Next Generation Science Standards

Delaware's Implementation Plan

February 2014

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PREFACE:

The NGSS Implementation Plan is a product of significant collaboration amongst key stakeholders groups in the State of Delaware. The document is meant to be dynamic and responsive to school and district needs and be refined constantly to meet the changing needs of key stakeholder groups. This plan is grounded in science education research over the last several decades and guided by key national documents such as *A Framework for k-12 Science Education* and the *American Association for the Advancement of Science (AAAS) Atlas of Science Literacy.*

The DE Science Coalition, a group of state school districts and charter schools, is an example of how local control can be combined to realize efficiencies of size and scale. This implementation plan has been adopted by the DE Science Coalition, yet the exact implementation may look differently at each member school and/or district. These schools and districts choose to work together for the greater good of the science community and to meet the vision of the *Frameworks* and the implementation plan.

The plan recognizes the great diversity of teachers and students in schools and expects the implementation to produce high-quality, research-based professional development for educators.

The plan recognizes that we live in an increasingly technological world and that the jobs of tomorrow will be based in applied science and mathematics. Standards, curriculum, assessment, and instructional practices should adequately prepare students to be college and career ready. Curricular units are tools to be used by teachers in the implementation of the standards. The importance of the teacher cannot be understated. The implementation of the *Next Generation Science Standards* forces teachers to concentrate as much on the "how" we teach science as much as the "what" we teach in science. An essential component of success will be a well-educated teaching workforce.

VISION:

Vision: Delaware will ensure that all students will have the world class science education they need to succeed and to support our state's economy at globally competitive levels.

> *By the end of the 12th grade, students should have gained sufficient knowledge of the practices, crosscutting concepts, and core ideas of science and engineering to engage in public discussions on science-related issues, to be critical consumers of scientific information related to their everyday lives, and to continue to learn about science throughout their lives. They should come to appreciate that science and the current scientific understanding of the world are the result of many hundreds of years of creative human endeavor. It is especially important to note that the above goals are for all students, not just those who pursue careers in science, engineering, or technology or those who continue on to higher education.*
>
> *A Framework for K-12 Science Education* (2012, p.9)

NGSS IMPLEMENTATION LEADERSHIP TEAM:

The State Board of Education, through adoption of the revised 14 DE Admin. Code 501 Content Standards, charged the Delaware Department of Education (DDOE) with the development and dissemination of a timeline for implementation of the NGSS. The DDOE created a NGSS Implementation Leadership Team, representing key stakeholder groups in the science community, to accomplish this task. All members voluntarily accepted invitations from the DDOE to join the committee and were existing members of the Delaware Science Coalition. This team has led the development of the state's NGSS implementation plan with constant review from the DE Science Coalition Steering Committee membership.

Team Members:

Dr. Michelle Kutch	Brandywine School District, Curriculum Program Supervisor
	Science Coalition Co-Chair
Mr. Gene Montano	Capital School District, Supervisor of Instruction
	Science Coalition Co-Chair
Dr. Shelley Rouser	DE Department of Education, Director, K-12 Initiatives & Educator Engagement
Mrs. Tonyea Mead	DE Department of Education, Education Associate, Science
Dr. John Moyer	DE Department of Education, Education Specialist, Science
Mrs. April McCrae	DE Department of Education, Education Associate, STEM Coordinator
Mr. David Pragoff	Delaware Nature Society, School and Group Programs Team Leader
Dr. Terri Hodges	Delaware PTA, President
Mr. Judson Wagner	Brandywine School District, STEM Program Supervisor/ Instructional Technology
	DE STEM Council, Co-Chair
Mr. Edward McGrath	Red Clay School District, Science Supervisor
Dr. Zoubeida Dagher	University of Delaware, Professor of Science Education
Mrs. Peggy Vavalla	DuPont, Education Liaison, Center for Research & Education
Dr. Rita Vasta	New Castle County Vo-Tech School District, Instructional Coach
	Prestige Academy Charter School, Board Member
Ms. Sharon Densler	Capital School District, Science Specialist
	DE STEM Council, Board Member

BACKGROUND/RESEARCH BASE:

National Science Education Standards – Standards for Professional Development
(National Research Council, 1996)

Professional Development Standard A
Professional development for teachers of science requires learning essential science content through the perspectives and methods of inquiry. Science learning experiences for teachers must
- Involve teachers in actively investigating phenomena that can be studied scientifically, interpreting results, and making sense of findings consistent with currently accepted scientific understanding.
- Address issues, events, problems, or topics significant in science and of interest to participants.
- Introduce teachers to scientific literature, media, and technological resources that expand their science knowledge and their ability to access further knowledge.
- Build on the teacher's current science understanding, ability, and attitudes.
- Incorporate ongoing reflection on the process and outcomes of understanding science through inquiry.
- Encourage and support teachers in efforts to collaborate.

Professional Development Standard B
Professional development for teachers of science requires integrating knowledge of science, learning, pedagogy, and students; it also requires applying that knowledge to science teaching. Learning experiences for teachers of science must
- Connect and integrate all pertinent aspects of science and science education.
- Occur in a variety of places where effective science teaching can be illustrated and modeled, permitting teachers to struggle with real situations and expand their knowledge and skills in appropriate contexts.
- Address teachers' needs as learners and build on their current knowledge of science content, teaching, and learning.
- Use inquiry, reflection, interpretation of research, modeling, and guided practice to build understanding and skill in science teaching.

Professional Development Standard C
Professional development for teachers of science requires building understanding and ability for lifelong learning. Professional development activities must
- Provide regular, frequent opportunities for individual and collegial examination and reflection on classroom and institutional practice.
- Provide opportunities for teachers to receive feedback about their teaching and to understand, analyze, and apply that feedback to improve their practice.
- Provide opportunities for teachers to learn and use various tools and techniques for self-reflection and collegial reflection, such as peer coaching, portfolios, and journals.
- Support the sharing of teacher expertise by preparing and using mentors, teacher advisers, coaches, lead teachers, and resource teachers to provide professional development opportunities.
- Provide opportunities to know and have access to existing research and experiential knowledge.
- Provide opportunities to learn and use the skills of research to generate new knowledge about science and the teaching and learning of science.

Professional Development Standard D
Professional development programs for teachers of science must be coherent and integrated. Quality preservice and inservice programs are characterized by

- Clear, shared goals based on a vision of science learning, teaching, and teacher development congruent with the *National Science Education Standards*.
- Integration and coordination of the program components so that understanding and ability can be built over time, reinforced continuously, and practiced in a variety of situations.
- Options that recognize the developmental nature of teacher professional growth and individual and group interests, as well as the needs of teachers who have varying degrees of experience, professional expertise, and proficiency.
- Collaboration among the people involved in programs, including teachers, teacher educators, teacher unions, scientists, administrators, policy makers, members of professional and scientific organizations, parents, and business people, with clear respect for the perspectives and expertise of each.
- Recognition of the history, culture, and organization of the school environment.
- Continuous program assessment that captures the perspectives of all those involved, uses a variety of strategies, focuses on the process and effects of the program, and feeds directly into program improvement and evaluation.

Principles Behind Professional Development in Science Education
(NSTA Position Statement, Professional Development in Science Education)

To achieve the goal of providing professional development for science educators throughout their careers, professional development programs should incorporate the following guiding principles (Loucks-Horsley, Love, Stiles, Mundry, and Hewson 2003; Elmore 2002; Darling-Hammond and Sykes 1999):

- Professional development programs should be based on student learning needs and should help science educators address difficulties students have with subject-matter knowledge and skills.
- Professional development programs should be based on the needs of science educators—of both individuals and members of collaborative groups—who are involved in the program. Ongoing professional development initiatives should be assessed and refined to meet teachers' changing needs.
- To best serve all students as they learn science, professional development should engage science educators in transformative learning experiences that confront deeply held beliefs, knowledge, and habits of practice.
- Professional development should be integrated and coordinated with other initiatives in schools and embedded in curriculum, instruction, and assessment practices.
- Professional development programs should maintain a sustained focus over time, providing opportunity for continuous improvement.
- Professional development should actively involve teachers in observing, analyzing, and applying feedback to teaching practices.
- Professional development should concentrate on specific issues of science content and pedagogy that are derived from research and exemplary practice. Programs should connect issues of instruction and student learning of knowledge and skills to the actual context of classrooms.
- Professional development should promote collaboration among teachers in the same school, grade, or subject.

Ready, Set, Science! Putting Research to Work in K-8 Science Classrooms
(National Research Council, 2008)

> In order to teach effectively, the teacher must first understand the subject being taught. There is a growing body of evidence that what a teacher knows about science influences the quality of instruction and has a powerful effect on the success and type of discussions that teachers engage in and sustain with students (p.153).

> At the core of teacher professional development, we should focus on challenging conventional wisdom about learners and building a contemporary research-based view (p.155).

America's Lab Report: Investigations in High School Science (National Research Council, 2006)

> Conclusion 4: Improving high school science teachers' capacity to lead laboratory experiences effectively is critical to advancing the educational goals of these experiences. This would require major changes in undergraduate science education, including providing a range of effective laboratory experiences for future teachers and developing more comprehensive systems of support for teachers (p.7).

> The limited quality and availability of professional development focusing on laboratory teaching is a reflection of the weaknesses in the larger system of professional development for science teachers (p.149).

The Effects of Kit-Based Science Curriculum and Intensive Science Professional Development on Elementary Science Achievement (Young & Lee, 2005)

> While there were no significant differences in the mean total scores for the kit-based students with low PD versus high PD teachers, the kit-based classrooms score significantly higher than students in nonkit classrooms on both the pretest and posttest, though there were significantly more minutes of science instruction in the nonkit classrooms (p.471).

> A key factor in the success of any educational reform is the knowledge and skill of the classroom teacher who is called upon to implement a new curriculum (p.473).

> Inadequate teacher preparation and support have been cited as contributing factors in the failure of earlier generations of science kits to lead to significant increases in student achievement … The traditional model of providing teachers with better materials accompanied by hasty staff development sessions is inadequate to the task of fostering the fundamental changes required (p.473).

> The results of this study add to the evidence that sustained science educational programs that combine high-quality materials and intensive teacher professional development in science and reform pedagogy have a positive impact on children's' learning of science (p.480).

> More effective science teaching may be accomplished in less time, given high quality materials and professional development targeted specifically to the use of reform pedagogy in guiding students in lessons (p.480).

Research-Based Recommendations for Professional Development for NGSS
Dr. Brian J Reiser, Northwestern University (Reiser, 2013)

What Professional Development Strategies are Needed for Successful Implementation of the
Next Generation Science Standards

Recommendation 1: Structure teacher sensemaking around rich images of classroom enactment. Teachers need to analyze and deconstruct examples in order to figure out what can be applied to their own teaching context. They need to work with rich cases that reflect the complexity of the teacher learning interactions, and contain enough context to explore the rationale for interactions and track their changes over time (Borko, 2004). One fruitful way to engage teachers with records of practice is for teachers to analyze video cases of teaching interactions (Ball et al., 2009; Boerst, Sleep, Ball, & Bass, 2011; Sherin & Han, 2004; van Es & Sherin, 2007). Video cases enable teachers to analyze student thinking, and the work of other teachers to elicit student ideas and help students work with one another's ideas. Video cases also help the teacher analyze how target subject matter and student thinking with these ideas are realized in classroom discourse (Boerst et al., 2011; Borko, Jacobs, Eiteljorg, & Pittman, 2008). The rich cases also provide examples teachers can study to explore how tasks in curriculum materials can provide experience with phenomena, raise questions, and help students construct explanations to make sense of the target ideas (Ball & Cohen, 1996, 1999; Borko et al., 2008; Roth et al., 2011). There are two related tasks in working with video cases. Teachers need to learn to analyze student thinking and classroom situations using the ideas of the reform (van Es & Sherin, 2007). This type of analysis is needed to anchor pedagogical content knowledge embodying strategies for supporting students in particular situations.

Recommendation 2: Structure teachers' work to be collaborative efforts to apply NGSS to their own classrooms. A clear implication of designing for active learning "in, from, and for practice" is the emphasis on constructing collaborative learning environments, in which teachers work together to understand, apply, and reflect on the reforms (Garet et al., 2001; Wilson, 2013). Such collaboration is a key element of the active sensemaking identified as needed to understand the reform (Putnam & Borko, 2000). The group context for this discussion around specific examples of practice can create opportunities for the analysis and argumentation needed to dig beneath the surface of the reforms, and to explore substantive issues in applying the reforms to practice (Sherin & Han, 2004; van Es & Sherin, 2007).

In investigating cases of NGSS aligned teaching, teachers could work together to debate their interpretations, and reach consensus as they do the science, analyze student work, and analyze teaching interactions. Teachers need to analyze and make sense of the ideas about the science to develop their own models and explanations. Cases could be presented as data to make sense of, not as examples to follow strictly. Teachers could analyze student work and raw classroom video (without a narrative telling them a single "correct interpretation") to uncover challenges the ideas and practices pose, and how students' ideas differ from one another and change over time. These PD tasks, just as the nature of learning in NGSS, would focus on knowledge-in-use rather than on abstract decontextualized knowledge. Whether working on science, student learning, or teaching questions, teachers would be asked to connect what they are seeing to their own classroom experiences, e.g., contrasting the way they are learning about the human body in the PD sessions with typical approaches currently used to teach the human body in their school. They could work to adapt lessons they currently teach to incorporate science and engineering practices, and to restructure the lessons to focus on a coherent storyline, in which questions about phenomena motivate the need to develop and use explanatory models.

Recommendation 3: Capitalize on cyber-enabled environments. The importance of responding to teacher learning needs across the K-12 system, combined with the need to offer sustained, job-embedded professional development, raise the question of using technology as part of a solution in addressing problems of scale. There are a variety of ways to incorporate technology, including the materials teachers use (e.g., digital video of classrooms, video of presentations), and the medium for communication (e.g., online course tools). The research on cyber-enabled learning is still emerging. Dede, Ketelhut, Whitehouse, Breit, and McCloskey (2008) reviewed the state of research on cyber-enabled PD. Dede et al. call for investments in scholarship in online professional development to build a much needed evidence-based conceptual framework that provides robust explanatory power for theory and model building. They are critical of a traditional emphasis on pure evaluation studies of "learning innovations" and recommend empirical studies with promise of generating knowledge on several critical variables, for example, design features, shifts in teaching practices, and technology-mediated interactions. Most importantly they call for studies that do not replicate traditional PD, but studies with methodologies and theoretical assumptions well suited to a cyber-enabled environment. Careful attention to the affordances of online tools can, in some cases, lead to teacher learning with positive outcomes equivalent to face-to-face professional development (Fishman et al., in press).

There are clearly potential benefits that appropriate use of technology could potentially provide. Expertise for teacher discussion groups could be provided through guiding videos. Technology can enable access to resources such as video cases, and examples of how curriculum materials can support students' science and engineering practices. Linked examples of curriculum materials, classroom enactments, and resulting student work can be provided.

However, a standard online course is unlikely to support the change in teacher practice that is needed. The challenge in adapting technology as part of a PD solution is to retain what we know is effective in PD – supporting a community of teachers working to make sense of reform ideas and apply them to their own classroom practice, supporting them in cycles of investigation, classroom teaching, and sharing and reflecting on the results from their own classrooms. Thus, online courses in which teachers are presented with information are unlikely to support change in teacher practice that is needed. Even the typical types of online discussion groups that accompany online courses could be insufficient. While these assigned discussions at least provide opportunities for teachers to dig deeper into the ideas and attempt to make sense of them with their peers, this doesn't provide the context in which teacher are working together to apply the ideas to their own practice. Technological supports, ideally, would be part of a system of supports for teachers engaged in the cycles of investigation of the science and pedagogy, enactment in their own classrooms, and study of their classrooms as they attempt to enact the ideas.

Research in Blended Online Learning (Compiled by Al Byers, NSTA, 2013)

Berger et al. (2008), Blended Online and F2F PD Model
    Target Audience: High School Physics (n=16)
    Research Findings: Strong online participation linked to student work, discussion tools/techniques

Krall et al. (2009), Self-paced, on-demand, hands-on kits, mentor
    Target Audience: Elementary and Middle Science Teachers (n = 43)
    Research Findings: Significant gains in subject knowledge. Hands-on most valued. Low mentor rating via email -- too critical

Owston et al. (2008), Blended online and face-to-face
    Target Audience: Middle School Science & Math (n = 33)
    Research Findings: Significant gains in teacher perception of inquiry. Weak online participation. Challenges in online component even when provide release time. Reading articles and commenting.

del Valle et al. (2009), Self-paced, 12 week module, instructor help
    Target Audience: K-12 in-service teachers (n=59)
    Research Findings: Mastery-sig. time over longer period, Task-focused-less time in shorter period, not prefer cohort learning. Procrastinator-little time, longer period to complete, prefers cohort learning.

Lowes et al. (2007), 4-week course, asynchronous discourse, readings, group project at end. 6 schools, 3 states
    Target Audience: Middle & High (grades 6-10)
    Research Findings: Online discourse analysis. Cheerleader-affirming + new information increases online participation. Vary over course to more questioning/challenging at end.

Whitaker (2007), On-demand: 3 levels of support A) web access B) reflection tools, resources, C) 1-on-1 video chat & teaching clip.
    Target Audience: pre-K teachers (n=235)
    Research Findings: Level of service significantly affects teacher participation. Group C log on more, Group A log on for longer periods of time, but significantly less frequently. Personalized feedback strongly valued. Better to respond quickly with brief message that delayed with longer posts

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ACTION PLAN - Communication

Essential Question: Why move from the Delaware Science Standards to the Next Generation Science Standards?

SMART Goal: By the end of the 2016-17 school year, all stakeholder groups will have a clear understanding on the vision, rationale, implementation plan, and rollout of the NGSS.

Rationale:

A science education system must be responsive to a variety of influences – some that emanate from the top down, some from the bottom up, and some laterally from outside formal channels (p.245).

A Framework for K-12 Science Education

Strategies:

1. Develop a vision and mission statement to guide the implementation of the NGSS in Delaware.
2. Develop a communications system that effectively communicates the key messages of the NGSS and engages all educators and stakeholders early, often, and throughout the implementation effort.
3. Conduct high-quality lead teacher meetings to bring together math/science and ELA/science teams that will serve as leaders of the NGSS plan.
4. Partner with other states to share communication resources.
5. Create a Delaware based NGSS website.

Timing	Leader(s)	Action Step(s)	Deliverable(s)	Status
Year 0	Leadership team Science Coalition	Create a vision and mission that guides the implementation of the NGSS (Strategy 1).	Create a vision statement

Create a mission statement | Ongoing |
| Year 1 Year 2 Year 3 | Leadership team Science Coalition DDOE public relations officer | Generate press releases and other forms of communication to inform the public, especially parents, and other stakeholder groups about the NGSS (Strategy 2). | Bi-monthly press releases and communication updates

Develop and disseminate a flyer/informational piece as a "take away" for participants. | Ongoing |
| Year 1 Year 2 Year 3 | Science Coalition | Plan and facilitate lead teacher and lead principal meetings to share information about the implementation of the NGSS (Strategies 2 & 3).

See also the Instructional Practices Action Plan | Fall lead teacher meeting Winter lead teacher meeting Spring lead teacher meeting Summer lead teacher meeting

Summer lead principal meeting (coordinate with existing meeting structure & schedule) | Ongoing |

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Year 0	Science Coalition NSTA	Develop, gather, and/or evaluate online resources (Webinar, videos, etc.) that communicate the key shifts associated with the NGSS (Strategy 2).	*Orientation to the NGSS* Webinar Shifts in NGSS Webinar *How to Use the Practices* Webinar *How to Use the Cross-Cutting Concepts* Webinar *Integrating CCSS Science Literacy into Lessons* Webinar *Integrating CCSS Math into Lessons* Webinar	Ongoing
Year 1 Year 2 Year 3	Science Coalition DDOE staff	Post exemplar lessons and other resources that communicate the effective implementation of the NGSS (Strategy 2). *See also the Instructional Practices Action Plan	Create and post videos of exemplary teaching that emphasize the three dimensions (disciplinary core ideas, cross-cutting concepts, & practices) of the NGSS.	Ongoing
Year 0 Year 1	DDOE staff	Plan, Develop/Adapt, and Implement a website where NGSS resources can be stored electronically (Strategy 5).	Modify the DDOE website to allow the storage and retrieval of electronic NGSS resources Create a Blackboard site to facilitate the storage and communication of NGSS resources. Create, adapt, modify, and/or utilize other state electronic resources to aid in the NGSS communication efforts (i.e. LEA newsletters, www.delexcel.org, etc.)	Ongoing
Year 0 Year 1 Year 2 Year 3	Tonyea Mead John Moyer	Share communication plans and documents with national partners in the "Adopted States Consortium" (Strategy 4)	Monthly conference call amongst adopted states. Post resources on the adopted states electronic resource storage system.	Ongoing

ACTION PLAN - Assessment

Essential Question: How can assessment drive changes in instructional practices?

SMART Goal: By the end of the 2016-17 school year, a comprehensive assessment system that is fully aligned to the NGSS will be implemented in Delaware.

Rationale:

Assessment refers to the means used to measure the outcomes of curriculum and instruction – the achievements of students with regard to important competencies. Assessment may include formal methods, such as large-scale standardized state testing, or less formal classroom-based procedures, such as quizzes, class projects, and teacher questioning (p.260).

Assessment developers will need to develop creative, valid, and reliable ways of gathering evidence about students' progress across the domains and grade levels to satisfy different purposes at different levels of the science education system (p.265).

A Framework for K-12 Science Education

Strategies:

1. Develop and implement a comprehensive, multi-layered assessment system that measures all three dimensions (disciplinary core ideas, cross-cutting concepts, & practices) of the NGSS.
2. Explore the possibility of modifying the school accountability system to include science as a performance .component/requirement of overall LEA assessment.
3. Identify key organizational issues that can be reviewed using assessment data; thereby creating a feedback loop for data and program management.
4. Partner with NGSS adopted states to develop, pilot and refine assessment items that can become part of a shareable cross-state item bank—especially at the formative and benchmark level, but possibly building to the summative/accountability level.

Timing	Leader(s)	Action Step(s)	Deliverable(s)	Status
Year 1 Year 2 Year 3	Science Coalition DDOE Staff Lead teachers Lead principals	Provide PD to lead teachers and principals on using NGSS aligned formative and benchmark assessment to drive instruction and identify gaps in existing materials and pedagogy (Strategy 1).	PD session(s) developed and implemented targeting the use of formative and benchmark assessments for learning. PD sessions held where teachers review student work and refine formative and benchmark assessments as well as instructional practices based upon results of the review. Teachers learn to score new assessment items.	Ongoing

Year 0	DDOE Staff	Create an assessment timeline indicating key activities and benchmarks toward the development of a complete, comprehensive science assessment system (Strategy 1).	Timeline is developed for the implementation plan that includes assessment changes over the next three years. • Blueprint • Sample item development • Pilot/field test items • Assessment implementation timeline • Interim / formative assessment items (similar to SBAC)	Ongoing
Year 1 Year 2 Year 3	DDOE Staff Assessment vendor(s)	Create NGSS aligned DPAS II, Component V Performance Assessments (Strategy 1). (See associated timeline)	K-12 DPAS II, Component V assessments are created and field tested that assess the three dimensions of the NGSS. • Focus heavily on the practices (performance assessments), which require a strong scoring criteria/rubric. • Pilot new assessments before full implementation for accountability purposes.	Ongoing
Year 2 Year 3	Secretary of Education State Board of Education Legislature	Explore opportunities to create policies and/or procedures where science scores factor into the overall accountability of an LEA (Strategy 2).	Science assessment scores are part of an overall school accountability system (such as previous "Safe Harbor", etc.)	Ongoing
Year 1 Year 2 Year 3	Science Coalition DDOE Staff	Use assessment data to drive decision-making practices (Strategy 3).	Assemble a subcommittee to review assessment data on a regular basis and provide feedback to the DDOE and to the DE Science Coalition.	Ongoing
Year 0 Year 1 Year 2 Year 3	DDOE Staff Other state assessment partners (i.e. SCASS, etc.)	Collaborate with national partners to create state level assessments (Strategy 4).	Evaluate current state-level assessment items as well as items from other national partner organizations for alignment to NGSS.	Ongoing

			Develop and/or modify existing assessment items to be aligned with NGSS. Create a state-level assessment that is NGSS aligned.	

ACTION PLAN - Instructional Practices

Essential Question: How can a high-quality/research-based professional development system change instructional practices?

SMART Goal: By the end of the 2016-17 school year, science instruction in all classrooms will demonstrate the blend of the science & engineering practices, disciplinary core ideas, and crosscutting concepts as outlined in the Frameworks. Leaders will take steps to ensure that all educators receive high-quality, research-based professional development (to improve the return on investment of these efforts).

Rationale:

Instruction refers to methods of teaching and the learning activities used to help students master the content and objectives specified by a curriculum (p.250).

Teachers are the linchpin in any effort to change K-12 science education …. In order to support implementation of the new standards and the curricula designed to achieve them, the initial preparation and professional development of teachers of science will need to change (p.256).

Teacher preparation programs and professional development programs will need to provide learning opportunities for teachers themselves in order to deepen their conceptual understanding, engage in scientific and engineering practices, and develop an appreciation of science as a way of knowing in a community of knowledge builders (p.264).

A Framework for K-12 Science Education

Strategies:

1. Establish and communicate a compelling vision that changes teachers' instructional practices.
2. Partner with other NGSS states and national experts (NSTA, Achieve, etc.) to share professional development resources.
3. Create, communicate, and implement a high-quality, research-based PD program that is a hybrid of both anytime-anywhere and face-to-face training and is a balance of content and pedagogy.
4. Build leadership capacity amongst science teachers and central office/building administrators through strategic professional development, a teacher-leader system, and a more collaborative Science Coalition meeting structure.
5. Explicitly integrate the *Literacy in Science and Technical Subjects* connections in NGSS professional development.
6. Communicate the connections between science, ELA, and mathematics expectations.
7. Provide exemplars of NGSS and STEM instruction in the form of lessons, classroom footage, assessments, etc.
8. Identify and share models of integrating the CCSS and science Instruction to address the current state of limited instructional time.
9. Collaborate with higher education and informal education agencies to provide NGSS aligned inservice and preservice professional development to educators.

Timing	Leader(s)	Action Step(s)	Deliverable(s)	Status
Year 0	Leadership Team	Create and communicate a vision for the implementation of the NGSS that reflects the intended changes in instructional practices (Strategy 1).	Vision statement included in the final implementation plan presented to the DSC Steering Committee in February 2014.	Complete
Year 0 Year 1 Year 2 Year 3	DDOE staff	Participate in the "Adopted States Consortium" and the Building Capacity for State Science Education (BCSSE) consortiums (Strategy 2).	Monthly conference call amongst adopted states. Post PD resources on the adopted states electronic resource storage system.	Ongoing
Year 0 Year 1 Year 2 Year 3	Science Coalition DDOE staff DFMSE staff	Elicit the assistance of nationally recognized experts in science professional development to help with the rollout of the NGSS implementation plan (Strategy 2).	Utilize experts from Achieve and other NGSS national associates to assist in planning and conducting PD (i.e Stephen Pruitt, Brett Moulding, etc.). Participate in BCSSE conferences and activities.	Ongoing
Year 0 Year 1 Year 2 Year 3	Leadership Team Science Coalition	Evaluate existing NSTA and other national online resources for possible use in the PD program (Strategy 2).	Review NSTA website for appropriate resources. Review NGSS website for appropriate resources. Review NGSX resources (Jean Moon, Tidemark Institute) for appropriate resources Search out other national resources to assist in PD planning and delivery.	Ongoing
Year 0	Science Coalition	Research and evaluate effective professional development models, that are high-quality and research-based, for use during the implementation of the NGSS (Strategy 3).	Review current research base on PD models specific to science education. Establish a PD model(s) for elementary and secondary science teachers. Evaluate and refine PD models.	Summer 2014

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Year 0 Year 1 Year 2 Year 3	Science Coalition DDOE staff	Establish and maintain a lead teacher program that focuses on building leadership capacity at the building level and provides professional development in improving instructional practices (Strategy 4).	Fall lead teacher meeting Winter lead teacher meeting Spring lead teacher meeting Summer lead teacher meeting	Ongoing
Year 0 Year 1 Year 2 Year 3	Science Coalition DDOE staff	Establish and maintain an administrative program that focuses on building leadership capacity at the principal level and provides professional development in improving instructional practices (Strategy 4).	Provide PD for LEA curriculum directors during the monthly DSC Steering Committee Meetings on instructional practices. Provide PD for administrators, with a focus on NGSS aligned instructional practices. Provide teacher evaluation tools to ensure instruction is NGSS aligned (i.e. walkthrough tools, "look fors", "ask abouts", etc.)	Ongoing
Year 0 Year 1 Year 2 Year 3	Science Coalition DDOE staff	Provide professional development to educators on integrating CCSS ELA Literacy standards and CCSS Math standards into science lessons (Strategies 5, 6, & 8).	Create webinars that describe how to integrate CCSS and NGSS into science instruction. Create webinars on the ELA, Mathematics, and Science & Engineering practices Integrate disciplinary specific literacy strategies into ongoing professional development programs.	Ongoing
Year 1 Year 2 Year 3	Science Coalition DDOE staff	Post exemplar lessons, assessments, and other resources that emphasize effective instructional strategies in the implementation of the NGSS (Strategy 7). *See also the Communication Action Plan *See also the Assessment Action Plan	Create and post videos of exemplary instructional practices that emphasize the three dimensions (disciplinary core ideas, cross-cutting concepts, & practices) of the NGSS.	Ongoing

Year 1 Year 2 Year 3	Science Coalition DDOE Staff UD DSU Wesley College Wilmington Univ. DTCC	Meet with higher education agencies that provide teacher preparation programs to ensure their programs are NGSS-aligned (Strategy 9). *See also the Communication Action Plan*	Initial NGSS awareness meeting between the Science Coalition and the state's major universities. Hold annual professional development session(s) that target the transition between preservice and inservice professional development.	Ongoing
Year 1 Year 2 Year 3	Science Coalition DDOE Staff Informal Education Agencies	Meet with informal education agencies that provide teacher professional development programs to ensure their programs are NGSS-aligned (Strategy 9). *See also the Communication Action Plan*	Hold annual professional development session(s) that target the outreach programs from informal education agencies, ensuring NGSS alignment.	Ongoing

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ACTION PLAN – Curriculum & Instructional Materials

Essential Question: What criteria are in place to ensure that high quality instructional materials, aligned to the Next Generation Science Standards (NGSS), are in the hands of teacher leaders/classroom teachers?

SMART Goal: All schools will implement with fidelity materials that are aligned to the Next Generation Science Standards (NGSS), to ensure the quality teaching of science in all elementary classrooms and 6-12 science classes.

Rationale:

Before thinking about the "how" of implementation, it is important to think about the "what"…teachers and principals must have the materials on which they will be trained. (Achieve and EDI, 2012)

Curricula based on the framework and resulting standards should integrate the three dimensions – scientific and engineering practices, cross-cutting concepts, and disciplinary core ideas …. In order to support the vision of this framework, standards-based curricula in science need to be developed to provide clear guidance that helps teachers support students engaging in scientific practices to develop explanations and models (p.246).

Curriculum developers will need to design K-12 science curricula based on research and on learning progressions across grade levels that incorporate the framework's three dimensions (p.264).

A Framework for K-12 Science Education

Strategies:

1. Develop a rubric for the systematic, quality review of curricular resources.
2. Review the NGSS to identify logical groups of standards, forming courses of study (Course Mapping).
3. Analyze current curricular materials for alignment to the NGSS (Gap Analysis –Alignment Study).
4. Evaluate new resources and/or modify current curricular resources to ensure proper horizontal and vertical articulation strategies, supporting the NGSS.
5. Create educator resources to assist with CCSS and STEM expectations.

Timing	Leader(s)	Action Step(s)	Deliverable(s)	Status
Year 1	Science Coalition DDOE Staff Achieve	Develop or adapt existing curricular evaluation rubrics (Strategy 1). • Rubrics will evaluate correlation to disciplinary core ideas, cross-cutting concepts, and the science & engineering practices. • Rubrics will use the 5E Instructional Model as a basis for evaluation criteria. • Rubrics will evaluate CCSS correlations as well as other interdisciplinary opportunities.	Selection of rubric or modification of an existing rubric for evaluation of curricular resources.	Ongoing
Year 0 Year 1	Science Coalition DDOE Staff	Create and implement a professional development program that trains science educators to properly apply rubrics and evaluate curricular resources (gap analysis – curricular alignment study) (Strategy 3).	Leadership team will create a PD session(s) allowing participants to properly use the GAP Analysis Tool (Achieve Equip Rubric, AIM rubric, etc.). Select educators to participate in the gap analysis – curricular alignment study.	Ongoing
Year 0 Year 1	Science Coalition DDOE Staff	Develop guidelines and expectations for participation in evaluation activities (Strategies 1 & 2). Identify participants for gap analyses, curricular alignment studies, and course mapping activities (Strategies 1 & 2). Evaluate curricular resources and develop gap analysis – curricular alignment and scope and sequence (course mapping) documents (Strategies 1, 2, & 3).	Identify criteria for participation in the gap analyses, curricular alignment studies, and course mapping activities. Apply selection criteria to select participants for evaluation activities. Committee develops a report for the Science Coalition identifying alignment between curricular resources and the NGSS expectations. Committee develops a report for the Science Coalition identifying how NGSS will be mapped across the grade levels (scope and sequence).	Ongoing

NGSS Implementation Plan   State of Delaware   February 2014

Year 0 Year 1 Year 2 Year 3	Science Coalition DDOE Staff LEA Literacy specialists LEA Math specialists	Develop vertical articulation models (grade bands vs grade levels) of the crosscutting concepts (Strategy 4).	Educators, such as specialists and instructional coaches, will develop resources to assist in the understanding of the vertical articulation of NGSS.	Ongoing
Year 0 Year 1 Year 2 Year 3	Science Coalition DDOE Staff LEA Literacy staff Literacy Coalition	Develop curricular resources that assist teachers in making cross-curricular connections and aligning materials with Literacy/ELA and Math (balance of hands-on kits with ability level text readings) expectations (Strategy 5).	Develop structures to capture media-based materials (videos, webinars, games, etc.) to support implementation efforts of the NGSS and the CCSS.	Ongoing

ACTION PLAN - DE Science Coalition Infrastructure

Essential Question: How can the DE Science Coalition be organized to best support the implementation of the NGSS?

SMART Goal: By the end of the 2016-17 school year, the Delaware Science Coalition will exist to collaboratively assist member schools and districts meet the vision of the NGSS, preparing students to be college and career ready.

Rationale:

The complexity of the system – with several components that are affected by or operate at different levels – presents a challenge to implementation of the framework and its related standards. Successful implementation requires that all of the components across the levels cohere or work together in a harmonious or logical way to support the new vision. This kind of system-wide coherence is difficult to achieve, yet it is essential to the success of standards-based science education (p.245).

A Framework for K-12 Science Education

Strategies:

1. Establish a leadership and Steering Committee meeting structure that supports the healthy functioning of the DE Science Coalition. (How should we be organized to get the work done efficiently and responsibly? What does this look like?)
2. Review and update the Science Coalition by-laws and standard operating procedures documents to ensure a healthy and well-functioning organization. (Roles and responsibilities, vision, mission, etc.)
3. Maintain fiscal stability and transparency of the DE Science Coalition.
4. Ensure an efficient materials resource center that supports the implementation of the NGSS instructional materials.

Timing	Leader(s)	Action Step(s)	Deliverable(s)	Status
Year 0	Science Coalition	Review the 2013 External Evaluation of the DE Science Coalition and make recommendations to the Steering Committee (Strategy 1).	All members of the Steering Committee will receive the External Evaluation report and have the opportunity to review the recommendations.	Complete Nov. 2013
			Membership will be engaged in a thorough discussion of the recommendations section of the report and their implications.	Complete Nov. 2013 Dec. 2013
			Establish a subcommittee to make recommendations to the larger membership in regards to organizational health and improvement possibilities.	Ongoing

Year 0 Year 1	Science Coalition	Create a Science Coalition Steering Committee meeting structure that best meets the needs of the membership and accomplishes the mission of the organization (Strategy 1).	Science Coalition establishes a subcommittee to review current meeting structure(s) and practices to provide guidance to the membership regarding the best meeting structure and practices to facilitate more collaborative discussion. Adopt and implement a new meeting structure that best meets the needs of all the Science Coalition members.	Ongoing
Year 0 Year 1 Year 2 Year 3	Science Coalition DDOE staff	Plan and hold an annual retreat for members of the DE Science Coalition (Strategy 1 & 2).	Leadership team plans and manages a retreat to address key issues surrounding the health of the organization. Science Coalition members participate in retreats to update by-laws and standard operating procedures documents, review the strategic plan, and evaluate the overall science program.	Scheduled Feb. 2014 Ongoing
Year 0	Science Coalition	Re-establish the vision of the Science Coalition (Strategy 2). Re-establish the mission of the Science Coalition (Strategy 2).	Establish a vision and mission statement to guide the Science Coalition.	Ongoing
Year 0 Year 1 Year 2 Year 3	Science Coalition	Review the Science Coalition by-laws and standard operating procedures documents (Strategy 2).	Establish the roles and responsibilities of coalition members (DDOE staff and co-chairs, etc.). Revise the MOA Revise the by-laws Revise the SOP manual	Ongoing

Year 0 Year 1 Year 2 Year 3	Science Coalition DDOE Staff DFMSE staff	Science Coalition leadership maintains a fiscally responsible and transparent program (Strategy 3).	The budget subcommittee meets quarterly to review funding sources and the fiscal stability of the organization.	Existing
			Quarterly financial reports are provided to the steering committee showing funding sources, allocations, and current expenses.	Existing
			Science Coalition leadership continually seeks funding sources for constant refinement and improvement of the organization and the implementation of the NGSS (i.e. grants, etc.).	Ongoing
Year 0 Year 1	Science Coalition	Establish a system where new curricular materials can be reviewed and evaluated (Strategy 4). *See also the Curriculum & Instructional Materials Action Plan*	Establish a curricular materials subcommittee to develop evaluation criteria and procedures.	Ongoing
Year 0 Year 1 Year 2 Year 3	Science Coalition	Establish and maintain a system where the operations of the materials resource center are reviewed, refined, and/or modified to meet the needs of member schools and districts (Strategy 4).	Establish a materials resource center subcommittee. The materials resource center subcommittee provides frequent reports and recommendations to the Steering Committee on the efficient operation of the materials resource center.	Ongoing

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