators emphasize this application in their expectations, instruction and assessment of students?<br>• Do our schools and support systems facilitate collaboration among science educators to demonstrate the reach of scientific practices and crosscutting concepts across the core ideas in the disciplines?<br>• Do we have a plan to ensure that our local summative science assessments are written for the NGSS? |
| All practices and crosscutting concepts are used to teach core ideas all year. | • Do our current science standards require students to build skills in scientific practices and crosscutting concepts by focusing on them — and connecting them to content — throughout each school year?<br>• Do our science educators teach science practices and core concepts as a progression of core content rather than in addition to it? Do they use these practices and concepts to build in-depth student understanding in the context of the content areas covered throughout the school year?<br>• Do our schools and support systems equip and encourage educators to plan their lessons in this way?<br>• Do schools and teachers have access to the consumable physical materials (beyond textbooks/curriculum materials) to prepare and execute the classroom investigations and design work required by the NGSS? |

| | |
|---|---|
| Science concepts build coherently across K–12. | • Do our current science standards lay out expectations for student scientific knowledge as a progression across grades, or do they expect the same content (or unrelated content) to be taught across multiple years?<br>• Do our science educators treat science content as a cumulative body of knowledge built year by year? Can they assess students' prior knowledge and take appropriate remedial action?<br>• Do our schools and support systems emphasize the collaboration of educators across grade levels to ensure this progression of knowledge for their students? |
| The NGSS focus on deeper understanding and application of content. | • Do our current science standards expect students to master scientific core ideas and principles (e.g., "molecules are made up of atoms, and have different properties depending on their combination") and use them in multiple contexts, rather than memorizing particular facts or details with little or no context (e.g., "the molecule CO, carbon monoxide, is a poisonous gas")?<br>• Can our science educators emphasize a deep understanding of core ideas, sometimes at the expense of particular details associated with those ideas?<br>• Do our schools and support systems give educators what they need to keep coming back to and focusing on these Disciplinary Core Ideas? |
| Science and engineering are integrated in science education from kindergarten through grade 12. | • Do our current science standards require students to use engineering design ideas and practices alongside the traditional science disciplines from kindergarten through grade 12?<br>• How comfortable are our current and candidate science educators with engineering design? Do they raise it to the same level as scientific inquiry as a core practice in science instruction? Do they give core ideas of engineering and technology equal weight with those in other disciplines?<br>• Do our schools and support systems prepare our educators to teach engineering design and the core ideas of engineering and technology? Is this reflected in policy/funding for course offerings and their content? |
| Science standards coordinate with the CCR in English language arts/ literacy and mathematics. | • Are our current and candidate science teachers aware of and knowledgeable about the CCR?<br>• Do our schools and support systems allow and encourage collaboration across scientific and nonscientific disciplines in the teaching of literacy, numeracy and science? |

[3]Source: Achieve, 2013.

## Recommendation

As discussed in the preceding sections, there are many reasons for Kansas to adopt the NGSS. The NGSS provide a substrate on which to construct curriculum that will strengthen our work force, prepare students for college or careers, expand the pool of STEM knowledgeable citizens, improve equity in our education system, and place Kansas as a leader in science and STEM education and workforce development. These are grand ambitions, and adopting the NGSS is a bold step. Though all indicators point to a dramatic improvement in science education and thus student learning, Kansas will be on the vanguard. As with any innovation there are rewards and risks. The risks – adopting the NGSS does not improve science education and student performance, there is no increase in the STEM workforce. Grim outcomes, yes, but we already are failing to fill the STEM workforce quota, and are not viewed as a STEM powerhouse. The potential reward for adopting the NGSS is improved student learning in science, a STEM workforce second to none, an improved economy, and establishing our leadership in science and STEM education. The return on investment from adopting the NGSS as the Kansas Science Standards is high if implemented with an eye towards fidelity of the NGSS and *Framework for Science Literacy*. The reward of investing in the NGSS, based on the analysis of the Kansas NGSS Review Committee, far outweighs the risk. Maintaining status quo is tantamount to failure to survive in the competitive market nationally and internationally.

The benefits offered in adopting the NGSS at this point in time, rather than waiting until 2014 or through piecemeal adoption will assist Kansas in becoming a leader not only in STEM education, but also revitalize our workforce. Why would we wait to implement a tool that could be so powerful for the students and the communities that they will grow to serve? The NGSS provide a solid foundation of skills, knowledge, and broader understanding of science than our current standards and better align with what has been learned about how students learn science. The Kansas NGSS Review Committee, based on its close review and opportunity to revise the NGSS, fully recommend the adoption of the Next Generation Science Standards. District curriculum based on these standards will serve our students and thus are state very well in the 21st Century.

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