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Next Generation Science Standards

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Summary Points

- The Next Generation Science Standards are K-12 performance expectations that states may voluntarily adopt.
- Though Arkansas has not yet officially adopted the NGSS, the State Board of Education unanimously voted to endorse the NGSS, and the ADE has created a plan for implementation to begin in 2016.
- There is disagreement about whether the NGSS are more rigorous than Arkansas' current science standards.
- Supporters of the standards cite their emphasis on critical thinking and potential to prepare students for STEM careers.
- Some critics of the standards argue that they are not rigorous enough. Others disagree with the NGSS's approach to evolution and climate change.
- If adopted, the NGSS will be adapted to fit Arkansas' needs and will become the "Arkansas K-12 Science Standards."

Next Generation Science Standards

This policy brief provides an overview of the Next Generation Science Standards (NGSS), voluntary state science standards that are intended to improve the quality of science instruction in the U.S. The brief discusses the history of science standards, the development of the NGSS and its current status, arguments for and against the standards, and the status of the NGSS in Arkansas.

Introduction

The standards movement is best known for the hotly-debated Common Core State Standards for math and English Language Arts, but lesser-known state standards have been developed in other subjects, including science. Although the Next Generation Science Standards (NGSS) have largely flown under the radar, the topic is important because officials at the Arkansas Department of Education (ADE) report that Arkansas is halfway to adopting these standards.

Why new science standards? Several factors prompted the development of the NGSS. First, science education in the United States has been called "dismal."¹ The National Assessment of Educational Progress (NAEP) scores in 2009 found that barely one-third of fourth graders were at or above the "proficient" level in science, followed by 30% of eighth graders and 21% of students at the end of high school. Other studies have shown that just 30% of U.S. high school graduates are prepared for college-level

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science courses. International comparisons are often even worse.¹

The science achievement of our graduates is predicted to be directly related to the long-term health of the U.S. economy. Proponents of higher science standards point to troubling technological declines, such as the shrinking number of patents (in 2010, foreign competitors filed over half of U.S. technology patent applications) and declining high-tech exports, as evidence for the need to strengthen science education. Proponents also believe that higher quality science education will better prepare youth for future jobs, which will increasingly require more science knowledge and technical skills.²

Lastly, most states' current science standards are considered outdated. Most states' standards are based on the National Science Education Standards, developed in 1996, or the Benchmarks for Science Literacy, developed in 1993. While many consider these documents to be good blueprints, they are both over 17 years old. Due to recent advances in science and an increased emphasis on improving STEM (Science, Technology, Engineering and Math) education, the developers of the NGSS believed that it was time for science standards to be updated.³

Development of the NGSS

Lead partners in the development of the NGSS include the National Research Council (NRC), the National Science Teachers Association (NSTA), the American Association for the Advancement of Science (AAAS), and Achieve. Funding for the project was provided by the Carnegie Corporation of New York, Dupont, and the Noyce, GE, and Cisco Foundations.⁴

Developing the standards was a two-step process. First, the NRC, a division of the National Academy of Sciences, first convened a committee of 18 science specialists in their fields. This committee developed *A Framework for K-12 Science Education*, a document that identified the science concepts that experts believe K-12 students should learn. A public draft of this document was released in July of 2010, feedback was considered, and a final *Framework* was released in July 2011. Second, 26 lead state partners, including Arkansas, provided feedback to the standards' writing team. The standards went through multiple reviews, including two public drafts that allowed science educators to give feedback on the standards. This process resulted in the K-12 Next Generation Science Standards, completed and ready for voluntary state adoption in April 2013.⁵

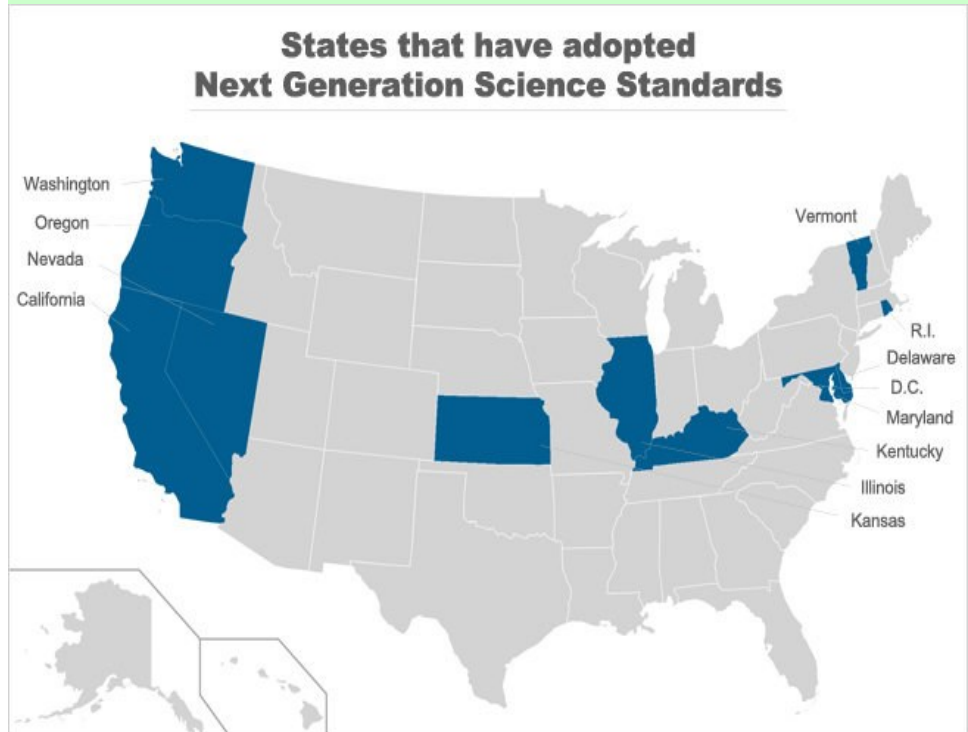
Current Status of the NGSS

Though the final version of the NGSS came out over a year ago, only 12 states and D.C. have chosen to adopt the standards so far. In contrast, one year after the release of the Common Core, 44 of the 46 eventual CCSS states had adopted the standards, with 29 states adopting the standards within 2 months of their release.⁶ Many attribute the slower rate of adoption of the NGSS to the lack of federal incentives attached to the standards. The federal government required that states adopt the Common Core or other college- and career-ready standards to be eligible for Race to the Top grants, and later to be eligible for waivers from provisions of the No Child Left Behind act, but there are no such financial incentives for adopting the NGSS.

States That Have Adopted the NGSS

As can be seen from this map from June 2014, 12 states (California, Nevada, Oregon, Washington, Vermont, Rhode Island, Delaware, Maryland, Kentucky, Illinois, Kansas) and the District of Columbia have adopted the Next Generation Science Standards so far.⁷

Several other states, including Arkansas, have initiated some exploration or a review into adopting the NGSS. So far, only South Carolina and Wyoming have explicitly decided not to adopt the NGSS.



Support for the NGSS

One form of support for the NGSS comes from the business community, who is hopeful that the NGSS will increase the quality of the workforce. In May 2014, several Fortune 500 companies, including ExxonMobil, Intel Corp., and Time Warner Cable, met at a two-day summit in Arlington, Virginia, where company representatives and STEM program leaders discussed the role of businesses in supporting education in STEM subjects. As a result, twenty-six companies signed a pledge stating that they will help advance STEM education and advocate for the Common Core State Standards and the Next Generation Science Standards.⁸

Others praise the NGSS for introducing more inquiry-based learning opportunities into science instruction. Under the NGSS, students are expected to ask questions, develop and use models, and make evidence-based arguments. Proponents say this sort of critical thinking is lacking in many current state science standards.⁹

The Arkansas Department of Education has also expressed support of the standards, stating that the NGSS will require more science instruction in earlier grades, will include principles of engineering and the use of technology at all grade levels, and will consequently better prepare students for college and careers.¹⁰

Criticisms of the NGSS

According to a 2013 report from the Fordham Institute, the NGSS earn a grade of “C” due to their lack of rigor, content, and clarity. Fordham’s criticisms include that the NGSS:

- Have missing and implicit content (fail to explicitly require science content in early grades, then assume that this content has been mastered in subsequent grades)
- Include “assessment boundaries,” which put limits on what students are required to know (could be problematic for advanced learners)
- Lack math content, even in situations when math is essential to the science that students are being asked to master¹

The Fordham Institute study also compares the quality of states’ current science standards to the NGSS (see “Arkansas Science Curriculum Framework vs. NGSS”).

Others do not agree with the NGSS’ treatment of climate change, which calls for students to be taught that humans have influenced global warming starting in middle school. Critics say that the science is not solid on this point, although nearly all climate scientists agree that climate trends have very likely been affected by human activities. Yet, this does not necessarily match up with public opinion. According to an April 2014 Gallup poll, one in four Americans are skeptical of humans’ role in climate change.¹¹

Another thorny topic is the teaching of evolution. Critics say that the NGSS do not consider all sides of the issue related to evolution. Several court cases, including a 1987 Supreme Court case, have found teaching creationism in public schools to be unconstitutional. At least two states, Louisiana and Tennessee, have laws that allow their public schools to teach critiques of scientific theories, aimed at evolution. According to a 2012 Gallup poll, Americans are about evenly split on the topic of evolution; 46% of Americans believe in creationism, and 47% believe in evolution (with 32% believing in evolution with guidance from God).¹¹ In contrast, a 2009 Pew survey found that 87% of scientists “think that humans...have evolved due to natural processes.”¹²

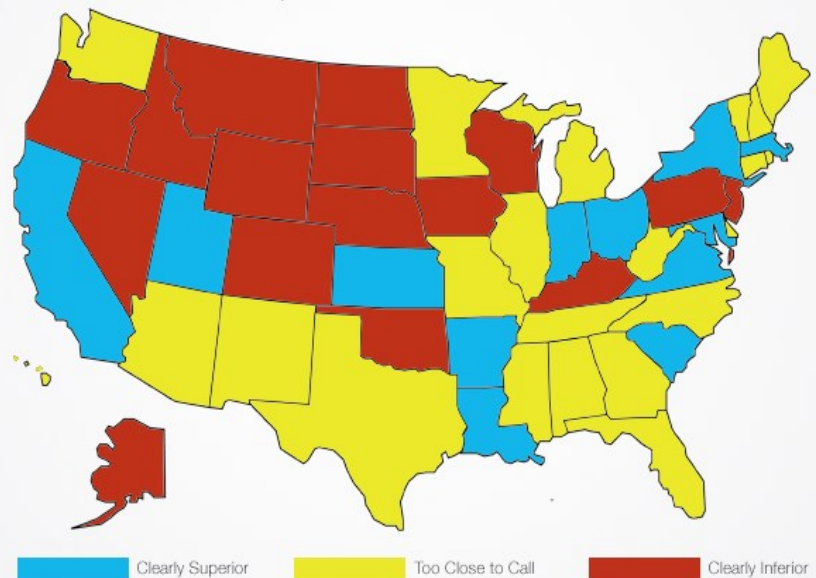
Arkansas Science Curriculum Frameworks vs. NGSS

In a 2013 report from the Fordham Institute, the NGSS received a grade of C. This report focused on content, rigor and clarity of K-12 expectations for science.¹ In contrast, Arkansas’ science standards earned a B and were ranked as “clearly superior” to the NGSS. Arkansas’ science standards were praised for being constructed based on TIMSS (Trends in International Math & Science Study) framework, good organization, excellent physics, chemistry, and biology standards, requiring dissections, and their “unflinching” treatment of evolution.

Fordham criticized Arkansas standards for including some vague language such as the requirement that 5th graders “summarize the characteristics of science” without defining these characteristics, poor scientific inquiry and methodology standards, and some inaccurate definitions in the glossary attached to the K-8 standards. Yet, overall, Arkansas science standards received a good review, especially in comparison to other states.¹³

State Standards Compared to NGSS

How do state science standards compare with the NGSS?



Arkansas’ standards are ranked as “clearly superior” to the NGSS.

Current Arkansas Science Standards

The current Arkansas Science Curriculum Frameworks were most recently revised in 2005, and the state put further revision on hold until the NGSS were released. In grades K-8, Arkansas has science curriculum frameworks that cover the strands of nature of science, life science, physical science, and earth and space science. In grades 9-12, Arkansas has course-specific curriculum frameworks for anatomy and physiology, biology, chemistry, environmental science, physical science, and physics. In order to graduate from high school, Arkansas students must take three science courses, including a biology course and two physical science courses.¹⁰

Under the current Arkansas science standards, students are assessed through the ACTAAP (Benchmark) exams in grades 5 and 7 and in high school through an End-of-Course exam in Biology. Historically, Arkansas students have scored less well in science than in math and literacy. For example, in 2013-14, **82%** of 5th graders scored proficient/advanced in literacy, **68%** in math, and **57%** in science. The difference in scores is more pronounced in 7th grade, where in the same year, **77%** of 7th graders scored proficient/advanced in literacy, **69%** in math and only **37%** in science.¹⁴ However, the science exam is a newer test (began in 2008-09 vs. math and literacy in 2004-05), and science testing is not considered to be a “high-stakes” test because it is only required at a few grade levels science scores do not factor into No Child Left Behind school ratings. In addition, Arkansas high school students have struggled on the Biology exam. Year after year, these scores have been the lowest among End-of-Course exams. As for NAEP testing in science, Arkansas 4th and 8th graders typically score less well than the national average, but not by much. In 2009, the average score of an Arkansas 4th grader in science was **146**, lower than the national average score of **149**.¹⁵

Status of the NGSS in Arkansas

As part of Arkansas’ role as a lead state partner, the state has agreed to give serious consideration to adopting the Next Generation Science Standards. In order for this to happen, Arkansas law requires that a timeline be followed regarding the review and revising of academic content standards. First, external experts must review and comment on current standards (as Fordham has done). Next, a review committee is assembled, comprised of K-12 teachers and administrators,

instructional facilitators, and higher education content experts. In June 2013, this committee reviewed the NGSS and a majority (88%) concluded that the NGSS are superior to Arkansas’ current science standards. The committee also praised the standards for how well they align with the state’s STEM initiatives and recommended that the Arkansas Department of Education (ADE) adopt the NGSS.

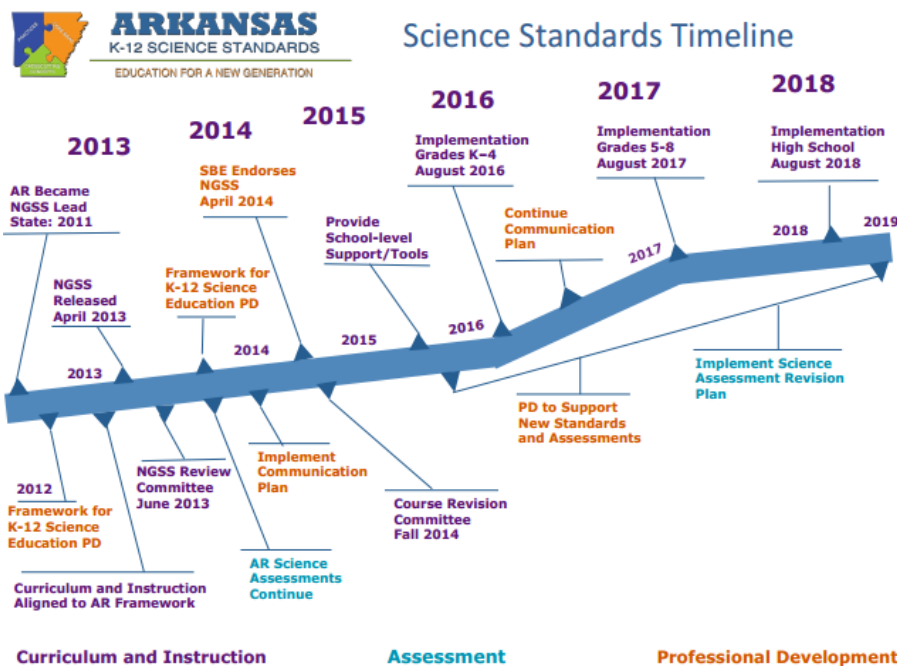
In April 2014, Dr. Tracy Tucker, Director of Curriculum and Instruction at the ADE, presented this recommendation to the State Board of Education, along with a proposed timeline for implementation. The SBE voted unanimously to endorse this plan.¹⁷ According to Michele Snyder, Science Program Advisor for Curriculum and Instruction at the ADE, Arkansas is now halfway through the process for official adoption of the NGSS.

Next steps include bringing in committees (K-8 and 9-12) to map the standards into courses and grades that meet the requirements for Arkansas Standards for Accreditation, studying the recommendations of the expert reviewers, and adding any clarification to the performance expectations of NGSS for Arkansas teachers. Once that work is done, the standards will be brought to the State Board of Education for adoption. If adopted, the NGSS will be adapted to fit Arkansas’ needs and will become the “Arkansas K-12 Science Standards.” Following official adoption, the plan calls for educators to receive professional development and for implementation of the standards to begin in August 2016 for grade K-4, August 2017 for grades 5-8, and in August 2018 for high school. Implementing the standards for different grade levels in different years is similar to the strategy that Arkansas used for Common Core implementation.

The Arkansas timeline calls for discussion to begin in 2017-18 about revising plans for science assessment. If the NGSS is formally adopted, Arkansas’ science testing will change, but the ADE has stated that it is too early to determine the nature of this change.

Arkansas’ Timeline for Implementation of the NGSS

At the June 2014 State Board of Education meeting, a working draft of the Plan for Development and Implementation of Arkansas’ K-12 Science Standards was approved. Below is the proposed timeline for implementation.¹⁶



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Conclusion

The Next Generation Science Standards have not been as widely publicized as the Common Core State Standards, and therefore the backlash has been less prevalent. However, similar to the CCSS, there are many differing views on the NGSS, both in opposition and in support.

According to the Fordham Institute report, which expresses doubts about the quality of the NGSS, many states are reluctant to adopt the NGSS because they are overburdened with implementing the Common Core. The Fordham authors recommend that state leaders consider if they have the resources and ability to implement the new science standards in the near future; if not, they recommend that states hold off adoption until they can be serious about implementation.

Arkansas appears to be heeding this advice. Although the Natural State has not officially adopted the NGSS, the ADE has developed a serious plan and timeline for implementation, which has been endorsed by the State Board of Education. This plan calls for gradual implementation of the Arkansas K-12 Science Standards, which appears to be a wise decision at a time when Arkansas is occupied with the implementation of Common Core, PARCC testing, and TESS, the new teacher evaluation system.

In sum, Arkansas seems well on track to potentially adopt and implement the NGSS. It is important to remember, however, that what will ultimately affect Arkansas classrooms is the quality of the future science assessments and the incentives that schools have to prepare students for these assessments. According to the ADE, Arkansas will likely continue to use its current science assessments for several more school years, as the timeline says that plans to revise science assessments will not be made until the 2017-18 school year. Therefore, it may be several years before Arkansas schools begin to feel the full impact of the Next Generation Science Standards.

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