

Instructional Materials and Implementation of Next Generation Science Standards: Demand, Supply, and Strategic Opportunities

A REPORT FOR



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In 2012, the National Research Council released *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (NRC, 2012 and funded by the Carnegie Corporation of New York). The report described essential science content and practices that all students should learn by graduation from high school. The *Framework* served as a vision for K-12 science education and the basis for new policies, namely the development of new science standards—the Next Generation Science Standards (Lead States — NGSS, 2013).

As a supporter for both the *Framework* and the NGSS, the Carnegie Corporation of New York remains deeply committed and engaged in supporting the vision of teaching and learning represented by new college and career ready standards for science. When it comes to the states that have adopted or adapted the NGSS, the Corporation remains focused on translating the vision of the NGSS into instructional materials, classroom assessments, and teachers' professional learning. In early 2017, the Carnegie Corporation of New York provided financial support to analyze, discuss and report on the landscape of the NGSS implementation with a specific focus on aligned and high quality instructional materials and the integration of professional learning. Using themes of the marketplace including supply and demand as well as reflecting on classroom assessment, field testing, quality assurance and implementation, thought leaders contributed to system-wide thinking about accelerating and scaling the implementation of the NGSS for the students, teachers, districts, and states that have already adopted or adapted the NGSS as their state science standards.

The journey and challenges of the Common Core State Standards has provided important case studies for implementing the NGSS. While the assessment community led the initial efforts with the NGSS, the rest of the community was slow in developing awareness of and support for

implementing the NGSS. In part, the science education community watched and learned from the Common Core effort. As Common Core State Standards efforts matured, two things became clear — ***the need for better and high quality instructional materials is urgent and real; and, materials and implementation need to be connected to ongoing and sustained professional learning for teachers.*** Although urgent, the development of high quality instructional materials in science has been slow, in part due to anticipated funding from federal agencies such as the National Science Foundation (NSF). As science education communities became more aware of the benefits of the standards, and state and district adoption occurred, demand for instructional materials by state and district leaders and K-12 classroom teachers grew. Similar to the early days of the Common Core State Standards, many teachers, schools and systems started creating their own materials driven by the need to begin the process of implementing new standards.

While many aspects of the education, policy and social landscape have changed since the early 2000's, the fundamentals — the need for high quality instructional materials, assessments and professional learning, have not.

Connecting, developing and linking instructional materials and professional learning are essential next steps in the realization of the NGSS and contemporary science education reform. This report considers the state of the science education marketplace in light of the NGSS, reflects on the development of instructional materials that are aligned with the NGSS, shares the importance of integrating professional learning into the science learning and teaching system, and describes the vision for providing equal and uncommon access to high quality science education materials to all across the U.S.

Education leaders are looking for materials that support students in seeing the world in a way that more accurately reflects how scientists see the world.

Insights on NGSS & Instructional Materials — Current Conditions

The U.S. and states allocate financial resources to education based on the number of students in a given state, district or school. Those resources, often subsidized, are then distributed across the system. Education is big business in the U.S. with almost 9% of the GDP being spent on educational resources (\$640 Billion annually), 9th in GDP distribution behind healthcare. Approximately \$1.06 Billion is spent annually on science education — supplemental materials, curriculum and instructional resources.

Who benefits from these investments? The (approximate) 50 Million students enrolled in preK-12 education programs across the country (including charter, private, and other special schools). Of these 50 Million students, approximately 52% (25.8 million) are in states that have adopted the NGSS or adapted their standards to meet the expectations of the NGSS. Not factored into this number are the climbing number of home schooled children with a passion and reputation for ways of doing science through activities and student guided programs.

With over half of the U.S. population in states where awareness, education, and programs are being built around the NGSS, demand for instructional materials is there. Education leaders are looking for materials that support students in seeing the world in a way that more accurately reflects how scientists see the world — referred to as three dimensional learning. Teachers and leaders who use science programs built under the prior science standards inquire as to where they can get materials that are of the same quality they have been accustomed to.



What about the current supply of instructional materials available to the market described earlier? The current supply is disaggregated and hard to find. Once a potential customer does find these materials, they are largely classroom lessons, with units or fully developed programs in short supply. There are very few programs available across the PreK-12 spectrum that model and feature the science and engineering practices, and limited examples or tools that model and support crosscutting concepts.

Where does a teacher, parent, science specialist or procurement go to find these materials? For literacy and math programs (as part of the Common Core State Standards) EdReports provides ratings and a ranking system for instructional materials. It is anticipated that they will do the same for science. Currently, people looking for materials find them by 1) speaking to a vendor or publisher they already know; 2) through a professional learning program; and 3) word of mouth and conferences. There is no one place — website, catalogue or organization to find these materials.

The language used to describe and explain NGSS instructional materials is complex.

None of the materials cataloged for this report have been through the Educators Evaluating the Quality of Instructional Products (EQuIP) Rubric for Science, a tool developed by Achieve and the National Science Teachers Association that provides criteria by which to determine the alignment and overall quality of lessons and units with respect to the Next Generation Science Standards (NGSS). Likewise, there were no materials that have officially been through the Primary Evaluation of Essential Criteria or PEEC-Alignment another tool developed by Achieve that allows individuals to review full course materials for their alignment with the innovations set forth in the NGSS before using the EQuIP Rubric for Science to review individual units of instruction.

In terms of building supply to meet demand, there are many within the science education community who know a lot about how to design high quality *educative* instructional materials. They have years of content knowledge and demonstrated success with designing materials that work for students and teachers (validated by data and long-term studies). Many of these developers operate under an older business model, developing materials as financial resources are secured. They typically partner with publishing companies to market and sell the materials. Few are available for free, are online and come with robust and sustained professional learning opportunities. In short, there is little to no coordination within the developer community to know who is working on what type of program, and the impressive body of knowledge they hold is scattered and in some cases siloed from the field and their peers.



A final point on supply, the language used to describe and explain NGSS instructional materials is complex. No two descriptions are the same and the lack of consistent messaging leads to many questions about the overall benefit, quality, and time it takes to achieve implementation. The lack of clarity makes it very challenging to create robust and scaled demand. When educators are not clear about the connection between materials, implementation and professional learning as not part of the equation, it makes it easy for teachers and leaders to step away from materials designed for the NGSS and to keep using what they already have and what they know.

Organizations offering education resources that are free and online have taken the lead on creating accessible platforms and hubs as places to share and spread ideas.

NGSS Innovations

NGSS innovations highlight the role that instructional materials and professional learning can play to guide and provide practical strategies for teachers and students. With high quality materials in hand, new and multi-dimensional ways of learning, teaching and thinking can become a reality in all classrooms across the U.S.

Technology as a delivery system also plays an important and disruptive force in the implementation of the NGSS. As more teachers engage in online professional learning, the design and delivery of instructional materials, the process for sharing feedback, the use of video and participation in virtual learning to support implementation, allow teachers an alternative to the textbook experience and the wait that comes with textbook purchases (think about the time to get the book and the significant time taken to update or revise published programs).

Organizations offering education resources that are free and online have taken the lead on creating accessible platforms and hubs as places to share and spread ideas. Open Up Resources and Great Minds are non-profit organizations that provide access to instructional materials and connection platforms that are easy to use, inspiring teachers to share insights and best practice.

Access to and use of technology has enabled new ways working and collaboration. For the first time (maybe ever), district leadership, teachers, professional learning providers and those developing instructional materials are coming together to figure out new ways to provide students and teachers the support needed to implement the NGSS real time with the ability to share, iterate, and change with a few key strokes. The speed to market phenomenon that we have seen in the retail sector has made it to education. Overtime, this will transform the purchase of instructional materials and the support for professional learning.

What about the NGSS is innovative, new, and different?

Both teachers and instructional material developers need to consider the following when developing and implementing instructional materials designed for the NGSS:

- 1. Explaining phenomena and designing solutions** — beginning with local and real life challenges, students use content from the disciplinary core ideas, connection through the cross cutting concepts and tools from the science and engineering practices to create solutions.
- 2. Three dimensional learning** — the integration of three dimensions in one lesson is both practically and intellectually challenging and more representative of tackling real science challenges.
- 3. Building K-12 progressions** — just like in real-life, everything in science is connected to and builds on knowledge learned before to gain a new and deeper understanding about the world and phenomena.
- 4. Alignment with English Language Arts and Math** — connecting to and integrating with the disciplines that are the focus of the Common Core Standards is essential.
- 5. Linking instructional materials to sustained and continuous professional learning** to fully implement the NGSS in schools.

Key requirements include rethinking professional learning as an integral and essential part of the NGSS implementation puzzle.

Instructional Materials & NGSS: Roadmap for the Future

Over the course of this project and convening, key requirements that shape the future vision of a scaled and successful NGSS implementation over the next ten years include:

- **Instructional materials as the essential component to enact the NGSS** — the vision of the *Framework* and the NGSS will not be realized without new high quality instructional materials for K-12 science education.
- **Linking and embedding professional learning with instructional materials** — rethinking professional learning as an integral and essential part of the NGSS implementation puzzle.
- **Collaboration** — between instructional material developers, states, districts and their teachers and professional learning community. Collaboration is also needed with all the parts of the education system, to include parents, teachers, students, formal and informal communities, and the assessment community.
- **Integration** — field testing and quality assurance on supply, assessments and professional learning.
- **Differentiating high quality** — to increase demand for high quality instructional materials, the community will define quality materials and tools for professional learning, using that definition and associated tools to brand high quality instructional materials for the NGSS.
- **Better coordination among a larger set of players to address and embrace innovations with the NGSS** — Utilizing a community of interested partners, stakeholders and investors, better coordinate on the development and distribution of materials at scale. This includes lessons, units, and programs as well as the coherence in scope, sequence, content, and grade span.



The anchors that provide a foundation and enable the realization of this NGSS vision in 10 years include:

- **Integrated professional learning** — highly relevant, pre-service and in-service programs integrated with the NGSS aligned instructional materials. Professional learning must be ongoing, valued, and embedded within districts; with the ability to address a variety of contexts and assessment tools.
- **Equity and access for all students and teachers** — at the core of many development models for new instructional materials is an increase in culturally aware programs designed with feedback from teachers based on field testing in schools.
- **High quality learning, teaching, and assessment** — examples of student and teacher work in various modalities that exemplify what three dimensional learning and teaching look like, how students respond to instructional materials, and how to know what students have learned.

How does the field accelerate its movement toward this vision now? What are some solutions, if implemented today that will enable the right conditions for full-blown implementation of the NGSS?

Big Themes

Expand SMART Supply

SMART Supply requires a more strategic and coordinated effort amongst all the stakeholders. Part of expanding the availability of high quality aligned instructional materials includes ongoing focused convenings between instructional material developers, professional learning leaders, and states and district leaders who are ready to implement the NGSS. Regular communication and sharing will help address the disaggregated nature of current supply and better coordination (perhaps even collaboration) on new and updated materials. SMART supply also requires a simpler way to describe the NGSS that focuses less on the *what* and more on the *why* and *how* this is better for all students. SMART supply and its customers will benefit from open and online resources stepping in to provide an easy-to-use place to locate and purchase ready to use instructional materials.

Catalyze SMART Demand

Catalyzing SMART Demand requires a general public who has an easy and digestible way to think about and discuss the NGSS that is not intimidating or insulting. If customers can understand the benefit of NGSS instructional materials and approaches, they will demand more of these materials, making it easier to justify the expense associated with building the supply. Providing abundant examples (videos, podcasts, blogs and write-ups) of what high quality instruction, student and professional learning look like in many different geographies and cultural contexts will also go a long way to converting late adopters to the power of the NGSS.

SMART Demand also requires big changes to the traditional business models ingrained in science education. The current environment contains old materials repurposed for the NGSS and there is confusion about quality. A rating system that is intended by EdReports will also help bring clarity to the difference between high quality and those materials that do not align with the NGSS.

Innovate to Accelerate Implementation

The most innovative means of accelerating the implementation of the NGSS are to:

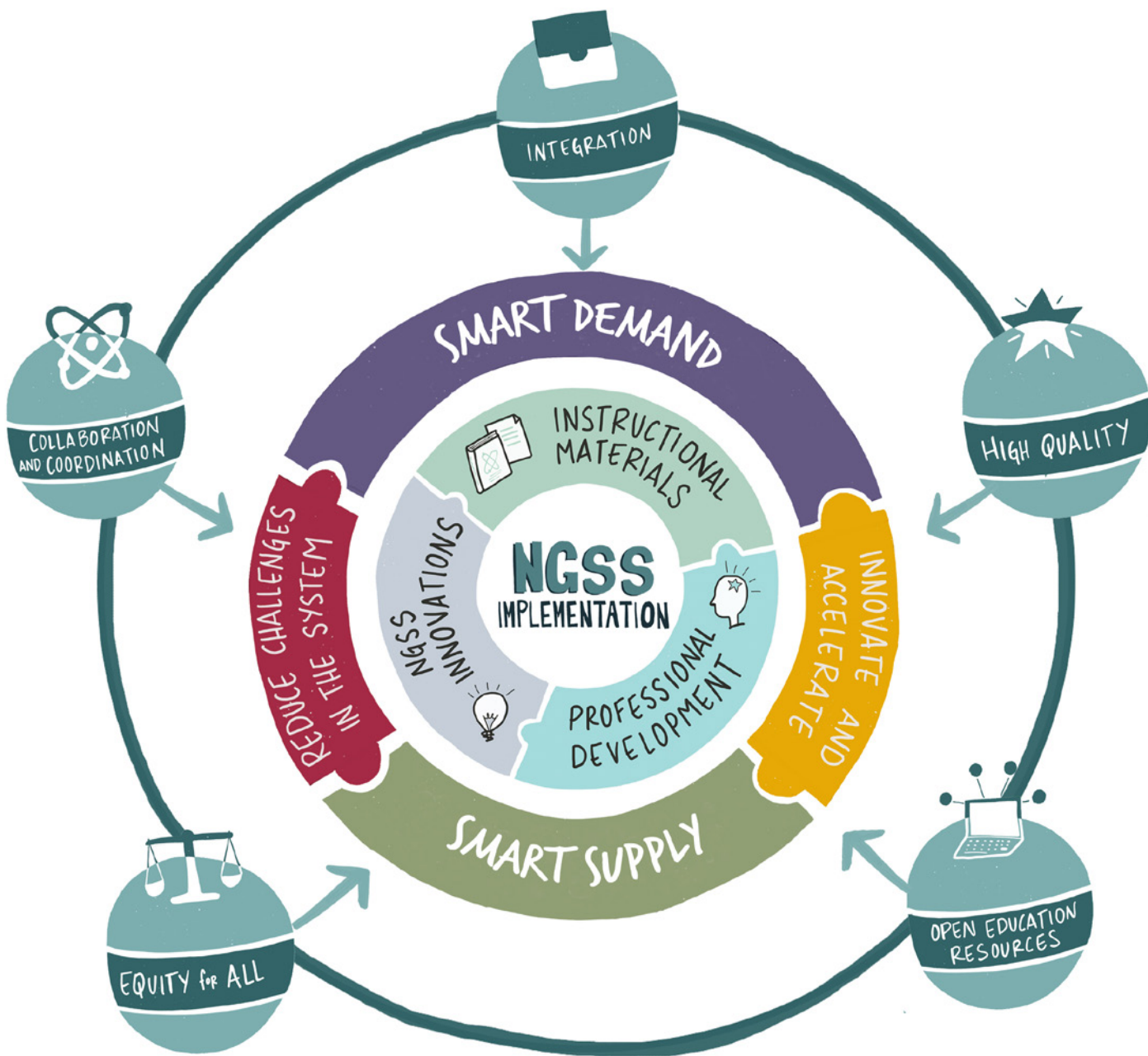
- Collectively develop high quality instructional materials along with the professional learning that accompanies the materials
- Embed the professional learning so teachers have a supportive environment to rapidly expand their approach to teaching and learning
- Create open and iterative NGSS instructional materials to be widely distributed and changed as teachers and their students become more skilled and proficient in their abilities to teach and learn guided by the NGSS.

Reducing System Challenges by Leveraging Opportunities

The challenges to scale and accelerate implementation of the NGSS are significant. There are legislative, financial and even societal barriers when it comes to embracing a new way of learning and teaching science that is different from what has traditionally been in schools. High-quality, widely adopted, and aligned instructional materials provide the best chance to move the implementation of the new college and career ready science standards forward. Working collaboratively with both state and district levels will provide developers new perspectives and strategies to ensure the materials and associated professional learning is relevant and meets the needs of all students and their teachers.



NGSS Implementation



Conclusion

By Spring 2017, eighteen states plus the District of Columbia will have adopted the NGSS as their state science standards. In addition, fifteen states have used the *Framework* and adapted their state science standards to meet the expectations of the NGSS. This represents more than fifty percent of the student population in American schools. This does not include the six states that are currently developing new science standards using the NGSS and the numerous school districts that have adopted or adapted the NGSS regardless of their state standards.

The demand for high quality instructional materials is currently, beyond the supply. This situation represents an ideal opportunity for developers and publishers who can respond in a timely manner and deliver what is being sought after. To help guide the developer and buyer, criteria for evaluating materials are in place with new tools emerging (See, e.g., EQuIP Rubric for Science, PEEC-Alignment from Achieve and guidelines and tools for evaluating instructional materials from BSCS). These tools and processes will begin to define and clarify high quality as more units and programs come online and become available. And, states, school districts, and science teachers have progressed beyond an initial awareness of the NGSS and are taking the matter of classroom assessments, teacher professional learning, and instructional materials aligned with the NGSS into their own hands.

The requirements and anchors cited earlier serve as guideposts for experimentation, solutions, and implementation. We are at a critical time in the implementation of the NGSS, and the support from the Carnegie Corporation of New York for this report and other associated activities is a wake-up call about the work that needs to be done in order to gain support and increase momentum. The urgency to take action in multiple areas at the same time cannot be underscored. Given the demands of the marketplace and the opportunities presented, like life, some things have to occur at the same time.

How do we prioritize what we know, to learn more about what we don't know?

Like life itself, not everything is sequential, neat and clear. To truly create the conditions for the ideal future outlined here, all of these elements need to be considered simultaneously, and now.

- Enable and support ways for the science education curriculum development community to work more collaboratively with each other and with colleagues from states and districts to ensure that all efforts (instructional materials, professional learning and classroom assessments) are relevant and meet the needs of all students and their teachers.
- Increase the capacity of professional learning providers and district science leaders who are key to implementing new instructional materials aligned with the NGSS. Support the development of other education leaders who can code-shift between the science education environment and the school/district leadership culture within educational systems.
- Consider the total community of professionals that publish, support, and use instructional materials when developing them.
- Give priority and support to innovative ways to bring the overall costs of high quality instructional materials down and increase access to teachers and their classrooms with speed and efficiency
- Educate, disrupt, and challenge a market that is dominated by an industrial age model of delivering education (similar to manufacturing) as the primary way to expand the market and embrace all customers, from diverse geographies, various backgrounds and contexts.
- Address and simplify the complexities of the NGSS to create a ground swell of support that will sustain full implementation.
- Advance the NGSS to equip young people as they make their way in new and different learning environments (e.g., under the revised ESSA; school choice, magnet schools, homeschooling), and prepare them to solve the world's most challenging and important issues.

Implementation of the NGSS is dependent on high quality, open and iterative instructional materials combined with robust, innovative and sustained professional learning.

Merely developing, touting and building awareness for the NGSS is not enough. The NGSS provides young people in the U.S. with skills, mindsets and strategies to address some of the country's most urgent and challenging problems while contributing to a vibrant and thriving future on this planet. Implementation of the NGSS is dependent on high quality, open and iterative instructional materials combined with robust, innovative and sustained professional learning. This is a wake-up call to work together in new ways and on educational systems and business models we are in the process of imagining. Do not hang up and continue yesterday's dreams; it is a new day and time to get up and go to work.

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