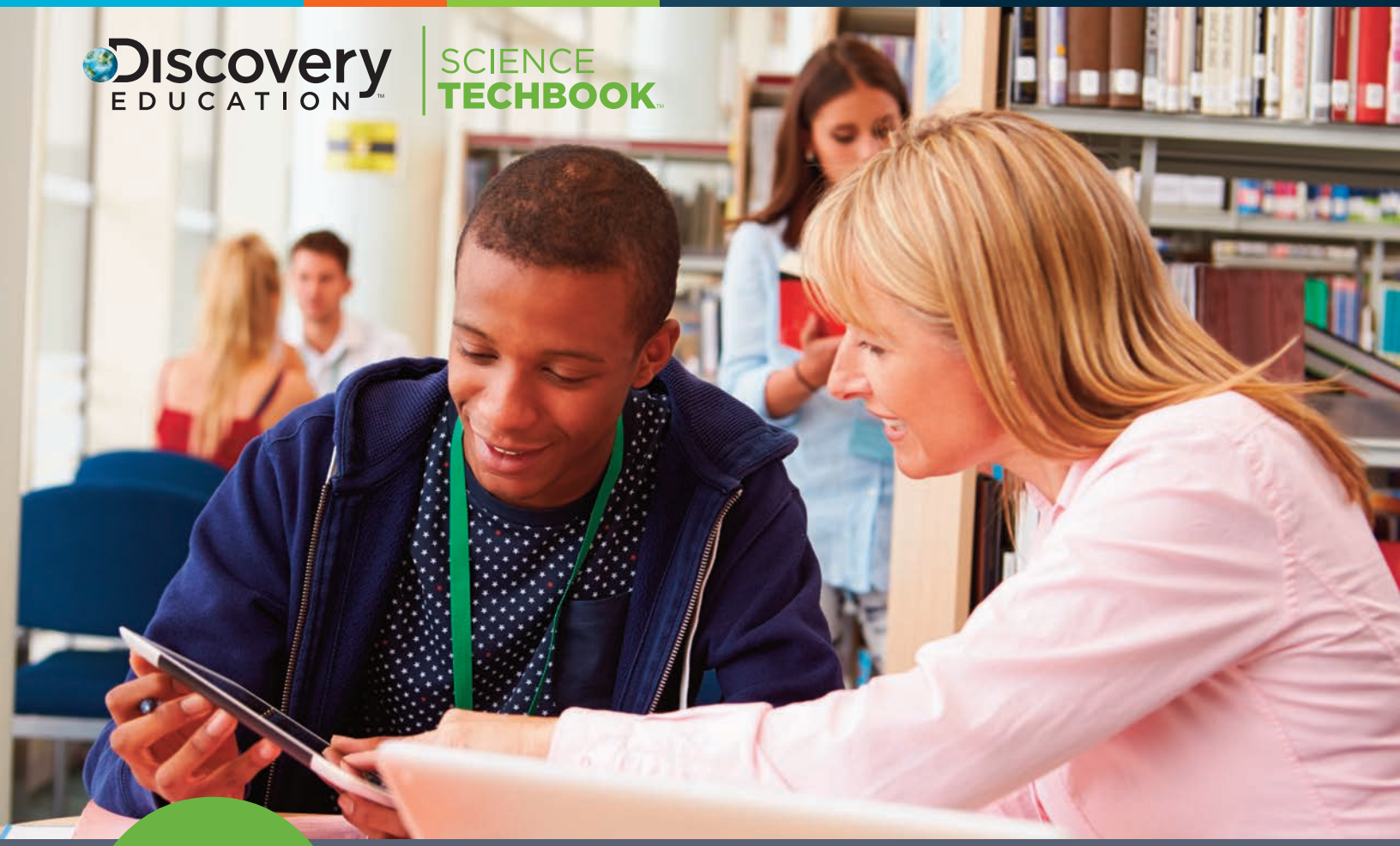
Discovery EDUCATION | SCIENCE TECHBOOK



Transforming Science Education for a Digital Era

A digital textbook from Discovery Education teaches students how to think, act, and work like scientists by taking an inquiry-based approach that incorporates interactive activities, simulations, virtual labs, and high-quality video.

CONTENTS

eSCHOOL NEWS
Daily Tech News & Innovation

EXECUTIVE SUMMARY

American students are zoning out. In a 2013 Gallup Student Poll, only 44 percent of high school students said they were engaged with their learning compared with 76 percent of elementary school students. Not surprisingly, the 2012 Program for International Student Assessment showed American 15-year-olds trailing their peers from other developed nations in science, technology, engineering, and math (STEM) performance, with the United States ranked 27th out of 64 countries.

Matthew Cwalina
Senior Director,
Learning Initiatives

Now, a digital Science Techbook from Discovery Education aims to re-engage students at all levels, helping them not only understand complex scientific concepts but relate them to their own lives, too. The Science Techbook, as it is known, uses video, photos, audio, text, and interactive features to bring science alive in a way that traditional textbooks—and many e-texts—have failed to do.

"The number one reason students struggle in reading informational text is because they lack the imagery in their minds," said Matthew Cwalina, senior director of Learning Initiatives for Discovery Education. "With science, we're often talking about things that they can't picture—atoms, for example. If we can provide in-depth analysis through video first, and then have them read about the same topic, it's going to help them understand. That's not possible in a PDF version of a book."

Accessible from any digital device with a browser, the Science Techbook is available in two series: One is geared toward elementary and middle school grades; the other, for high school students, covers Biology, Chemistry, Physics, and Earth & Space Science. Both series employ the 5E Instructional Model (Engage, Explore, Explain, Elaborate, Evaluate), developed by the Biological Sciences Curriculum Study, to help students learn what it means to be a scientist.

"We want to be a resource that immerses students in the process of thinking, acting, working, and behaving like a scientist," said Cwalina. "Scientists investigate, but they also read, they write, and they present their findings and critique."

Custom video, plus footage and materials gleaned from Discovery's cable channels and 300-plus video-education partners, ensures that students have access to high-quality visual resources across the board. Teachers can then use this wealth of multimedia to create individualized assignments based on the learning styles of the students in their classes. "People learn in different ways—some learn through text, others are more tactile, and still others through audio or visual components," said Cwalina. "We've created Techbook so teachers can build assignments tailored to a study group or individual student's strengths and weaknesses."

Even with differentiated instruction, the effort to engage students will remain an uphill battle if kids can't relate to the scientific concepts they're studying. That's why the developers of the Science Techbook make a concerted effort to focus on experiences that demonstrate how everyday life is filled with science—and that anyone can be a scientist. "Curriculum specialists across the country want kids to see relatable experiences," said Cwalina. "They want kids to be able to identify with their curriculum."

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While the Science Techbook can be used as a stand-alone resource, it is not intended as a fire-and-forget course. "We don't believe in a self-paced course where students can just go through and it's 'click, click, click,'" said Cwalina. "The number one factor for student success is going to be the teacher. Our goal is to support the teacher."

WHY SCIENCE TECHBOOK STANDS OUT

The 5Es (Engage, Explore, Explain, Elaborate, Evaluate) are an instructional model developed in 1987 as part of the Biological Sciences Curriculum Study. The Discovery Education Science Techbook applies this same model in a 21st-century setting, in the form of a digital textbook that uses video, photographs, audio, and interactive components to engage students at all grade levels. For each concept covered in the Techbook, students use a tabbed structure to move from one E to the next.

"This model of instruction marries really well to all the research about how people learn—tying new knowledge to prior knowledge, and using experiences and events to acquire knowledge," said Cwalina. "We don't want to be a resource that is just text. It's got to be an immersive experience where students are actively participating."

To achieve this immersive experience, the Science Techbook emphasizes five key areas:

Student Engagement

As the first tab in the 5E Instructional Model, Engagement, sets the stage for everything else. To draw students in, each scientific concept in the Techbook begins with a real-world problem that impacts the students' lives in some way. Video is particularly valuable in helping students conceptualize the scientific principles at work around them.

"We're building that visualization," said Cwalina. "We can draw on the work that Discovery has done with *Planet Earth*, or *Life*, or *Frozen Planet*, or any of these really high-quality cable series." In addition, Discovery Education develops its own content and draws on video footage from more than 300 other partners.

But the task of engaging students goes far beyond simply augmenting text with video. At least one interactive resource—a virtual lab or a simulation, for instance—is embedded in every concept or chapter in the Techbook. "We heard from teachers across the country that they want to do hands-on lab experiences, but they don't have time to set up a lab, tear it down, and then set up a new one," said Cwalina. "The Techbook allows them to do these labs in a virtual environment whenever they want."

In one of the virtual labs in middle school, for example, students investigate the thermal conductivity of different materials for cookware, trying to figure out which are best for cooking surfaces and handles. From there, they progress to a hands-on experience where they design their own cookware.

Disciplinary Literacy

A central goal of the Techbook is teaching students how to apply the scientific method. "We don't want science instruction to be an event—we want it to be a practice," said Cwalina. "How do scientists approach problems? They read, they investigate, they ask questions, they formulate explanations, they critique the explanations of others, and refine their own. We want the Techbook to cover all these aspects of how scientists work."

Following the 5Es approach, students are introduced to problems during the Engage phase, using the Techbook's multimedia content to understand the scope of the question at hand. In the Explore phase, they gather evidence from text, hands-on labs and investigations, or simulations that might help them answer the question. During the Explain phase, they look at the evidence, analyze it, and formulate an explanation for what they're seeing. A key step in this process is for students to present their explanations to their peers, just as scientists do.

A tool called Board Builder allows students to create multimedia presentations in which they outline their approach, their evidence, and their conclusions.

"They have to undergo that peer review," said Cwalina. "Coming out of that debate—and after observing the presentations of others—students should be encouraged to reflect on their explanations. What new information is there? Do they have to refine their explanation or not? That's really the heart of disciplinary literacy to us."

Learning Differentiation

In designing the Science Techbook, Discovery Education adhered closely to the principles of the Universal Design for Learning, which advocates giving students multiple ways to engage and interact with learning materials. "We know that people learn in different ways," said Cwalina, noting that students might use text, touch, sight, or sound to learn most efficiently. "Every concept—every chapter—incorporates all these different types of modalities."

As a result, students can tackle difficult-to-understand science concepts using the approach that suits them best, with other media components providing additional layers of reinforcement and nuance. The same approach is used for assignments, which can be tailored by teachers to meet the learning styles of individual students or groups of students. "Teachers can push resources to their students to play off their strengths and support their weaknesses," said Cwalina. "If they're struggling readers, we want to help them improve in that area, but we can also tailor their assignments to include more video, for example."

The text in the Science Techbook can also be customized to accommodate different reading levels, ensuring that students with reading difficulties don't fall behind in a subject where they may otherwise excel. In addition, the text can be toggled to Spanish in the high school edition, while the K-8 edition can be switched to French or Spanish.

Culturally Responsive Teaching

One reason students become disengaged during the course of their school careers is because they feel little connection to the materials they're studying. "Curriculum developers across the country tell us they want their kids to see relatable experiences and to be able to identify with their curriculum," said Cwalina.

To satisfy these expectations, the Science Techbook embeds a range of what Discovery Education calls "cultural pieces" into the digital textbook. For example, the Techbook incorporates videos and stories from the Discovery Education 3M Young Scientist Challenge, an annual competition where middle school students compete to develop innovative solutions to everyday problems.

"These middle schoolers come up with some really incredible ideas that just blow me away," said Cwalina. "Seeing them in the Techbook, other students realize, 'Hey, I can do this, too!' That's really the cultural piece we're looking for."

Formative Assessment

Cwalina is adamant that the Science Techbook not be seen as a self-paced course. "We know from student-achievement data that the number one factor affecting student achievement is the teacher," he said. "We're about supporting the teacher within the context of the overall program."

As part of that role, the Science Techbook incorporates a host of formative assessments to help teachers refine and adapt their instruction throughout the course. In the Engage phase, the assessments tend to be more informative in nature, helping teachers discover what students already know. "We provide that formative opportunity early on through assignments or questions posed by the teacher," said Cwalina. "It allows teachers to uncover misconceptions that students often bring to the table."

The Science Techbook is also starting to incorporate what Discovery Education calls Technology Enhanced Items (TEIs), including quiz applets that can be used to gauge student comprehension during the Engage stage of a scientific inquiry. Students might be asked to pick the correct classification for an organism, for example, or to write an open-ended response to a question. "As students read the text, it gives them something to do that really deepens their thought process and their knowledge base," said Cwalina. "The results are also sent to the teacher to show how well students have grasped the information."

In Explain, which is the third stage of the 5E Instructional Model, students must show the data they've collected and then explain what they believe the data indicates. "This is formative in nature as well," explained Cwalina. "It's a really good way to check what students know and are able to do. Teachers will know whether or not they get it."

The same kind of assessment is used in the Elaborate stage, when students perform hands-on activities and labs. "At this point, students are investigating a question and formulating an explanation," said Cwalina. "At the end, they answer questions about the conclusions they have reached."

Finally, the Evaluate component of every inquiry provides a summative assessment of what students have learned through multiple-choice and open-ended responses. The results are all collected automatically and shared with students and teachers. Teachers can then slice and dice the data by individual student, by class, and even by question. "If the correct answer on an assessment is C, and the majority of a class answered D, it can tell a teacher that the class misunderstood something," said Cwalina.

KEY FEATURES

Board Builder: Board Builder is a multimedia tool that works like a digital poster board, allowing students to present their data and explain their conclusions as part of a scientific inquiry. Students can create their own content, including video, photos, and text, and then embed it in their digital board. For a project at a school in North Carolina, for example, students posted a podcast of themselves on a roller-coaster ride during which they explained the change between potential and kinetic energy.

Updating: As a web-based resource, the Science Techbook suffers from none of the updating challenges faced by printed texts. Content is updated constantly, with the latest information available to students and teachers immediately. As an example, Cwalina points to the fly-by of Pluto by a NASA spacecraft on July 14, 2015. "The very next day, we had content to support that event," he said. "Teachers know that they will always have the most current science that exists. You can't say that with a textbook."

Global Wrap: As part of the Science Techbook's commitment to stay up to date, *Global Wrap* is a weekly show that covers major current events from around the world, including breaking science news.

Glossary: Learning academic vocabulary is part of developing disciplinary literacy. While most science textbooks have a glossary, the Science Techbook glossary utilizes the same multimedia approach as the rest of the digital textbook. To improve comprehension, an animation explains the term before students actually read the definition. The mix of animation, video, and text improves the likelihood that students will both understand and remember the word.

Accessibility: The student version of the Science Techbook is compliant with Section 508 of the Rehabilitation Act of 1973. Students can change the size of the font, change the reading level, or have the text read aloud. The text-to-speech feature is useful for all learners, not just those with physical disabilities: If students can't pronounce a word, for example, they can simply highlight it and the Techbook will read it aloud to them.

Flexibility: The Science Techbook comes in three versions: national, state-specific (where available), and Next Generation Science Standards (NGSS)."We designed it to be flexible, because every state, every district, and every classroom is different," said Cwalina.

HOW THE TECHBOOK WORKS

The Science Techbook is a web-based resource housed at www.discoveryeducation.com. Built entirely in HTML5, the site can be accessed from any device with a browser and automatically optimizes itself based on the device. By requiring a unique login for each student, the system can deliver differentiated assignments to individual students and track their performance. These results can then be exported to a school's learning management system (LMS). "We have experience working with just about every LMS provider," said Cwalina.

A free iOS app is also available through Apple's app store, which allows students to download sections of the Techbook onto an iPad to take home. The app is particularly useful for students who have no Internet access at home or who rely on usage plans with data limits.

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