NEXT GENERATION SCIENCE STANDARDS DISTRICT IMPLEMENTATION WORKBOOK

Introduction

The Next Generation Science Standards (NGSS) represent the culmination of years of collaboration and effort by states, science educators, and experts from across the United States. Based on the National Research Council's *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* and developed in partnership with 26 lead states, the NGSS have the potential to drive improvements in American science education and better prepare students for college, career, and life in the 21st century.

What's Included?

This *NGSS District Implementation Workbook* is designed for current or aspiring district leaders—from board members to superintendents to science coordinators and teachers—to help them improve science education for students in their schools and communities. Implementation of any set of new standards is difficult, and implementing the NGSS brings a unique set of challenges. Moreover, every district is different. Just as each child brings unique questions, insights, attitudes, and ideas to a classroom, each school and district has a unique set of rules, policies, traditions, constraints, resources, and cultures. Building on the advice of experts, many of whom are district leaders on the leading edge of science instructional improvement, as well as the National Research Council's *Guide To Implementing The Next Generation Science Standards*, this workbook generalizes the issues and challenges associated with NGSS implementation and presents key questions, timelines, decisions, and considerations for leaders. It is not a recipe to be followed or a case study of examples but a set of questions and exercises recommended by leaders to help other leaders around the country.

Many variables influence the ability of a district to implement new science standards. Standards are connected to nearly every other aspect of the educational system—curriculum and instruction, assessment, professional learning, teacher hiring, and budgeting, among others—and therefore, the NGSS are just one small aspect of overall efforts to improve science education. This workbook attempts to focus on four core factors: (1) educator support, (2) informed stakeholders, (3) high-quality instructional materials, and (4) an effective assessment system. In nearly all situations, however, other aspects will need to be considered as well—for instance, after-school science programs, school building and laboratory maintenance, new teacher induction, and procurement of supplies—and this workbook only touches on those areas. Use it as the floor for learning and development, not the ceiling.

This workbook is organized into chapters. The first three chapters of this workbook aim to help district leaders develop implementation strategies and timelines that are coherent with other district efforts, based on a robust understanding of the current context, and designed to be managed well. The last four chapters focus on specific and particularly important parts of that plan as outlined above.

Appendix A provides supplemental resources—including some worksheets and tracking documents—that can be downloaded and used as districts create their implementation plans. Each chapter begins with a set of framing questions, designed to get the reader thinking about the essential ideas, and a list of objectives that describe the work within the chapter. The subsequent text includes advice and questions for district leaders, often organized as a series of exercises to generate deeper thinking. As with any standards, the NGSS come with their own vocabulary and acronyms, so please refer to the glossary of commonly used terms in Appendix B.

How Should This Workbook Be Used?

There are many ways to use this resource. District leaders should read through the text, and make sure that they are also familiar with ancillary resources such as the *Framework*, the standards, the assessment guide, and the guide to implementation. Leaders can then pick a section that's particularly relevant to the school or district, think through some of the questions in a particular chapter, download one of the exercise templates, and work through one set of questions therein. Take those answers and talk to others in the district about them—at a school board meeting, in a school, at a community event. Think about some other questions that arise, and seek answers from others outside the district—a district leader in another district, leaders at the state education agency, or teachers at a science convention. When the time is right—when leaders feel they have some solid answers and also some tricky questions—start focusing on actions to take.

There are several "big ideas" built into this workbook. One is that **planning is an essential part of the work**, and that every district should have a plan that describes how they will improve science teaching, learning, and leading. Certainly, a district's science plan needs to connect with other plans the district may have, and dovetail with plans focused on communications, assessment, budgeting, and the like. Clearly articulating a district's goals for science education, and the key strategies leaders will use to reach those goals, is key for both leaders and stakeholders alike. Another big idea is that **the practice of leading involves many people in a variety of roles and with various amounts of authority**. Throughout this workbook, there are many references to teams and committees that should be established, managed, and guided. While the specifics depend on the local context, experts agree that to make a change in a district as significant as new science standards, the ongoing input and advice from many people is essential if those changes are going to last and have the profound effect on student outcomes that we all seek.

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Chapter 7: Using High- Quality, Aligned Assessments *Page 41*	• Understand how to determine what assessment opportunities are needed to achieve district goals and objectives in science • Develop a process for creating an assessment plan for the NGSS
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Chapter 1: Integrating the NGSS into District Plans

Framing Questions

- How will your district integrate the NGSS into existing plans and goals to ensure that all students are prepared for college and career upon high school graduation?
- How will the NGSS support your district's goals for its students?

Chapter Objectives

This chapter will help districts:

- Identify how the NGSS fit into a district's vision and goals for student success; and
- Become familiar with the most significant innovations within the NGSS.

The Importance of a Unifying Instructional Vision

An instructional vision describes the teaching and learning a district seeks for its classrooms. It can be anything from a simple phrase or mantra to a collection of video clips of classrooms to more extensive documents about practices that describe "what it looks like." The best visions bring people together, unify strategies and efforts, and are clear enough to aid with prioritization and decision making as the work unfolds. As a district leader, think carefully about what a district's instructional vision should look like and how leaders might best communicate it to principals, teachers, parents, and others.

The NGSS include five conceptual innovations that have implications for nearly every aspect of science teaching and learning (see Figure 1). By explicitly describing how these innovations connect to other initiatives and positioning them within a broader vision about students and learning, key stakeholders involved in the implementation process can develop a better understanding of the work and time involved in using new standards. More information about articulating a vision based on the NGSS can be found in chapter 3 of the *Guide to Implementing the Next Generation Science Standards*.

Figure 1: Five Innovations in the NGSS

Innovation	Less Of	More Of
1. Explaining phenomena and designing solutions to problems	Acquiring disconnected science facts as the only goal of lessons for students and teachers.	Making sense of phenomena and/or designing solutions to problems drives student learning of science and engineering practices, disciplinary core ideas, and crosscutting concepts so that important science facts are learned in context.
2. Three-dimensional learning	Students learn skills of science and the content of science as separate bodies of knowledge passively by listening to lectures, reading about topics, and participating in intermittent labs that confirm lecture or readings.	Students learn science by directly engaging in the practices that scientists and engineers do (e.g., planning and carrying out investigations) to learn and deepen their understanding of science knowledge, including making connections within and across science domains and progressing through key science ideas that can be used to make sense of the world and solve problems. Students do this by developing, using, and integrating knowledge and practice across the "three dimensions" of science: Science and engineering practices (the behaviors and approaches scientists use), the crosscutting concepts (ideas that are used to make sense of science across domains, like systems thinking), and disciplinary core ideas (the most important terms, formulas, concepts, and ideas in each science domain that all students should know and be able to apply).
3. Building K–12 progressions	Concepts disconnected from prior learning and may be implicit or tangential to the core	Explicit K–12 learning progressions, both within and across years, for science and engineering practices,

Innovation	Less Of	More Of
	concepts.	disciplinary core ideas, crosscutting concepts, nature of science, and engineering.
4. Connecting the NGSS to ELA/literacy and mathematics	No explicit connections to other subjects.	Explicit connections to and alignment with ELA/literacy and mathematics.
5. All standards, all students	Science, especially advanced topics, is only for those interested in STEM careers. Science opportunities are inconsistent for all K–12 students.	The NGSS highlight important learning for all students at all grades K–12.

From Visions to Plans

Each district should have a plan for science. While visions can be inspiring and provide direction, they do not necessarily result in concrete actions or real change. Effectively implementing the NGSS means more than just replacing one set of standards with another or tweaking existing policies and practices. Given that the NGSS generally represent learning goals that are significantly different from current outcomes, the amount of work required to change other aspects of the system is considerable. This work will include strategic analysis and modification of the overall science education system, including its connection to instruction in other content areas. Therefore, district plans for science should highlight strategies that will lead to strong NGSS implementation.

Connecting the district's science plan with other plans—such as those for teacher recruitment or professional development—and identifying ways to integrate the implementation of the NGSS with existing initiatives can ease the burden of transition for schools and educators. At a minimum, such plans should articulate goals for science learning and instruction and identify the major strategies used to reach those goals. Effective plans frequently identify the individuals and teams responsible for certain strategies or tasks and include budget numbers with each strategy. Additionally, those plans are often designed based upon extensive input from parents, teachers, school leaders, and community members and are made publicly available on the district's website. When plans and strategies are connected, district leadership can help principals and teachers become supporters rather than opponents of the change that might be necessary. It is important to remember, however, that science is a distinct discipline, and so the strategies to enact science standards will likely differ from strategies focusing on improving performance in other disciplines.

Starting the Planning Process

There are various ways to start crafting a plan to improve science performance in a district. Many of the steps will be determined by local policies and rules or by the nature of the plan that is being developed. Key steps in nearly every effort should involve understanding the current status of a district's plan and identifying any efforts and initiatives that are under way that may need to be accelerated or altered during implementation of the NGSS.

Exercise 1 provides an example of a guide to assess and build on current district capacity. The chart below offers *examples* of the types of questions that can be used to identify and examine existing initiatives, but districts may need to expand the list or revise the sample questions based on individual needs.

Exercise 1: How Do the NGSS Fit into Existing Initiatives? Self-Assessment

Existing Initiative—College and Career Readiness	
To what extent does the district's current instructional improvement plan connect to NGSS teaching and learning? (To understand the relationship between the NGSS and college and career readiness, see NGSS Appendix C.)	*Example: Our district plan for instructional improvement focuses on college and career readiness. It calls for students to be able to formulate conclusions from student-driven research. Students will gain this skill through using the science and engineering practices of the NGSS.*
What science and engineering instruction and/or courses do we currently offer? Which students enroll and complete those courses? How is their performance?	*Example: General science in K–8 that all students take, and Biology, Physics, and Chemistry in high school, but only about 20 percent of students take all three.*
Existing Initiative—STEM	
Which aspects of the NGSS connect either directly or indirectly to our existing STEM initiative? How much of the STEM initiative focuses on NGSS-aligned science instruction?	
What knowledge, skills, and expertise do our STEM educators and district leaders have that we can build on?	

Existing Initiative—English/language arts	
What methods do we have for collecting evidence that English/language arts standards are being implemented well? How can we use similar methods to monitor evidence for successful NGSS implementation?	
Which strategies for English/language arts standards implementation worked best in terms of achieving positive changes in classroom practice and student achievement?	
Which strategies were less effective that might we need to revisit and revise for the NGSS?	
What opportunities exist within current English/language arts initiatives to include the NGSS in meaningful ways?	
Which district personnel have implementation expertise that we can use?	
Existing Initiative—Mathematics	
What methods do we have for collecting evidence that math standards are being implemented well? How can we use similar methods to monitor evidence for successful NGSS implementation?	
Which strategies for math standards implementation worked best in terms of achieving positive changes in classroom practice and student achievement?	
Which strategies were less effective that might we need to revisit and revise for the NGSS?	

What opportunities exist within current math initiatives to include the NGSS in meaningful ways?	
Which district personnel have implementation expertise that we can use?	

After completing Exercise 1, a district can begin to both determine its current capacity to support NGSS implementation and analyze any lessons learned from existing strategies or practices.

Data to Illustrate the Need for Science Improvement

It is essential for district leaders to obtain support from school administrators, educators, and parents throughout the change process. One strategy that district leaders can use at the onset is to highlight how improving science education can fulfill an existing need. Districts can use existing systems of evaluation to determine these needs and highlight the implementation of new science standards and classroom instruction as a solution for addressing the needs.

Exercise 2 provides a chart that can be adapted to collect data about a district's existing science instructional efforts and outcomes. Districts should select or add only the metrics that are relevant to their aspirations and their vision.

Exercise 2: Identifying Data to Support Improvement

Which metric?	What does that metric tell us about current performance?	What strategies might we use to improve this metric?
Standardized science test scores (by grade/course, socioeconomic status, students with disabilities, English language learners, gender, race/ethnicity, etc)	*Example: Achievement gaps exist or are increasing/decreasing over time.*	*Example: Targeted interventions for at-risk schools or classrooms to provided additional support.*[1]

[1] Note that the Next Generation Science Standards were developed to explicitly address equity issues. For more information, see NGSS Appendix D.

Which metric?	What does that metric tell us about current performance?	What strategies might we use to improve this metric?
Time allocated to science instruction in elementary grades	*Example: Science is rarely taught, or the amount of time spent on science is uneven in elementary grades.*	*Examples: Policies requiring a certain number of minutes each week be dedicated to science; districtwide adoption of science instructional materials with appropriate professional development support for elementary teachers*
Participation/performance in Advanced Placement (AP), International Baccalaureate (IB), and/or dual enrollment science courses overall and by subgroup	*Example: A small number of students have high scores on AP science courses.*	*Examples: Clearer rules and policies for placing students into certain science classes; tighter management of course prerequisites throughout the science department; use of various "AP potential" indicators by the counseling department*
Grade distribution within science classes	*Example: Large grade disparities exist, especially between English language learners and English speakers.*	*Examples: Making the connections to English/language arts standards set out in the NGSS will help focus students on English language skills during science lessons; strategies for English learners (in NGSS Appendix D) can help translate the science better.*
Number and type of laboratory experiments conducted within typical courses	*Example: The number of lab experiments has increased significantly since we got our new laboratory classrooms three years ago, but the experiments usually entail students following a set of directions and have not led to increased proficiency.*	*Examples: Building science classes around explaining phenomena and designing solutions to problems will allow us to use our lab equipment more effectively.*

Which metric?	What does that metric tell us about current performance?	What strategies might we use to improve this metric?
Curriculum materials used in science classrooms	*Example: We have textbooks that are 4 years old and do not align with our new standards.*	*Example: Conducting a review of available, NGSS-aligned instructional materials to support teachers better (see EQuIP and PEEC)*
Percentage of science educators with degrees and/or certification in science	*Example: Grades 6–12 teachers are certified to teach in science, but elementary teachers are not required to be certified and often struggle with the content.*	*Example: Ensuring that all science teachers feel comfortable with NGSS instructional shifts and their own content knowledge; content-specific professional learning for K–5 teachers*
Frequency with which students are pulled out of science for special education support, English language learner support, band, speech		
Percentage of district budget for science compared to English/ language arts and math		
Dedicated support staff for science		
Mechanisms in place for consumable materials and/or kits		
Opportunities for teacher collaboration around science implementation		

Which metric?	What does that metric tell us about current performance?	What strategies might we use to improve this metric?
Demographics of student enrollment in science classes		
Current configuration of science disciplines (e.g., integrated in middle school; discipline-specific in high school with AP, career technical education, IB)		

After completing Exercise 2, a district will have gathered critical information regarding its existing science practices and initiatives. The district should be able to construct a more accurate view of its current science education program and what needs to be improved for its successful transition to the NGSS.

Chapter 2: Reviewing System Capacity, Assessing Needs, and Budgeting

Framing Questions

- What resources and strategies can your district use to ensure that the expected NGSS instructional shifts will occur in most classrooms?
- What gaps or capacity needs could hinder your implementation goals?
- What additional supports will teachers, principals, and/or district school leaders need to implement the NGSS?
- How much existing funding can fulfill the needs your district science plan? What budget modifications will be needed?
- Does the district need to leverage new funding streams for NGSS implementation goals?

Chapter Objectives

This chapter will help districts:

- Understand existing capacity for NGSS implementation (e.g., personnel, financial resources, physical resources, existing strategies/routines);
- Identify gaps in capacity for implementation;
- Brainstorm strategies to fill key gaps;
- Understand what funds are available in the existing budget and what funding gaps will exist during the implementation process;
- Know where to look to find supplemental resources (e.g., federal, state, local, private funds);
- Identify creative funding best practices from other states and districts; and
- Think creatively about how to close gaps without necessarily bringing in extra revenue (e.g., in-kind partnerships).

Identifying System Capacity: What Does the District Already Have?

District leaders should analyze prior implementation plans and strategies before embarking upon the next new initiative. When implementing new initiatives, an immediate focus can easily become, "What additional capacity and resources are necessary?" But first, district leaders should try to think about what the district already has available. For example, the district likely has instituted changes to academic standards in the past, and if so, some institutional knowledge may be able to describe the protocols that were used and some lessons learned. Knowing what has been previously successful and challenging can help district leaders better assess what can be used and predict what is still needed.

Identifying and Filling Gaps

Focusing on existing capacity and structure will allow for a more seamless integration of NGSS implementation and may cause schools and educators to feel less overwhelmed about the transition. For example, professional learning communities that already exist may serve as venues for NGSS trainings or staff reviews of instructional materials. Allowing educators to use existing time to examine and prepare for instructional shifts helps them more effectively engage in the transition process. Districts should think about their resource budget as well. Where will existing resources be sufficient? Where will gaps need to be filled?

Effective implementation of the NGSS will require a budget, which will be discussed below; however, additional resources (including people, space, and time) may also be necessary. For example, districts may need access to specific technology, space, or equipment for training educators, leaders, or district personnel willing to work before or after regular school hours on different implementation tasks. In addition, specific personnel within the district may need to devote designated amounts of time to the implementation process, which may necessitate shifting responsibilities or rethinking job descriptions.

Developing a Budget

Implementing new initiatives takes money. By having clearly identified goals and strategies, along with detailed information regarding the district's needs in each implementation category, districts can determine the financial resources required for effective NGSS implementation and, consequently, make the case for the necessary funding in the district's budgetary process.

As with other aspects of implementation, developing the budget is iterative. District leaders may need to create an initial budget early in the process and then revise that budget as they plan and implement. When considering a budget, district leadership should identify how existing funds are allocated throughout the district and determine the breakdown between state and local funding. Districts may receive state funding for specific initiatives, but understanding what mandates may come along with state-level funding is important. For example, are specific performance accountability measures tied to science or overall funding? Understanding stipulations and knowing how much money is specifically directed toward science education will help those leading the implementation process.

Districts already have budgeting processes, and budgeting for NGSS implementation will most likely be similar. It will be up to district leaders to provide realistic estimates of the funding required to implement the NGSS effectively.

Additionally, district leaders must continuously work to ensure that implementation is a districtwide priority and that sufficient funds are allocated.[2]

Gaps in Funding

Once budgets are created, districts may notice critical gaps in required versus available funding. Once those gaps are identified, leaders can begin to look beyond the district and state for further fiscal support—or change their goals to match the resources that are available. Some districts have access to third-party funders that will support science education initiatives. Examples of these funders include education foundations, STEM centers, and/or local/regional business groups that support STEM education. Another option is to seek partnerships that can fill gaps through in-kind services. For example, rather than providing a financial contribution, informal science centers, parents, or community-based advocates may be willing to donate services to fill specific gaps. Additionally, looking to other districts for assistance and, where possible, guidance is important. Partnerships with other school districts are an option to share costs for expenses such as professional learning opportunities and expertise.

[2] District leadership teams may wish to explore the Smarter School $pending website. The site provides several free processes and tools that help districts use resources effectively to increase student achievement rates.

Chapter 3: Leading Change

Framing Questions

- Who will be included in your district leadership team?
- What are the indicators of successful NGSS implementation? How will those indicators inform your district's plan?
- How will your district create a timeline to enact the NGSS and set milestones to indicate that the plan is on track?
- How will responsibility for each element of the implementation plan be assigned?
- How will your district establish routines to monitor progress toward achieving your goals and adjust accordingly to setbacks?
- How will responsibility for monitoring progress be assigned?

Chapter Objectives

This chapter will help districts:

- Identify quality candidates for a leadership team;
- Create milestones for success and phases of implementation;
- Identify overlapping timelines for milestones and phases;
- Create a system for monitoring progress of NGSS implementation;
- Set reasonable measures of success and goals for those measures;
- Assign responsibilities for monitoring growth and progress; and
- Identify time to reconvene and to take stock of implementation successes and failures.

Building a Leadership Team

People working in isolation cannot successfully implement the NGSS. Identifying a team to guide the implementation process increases collaboration across the system. This collaboration can generate better solutions to the inevitable implementation challenges that will arise, engender continuity as the work moves across classrooms, grades, and schools, and increase engagement and willpower to make change. A leadership team also ensures ownership of the implementation process, which is essential for making meaningful change.

Each district needs to have a science leadership team. The size of a district science leadership team may vary depending on the size and structure of the district. Ideally, the team will have three or more members; however, ensuring that the team is not too large to function effectively is also important, keeping in mind that additional people may be consulted or called on for specific purposes during the implementation process. The team should be composed of people who have the knowledge, expertise, influence, and authority to guide the multiyear implementation process. When creating the district leadership team, assessing each member's level of understanding of the new science standards will be important. If every team member does not already have a deep knowledge of the conceptual shifts and changes in instruction and assessment practice inherent in the NGSS, it should first undergo targeted professional learning.

Furthermore, additional committees or smaller teams will likely be needed for portions of the overall work. For instance, a communications team will need to craft messages and deliver statements to various constituents, a group of assessment leads and teachers will need to oversee new testing plans, and a variety of teachers and parents might form an instructional materials committee to review and recommend new curriculum products. Information about these teams is provided in the subsequent chapters.

To begin thinking strategically about who should be on the district team, districts should complete Exercise 3. Remember to think about key staff across the district when considering the following questions:

1. **Science Education**: Who has the science education experience and knowledge to ensure this effort moves forward appropriately?

2. **Authority**: Who has the authority to make district policy decisions about implementation (e.g., decisions about budget, professional learning, assessment, staffing, release time)?

3. **Communication**: Who has the knowledge, expertise, influence, or authority needed to communicate the major innovations in the way science will be taught and in how students will demonstrate proficiency of the NGSS?

4. **Management**: Who has experience or expertise in managing systemic change successfully in the district?

Exercise 3: Selecting District Implementation Team Members

Potential Team Member (name)	Science Education Expertise?	Authority?	Communication?	Management?	Possible Roles and Responsibilities (roles)
		(very low, low, high, very high)			
1.					
2.					
3.					
4.					
5.					

After completing Exercise 3, a district will have generated a list of candidates for the district's science leadership team.

Indicators of Successful NGSS Implementation

Achieve developed the *NGSS District Implementation Indicators* document with support from state, district, and local educators and based it upon key recommendations from the National Research Council's *Guide to Implementing the Next Generation Science Standards*. The document outlines key hallmarks of successful NGSS implementation at the district level and highlights examples of measurable action steps that districts can take to clearly define and achieve desired implementation goals. District leaders should use this information to determine the substance of their science improvement plan, including implementation indicators.

Creating Goals, Milestones, and Timelines

Implementation of a new plan should occur systematically. A plan is not merely a linear sequence of actions; instead, leaders must consider all aspects that must move forward concurrently and then determine how to incorporate these changes into the broader system. Before establishing a timeline or putting the district's NGSS implementation process in motion, districts should think about all the categories of the system (e.g., professional learning for educators, instructional materials) and how they will interact when fully aligned to support implementation.

What changes will need to take place first in the categories of the system for successful implementation to happen?

Once district leaders have decided upon their science improvement priorities, they should develop a list of measurable actions that can be taken to achieve the goals of each indicator. The measurable actions should align with milestones identified earlier and provide for the collection and analysis of data points at regular intervals. For example, in the case of the indicator *"[e]ducators use high-quality instructional materials designed for NGSS learning and meet diverse student needs,"* measurable actions might include:

- Creating an inventory of existing science instructional materials to identify which tools are currently used within and across schools;
- Providing and using objective criteria to evaluate instructional materials for alignment with the NGSS, including using research- and practitioner-informed criteria to determine the qualities of instructional materials that can best support diverse students; and
- Training educators involved in the instructional materials adoption process to evaluate existing and new instructional materials for alignment with the NGSS.

Exercise 4 can help district leaders think through these categories, their goals, and associated milestones. There are many project planning and strategic planning resources available to districts that can be helpful in their improvement efforts; the example here is but one high-level model that could be adapted as part of the NGSS implementation process.

Exercise 4: Implementation Goals and Milestones

Work through the following six steps, using the table provided to articulate the major categories of work, goals for each, and the milestones to check in on progress.

1. **Identify categories**. Identify categories or initiatives of the district's education system that will require changes for successful implementation of NGSS. Categories might include equity and access, management, professional learning, instructional materials, communications, collaboration, school structures, and student outcomes. Refer to the National Research Council's *Guide to Implementing the Next Generation Science Standards* for more information.

2. **Choose goals**. Each category needs a definition of success—a statement or measure that describes what the district is seeking, and a way to determine when success has been reached. There are many examples of goals in the *NGSS District Implementation Indicators* document.

3. **Draft milestones**. After identifying the major categories of implementation, identify several milestones within each category. Each milestone should describe a tangible accomplishment that represents progress, and milestones should be distributed over time so that the overall work can be regularly monitored.

4. **Determine dependencies**. Look at the categories and their milestones identified and determine whether certain categories depend on others. What categories need to be set in motion first? Do these categories need to be completed before others can begin to move? Adjust goals and milestones as appropriate.

5. **Assign roles**. Think about who needs to be involved in planning and managing each category. From the district leadership team, who will be managing each category, and will that individual need a support team to achieve certain milestones? What protocols are needed to ensure effective communication within and across teams for each category?

6. **Identify target completion date**. After filling out the first five columns of the following chart, look at the major milestones that need to be accomplished and consider what steps the district must take to reach those goals. With these steps in mind, consider target completion dates so that implementation leaders can start to lay out a path and a timeline for each category and its milestones. When determining timelines, district leaders may want to:

    - Consider other initiatives that the district has undertaken recently then consider how the new plan may fit into the existing ones.

    - Arrange each category's milestones in the order that they need to be reached.

    - Consider the time it will take to accomplish each milestone, who will be affected along the way, and what aspects of the plan will increase individual workloads.

    - Create timelines that allow sufficient time to adjust for changes along the way.

    - Identify major barriers. How can district leaders proactively arrange the timeline and put processes in place to surmount these challenges?

Identify Categories		Choose Goals	Draft Milestones	Determine Dependencies	Assign Roles	Deadline
1	*Example: Professional learning*	*Example: All middle school science teachers are able to en-act the district's new instructional materials with fidelity.*	*Example: All science teachers in schools A, B, and C receive the initial summer professional learning.*	*Example: Communications, Collaboration, Budget*	*Example: John Doe, the district professional develop-ment guy.*	
		Example: All principals and administrators are able to consistently use the district's science classroom observation guide in the pro-cess of coaching teachers to improve instruction.	*Example: All school administrators receive professional learning to understand what an NGSS classroom looks like.*			
2						
3						

After completing Exercise 4, a district will have organized the work of implementing NGSS into categories, and articulated goals and milestones for each.

Monitoring Implementation

Once a plan has been crafted, district leaders need to monitor the implementation of each part of the plan. This can be done by collecting a variety of data that describe implementation, and by constructing regular routines for various system wide actors (e.g., teachers, principals, central office staff) to review and learn from this data.

Data can be collected from various sources and in different ways, such as online surveys or focus groups,

but all collected data should specifically inform districtwide implementation efforts. Further, districts should not limit data collection to student performance metrics because those metrics may not provide a reliable or comparable measure of success, particularly in the first year or two of implementation. Rather, to collect data to measure progress in each category of implementation, districts should consider the different sources from which they could capture data about the NGSS transition: educators, school leaders, parents, instructional specialists, and students (in ways other than their performance). The *NGSS District Implementation Indicators* document, mentioned above, outlines ways to monitor implementation that can serve as mechanisms for collecting data. Districts should be patient and thoughtful about the most important questions regarding implementation and construct data systems that are designed to explicitly answer those questions.

District leadership teams should establish routines for continuous evaluation of implementation. All implementation planning documents should be considered living documents that can be refined and adjusted as additional evidence is gathered. The leadership teams should identify the district's existing routines (e.g., in-person meetings, conference calls, written correspondence) and leverage these routines as much as possible, integrating NGSS progress monitoring when possible.

For example, if a team already has a standing staff meeting, it could designate a portion of the meeting to discuss progress in NGSS implementation. Next, the leadership teams should identify any implementation categories and milestones that have no routines and establish methods for continuous evaluation.

After identifying the existing routines to monitor progress for NGSS implementation, the district leadership teams should find the categories and milestones that have no routines. The teams should establish regular progress monitoring check-in routines for these categories, making sure to lay the groundwork so that all key parties are involved in the routines and all categories are accounted for.

When organizing districtwide routines, leadership teams should consider these three questions:

- Who should be involved in the meetings, and to whom does the progress need to be reported?
- What is the most effective method for information sharing?
- When are the best times for the routines to occur?

Chapter 4: Supporting Educators and School Leaders

Framing Questions

- How much does your district know about, or understand, the NGSS at this point?
- How will your district support professional learning for principals and teachers?
- How will district leaders communicate the NGSS implementation process and instructional shifts to principals and teachers?
- What structures, tools, and resources will your district provide and/or develop to ensure that instructional shifts required by the standards occur in every classroom?

Chapter Objectives

This chapter will help districts:

- Consider ways that principals and teachers can be supported throughout the transition to new science standards;
- Plan effective systems for professional learning for both principals and teachers;
- Develop communication channels for principals and teachers;
- Identify tools, resources, and partnerships that can help principals and teachers with the important shifts in instruction and learning; and
- Anticipate challenges that principals and teachers will experience and develop plans for how to address or avoid these potential issues.

The Importance of Developing Capacity

The changes required by the vision of the NGSS are significant enough that even the most veteran educators and school leaders will require support throughout the transition to the new standards. This chapter covers three important aspects districts should consider when providing this support: (1) High-quality professional learning for educators and school leaders; (2) facilitating collaboration and a community with partnerships for schools and educators, and (3) communication within the district.

Professional Learning

A 2015 survey of educator working conditions found that the biggest stressor for 71 percent of educators surveyed was the "adoption of new initiatives without proper training or professional development." It is vital that the professional learning system created by the district regarding the transition to the NGSS be accessible to and designed for its full range of educators and school leaders.

When beginning to create plans for professional learning, the district should coordinate with the state education agency's professional learning plan if it has one. In most cases, however, the responsibility for ensuring that all the science teachers and school leaders across the district are prepared for implementation of the NGSS will fall to district leaders. There are many resources that provide a robust review of professional learning and professional development options for districts. The National Academies of Sciences, Engineering, and Medicine's *Science Teachers' Learning: Enhancing Opportunities, Creating Supportive Contexts* is a recent research synthesis that might serve as a useful starting point for district leaders looking for professional development needs.

Below is a checklist to guide districts' thinking when developing an effective professional learning system.

Choose Training Content Purposefully and Based on Evidence
Generally, content for professional learning for the NGSS should broadly encompass three main categories: ✓ *Science Content Across All Three Dimensions*—The knowledge, skill, and competencies teachers need associated with scientific practices, disciplinary core ideas, and crosscutting concepts, as well as using them together to make sense of the natural and designed world. ✓ *Science Teaching Pedagogy*—The pedagogical content knowledge and teaching practices that support students in rigorous and consequential learning of science. ✓ *Strategies to Ensure Access and Equity*—The knowledge, skill, and competencies for teachers to enable *all* students to learn next-generation science, including the development of instructional practices that are responsive to a diverse range of students.
Model Classroom Experiences and Use Student Work Examples
✓ Focus on enacting well-designed lessons and units throughout the professional learning experience. ✓ Model the instructional approaches being learned and allow for educator analysis. ✓ Provide opportunities for educators to practice new knowledge, skills, and approaches and receive immediate feedback. ✓ Include an on-site follow-up in the educator's classroom.

- ✓ Help educators make sense of available performance data—student work, state-required assessments, and everything in between—and use the findings to drive improvements.
- ✓ Include educators reflecting on their practice and on their own students' work.

Align with NGSS Implementation Plan Milestones and Timeline

- ✓ The professional learning plan should reflect the multiyear NGSS transition timeline and milestones.
- ✓ The professional learning plan should identify expectations for incremental improvements in implementation.
- ✓ The professional learning plan should identify a way to monitor progress to measure success for those milestones (e.g., periodic assessments at defined milestones).

Allow for Feedback and Adjustments

- ✓ The pace of the professional learning system should be guided not only by the implementation timeline but also by the capacity of educators and school leaders to shift their practices while simultaneously ensuring the success of students.
- ✓ The leadership team should determine how professional learning effectiveness will be measured so adjustments can be made (e.g., pre- and post- surveys, educator reflection, external evaluation, or student progress).
- ✓ The professional learning should also allow for ongoing refinement as educators and their schools gain expertise in implementing the NGSS.

Take Advantage of Existing Structures and Resources

- ✓ A professional learning system should take advantage of existing learning opportunities, resources, and partners, such as professional learning attached to instructional materials selection or assessment system design.
- ✓ The leadership team should determine how NGSS professional learning will be integrated with other professional learning already offered in the district.
- ✓ Some structures, particularly instructional materials and assessments, can provide cost-effective and timely mechanisms for professional learning. See the subsequent chapters about these two essential efforts.

Caveat: While taking advantage of the space in a school building and holding professional learning sessions on site may save money, off-site training has significant benefits: Educator engagement is higher

because physical obligations and distractions are removed, educators are given a separate place for reflection, and educators may feel safer being challenged because they are separated from people of authority linked to their evaluations.

Consider the Needs of Each Specific Audience

- ✓ A professional learning system should support both teachers' and school leaders' learning, ideally with targeted professional learning experiences for each. All the professional learning in the world for teachers does nothing if a school leader does not encourage the teaching of science or understand the vision of the NGSS.
- ✓ A professional learning system should be content and grade specific. Just as educators and school leaders take the needs of diverse students into account, professional learning programs should take diverse education professionals into account as well—veteran and new, all grade levels, and differing learning styles and abilities.
    - o Identify the strengths of the staff and the gaps that need to be addressed by professional learning.
    - o Determine how coherence across grade levels will be maintained while meeting the need for content-specific professional learning.
- ✓ A professional learning system should identify how new hires (during or after the transition) will engage in the professional learning.

Ensure That the Professional Learning Plan Includes a Sustained Support System

- ✓ Professional learning should be ongoing throughout each school year rather than an isolated, one-time opportunity.
- ✓ School leaders play a big role in ensuring that there is a sustained element of a comprehensive and continuing support system, and therefore professional learning that enhances principals' understanding of and support for instructional changes required by the *Framework* is essential.

Caveat: While online professional learning is a tempting and affordable way to reach greater numbers of educators and school leaders for sustained support and can allow for adjustment to individual needs, more research in the field is needed to determine its effectiveness.

Consider a Teacher Leader System

- ✓ Especially for larger districts, designating teacher leaders from each school or group of schools and then having them lead implementation efforts and pass the information along to their

community is an efficient and cost-effective option.

Caveat: A teacher leader system may pose challenges in ensuring consistent and high-quality training throughout the district and may require additional oversight.

Establishing Communities and Partnerships

The National Academies of Sciences, Engineering, and Medicine's *Science Teachers' Learning: Enhancing Opportunities, Creating Supportive Contexts* points to recent research that suggests that "teacher quality is dependent not only on individual educators but also on their communities." An environment that facilitates educator collaboration often depends on school leader buy-in and available time and resources. To encourage and facilitate educator science collaboration within and across districts, a district could encourage or require that schools provide time continually throughout the school year. Here are a few types of typical collaboration routines to consider.

"Horizontal" Collaboration

Science educator collaboration time that allows teachers within and across schools in the same grade level or grade band or who teach the same course to plan, debrief, and problem solve about new teaching strategies will provide much-needed support throughout this transition and throughout implementation of the NGSS. This collaboration time can prevent teachers from feeling isolated and allow them to take advantage of the collective capacity of science educators across the district. Further, districts can expand this collective capacity if they are willing to partner with science educators from other districts, creating a network to share ideas, resources, and instructional materials. Rural districts may want to focus on digital collaboration if they are geographically isolated.

Science teachers should also be afforded dedicated time to collaborate with educators in other content areas, as appropriate. In addition to identifying supports and strategies from other content areas that could be used by science teachers in their classrooms, this collaboration time could help to foster the integration of science with other disciplines like mathematics and English/language arts, depending on the district's overall needs and priorities.

"Vertical" Collaboration

Time should be provided for science educators across different grade levels to collaborate and to encourage vertical planning. The three dimensions of the NGSS are intentionally developed as learning progressions across K-12, and educators could use this collaboration time to ensure coherence across the grade levels. Planning for coherence is important so that teachers have a clearer idea of both what their students learned in prior grade levels and what students need to know to be prepared for the next grade level.

Third-Party Partnerships

External organizations can help support educators and school leaders in many ways. One way to get this external support is to encourage school leaders and educators to be involved with organizations outside of the school. Recommendation 17 of the *Guide to Implementing the Next Generation Science Standards* says:

Science education leaders should identify partners in their region and community that have the expertise, motivation or resources to be supportive of their efforts to implement the NGSS and develop relationships with them. In collaboration with potential partners, leaders should determine the kind of support each partner is most suited to provide and develop strategies for working with them.

Whether through professional learning training or different methods of partnership, the opportunity for educators to interact with scientists and experts who can enhance their understanding of the content is extremely valuable. Establishing partnerships between formal and educators may enable districts to facilitate unique professional learning opportunities, increase learning opportunities for students, and offer new lessons or activities that engage students in real-world phenomena. Some third party-partnerships to consider include:

- Higher education institutions;
- Science and technology centers;
- Local businesses;
- Museums;
- Professional learning networks; and
- Science teacher associations.

Communication Within the District

One of the most important aspects of supporting teachers and principals is to establish a clear channel for communicating consistent messages across the district. This communication should not just come from central office down to the classroom; educators and school leaders should find it easy to ask questions, provide feedback, and express concerns to district leaders. It is important that districts communicate internally before external communications begin: educators and administrators should always hear from districts and should never learn of district plans through communications meant for parents and external stakeholders.

A plan for communicating with educators and school leaders in a district is essential to ensure that the messaging is as effective and consistent as possible. Below are some questions to consider as districts incorporate science instructional improvement efforts into their communications plan. Districts will likely want to create separate plans for educators and school leaders, as the messages delivered to each may differ. Review the NGSS Overview for Principals infographic for sample messaging for school leaders.

Messages

Identify the messages district leaders want to convey to educators and school leaders.

- What are the changes, shifts, and expectations associated with the NGSS?
- What is timeline for implementation?

- Who is making decisions about NGSS implementation? When and how will those decisions be made?
- What changes to assessment plans and structures are anticipated?
- What changes in instructional materials and resources are coming?
- How will the science course scope and sequences be different?
- What will be different about collaboration time and school culture? How will these efforts be led at the school level?
- What examples best exemplify the direction we are heading?

Timeline

Determine the order in which the district wants to relay this information to educators and school leaders.

- What other information will be provided, and when will that occur?
- What is the most important information to provide first?
- What other information will the district be sharing that might overwhelm and distract from the message about the NGSS?

Assets and Allies

Identify the people who can deliver the message effectively.

- Whom do educators and school leaders trust? How can those relationships be leveraged to better deliver messages?
- Whom should the message come from?
- What is the political climate, and how might that influence how the various messages will be heard?
- Which trusted third parties might the district be able to work with (e.g., science or STEM centers, teacher's union, science teacher associations, scientists, community organizations or other academics)? Are there some that are likely to create some opposition if they are not involved early in the process?

Communications Channels

Identify how the district will convey this information to educators and school leaders.

- How can the district monitor and ensure that all educators and school leaders receives the appropriate messages?

- Which pre-existing newsletters, online communities, or meeting routines could be used for these purposes?

- Which communication channels will allow for feedback so that the district can receive and respond to questions or misconceptions?

Chapter 5: Engaging Parents and Stakeholders

Framing Questions

- How will your district communicate "the case" for the NGSS? What statements can be made that will resonate with parents and the local community?
- Whom will your district engage to deliver the message(s)?
- What key audiences need to hear the message(s)?

Chapter Objectives

This chapter will help districts:

- Develop a communications strategy that includes reaching parents and key stakeholders.

Crafting Messages for the Community

The success of the NGSS in the classroom will depend not only on student results or educator successes but also on buy-in from the surrounding community. The NGSS represent a significant shift in goals for student learning, and if community members, especially parents, are not prepared for these shifts in advance, significant pushback could build up in the community. Having a thoughtful and consistent communication and engagement strategy that carefully considers how to involve parents and other critical stakeholders is therefore important.

When engaging the community about the new science standards, districts should let the different stakeholders know how the new standards will benefit their individual goals and priorities. Parents and guardians may care about, first and foremost, how this change will improve their students' lives and expand opportunities after high school. Local employers may care about the innovative thinking and problem-solving of potential future employees while higher education leaders may care about the skills and knowledge future students will bring to college campuses. Some messages to consider communicating to parents and stakeholders might include:

- How these new standards will prepare students for success in high school and beyond;
- How students will learn science in their classrooms and what that will look like with these new standards;
- What the new standards expect of students and how parents and community members can help; and
- How these standards promote equity and access for students traditionally underserved in a science classroom.

To see some sample communications resources, review the NGSS Parent Guides for grades K–2, grades 3–5, grades 6–8, and grades 9–12; NGSS Messaging Cards; Infographic: How Will Science Education Change with the NGSS; Infographic: Science Education Needs an Update; and Public Attitudes Toward Science Standards.

Building the Communications Plan

Just as the communications plan for teachers and principals requires consistent messaging, the community benefits from consistent messages to increase clarity and to temper misunderstandings. It is important for leaders throughout the district to present a united front when rolling out these changes. District leadership teams should consider communicating with and involving students, parents, and community members during the planning process, as well as when making decisions such as prioritizing targets, identifying strategies, or setting trajectories. Stakeholders who are invited to participate in a process such as NGSS implementation can become the district's best advocates for change.

With a well-constructed plan, community stakeholders can do the work of building support themselves. If they internalize the right key messages from the district, they will build momentum for a shift that is truly best for students. Here is a step-by-step guide to help districts think through how to communicate with parents and community stakeholders.

Do not forget the big picture

Start by looking at the district's ultimate goal for the NGSS. This unified goal should be the basis for all the messages.

1. **Identify key audiences.** Parents, the larger community, and business leaders might not need to hear exactly the same message, so thinking through who *each target audience* is and what might interest the audience is helpful.

    - Students, educators, and parents will be most directly affected by the changes brought about by the transition to the NGSS and will need to know and understand more about the innovations in teaching and learning, student expectation, as well as the district's goals, milestones, and strategies.

    - Business and community leaders, on the other hand, may need to know less about the innovations and specific targets and more about the benefits that may directly affect them, like how the NGSS will better prepare students for careers and citizenship by making them more knowledgeable about science.

    - Other community members may need to hear only a quick "elevator speech" or view a simple infographic depicting the district's vision that gives them a general idea about what is happening.

2. **Craft short, clear messages for each audience.** Craft no more than three short, clear messages for the district to convey that support its overall goals. With these messages in place, leaders will be able to create consistent communications tailored to the needs of each stakeholder group. Among other things, messages may address:

    - The benefits of and evidence for the NGSS;
    - The changes, shifts, and expectations of students and parents associated with the NGSS;
    - The details of a multiyear timeline for implementation for each grade level, including changes in science courses or instructional time; or
    - Changes to assessment plans and structures.

3. **Anticipate and address likely opposition.** If a group or organization is likely to resist the NGSS transition, be sure to address any misconception early and directly. Contacting and involving possible detractors early on to discuss their concerns may create a better relationship and address problems before they start. Throughout the process, predict questions and construct responses to have consistent messaging ready. Some possible pitfalls include:

    - Leaders who don't have a robust science background might be uncomfortable observing science classrooms, sharing leadership with teacher experts, or prioritizing science in their work;
    - Teachers may resist new curriculum or course assignments, or having to participate in additional professional learning; or
    - Vendors may worry they will lose contracts or potential revenue streams.

Get the messages out

Now that key messages have been crafted, think about how and when the district will communicate them to parents and the community.

4. **Communication channels.** Consider which forms of communication will be best for each stakeholder group and how best to deliver those messages. Using multiple forms of outreach while taking advantage of existing communication channels is often best. Here are some examples:

    - School and local newspapers or newsletters offer existing means for general communication;
    - Email, websites, and social media can engage parents and involve a wider audience;
    - Open houses, parent-teacher association meetings, or school showcases provide opportunities for educators and schools to show parents and community members what is happening; and
    - Quick infomercials at sporting events, posters, or flyers might also offer opportunities for sharing the vision.

5. **Choose messengers wisely.** Messages are better received if they come from a trustworthy source. If a trusted group or public figure supports improved science or STEM education, ask that group or person to deliver or endorse the messages. For example, when speaking to parent groups, teachers are the best messengers. Or when speaking to community members, a beloved mayor's support for the standards may make a big impact. Think about who audiences most trust and want to hear from.

6. **Timing.** Some stakeholders may take priority and receive messages first (e.g., perhaps targeting active volunteer parents or those in the parent teacher association is important before moving on to broader groups).

Get parents and students involved

Parents are arguably the most important group to engage as a district begins the process of implementing the NGSS. They want their children to succeed and can quickly support initiatives that are presented to be in their best interest. Parent support will be integral to creating a lasting change in the district's approach to science education. When determining the best way to engage parents, consider the following:

7. **Allow opportunities to get feedback from parents.** Involve parents in decisions and ensure that their voices are represented. Consider those who may not have easy access to transportation or flexible work schedules and find solutions for them. Whatever channel of communication the district uses, ensure that parents have a chance to respond, ask questions, and have a conversation.

8. **Provide multiple opportunities for parental involvement.** Again, take advantage of existing structures set up for parental involvement, especially those that were effective when implementing other school reforms.

9. **Listen to students.** Since schools and districts exist to serve students, engaging students throughout a change process is important. As students get older and make more decisions about their own learning, establishing systems to understand what sorts of courses and lessons are most meaningful to them will be helpful. Young students can be incredibly insightful and enthusiastic about their learning, and are innately curious about the natural and designed world, so capturing and sharing that engagement can help districts refine their work.

Get the broader community involved

10. **Engage organizations and influential allies.** The district can also build support for implementation by engaging organizations and influential spokespeople throughout the community. Refine the messages to resonate with stakeholder groups and their needs and encourage them to host science nights or other events to show their support. These stakeholder groups can include, but are not limited to:

    - Local officials;
    - Local school board members;
    - Local postsecondary institutions, including local scientists;
    - Local business or major regional employers; and

- Informal education organizations (e.g., local museums, scientific societies, after school educational providers).

After thinking through the step-by-step guide above, districts can use Exercise 5 to develop ideas for communicating with students, parents, community members, and other stakeholders.

Exercise 5: Developing Ideas for Communicating with Students, Parents, Community Members, and Other Stakeholders

With Whom Do We Need to Communicate?	Targeted Message: What Do They Need to Know?	Why Is This Important to Them?	How Can We Most Effectively Get the Word to Them?	Who Needs to Work on This?	How Will We Check to Make Sure We Are Communicating Effectively?

After completing Exercise 5, a district will have generated a list of targeted communication messages and a list of the key people who need to receive them.

Chapter 6: Identifying Instructional Materials

Framing Questions

- How will your district ensure that instructional materials (including lesson plans, kits, and other instructional tools) are aligned to the NGSS?
- How will your district build the capacity of principals and teacher to identify aligned, three-dimensional instructional resources for the NGSS?
- How can the process of selecting aligned materials build relationships among educators and deepen their understanding of the NGSS in a way that supports districtwide implementation?

Chapter Objectives

This chapter will help districts:

- Understand what it takes to assess the quality and alignment of three-dimensional instructional materials and what resources are available to aid in this assessment; and
- Inventory instructional resources so districts know what is available, can determine if those resources are adequate, and can plan to acquire what is missing.

High-Quality Instructional Materials

Effective implementation of the NGSS requires quality instructional materials that support phenomena-driven, three-dimensional learning, as well as the other innovations of the NGSS. The district should develop a strategy for obtaining instructional materials that are designed for the NGSS and transitioning materials that are already available. The strategy should include plans for what will happen during the transition time; how materials will be vetted; how materials will make it to the classroom in a timely manner; and how educators will be trained to use them properly during their instruction. Consider the following questions to help determine the district's role in this process:

- Will the district evaluate materials to distribute to schools?
- Will the district evaluate materials and compile a list of recommended materials?
- Will the schools be able to evaluate materials and adopt what they want?

Most states leave instructional materials decisions to local districts; some states have lists from which districts may choose from; still others provide additional quality criteria to help districts make better instructional materials decisions.

Why Focus on Instructional Materials?

Instructional materials—loosely, the texts, lessons, and tools that teachers use in their classroom to plan, sequence, and deliver lessons—play a critical role in science education. In most schools, the available

textbooks define the sequence and nature of the content that is taught. Most teachers do not have nearly enough time or know-how (and it is unfair to expect that they should do so) to design lessons and laboratory activities for students every day. Quality varies across publishers and providers. In districts with high student mobility and/or high numbers of science teachers with limited experience or content knowledge, investing in robust curricular supports has the potential to mitigate those challenges. Well-designed instructional materials—those that are informed by science education research, subject to extensive field-testing and revision, and attend carefully to the complexities of the NGSS—coupled with supportive professional learning within a coherent system can help dramatically improve science teaching, learning, and leading.

Moreover, with the rise of the internet, teachers have more and easier access to lessons and units than ever before. However, just because a lesson or unit is available online does not mean the quality is high—which means teachers need to understand what quality lessons look like to be strong consumers. Clear guidance from the district about the selection and usage of instructional materials has the potential to improve lesson quality considerably.

Developing a Process for Evaluating the Quality of Instructional Materials

A first step is to establish an instructional materials committee that is managed by the district leadership team and made up of members who understand the NGSS, the innovations of the NGSS, and the shifts required in instructional materials so that they are truly designed for the new standards. The members of this committee should take part in specific professional learning opportunities so they are calibrated and trained on how to evaluate instructional materials for the NGSS. This group should be connected to any other leadership teams that exist so that efforts are coordinated and capacity continues to be built across the district.

To ensure consistency in the quality of instructional materials across the district, any materials reviewed by the committee need to be examined against specific criteria. The committee should agree on a set of criteria that will be used to vet all the materials, and all members of the committee should also be trained and calibrated on how to use these criteria. The Educators Evaluating the Quality of Instructional Products (EQuIP) Rubric for Lessons and Units: Science is designed to evaluate the degree to which lessons or units are designed for the innovations of the NGSS, so districts may want to consult this rubric as they think about the criteria they will use to examine instructional materials.

Districts also may find the Facilitator's Guide for Using the EQuIP Rubric useful for providing the professional learning necessary to use the rubric effectively. In addition, the Primary Evaluation of Essential Criteria for Alignment: NGSS Publisher's Criteria uses the EQuIP rubric for science as a sampling tool to evaluate year-long or multiyear instructional materials programs, including textbooks and curricula, for the degree to which they are designed for the NGSS.

When beginning the search for quality instructional materials, the district should inventory the instructional materials that it already has on hand.

The committee should think through and identify the process it will use to vet the existing instructional materials while considering the following questions:

- How will the district determine which instructional materials to examine?
- Who will examine and evaluate the instructional materials?
- What rubric or checklist will the district use to evaluate the instructional materials?

If schools in the district use the same resources for science courses, Exercise 6 provides a table that may be used or adapted to audit overall existing instructional materials.

Exercise 6: Conducting an Audit of Existing Instructional Materials

Use the following table to highlight the instructional materials currently used in the district. Note that for each grade or course, there may be multiple instructional materials used. Also, note that purchasing or adopting particular resources or programs is not the same as using them. Often, teachers adapt or ignore instructional materials (particularly if they never received professional learning about how to use them), so focus on generating an honest assessment about what is currently being used in the district.

Grade or Course	Instructional Materials Currently Used	Designed for NGSS?	Current Usage?	Recommendation

After completing Exercise 6, a district will have a solid audit that describes the current instructional materials available.

Once the committee has determined what instructional materials the district already has for each grade or course, it can better identify instructional materials needs. The review should involve the use of a set of clear criteria, similar to the process for vetting existing materials. The committee should check to see if the state has offered any guidance on aligned materials or posted any resources for evaluating commercial materials. The district should be aware that, as with the implementation of any new standards, the implementation of the NGSS is accompanied by an abundance of new, commercially prepared materials that claim to be aligned.

When considering the purchase of new materials, the district should proceed with caution and spend time reviewing any potential new resources.

After evaluating existing and commercial materials, the committee should develop an action plan and a budget. It should consider how much the district can afford to spend on instructional materials and all other things required for high-quality science instruction (e.g., laboratory materials, consumables).

Developing Strategies for Distributing Instructional Materials

In most cases, it is the district's role to determine how instructional materials are purchased and distributed. Some steps and questions that the district should consider are:

Who will be responsible for each step of the dissemination process, from initiating the procurement process to unpacking of new instructional materials in each classroom?

- What will the role of the instructional materials committee be?
- What will instructional specialists, coaches, department chairpersons, and teachers be responsible for?
- What will principals be responsible for?

What is the timeline for each step of distribution?

- When will instructional materials be evaluated and identified?
- When will contracts with developers be finalized?
- When will educators be trained in using these instructional materials?
- When will instructional materials be ready for the classroom?
- How will district leaders ensure that all educators have access to and support for the new instructional materials?

How will the district communicate about this process?

- Who will be affected by this process and how will the district communicate messages to each group?
- What will school leaders need to know?
- What will educators need to know?

Educators will need training on how to effectively use the new instructional materials in instruction. This need should be kept in mind when planning the timeline for distribution, as educators should be trained on instructional materials before using them in the classroom.

Scope and Sequence

This chapter does not cover all decisions a district will need to make about instructional materials as this new vision of science education comes to fruition. For example, if the state does not mandate a scope and sequence for science, the district should consider organizing the middle and high school standards into courses that make sense for its students. NGSS Appendix K is designed to help with this process, providing model course maps for both integrated and domain models. Additionally, NGSS Example Bundles illustrate both the process and examples for various ways that performance expectations can be bundled within a school year, providing more of a link between course maps and instruction.

Chapter 7: Using High-Quality, Aligned Assessments

Framing Questions

- What are the goals or objectives of your science assessment system?
- What role will the district play in assessments?
- How might you best acquire or develop assessments that will meet your goals?
    - Will there be district wide assessments and for what purpose?
    - Will the district help improve classroom assessments?
- How will you build the capacity of school leaders and teachers to effectively use the designated assessment system?

Chapter Objectives

This chapter will help districts:

- Understand how to determine what assessment opportunities are needed to achieve district goals and objectives in science; and
- Develop a process for creating an assessment plan for the NGSS.

New Goals, New Approaches: District Assessment System Considerations for the NGSS

As educators implement a wide variety of strategies to improve science outcomes for students—through shifting instructional practices, selecting new instructional materials, and engaging in new kinds of professional learning experiences and communities—they need feedback about whether their approaches are moving students toward the rigorous three-dimensional performance goals as described in the NGSS. The adoption and implementation of new standards will require that new assessments be implemented to monitor and provide feedback to students, parents, educators, and leaders about what decisions—programmatic, resource allocation, and instructional—need to be made to improve outcomes for all students. Furthermore, many federal and state rules require some sort of assessment and reporting of science performance.

Most districts have a plan to administer certain assessments, and these assessments are often tied to an overall accountability or improvement plan. As the district determines how to move forward with an assessment system that is consistent with its science performance goals, consider the following questions to guide decision making about the district's next steps and ensure that science has an appropriate place within the district's overall plan:

- What science assessments does the district currently administer and for what purpose? What about the state?

- What assessment information do district leaders, schools, teachers, parents, and students need to improve performance? How will that information be used?

- What signals about the nature and relative importance of science teaching, learning, and leading does the district want to deliver to stakeholders via their assessment?

Designing and implementing an assessment system for the NGSS requires a markedly different approach to science assessment than traditionally taken. The National Research Council's *Developing Assessments for the Next Generation Science Standards* recommends that, to effectively measure student progress toward the goals established by the standards, a system of assessments should allow stakeholders to coherently connect and use information from classroom and larger-scale assessment opportunities together to get a complete understanding of student and programmatic progress.

Such a comprehensive system of assessments has the potential to generate a robust suite of usable information about science performance, but can be challenging to execute. Quality district science assessment plans ensure stakeholders (1) have access to varied information from different kinds of assessment opportunities and (2) have adequate support for analyzing and interpreting assessment data to make improvements, though in practice this often means that most assessment decisions are left to the school or classroom. Some components of well-received district assessment plans include components that:

- Inventory all assessments students are required to take, including statewide assessments, to determine the purpose, actions supported, gaps in feedback needs, and redundancies that should be addressed.

- Ensure that routines and systems are in place for educators to engage with and appropriately use assessment information.

- Value and enable continuous improvement, both for assessment quality and student outcomes.

- Prioritize classroom assessment and evidence from student work evaluation, including:

    - Clarifying policies and expectations about quarterly, end-of-semester, and end-of-course exams generated by teachers or teacher teams;

    - Developing or procuring classroom assessments and tasks that model high-quality, aligned tasks and can be used by teachers in the classroom to both drive instructional improvements and collect data about student learning;

    - Using information from classroom work to inform the development of school and district assessments, rubrics, scoring guidelines, and feedback; and

    - Integrating the analysis of a range of student work with other assessment data.

- Center on improving outcomes for all students in the district.

It is important to note that many states are considering ways to support comprehensive assessment systems, and knowing about the state's current and planned approaches to assessment is imperative for a district assessment plan. The district should remain apprised of any decisions, pilot programs, or supports the state develops related to science assessment systems. This knowledge will ensure that the district has

a clear voice in the development of such supports and that its own assessment plan is consistent with, rather than contrary to or duplicative of, state efforts.

Defining the Scope of the Assessment Work

Before identifying who will lead the district's assessment work or how to proceed with modifying the district's current assessment system to suit new standards, defining the scope of the assessment work will be important. Consider the following questions to support establishing expectations and guardrails on the assessment work moving forward:

- Is the district leadership team charged with determining how to overhaul the assessment system to better improve science outcomes, or is the scope limited to revising existing assessment opportunities and ensuring that they are aligned to the NGSS?
- What are the capacity, resource, and/or administrative constraints (e.g., budgets, existing contracts) on the science assessment system?
- What is the timeline for the phases of the assessment work? How does this timeline interact with other implementation efforts, such as instructional materials selection, teacher evaluation, and professional learning opportunities?
- Are other policies or implementation targets (e.g., data and accountability systems) that could involve science assessment information flexible enough to account for new assessment recommendations?
- Do certain assessments need to be prioritized due to their timing, use in accountability formulas, popularity with or use by schools and teachers, or impending contract decisions?
- Will the district leadership team be making recommendations or decisions regarding science assessments in the district?
- Given the recent history of excessive testing, which assessments make most sense to be driven at the district level, and which are best left to the state, school, and classroom?

The answers to these questions will help the district leadership team decide who should be involved, how to allocate resources, and how to prioritize the necessary next steps for new assessment systems for the NGSS.

Aligning the NGSS and Assessments

Before the district can make determinations about existing or new assessments and whether they can meet district needs, it must determine how to evaluate the degree to which assessments are designed for the NGSS. The range of assessment types that could be considered—classroom-embedded formative and summative assessments, external monitoring summative assessments, student portfolios, performance tasks, etc.—means that alignment criteria specific to that assessment format should be considered. There are some guidelines, briefly described in Figure 2, that the district can use to inform its targets for NGSS assessments, derived from the NGSS innovations and other relevant features of the NGSS.

Figure 2: NGSS Guidelines for Assessments

NGSS Feature	Implication for District Assessment Considerations
Performance expectations	The standards are written as performance expectations—measuring the standards, therefore, requires student performance, in contrast to only rote memorization or factual recall.
Explaining phenomena and designing solutions to problems	Assessments need to be designed to give students the opportunity to demonstrate how well they can use their scientific knowledge and practice to make sense of authentic phenomena and/or design solutions to meaningful problems. This requirement means that assessments should support students' meaningful interactions with contexts and provide sufficient time to have the necessary range of experiences; when this is counter to the purpose of the assessments (e.g., an on-demand monitoring assessment administered to all students in the district), reasonable proxies will need to be determined that meet testing constraints.
Three-dimensional learning	Assessments need to reflect the three-dimensional nature of the standards. Students should have the opportunity to: • Show what they know and can do the way scientists and engineers do—through questioning, investigating, explaining, arguing, modeling, analyzing data, and problem-solving; and • Demonstrate grade-appropriate knowledge and practice across all three dimensions of science education, together and purposefully (in contrast to isolated facts that are disconnected from each other and a purpose, separating knowledge and practice, or assessing student facility with each dimension separately).
K–12 progressions	Some assessments likely need to provide information about where students fall on a continuum of knowledge and practice expected between the beginning and the end of a grade level or band.
Aligned to mathematics and English/language arts standards	Assessments use grade-appropriate mathematics and English/language arts targets when appropriate and needed to support the science goals.

NGSS Feature	Implication for District Assessment Considerations
All standards, all students	Assessments need to give all students—including those with diverse needs and backgrounds—opportunity to demonstrate their knowledge and practice across the range of science described by the standards. Providing this opportunity means assessments must be: • free from bias; • designed to allow a range of response modes and approaches; • designed to allow appropriate accommodations that maintain the integrity of the assessment goal; and • designed to measure a range of complexity, and collectively designed to measure whether all students in the district have the opportunity to learn the full range of knowledge and practice described by the standards.
Depth and breadth	Assessments signal and measure the depth and breadth of the NGSS through the combination of classroom and external assessments designed for different purposes. No single assessment will be able to measure the full depth and breadth expected of students at a grade level or band—and that is okay, if varied assessments designed for specific purposes are used.

Ultimately, it is important to remember:

- The best information about what NGSS performances "look like" comes from the classroom.
- Good assessments—administered at the state, district, and classroom levels—are consistent with what should be happening during instruction in the classroom.
- Different kinds of assessments meet different kinds of needs.
- Large-scale assessments provide the signal to inform what instruction should look like, and classroom assessments provide the lever to get there.
- System wide coherence—within the assessment system as well as between the assessment system and other components of the district's science system—is critical.

Processes for Evaluating and Developing NGSS Assessments

Before the district can make clear determinations about the assessments it will implement, it needs to have a clear sense of what information needs exist, what kind of evidence would be required to meet that need, and what assessment or other informational tool will provide that evidence. When determining the purposes that need to be reflected in a district's assessment system, consider the following questions:

- Who are the key stakeholders whose needs must be met?
- Based on the district context and demographics, should subgroups within the identified stakeholders be explicitly addressed?
- How will we acquire an accurate understanding of these stakeholders' assessment needs and concerns?
- Based on our science implementation plan, are there milestones or goals that should be signaled through our assessment system?
- What is required by state law or other policies that have implications for science assessments?
- With a shift to new science standards, what information will support improvements to classroom instruction?

Exercise 7 is designed to help identify the key science assessment needs for the district; Exercise 8 helps districts inventory their current science assessment offerings.

Exercise 7: Stakeholder Assessment Purposes Inventory

Use the following table to articulate what various stakeholders need from an assessment system. For each stakeholder, define the most relevant or important questions for them, and the evidence or data that could best answer those questions. In the concerns column, indicate issues that might be associated with particular questions (e.g., connections to teacher accountability) or data sources (e.g., expensive to procure reliably). These needs may vary across schools, grade bands, and disciplines, and having an accurate sense of what stakeholders truly need from the district will be important. The district may want to consider a variety of mechanisms for collecting this information, including focus groups and surveys. Specific groups within each of these stakeholder groups—such as English language learners and students with disabilities—should be considered explicitly, based on the needs of the district.

Stakeholder	Relevant Questions	Evidence Needed and Best Possible Sources	Concerns
Students			
Parents			
Teachers			
School leaders			
District leaders			
State			

After completing Exercise 7, a district will have generated a list of key questions that key stakeholders need answered from their science assessment system.

Exercise 8: Current Assessment Inventory

Many in the district, including teachers, parents, school leaders, and district leaders, likely will each have assessment needs specific to the NGSS that must to be met. It will be important to not immediately jump

to adding new assessments, as this might overburden teachers and students. A first step is to inventory what is currently being administered in the district; determine whether it is serving a needed purpose and is aligned to the NGSS; and decide whether the assessment should be kept, modified, or eliminated. The *Student Assessment Inventory for School Districts* describes a detailed process and provides tools that can support a district's needs for science assessment inventory, either alone or as part of a broader district assessment inventory. Exercise 8 can provide a helpful starting point to consider how to evaluate a district's current assessments.

Assessment		
Purpose of the Assessment?		
Who Takes This Assessment?		
How Is the Information from this Assessment Used?		
Evidence of Alignment To/Designed for the NGSS and the Purpose of the Assessment?		
Evidence of Non-Alignment To/Not Designed for the NGSS and the Purpose of the Assessment		
Recommendation (Keep the Assessment; Modify the Assessment; Eliminate the Assessment)		
Rationale for Recommendation		

After completing Exercise 8, the district will have an inventory of current science assessments.

Procurement Issues

Once the district has determined (1) the assessment needs and (2) the current assessment landscape, the district will need to identify gaps and next steps to address those gaps. Consider the following questions:

- Based on the inventory of existing assessments, what are the recommendations for keeping, modifying, or eliminating current science assessments?
    - Who is the decision maker?
    - What next steps need to be taken to act on the recommendations?
- What assessment gaps between needs and currently administered assessments were identified?
- Are any gaps prioritized and why?
- What capacity constraints need to be accounted for when developing a plan to address gaps?
- Who is responsible for orchestrating the necessary next steps?

As the district considers how to procure the needed assessments to measure the NGSS, the district should consider a couple of options:

Procurement Option	Benefits	Challenges	Considerations
Vendor-developed	Can take advantage of vendor capacity and assessment development expertise, as well as any content expertise available. Can explore assessment systems connected to other programs (e.g., instructional materials; formative, interim, summative assessments) May include embedded systems/infrastructure to support data interpretation, aggregation, and use. May be congruent with what is used in other content areas.	Need a rigorous evaluation protocol that ensures alignment to the NGSS and intended purposes. May be limited to the vendor's approach, including assessment design, item specifications, delivery platform, etc. May have limited connections to desired purposes. May include additional features that are unnecessary or unhelpful for designated purposes. May be difficult to modify as needed. Can be costly.	Careful RFP development: Make sure that the assessment RFP released includes clear expectations, embedded feedback loops, and mechanisms for continuous improvement. Consider an RFP for intentionally designed assessments, rather than off-the-shelf assessments. Consider including educators in the selection, evaluation, and feedback loops with the vendor. Consider embedded professional learning opportunities to ensure educators are knowledgeable about how to use (and can advocate for) the assessments. Consider asking the vendor to engage in information-gathering sessions with stakeholders and iterative NGSS training.

Procure-ment Option	Benefits	Challenges	Considerations
District-developed	Can completely tailor assessments and accompanying systems to needs, purposes, and alignment criteria, including format, distribution, availability, scoring, reporting etc. Can use tasks and lessons learned from classrooms within the district (e.g., student portfolios; teacher-submitted tasks). Can intentionally build buy-in, capacity, and assessment literacy. May be easier to modify over time.	Depends on district capacity to develop assessments—can be time intensive and force some timelines. Requires that those involved in assessment development are comfortable with the NGSS, NGSS innovations, and assessment design. May have delivery platform limits. May require significant capacity to contend with administration, security, scoring, and data-sharing infrastructure.	Consider the necessary developer training, feedback loops, and work time needed, as well as existing expertise and any outside support needed. Consider developing supports to enable educators to develop their own classroom assessments when appropriate. Consider using existing teacher efforts—including assessment tasks, student work, and teacher expertise—to develop assessments, alignment expectations, and desired student performances for districtwide assessments.

The district may find that the best option is a combination of the approaches above, depending on the different purposes, timelines, and expectations. For both options, districts should consider:

- Who is making the decision about procurement process?
- What are the district's procurement rules and processes?
- Who needs to be involved in determining next steps?
- Who needs to be involved in the development plan or RFP?
- Who needs to be part of the writing or review processes?
- What is the plan for the assessment rollout?
- What is the communications plan regarding the assessment approach, rollout (including options for pilots and field tests), and expectations?

The district should also consider whether partnering with other districts is an option. For both district and vendor developed procurement options, working with other districts may enable better assessments through shared capacity. For example, multiple districts that submit an RFP together may be able to have a greater monetary incentive for better assessments and/or better vendor negotiation; districts working together to develop tasks could contribute to a shared bank of assessments to draw from; and educators and assessment leaders can share developer training, evaluation processes, and lessons learned.

Routines and Mechanisms to Support Using Assessment Data

Getting the right assessments is important; just as important is ensuring that routines and mechanisms are intentionally established and used to support educators—including teachers as well as school and district leaders—in using the assessment data to take next steps, make decisions about programs, and improve their craft. As the district considers its assessment system, ensuring that all relevant stakeholders know how to find assessment data, what the data can tell them, and how to use the data to guide next steps will be important. The district should consider the following questions to help determine next steps regarding assessment literacy and use of assessment data:

- Are educators supported in understanding the purposes and intended uses of each assessment?
- Do educators have the time and professional learning opportunities to collaboratively examine assessment results?
- Do educators have time and space to collaboratively examine and consider assessment performance, student work, and the tasks students see?
- Are educators technically supported in understanding assessment administration and how to interpret results and score reports?
- What is the timeline for various assessment results to become accessible?
- Are educators supported in determining appropriate next steps based on assessment results?
- How do teachers communicate assessment results to parents and students?
- How does the district communicate assessment results to stakeholders, including the school board, the community, and the state?
- Are educators supported in understanding, developing, and using formative assessment processes?

Adopting the NGSS is an important step in the journey of science instructional improvement. Because the NGSS represent the best thinking of many states—and the teachers, school leaders, and scientists who make up those states—they are a promising tool to use to improve outcomes in science for students. While standards by themselves are no silver bullet and do not stand alone, they do provide the necessary foundation for local decisions about improving instruction, curriculum, and assessment. By aligning the need for improved standards with the common vision in these areas, districts are more likely to have stakeholder support. This common vision serves as the guidepost of the work, becoming a point of reference in most decisions. Every part of the implementation plan should play a part in enabling students, educators, and schools to contribute to making progress toward that vision.

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Appendix A: Links to Full Excel Versions of the Tools in This Workbook

Click on the following links to download Excel versions of the eight exercises and self-assessments included in this workbook:

Exercise 1: How Do the NGSS Fit into Existing Initiatives? Self-Assessment

Exercise 2: Identifying Data to Support Improvement

Exercise 3: Selecting District Implementation Team Members

Exercise 4: Implementation Goals and Milestones

Exercise 5: Developing Ideas for Communicating with Students, Parents, Community Members, and Other Stakeholders

Exercise 6: Conducting an Audit of Existing Instructional Materials

Exercise 7: Stakeholder Assessment Purposes Inventory

Exercise 8: Current Assessment Inventory

Appendix B: Glossary

In addition to these commonly used terms, please see the List of Common Acronyms used by Next Generation Science Standards.

The Framework. A shortened title for the 2012 foundational report, *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, published by the National Research Council (NRC) describes the scientific consensus for the science knowledge and practices students should acquire in the course of their K-12 experience. A team of 26 states, coordinated by Achieve, developed the Next Generation Science Standards based on the recommendations and information described in the *Framework*. *The Framework* is available online in a variety of formats from the National Academies Press.

Bundles/Bundling. Grouping elements from multiple performance expectations into appropriate goals for lessons, units, and/or assessments. Students can develop and use the elements that are bundled together to build toward and demonstrate proficiency on a set of performance expectations in a coherent manner. The resources available here provides more description and some video examples of bundles and bundling.

Performance Expectations (PEs). The NGSS are organized into a set of expectations that collectively describe what students should be able to do by the end of a period of instruction, generally measured by years of schooling (grade levels or grade bands). The performance expectations describe the learning goals or outcomes for students. Each performance expectation describes what students should know and be able to do, often with a **clarification statement** that provides examples or additional emphasis to the particular performance expectation. An **assessment boundary** guides the developers of large-scale assessments, but should not be seen as limits on classroom instructional activities. Each performance expectation reflects the integration of targeted disciplinary core ideas, an element of a targeted crosscutting concept, and an element of the science and engineering practices that are defined in the *Framework*. Note that like all sets of standards, the NGSS do not prescribe the methods or curriculum needed to reach these outcomes, nor do they describe instructional activities.

Phenomena. Phenomena are observable events. Lessons designed for the NGSS focus on students using the three dimensions together to make sense of phenomena or design solutions to problems. Some additional resources about phenomena are available here.

Three Dimensions. As described in the *Framework*, these are the three strands of knowledge and skills that students should explicitly be able to use to make sense of phenomena and design solutions to problems. The three dimensions are the Disciplinary Core Ideas (DCIs), Crosscutting Concepts (CCCs), and Science and Engineering Practices ("the Practices" or SEPs).

> **Disciplinary Core Ideas (DCI).** The fundamental ideas that are necessary for understanding a given science discipline. The core ideas all have broad importance within or across science or engineering disciplines, provide a key tool for understanding or investigating complex ideas and solving problems, relate to societal or personal concerns, and can be taught over multiple grade levels at progressive levels of depth and complexity.
>
> **Crosscutting Concepts (CCC)**. These are concepts that hold true across the natural and engi-

neered world. Students can use them to make connections across seemingly disparate disciplines or situations, connect new learning to prior experiences, and more deeply engage with material across the other dimensions. The NGSS requires that students explicitly use their understanding of the CCCs to make sense of phenomena or solve problems.

Science and Engineering Practices (SEP). The practices are what students *do* to make sense of phenomena. They are both a set of skills and a set of knowledge to be internalized. The SEPs reflect the major practices that scientists and engineers use to investigate the world and design and build systems.

Three-Dimensional Learning. Students actively engage with the practices and apply the crosscutting concepts to deepen their understanding of core ideas across science disciplines as the mechanism by which they learn science. Click here to read more.