SCIENCE TECHBOOK

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Finding Success with NGSS

Next Generation Science Education with Science Techbook

Executive Summary

The modern world demands knowledge, skills, and problem-solving acumen that are vastly different from what was required even a generation ago. We are now in an era in which 21st century skills are no longer aspirations; they are necessities for graduates who are prepared to participate and prosper in the global economy. To keep up with rapid change and prepare students for the future, science education has transformed over the past decade to better engage K-12 students in the sciences and cultivate the critical skills that come with them. This transformation was catalyzed by the National Research Council's *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (the Framework)*, released in 2011, and the *Next Generation Science Standards (NGSS)* released by Achieve, Inc., in 2013.

The NGSS require a significant culture shift in the teaching and learning of K-12 science, moving toward phenomena-based classrooms in which students learn through investigation and design, solve real-world problems and develop meaningful understanding of the three dimensions of science and engineering—all while developing and employing skills in research, analysis, critical thinking, creativity, communication, collaboration, productivity, and leadership. This necessary shift will mean that today's students will better understand the world in which they live and participate in solving the problems of today and tomorrow.

While the NGSS have accelerated and deepened science education with their sophistication and complexity, they have also brought significant challenges for educators in regard to resources, pedagogy, professional development, and implementation.

Discovery Education's signature science education resource, *Science Techbook*, is steeped in the principles of three-dimensional teaching and learning central to these new standards and designed to align with the specific standards adopted by each state.

Science Techbook was developed by experts in NGSS and three-dimensional instruction with help, input, and feedback from classroom teachers to facilitate this transition in science instruction and provide schools, educators, and students with the teaching and learning resources they need to discover, experience, and thrive in the next generation of science education.

Introduction

The current era marks a period of rapid change with technological advancements, the interconnectedness of the global economy, and climate change. Students must be prepared to navigate this continuously evolving landscape and solve the big problems of tomorrow that we cannot even fathom today. Yet for decades, our country's approach to science education has fallen short of both engaging students to understand the fundamentals of science and preparing students to lead in tomorrow's world.

Up until the past few years, K-12 science was taught based on standards developed in the 1980s, which lacked systematic organization across grades, emphasized broad topics and discrete facts, and lacked experiential learning that lends itself to engagement and depth of knowledge (National Research Council, 2012; NGSS, 2019). Today, most people, including many students, have smartphones that provide Internet access, cameras, and multimodal resources, yet the science standards in many states were written before the Internet existed. In fact, most standards predated scientific advancements that eliminated the measles from the United States, landed a rover on Mars, mapped the human genome, developed robotic limbs, declassified Pluto as a planet, and made Siri and Alexa household names (NGSS, 2014).

While K-12 instruction increased its emphasis on making science education accessible and relevant to all students since the 1980s, there remained a lack of understanding about the depth of institutional barriers to achieving equity and the strategies that might address those barriers. The inadequacies of science education were known broadly in scientific and education communities but were deprioritized as the K-12 education reform movement at the turn of the century focused on reading and mathematics, fueled by the federal mandates of the *No Child Left Behind Act* of 2001.

During the NCLB era, rapid technological advances brought about a new economic reality: Demand for highly skilled talent in science, technology, engineering, and mathematics (STEM) fields far outweighed the talent pipeline, and that gap was rapidly increasingly. A 2005 U.S. National Academies report, Rising Above the Gathering Storm, linked innovation and prosperity in society to knowledge-based careers. The national attention this report garnered, combined with lagging math and science rankings on international benchmark assessments and growing demand in STEM jobs, fueled a new focus on STEM education (USDE, 2016).

Simultaneous to the growing momentum around STEM was a call to action to shift the culture of science education, beginning with America's Lab Report: Investigations in High School Science, a 2006 report of the National Research Council that "helped science educators shape their instruction by linking evidence-based teaching approaches to desired student outcomes" (National Research Council, 2006).

In 2009, the Council of Chief State School Officers and the National Governor's Association Center for Best Practices embarked on a movement to develop a singular set of high-quality learning standards for English/language arts and mathematics, culminating in the Common Core State Standards that were subsequently adopted fully or in a modified format by 44 states (CCSS, 2019). These research-based standards were designed to prepare students for successful participation in a global economy and set the climate for a common approach to education developed *by* the states *for* the states.

That same year, the Carnegie Corporation and Institute for Advanced Study issued "The Opportunity Equation: Transforming Mathematics and Science Education for Citizenship and the Global Economy," a report that made the case for a common set of science standards, stating: "The world has shifted dramatically—and an equally dramatic shift is needed in educational expectations and the design of schooling" (Carnegie, 2019).

Following this report, the Carnegie Corporation funded the development of a framework for science education and a common set of standards based on it. The National Research Council released *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* in 2011 (National Research Council, 2012).

The shift in expectations for science education culminated in the creation of the Next Generation Science Standards (NGSS), a robust set of standards built upon the *Framework*. To develop the NGSS, Achieve, Inc. led a collaboration of 26 lead state partners and other critical partners, including the National Research Council, National Science Teachers Association, and the American Association for the Advancement of Science. The standards were benchmarked internationally against countries with high student performance in science and engineering (NGSS, 2019). This paper discusses the key shifts in teaching and learning expectations and how these expectations are addressed by Discovery Education *Science Techbook*.

Your Partner in Next Generation Science Instruction

At Discovery Education, we see our role as bridging the gap between the realities of what is currently happening in science education classrooms and the aspirational vision of what it could be. Our goal is to support teachers in delivering exceptional science education to all students while making the transition seamless. Our curricular experts have sifted through the complex expectations, developed resources that align with the vision for next generation science, and created comprehensive embedded supports to help teachers deliver their new instruction with confidence. We continuously listen to and talk with teachers about their challenges and needs and refine our suite of services based on this feedback.

Discovery Education *Science* is a phenomena-driven middle school learning program that cultivates lifelong curiosity and invaluable real-world skills by placing students at the center of each three-dimensional storyline to lead exhilarating investigations that uncover the mysteries of the universe. As a key component, *Science Techbook* is steeped in the principles of NGSS and designed to align with the specific standards adopted by each state.

A New Direction for Science Education

The *Framework for K-12 Science Education*, and the robust NGSS that followed, set a new direction for science education. The Framework was built upon the following guiding principles:

- All children have natural curiosity and the ability to learn.
- Science education should focus on a few core concepts.
- Thorough understanding of scientific knowledge occurs over time and should be facilitated through well-designed learning progressions.
- Science and engineering require both knowledge about the current understandings of the world and the practices of establishing, extending, and refining knowledge.
- Science education should be relevant to student interest and experience.
- All students should have equitable access to quality science education, with respect to space, equipment, time, instruction, and cultural relevance (NGSS, 2019).

The Framework also emphasized integration of three fundamental dimensions (curriculum, instruction, and assessment) into all K-12 science standards:

- Established science and engineering practices.
- Crosscutting concepts that unify the study of science and engineering.
- Disciplinary core ideas in the physical sciences, life sciences, earth and space sciences, and engineering, technology, and applications of science (ibid.).

The NGSS are built upon the notion that students learn more deeply when investigation and design are at the center of the learning experience. "When students engage in science investigation and engineering design, they are able to engage deeply with phenomena as they ask questions, collect and analyze data, generate and utilize evidence, and develop models to support explanations and solutions" (National Research Council, 2019). Through the investigation and design processes, students take ownership of their learning as they draw connections with natural and designed phenomena. The standards emphasize five key concepts for K-12 science education:

- Science education should integrate the three equally important dimensions of learning identified in the Framework.
- All three dimensions build coherent learning progressions.
- Students should engage with phenomena and design solutions.
- Unique aspects of engineering and the nature of science should be addressed.
- Science is connected to math and literacy (ibid.).

Three-Dimensional Learning

The NGSS center around the three distinct and equally important dimensions to constructing scientific explanations. These dimensions are combined to form each standard or performance expectation, and each dimension works with the other two to help students build a cohesive understanding of real-world observations of science.

Science and Engineering Practices describe what scientists do to investigate the natural world and what engineers do to design and build systems. The *Framework* called for teaching both engineering and technology and the natural sciences (physical, life, earth and space) in tandem to emphasize the significance of learning about "the human-built world" and to promote the value of integrating science, engineering, and technology education (National Research Council, 2012). There are eight key practices that "better explain and extend what is meant by 'inquiry' in science and the range of cognitive, social, and physical practices that it requires" (NGSS, 2019). Students must perform these practices in order to truly learn and develop conceptual understanding.

1. Asking questions (science) and defining problems (engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (science) and designing solutions (engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information (Beatty & Schweingruber, 2017)

Crosscutting Concepts help students make sense of observable phenomena and explore connections across the four domains of science—physical science, life science, earth and space science, and engineering design. These concepts are:

- Cause and effect
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter
- Structure and function
- Stability and change (ibid.)

Disciplinary Core Ideas are the key ideas in science that have broad importance within or across science and engineering disciplines. These core ideas are foundational to understanding increasingly complex phenomena and build on each other as learning progresses over multiple grades with increasing levels of depth (ibid.). Examples include:

- Physical Sciences – matter and its interactions; motion and stability; energy, waves
- Life Sciences – structures and processes; ecosystems, heredity, and biological evolution
- Earth and Space Sciences – Earth's place in the universe, systems, and relationship with human activity
- Engineering, Technology, and Applications of Science – engineering design and links among engineering, technology, science, and society (ibid.).

In three-dimensional learning, students apply the crosscutting concepts, science and engineering practices, and disciplinary core ideas in an integrated fashion over time from elementary school through high school. Students demonstrate applications first so that they are ready to engage in science investigation and engineering design, and later they create and execute increasingly complex investigations (National Academy of the Sciences, 2019).

Science Techbook was designed to foster a dynamic classroom environment where students experience three-dimensional learning. Each concept in *Science Techbook* purposefully layers the dimensions so students can authentically demonstrate multiple science and engineering practices and crosscutting concepts. Students are expected to apply the disciplinary core ideas to figure out phenomena through analysis of text, data, and hands-on activities. Students are encouraged to design their own approach to these interactive experiences, with scaffolded support if needed.

Phenomena and Real-World Problem Solving

As a means to deeper student engagement and greater relevancy, the NGSS emphasize anchoring instruction in phenomena, where students are charged with solving real-world problems related to an observable phenomenon. Teachers identify and introduce a relevant phenomenon or circumstance, and the students must explain, resolve, or design a solution.

The challenge for teachers is that they must have a strong content knowledge foundation and be able to select phenomena that focus students on the connections between what they are learning and what is happening in the real world. The National Research Council states that phenomena that work well for these learning experiences should:

- Build on everyday experiences and be relatable to students.
- Relate to performance expectations, engaging students with the three dimensions.
- Be too complex for students to solve by looking online or within a single lesson.
- Be observable to students by way of scientific procedures, technological devices (telescopes, microscopes, etc.), or data collection and analysis.
- Be something students can learn more about with accessible data, images, or text.
- Be specific sets of circumstances, such as a case or problem, something puzzling, or something that the students are curious about.
- Be important problems or questions that people care about. (Beatty & Schweingruber, 2017)

Within each *Science Techbook* instructional segment, a real-world Anchor Phenomenon piques student curiosity and encourages them to ask questions and seek solutions that help them learn—and actually understand—the lesson. This approach shifts the focus from simply learning about and memorizing a topic to uncovering why or how an event happened. The Anchor Phenomenon sets a purpose for learning across the unit, and each concept within the unit begins with a smaller, real-world Investigative Phenomenon that inspires students to dive deeper into the content, uncovering the scientific principles behind each phenomenon while looking for evidence to explain it. Each unit culminates in a Unit Project that expects students to return to the Anchor Phenomenon and summarize their learning across the unit storyline, serving as a summative assessment of three-dimensional learning.

Student-Centered Learning

The NGSS classroom is student-centered, meaning students own their learning and seek to answer questions about which they are naturally curious while teachers facilitate the learning processes. The National Research Council details some of the observable differences of a student-centered classroom delivering NGSS-aligned instruction compared to the traditional science classroom.

LESS	MORE
Rote memorization of facts and terminology.	Students learn facts and terminology as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning.
Learning of ideas disconnected from questions about phenomena.	Students learn core knowledge focused on explaining phenomena and understanding context for the ideas and information using crosscutting concepts.
Teacher-provided information to the whole class, i.e., lecture-based instruction.	Students discuss open-ended questions around the strengths of the evidence used to generate claims and the significance of the ideas.
Traditional, independent reading in textbooks, expecting students to answer questions at the end of each chapter.	Students read multiple sources, including science-related journal articles and digital content, develop explanations that summarize what they've read, and answer key questions.
"Cookbook" laboratories or hands-on activities with pre-planned outcomes.	Student questions drive multiple investigations with a range of possible outcomes that collectively lead to multiple explanations or constructive arguments about outcomes.
Worksheets	Students write journals and reports and create posters and media presentations that explain, argue, and elaborate on ideas related to performance expectations.
Oversimplified activities for students who are perceived to be less able to do science and engineering	Teachers provide supports so that all students engage in sophisticated science and engineering practices and apply them in answering science questions.

Adapted from: National Research Council, 2015; Beatty & Schweingruber, 2017

The *Science Techbook* classroom is an active and dynamic learning laboratory in which students act as scientists and engineers to investigate problems and construct solutions. Students lead the way as they identify problems, develop scientific explanations for phenomena, build and test prototypes, conduct research, and determine the best solutions based on the collection and analysis of data. By constructing their own learning through questions co-created with the teacher, students utilize real-world situations to identify ways to improve and expand scientific knowledge and extend it to their everyday lives.

Equity and Inclusion

The current reform movement acknowledges the deep inequities in science education and emphasizes the need to address them. A 2019 National Academy of the Sciences report states, "The inequalities and inequities, intentionally produced throughout the history of U.S. education, endure and are ever-present challenges for realizing the Framework-guided vision for science education in the 21st century for which inclusion is a goal. A critical view of the current state of affairs indicates science education is not inclusive, and more work remains." The authors contend that equitable outcomes "require attention to how people think about student access, inclusion, engagement, motivation, interest, and identity, and about the actions and investments required to achieve such outcomes." They then provide explicit instruction on using inclusive pedagogies "designed to make education more inclusive of students from many types of diverse backgrounds and cultures" to drive toward equitable access and outcomes (National Academy of the Sciences, 2019).

Discovery Education has established equity and cultural responsiveness as core values in curriculum and content development. The Center for Culturally Responsive Teaching and Learning (CCRTL) defines cultural responsiveness as an approach to learning that validates and affirms different cultures for the purpose of moving beyond race and a superficial focus on culture. Attention to cultural responsiveness ensures that students clearly see themselves in this context and that they deeply experience different cultures throughout their educational experiences. Our content experts are trained in cultural responsiveness with the goal of ensuring *Science Techbook* and science teaching and learning are responsive to the students and teachers who use the product.

We are committed to helping science educators and students break through the barriers to equitable access and outcomes through inclusive pedagogy. *Science Techbook* was built upon the principles of the Universal Design for Learning (UDL) so that all students can access the learning process. The UDL was developed to improve teaching and learning based on scientific insights about how humans learn. When educators are aware of the UDL principles and learn how to address systematic learning variability, students become more engaged with content and make connections between emotion and cognition. It also allows more flexibility in the ways in which information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students engage. This approach reduces barriers to learning and supports and challenges students appropriately.

The UDL framework is built on three principles that are part of the fabric of *Science Techbook:*

Multiple Means of Engagement

Affective networks in the brain influence the "why" of learning—why learners get engaged, challenged, excited, interested, and motivated to learn. To engage students, instruction must stimulate learning by tapping into student strengths, interests, and motivations (Cast, 2019). Students' learning is strengthened when they can connect to their existing knowledge and experiences.

Science Techbook engages students through relevant content and cultural connections. It includes real-world problems and phenomena intended to draw students in based on their individual interests and natural curiosity and helps them see themselves as valuable contributors to the scientific community. Hands-on activities and virtual investigations provide immersive opportunities for students to engage in science and engineering practices, and science kits provide teachers and students with the materials they need to invent and develop creative solutions to real-world challenges. Students interact with a wide range of up-to-date images, subjects, and situations reflective of our nation's diversity across race, gender, age, culture, physical ability, socioeconomics, and geography. Students have many opportunities to select scenarios and content that spark their interest, yielding high levels of engagement regardless of student ability, prior knowledge, or background.

Teachers can select tools to differentiate instruction and gauge degrees of readiness and interest, as well as find resources to help vary content, process, product, all of which adapt readily to remote or in-class learning environments. *Science Techbook* is designed to meet the needs of all students and provides resources at point-of-use for English Language Learners (ELL), advanced learners, and students with disabilities in order for all students to participate in instruction and meet the expectations of the NGSS.

Multiple Means of Representation

Representations are connected to recognition networks in the brain that influence the "what" of learning—how we gather observable facts and categorize what we see, hear, and read (e.g., identifying words, concepts, or writing style). Instruction should, therefore, present information and content in different ways to appeal to different students (Cast, 2019).

Science Techbook provides a wide variety of means and modalities to access content via high-quality graphics, videos, virtual labs, hands-on activities, and robust STEM challenges that encourage student-centered learning. These resources, included in both digital and print, provide multiple representations of the content and the flexibility for teachers to assign targeted content to whole groups or individual students. Informational texts at various Lexile levels and embedded literacy tools help students strengthen their reading comprehension skills and develop both academic and discipline-specific language, while dynamic content provides context and assists students in accessing the text. *Science Techbook* also organically incorporates the writing process and expects students to use speaking and listening skills to demonstrate their understanding of science. Core interactive text allows for differentiation as well as accessibility of content through text read-aloud features, Lexile and language options, highlighting and note-taking tools, and an interactive glossary. The approach motivates students to think deeply about topics, engage fully, and own their learning experiences.

Multiple Means of Action and Expression

Strategic networks in the brain influence the "how" of learning—how we organize and express ideas, like writing an essay or solving a problem. Instruction and assessment should, therefore, include differentiated ways for students to demonstrate knowledge (Cast, 2019).

Throughout *Science Techbook*, learning experiences include a variety of differentiated pathways to learning and demonstrating knowledge, which promotes both student collaboration and individual exploration. For example, the hands-on activities and STEM projects provide opportunities for students to work together, while technology-enhanced items encourage individual thought and accountability. *Science Techbook* also includes Studio, an in-product authoring tool, which lets educators easily create, assign, and track progress while students use it to create and collaborate with digital content in a way that works best for them.

Literacy

With the integration of the Common Core State Standards, teaching students to read informational texts, use textual evidence to support their thinking, and write in a variety of domains has become standard literacy practice across all classrooms. Science content and images are exciting for students, exciting and motivating them to engage with tasks that deepen and hone their literacy skills.

The National Academy of Sciences held a workshop in 2014 to explore the intersections between the Common Core for English/language arts (ELA) Standards and the NGSS. Contributors agreed that both sets of standards require students to:

- Attend to evidence with precision and detail.
- Gather, synthesize, and corroborate complex information.
- Make and assess arguments orally and in writing.
- Make accounts of events and ideas.
- Integrate, translate, and evaluate prose, graphs, charts, and formulas. (National Research Council, 2014)

Contributors also agreed that oral and written language are two of the primary vehicles by which students gain knowledge in the science classroom. They delineated the following themes related to the importance of literacy in science education:

- Reading, writing, and speaking are important to making sense of scientific knowledge.
- Science reading, writing, and speaking are uniquely complex, explicit, and precise, requiring students to use specific receptive and productive language skills.
- Science texts have unique and challenging words, grammar, patterns, or representations.
- Science teachers have an important role to help students build disciplinary literacy.
- Students need time to grapple with challenging text and concepts in order to derive meaning.

The teaching of science provides multiple opportunities for students to read, think, and write like scientists. With Discovery Education's Science Techbook, students not only build their content knowledge, but also develop and strengthen their literacy skills, including their disciplinary literacy skills, through robust literacy resources and literacy-supported lessons that use research-based instructional reading, writing, speaking, and listening strategies.

Getting Started: The Literacy and Science Connection

Reading and comprehending informational texts, as well as informative, explanatory, and argumentative writing are essential elements in building interdisciplinary literacy skills as well as scientific literacy skills. As the expectations for reading and writing proficiency toward college and career readiness have accelerated, students must deepen their ability to access and interpret informational text. With *Science Techbook*, students interact with different types of text, produce text, participate in discussions, and engage in research.

Diverse Informational Texts

Interacting with informational text is an essential element of building students' scientific understanding in their development toward college and career readiness. *Science Techbook* provides students with a variety of texts in different formats to read, comprehend, and integrate into their writing as they collect evidence to make claims and support their reasoning. Multiple reading passages in a concept are written at different Lexile levels with different text structures, such as problem and solution, cause and effect, and compare and contrast. Students learn to read across all types of texts, and the passages may be used as mentor texts for writing.

The Writing Process and Science Connection

Writing is an important part of science because it is how real scientists document and communicate their ideas, activities, and findings. Our resources engage students in many kinds of writing, especially argumentation. Argumentative writing in science calls for evidence, often requiring students to read across several texts, watch videos and other media, and complete hands-on labs. *Science Techbook's* Explain section serves as the catalyst for the integration of the writing process across all science concepts. Using the Claim-Evidence-Reasoning structure, students learn to use evidence as a natural part of writing like a scientist.

Building Academic Language of All Students

Reading and writing success in science depends on the ability of students to understand the definitions of vocabulary words and how academic language connects ideas, adds details, or organizes the text. An interactive glossary within the Core Interactive Text supports students' learning of both Tier 2 and Tier 3 vocabulary words through videos, animations, and images to supplement the developmentally appropriate text definitions at critical places in the learning process after building conceptual understanding of scientific ideas.

Language Proficiency

English Language Learners (ELLs) build knowledge about how the English language works in varied contexts. Digital search features give teachers and students access to an extensive array of media and text. Teachers can assign content and tasks matched to individual students or groups, and language and display options allow students to adjust readability and language preferences.

Assessment

The goal of assessment is to support learning by collecting information from students about what they know and are able to do in relation to the standards. Three-dimensional learning, which occurs over time, requires an approach to assessment that:

- Examines how students use science and engineering practices in the context of the other two dimensions.
- Gives students multiple opportunities and means to demonstrate learning.
- Generates specific data for both the teacher and the student on what has been learned and what has not yet been mastered.
- Focuses on progress along a learning continuum rather than capturing correct and incorrect answers at a specific moment in time. (Beatty & Schweingruber, 2017)

The National Research Council suggests assessment should be reflective of the following principles:

- Assessment is grounded in the classroom, as an integral part of the learning process rather than an intrusion.
- Assessment should be part of a system that links it to instruction and curriculum, whereby all three elements are working together to help students progress in their learning within the new vision for science education.
- Assessments should work together giving teachers the information they need to adjust instruction and administrators the information they need about instruction across classrooms, schools, and districts. The information from a large-scale assessment should be reflective of what's happening in the classroom and therefore give teachers the information they need to inform instructional decisions.
- Assessments should reflect authentic opportunities to learn, meaning students are given equitable resources, time, and instruction to learn the assessed standards. Educators should be mindful that sometimes assessment results reflect inadequate opportunity to learn rather than a specific student's acumen with the content. Assessments should, therefore, be equipped with a mechanism for assessing whether students truly had equitable opportunity to learn (ibid.).

Within *Science Techbook*, formative and summative assessments are embedded into the learning cycle for each concept, along with unit-level assessments that work together with curriculum and instruction to support students in achieving proficiency in defined learning goals.

Formative Assessments

- **Technology-Enhanced Items** allow students to demonstrate three-dimensional proficiency. Student responses feed directly to the Teacher Dashboard, providing instant access to data to inform instruction. Each TEI has built-in scaffolded feedback for students. Summative Concept Assessments are in each concept, with their results displayed in the Course Assessments Dashboard. Teachers can identify areas of strength and weakness and adjust pacing of instruction.
- **Scientific Explanations** allow students to analyze complex text and authentic data and evaluate information to support a student-generated claim. Students and teachers can review and provide feedback to one another to increase the rigor of student responses.
- **Hands-On Activities and Labs** provide opportunities for investigation, engineering, and reason activities, by which students demonstrate science and engineering practices and analyze data to look for evidence of crosscutting concepts.
- **STEM Project Starters** encourage students to design and generate solutions to real-world problems, as well as conduct additional research. Teachers can observe and evaluate how students apply content knowledge to a new context and then present it within the concept.

Summative Assessments

- **Unit Projects** at the end of unit encourage students to design and generate solutions to real-world problems, conduct additional research, and reflect on their learning. Sample responses and scoring rubrics are included for additional teacher support.
- **Performance-Based Assessments** in each unit allow students to demonstrate three-dimensional learning through multiple prompts associated with a common scenario. Online Teacher Guides describe the multidimensional nature of each prompt and provide sample student responses.
- **Assessment Builder** and **Discovery Education's Studio** tool give teachers additional flexibility to create customized assessments.

Professional Learning

The sum result of these reform efforts is a fundamental shift in how teachers must approach teaching and learning. Perhaps the biggest challenge that the shift to NGSS-aligned curriculum has presented is the fundamental shift in how teachers must approach teaching and learning. Phenomena-based teaching, problem solving, collaboration, and communication are essential skillsets; rapid technological advances and changes are the norm; and interdisciplinary learning is expected.

Effective professional learning is needed to facilitate these shifts. The National Academy of Sciences recommends that high-quality, sustained, professional learning opportunities are needed to engage teachers as professionals with effective evidence-based instructional practices and models for instruction in science and engineering. Administrators should identify and encourage participation in meaningful professional learning so teachers develop successful approaches to effective science and engineering teaching and learning (National Academy of Sciences, 2019).

Embedded Support for Teachers

Science Techbook was developed so that teachers can find the resources they need, when they need them, to support instruction with a Teacher Edition (print and digital) and additional teacher materials embedded throughout the digital resources. It includes several tiers of support to assist teachers with planning three-dimensional learning experiences. Explicit guidance for three-dimensional learning is included throughout the print and digital Teacher Edition. In the digital *Science Techbook*, teachers can easily see the student view of content, and they can access additional support using the Teacher Presentation Mode toggle. Teacher notes, sample student responses, answer keys to online assessments, additional assessments, and teacher guides to hands-on activities are easily accessible, and visible to teachers only. Discovery Education science kits also include a Quick Start Guide for support with implementation.

Professional Learning Partnerships

Beyond *Science Techbook's* embedded supports, Discovery Education has taken substantial steps toward addressing 21st century skill deficits through research-based education partnership programs for teachers and students. We aim to provide high-quality professional learning that empowers districts, schools, and teachers with the tools to transform practices and impact student outcomes not just for today's learning needs, but in preparation for the skills of tomorrow.

Promising Results

Discovery Education partnerships throughout the country have yielded positive results for both teacher instructional practice and student achievement. Below are just a few such examples, presented alphabetically by state.

California | Districtwide STEAM Transformation with Discovery Education

Val Verde Unified School District in California infused science, technology, engineering, arts, and mathematics (STEAM) throughout the curriculum to promote 21st century learning skills. To facilitate this transition, Val Verde partnered with Discovery Education and implemented *Science Techbook* specifically because of its deeply-rooted connection to the NGSS, powerful model lessons, and focus on real-world, relevant phenomena. Schools now host STEAM-themed family engagement nights, there are district-wide, student-focused STEAM events, and the district's graduation rate is now 10 percent higher than the state's. Armed with 1:1 devices in most classrooms, students are not only mastering technology, they're creating new technologies. From as early as kindergarten, students are learning the building blocks of coding and developing a lifelong appetite for conquering new challenges. This work is augmented through the district's STEAM labs, an impressive overhaul of select classrooms featuring high- and low-tech engineering staples like 3D printers, interactive digital displays, and robotics equipment. Val Verde students are already looking ahead to the job market as they work in these advanced labs. High school course offerings now include computational logic and access to a career technical education lab where students can work with the same high-tech equipment found in modern warehouses. The district's superintendent said Discovery Education helped bring this transformation to fruition with a partnership that was alongside them every step of the way.

Florida | Achievement Results Among English Language Learners with Science Techbook

Collier County Public Schools and Discovery Education partnered to study whether the use of *Science Techbook* in elementary and middle schools affected student achievement. On average, English Language Learners (ELLs) whose teachers used *Science Techbook* performed better on the state's science standardized assessment than ELL students whose teachers did not use *Science Techbook*.

South Carolina | Achievement Results with Science Techbook and Professional Development

During the 2013-14 school year, South Carolina's Rock Hill Public School District transitioned to *Science Techbook* in conjunction with extensive ongoing professional development provided by Discovery Education.

At the completion of the first year, among fourth grade students, those in classrooms with high *Science Techbook* usage achieved higher scores on the standardized assessment than their peers in the low/non-user group.

Tennessee | Achievement Results with STEM Professional Development

During the 2014-15 academic year, Discovery Education provided extensive STEM professional learning to educators and access to digital content to both students and teachers in Tennessee's Oak Ridge Schools. The program focused on utilizing high-quality digital content to provide innovative, engaging, student-centered learning experiences. One year into implementation, participating teachers used technology and digital media more frequently, increased their use of technology and digital media for more student-centered learning activities, and reported higher skills and abilities for using technology and digital media in the classroom than during the previous academic year. Analyses of the impact on student achievement were completed for fourth grade reading, mathematics, and science and seventh grade mathematics and science. When students were similarly matched based on demographic characteristics, teacher usage of Discovery Education digital services and prior achievement results showed that, for several grades and subjects, students in high exposure classrooms were more likely to earn a proficiency level of "Proficient" or higher when compared to students in low/non-exposure classrooms. Higher proficiency percentages occurred for fourth grade reading and mathematics and seventh grade mathematics and science.

At Discovery Education, we see our role as bridging the gap between the realities of what is currently happening in science education classrooms and the aspirational vision of what it could be.

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