Shell Education

Levels 6–12

Strategies for Teaching SCIENCE

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What Is Important in Science Education?

Science instruction has been the focus of intense scrutiny of late. Countries around the world measure the quality of their educational systems by their science scores. It is no wonder, when the future holds so much promise for scientific inquiry—from technology to biology, from space exploration to molecular exploration, and from environmental issues to the search for energy efficiency. And yet, with all this promise as an industry, students often struggle with science, or see it as too complex to approach successfully. For teachers, the twenty-first century offers new options for teaching science. In their landmark book, *Classroom Instruction That Works*, Robert Marzano, Debra Pickering, and Jane Pollock (2001) note that teaching has become more of a science than an art. Research in the last two decades has helped educators develop a common understanding of effective instruction. The Partnership for 21st Century Skills (**http://www.p21.org**) describes new skills that students will need to compete as they enter the world. Science offers the ideal opportunity to instruct students in ways that will resonate with their learning styles and ignite their curiosity and problem-solving skills.

Strategies for Teaching Science provides educators with background information on effective instructional strategies with sample lesson plans and student reproducibles. These materials support students in truly understanding scientific concepts, rather than just memorizing procedures or following teacher-led lessons. This kind of deep conceptual understanding has never been more important than it is today. Numerous educational leaders have stressed the importance of mastering twenty-first century skills for today's students. Frank Levy and Richard Murnane, researchers at MIT and Harvard, found the changing workplace has strong implications for students (2004). Computerization and globalization in today's world mean that students need to be problem solvers who can think critically. No longer can students simply graduate from high school and expect to succeed. Levy and Murnane note that occupations requiring higher-level problem solving have seen dramatic increases in average salary in the past 30 years, while more traditional blue-collar positions have seen even greater drops in average pay. Even more importantly, these blue-collar positions require more complex skills than similar positions of the past. Clearly, students need to master twenty-first century skills. Moreover, competition for discovery is framing the political landscape. Every nation wants to be the first to find a faster way to communicate, a more efficient way to travel, a cure for life-threatening diseases, or a way to preserve the quality of life on Earth.

So what are twenty-first century skills and how do they apply to science? Students today need to participate in the inquiry of science. They also need to understand the critical thinking and real-world application of the problem solving that is involved in scientific investigations. And, they need to understand the interconnectedness between science and other content areas. Students should understand how to integrate science into all content areas, and especially how to use the emerging role of technology to assist their exploration. Of course, students need to be able to read scientific materials and to interpret and comprehend the complex ideas of a science textbook.

The need for students to learn these skills also means teachers need to use new ways of teaching. Science has always been based on demonstration and experimentation, but the changing educational landscape has left many classrooms with a shortage of funds for materials or a shortage of time for lab work. Still, there are ways throughout the 6–12 curriculum to help students understand key scientific concepts that do not require the latest lab equipment. Outdoor explorations, computer simulations, and virtual fieldtrips help teachers make the most out of limited resources.

Finally, new methods of assessing student understanding help teachers form a stronger picture of students' skills and tailor instruction to their needs. Teachers need to be able to offer formative assessments to guide their instruction and to meet students where they are. Just as no theory is formed based on one single evaluation measure in science, we cannot determine the effectiveness of our instruction through one assessment at the end of the year or the unit. Teachers must know how to provide ongoing assessments of their students' understanding, and know what to do for students who need more support along the way.

Vocabulary Development

Vocabulary has long been isolated contextually in science instruction. Teaching vocabulary in science is especially important for English language learners. Too often, students do not have an accurate understanding of scientific terms. Researchers have identified several barriers that inhibit their learning as well (Thompson and Rubenstein 2000). Many vocabulary words have different meanings in other content areas. For example, the term *solution* has different meanings in science versus mathematics. Other terms that are also commonly used in everyday language have more precise meanings in science. Still other words are only used in science. These terms must be taught to students explicitly.

Vocabulary words such as *enzyme* that are unique to the subject are difficult to learn. In this case, students are essentially learning a new language, and they need instructional strategies that will help them become aware of the new terms and apply them to problem-solving situations.

The National Reading Panel Report (NICHD 2000a) also identified academic vocabulary as essential in the development of students' reading skills. Academic vocabulary includes terms that are used throughout schooling. English teacher and author Jim Burke (http://www.englishcompanion.com/pdfDocs/academicvocab.pdf) identified almost 400 academic vocabulary words that students must know by the time they enter middle school. Terms such as *prove*, *conduct*, and *data* are commonly understood by proficient students, but those who only have a limited understanding of these terms may not be able to complete the simplest science experiments. Further, a variety of teaching strategies are necessary to teach academic vocabulary. The National Reading Panel Report (NICHD 2000b) found that vocabulary is learned both indirectly and directly, and that dependence on only one instructional method does not result in optimal vocabulary growth. Finally, with the adoption of Common Core Curriculum Standards, vocabulary acquisition is more important than ever. Students are expected to use and understand words in specific contexts, to decode common Greek and Latin roots, and to "acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal precise actions, emotions, or states of being…and that are basic to a particular topic" (Common Core State Standards Initiative 2010).

Content-area vocabulary is highly specialized with words that are not typically encountered in everyday life. Therefore, all students need explicit introduction to vocabulary words to understand the text. The task is even more complicated for English language learners and struggling readers. "Developing readers cannot be expected to simply 'pick up' substantial vocabulary knowledge exclusively through reading exposure without guidance. Specifically, teachers must design tasks that will increase the effectiveness of vocabulary learning through reading practice" (Feldman and Kinsella 2005).

While students' vocabulary skills may not be the primary concern in science, the literature certainly suggests it must be an important consideration. It is not enough to give students a list of words and have them look up the definitions in dictionaries or glossaries. Students who are struggling with vocabulary are not going to find the process easier by simply being given more words to sort through (Echevarria, Vogt, and

Short 2004). Struggling readers and English language learners need context-embedded activities that acquaint them with the necessary and most central words for comprehension of the content. This is why it is so important to use a variety of strategies to teach science vocabulary. Effective vocabulary development involves a rich contextual environment in which students learn terms as they read content area text (Echevarria, Vogt, and Short 2004). *Strategies for Teaching Science* includes a variety of strategies to teach vocabulary words and help students apply them in their work. Talking Drawings is one strategy that is often used in teaching English language learners, but it can be especially helpful for teaching vocabulary to all students. When students make mental images, they engage in an active information-handling process (Gambrell and Koskinen 2002). Engaging in the text through mental imagery promotes the active processing of the text because the reader must construct meaningful images that link prior knowledge with the information in the text.

Word Walls are another effective means of vocabulary instruction. A Word Wall is a bulletin board display of key vocabulary or concept words that allows continued exposure to new words. Involve students in the creation of Word Walls gives them a sense of ownership.

Have students identify word parts, especially when they are asked to read independently. Even younger students can identify common prefixes and suffixes, as well as bases, which will help them make predictions about the meaning of unfamiliar words. (More vocabulary strategy instruction can be found in *Reading Strategies for Science* [Macceca 2007].)

Differentiation

With a diverse population of students, teachers must use as wide a variety of teaching strategies as possible. They should consider not only the content of their instruction, but also the delivery of that instruction. Teachers must be clear about their expectations for how students will demonstrate mastery of the curriculum. “Differentiated instruction is much more than individualized learning or designing a lesson for every student. It involves building mixed-ability group instruction around the idea that individual students (or groups of students) learn in unique ways and at varying levels of difficulty” (Hamm and Adams 2008).

According to Tomlinson (1999) and Heacox (2002), some of the goals of differentiated instruction include:

- Developing challenging tasks for every learner.
- Attending to students’ readiness levels, instructional needs, and

learning preferences.

- Meeting curriculum standards for each student.

Every lesson in *Strategies for Teaching Science* includes suggestions for differentiating instruction for struggling learners, English language learners, and above-level learners. All lessons include opportunities for students to work independently, with partners, or in small groups, and to capitalize on various learning modalities designed to appeal to a broad range of diverse learners.

Differentiation can occur in three ways: by process, by content, and by product. To differentiate by process, include supportive modeling techniques, vocabulary building, use of illustrations and graphics, and scaffolded lesson planning. To differentiate by content, offer materials at different readability levels or provide options for the ways students may access content—either by reading, watching a video or live demonstration, or using audio. When differentiating by product, allow students choice in terms of the kinds of products they produce. For example, students could create a slide presentation, do a live demonstration, work with partners to complete interviews, hold debates, or turn in a written report.

Inquiry and Exploration

The Scientific Method

The most common form of inquiry in science is through the scientific method. This method offers a way of thinking and experimenting that emphasizes truth-seeking and has helped contribute to sweeping discoveries in science. The basic steps include:

- determining a testable question
- generating a hypothesis
- determining how to test the question
- analyzing results
- reviewing findings

Performing experiments, recording observations, and analyzing data are emotionally detached tasks. Through gathering evidence and offering the ability to reproduce the test, experimentation gains credibility.

Teaching the scientific method gives students a way to learn about and study the world around them. The scientific method requires broader, more analytical thinking, rather than simply following a series of steps to answer a question. For this reason, it is the first strategy addressed in this book because it is so well aligned with the twenty-first century skills and critical thinking that learners need today.

What will work for older, most adept students may not work for younger ones or those who have not progressed beyond concrete operational thinking (Cryer 2000). Therefore, it is essential to differentiate instruction to help all students develop testable questions about the natural world and design ways to test those questions while accounting for differences in abilities and readiness.

Scientific Inquiry Skills

According to the National Research Council (1996), inquiry-based lessons are student-oriented rather than teacher-oriented. The teachers provide information, as well as the time and resources needed for students to perform investigations, while the learners are engaged in evaluating evidence, formulating explanations, devising alternative explanations, and communicating their findings (National Research Council 2000). Traditional textbook explanations lack authenticity and do not allow students to generate testable questions. In the world they are entering, students need to use inquiry skills to solve increasingly more complex problems.

To develop inquiry skills, students need to practice asking questions in a safe, risk-free environment. In addition, students need to be able to communicate their thinking using specific vocabulary and calling upon cross-curricular connections. As students grow in maturity, technology can play a larger role in inquiry investigations.

Help students learn how to ask questions, collect evidence, use tools to interpret their findings, draw conclusions, and then communicate their ideas. There are three main types of inquiry to use in a science classroom, depending on your objectives (The Access Center 2004):

- structured
- guided
- open

Open-inquiry is one of the most important skills of scientific investigation and will be assessed on most standardized science tests. Students need to learn how to reason their way through difficult problems across the curriculum and for their entire educational careers.

Promote inquiry in science with the 5 E model, in which a lesson progresses through five distinct stages: engage, explore, explain, elaborate, evaluate. Students become engaged by an unusual event or circumstance that generates questions. Students then explore the concept with further investigation. Introduce vocabulary or offer evidence that helps explain the concept for deeper understanding. Students elaborate about what they know through writing or a performance-based task. Finally, evaluate the students' mastery of the content and decide what still needs to be addressed or revisited.

Critical Thinking and Questioning

Teaching Critical Thinking Skills

Critical thinking is the mental work we use to investigate complex questions. A number of factors affect a student's ability to think critically, including background knowledge, goals, and others. Students need to encounter three types of questions in school: fact-based with one right answer, reason-based with a few possible options, and opinion questions with an infinite number of answers (Paul and Elder 1996). They must be able to distinguish one type of question from others, and be prepared with specific skills to address any and all questions.

State, national, and international standardized tests require students to solve problems or answer questions based on complex real-life issues. Learning a discrete set of facts will not be enough for students to tackle these tougher questions. Students should use critical thinking every time they learn something and apply this skill to multiple settings. Foster critical thinking with questions:

- "How do you know…?"
- "How else can you show…?"

When students practice citing evidence, they are using comprehension and reasoning skills—such as inference and summarizing—which will help them form reasonable conclusions. Include some aspect of critical thinking in every area or lesson you teach. Scientists take critical thinking very seriously and are always questioning each other about their findings and conclusions.

Teaching Discrepant Events

Discrepant events are events in which one thing is expected to happen, but something unexpected happens instead. These entertaining events engage students and hook them immediately into questioning why, or how, something happens. Discrepant events can be simple or complex, and can be highly motivational (as well as cost effective).

The engaging aspects of science tend to wane as students get older, as reflected in test scores (U.S. Department of Education 2007). Motivation may be the key to sustaining student interest in science and improving test scores. Task value is a key aspect of motivation for students to continue to do well (Barlia and Beeth 1999; Osborne and Dillon 2008). If the information being presented is worthless in the minds of the students, they are less likely to expend effort to learn it. Using discrepant events is an effective strategy for keeping students engaged and motivated.

Real-World Applications

Outdoor Experiences

Getting outside to study science should be a critical piece of any comprehensive science program. While it may seem like a daunting task to manage, there is no better way to study natural processes and living things. Furthermore, research shows a positive link between interactions with plants, animals, and the environment and human health benefits (Frumkin 2001), including symptom abatement for children with attention deficit hyperactivity disorder (ADHD) (Kuo and Taylor 2004).

Outdoor activities can also provide shared experiences for students from diverse backgrounds. Capitalize on the ability to build vocabulary and make connections through outdoor explorations. Outdoor investigations help students become systems thinkers, learn the skills of scientific inquiry, and understand that science does not only happen in a laboratory or classroom (Ryken et al. 2007). Outdoor activities are fun, promote learning, improve mental health, and provide a more authentic science investigation than a laboratory-based experiment with controlled variables. Research shows that participation in outdoor explorations gives students stronger conflict-resolution skills, higher self-esteem, improved problem-solving skills, increased motivation to learn, and overall better behavior in class (California Department of Education 2005). It takes strong management strategies to make these experiences successful. But, with care and attention to details, these experiences can be worthwhile ways to vary the learning environment.

Teaching at Museums and Science Centers

Science and technology museums offer interactive exhibits designed to promote general science literacy, foster awareness of environmental topics, or display some of mankind’s greatest technological achievements. Going to museums could be the highlight of your students’ school year, and may foster a lifelong love of science.

A museum trip can be informal, such as a trip to the zoo, or more academic, such as a trip to a science center. Studies link visits to science museums to higher college attendance rates (Fadigan and Hammrich 2004), as these visits provide opportunities for students to learn science in a stimulating, informal setting which can be very motivating.

Planning is the key to creating an effective learning experience. From obtaining funding to arranging a docent, to planning the learning objectives ahead of time and preparing students for what to expect—a visit to the museum requires special consideration. Also remember to follow up with an activity that fosters deeper connections by asking students to reflect on what they viewed and how it relates to their current curriculum.

Science Competitions

Student engagement in science is enhanced by participation in enrichment activities, including competitions, particularly for girls (Weinberg et al. 2007). In fact, many college-aged students who go on to higher math and science courses report having participated in competitions in school.

Other benefits to including science competitions in the curriculum include:

- Gaining supplemental materials provided by the competitions (Libby 2006), which can supply the classroom with equipment and resources that may not otherwise be available.
- Providing students with an opportunity for an extended investigation that will test their tenacity and reasoning abilities, irrespective of their readiness levels.
- Providing authentic experiences with real-world problems.
- Bolstering the self-confidence of students from low-socioeconomic backgrounds and providing the opportunity for talented and advanced students to learn content knowledge far beyond what is encountered in a regular science classroom.
- Offering authentic recognition.

Students who participate in science competitions may do so through extracurricular clubs or with the help of a mentor or coach, so it is important to evaluate the opportunities for adult help and the amount of time involved before considering entering a competition. But the recognition afforded to these students can represent an achievement that can last a lifetime.

Integrating the Content Areas and Technology

Writing and Journaling about Science

According to the American Association for the Advancement of Science (1990), science instruction can be effectively integrated with language arts by using expository writing in the form of student science notebooks or journals. When literacy skills are linked to science content, students have a personal and practical motivation to master language and use it as a tool to help them answer their questions about the world around them (Saul 2004).

Writing in science is an effective learning strategy in that it helps students to communicate their thinking in a challenging medium, and can have a significant positive impact on their standardized test scores for science, reading, and writing—even for low-performing students and nonnative English language speakers (Amaral, Garrison, and Klentschy 2002). Writing can provide a window into a student's thinking process. In fact, the Common Core Curriculum standards require that students engage in content-area writing, especially in science, in a broad and general way from kindergarten through grade five; it also requires them to write with increasing content-area specificity in the middle and high school grades (Common Core State Standards Initiative 2010). Students are expected to write procedures, use technical vocabulary, and summarize their findings.

Have students use a science notebook or journal throughout the year as a tool for personal reflection and for constructing personal meaning. It can also be an excellent way to provide meaningful feedback to students.

In essence, writing in science class helps students to process information in complex ways and helps them to focus and refine their thoughts about the concepts. For teachers, it provides an effective source of formative and summative assessment. Writing can and should be used in all grade levels in a variety of formats. It fosters a hands-on approach and represents a real-life form of communication.

Reading in Science

The skills required to read and understand science writing are significantly different than the ones needed to read a story, poem, or newspaper article. Science textbooks are traditionally written above grade level and include a significant amount of new vocabulary. Students must recognize their own misconceptions about how to read a science textbook and learn strategies that will give them greater access to challenging text. Direct instruction in specific reading strategies is necessary to help students grasp the complex ideas that are found throughout science textbooks across all grades and fields. You must help your students develop the reading skills necessary to understand written scientific information.

It is important to use age-appropriate reading strategies depending on the readiness levels of your students. There are multiple reading strategies that will work across all grade and readiness levels.

When integrating technology, a partnership with the language arts teacher can help you understand reading strategies to apply to your own science textbook, especially for parts that seem confusing or that might be at a higher reading level than students can comprehend. (Text readability tests are also available online.)

According to the Common Core Curriculum Standards (2010), science reading requires that students determine relevant ideas, cite appropriate evidence, analyze text structures as well as symbols and features on the page, and integrate visual information, along with determining fact from opinion and comparing information from various sources. It is important to use a combination of reading strategies, as they apply. Students must learn to use these skills flexibly and be able to recognize when one strategy is more appropriate than another.

Scientific evidence supports that readers who generate questions during reading gain a deeper comprehension than those who simply read silently (NICHD 2000a). A multipronged approach to teaching reading in the science classroom will have an even greater positive effect. The section on reading in this notebook offers descriptions of different reading strategies, as well as indications of how and when to best implement each one.

Integrating the Arts

For most students, the school day is structured around a fairly rigid schedule. But to truly prepare students to be successful learners and capable citizens, we must offer flexibility and allow some time for spontaneous problem solving. Today's educational systems promote student thinking under specific categories of subjects, while real-life challenges rarely deal with only one subject of knowledge at a time. The arts offer a unique opportunity to synthesize learning and to apply concepts in novel and creatively challenging ways.

When students discover the beauty of the structure of the natural world, they gain an artistic appreciation for many scientific concepts. Through patterns, colors, and processes, students will see the artistry in the world around them.

On a more practical level, there is evidence that there will be a greater demand for artistic talents in the science and technology employment sectors (U.S. Bureau of Labor Statistics 2008). Future professions will require a strong foundational knowledge in the sciences to be able to create images that are both visually pleasing and factually correct. Encouraging students to explore their understanding of science through the use of the arts may open a career path for them in the future.

Students need multiple opportunities throughout the school year to use creative means in order to demonstrate understanding. Creating a portfolio of science-related illustrations, charts, and graphs is one way to document their understanding over time; it can also provide an excellent opportunity for students to communicate their understanding in nontraditional ways.

The Mathematics and Science Connection

Incorporating mathematics into science instruction should be easy. Nearly every new high school graduate will need to be capable in science, technology, engineering, and mathematics (STEM) fields in the near future. More jobs at more levels will require STEM-related skills, and the level of knowledge and skills will also be higher. Showing students the mathematics-science connection prepares them for a job in a STEM-related career.

The weakest link in a student's mathematics instruction is at the intersection of elementary and secondary mathematics, which means students are not able to transfer mathematical knowledge and problem-solving skills to a scientific setting. The following chart shows ways to promote critical thinking and analytical skills in a science class setting, promote transfer of knowledge, and increase a student's mathematical ability.

Ways to Integrate Mathematics and Science

Younger Students	Older Students
• data analysis • measurement • algebra and algebraic thinking • number sense	• estimation • graphing • proofs

When assessing science work, include categories for specific mathematical content and process knowledge to reinforce its importance.

Just as students should practice good reading and writing skills when they are in science class, they should do the same with their mathematics skills. Becoming mathematically literate is just as important for their future career success as being literate in reading and writing.

Technology and the Science Classroom

Technology is rapidly changing expectations for student learning. There is debate about the positives and negatives of incorporating technology into the classroom in terms of effectiveness and student productivity. While both sides have valid concerns, the true catalyst for technology to transform science instruction will come directly from teachers. Determining the amount of appropriate training needed, the cost of relevant equipment, and the cost and disruption to the school setting are of paramount importance when investing in new tools. Dennis Small, the director of educational technology for the state of Washington's public schools, said, "The real cost of using technology wisely has to do with professional development on a fairly long term" (MacMillan 2009).

While schools have been effective without technology, it is a fact that students are facing a world where tools beyond beakers and Bunsen burners will be a real part of their work environments. Education must catch up and help to prepare students to enter the world of the future. "There is a profound gap between the knowledge and skills most students learn in school and the knowledge and skills they need in typical twenty-first century communities and workplaces" (Partnership for 21st Century Skills 2004).

These critical skills include using technology:

- to research
- to communicate
- to access, manage, integrate, evaluate, and create

A set of benchmarks outlines expectations for students' understanding of technology at different grade levels. Teachers must feel competent and confident to use technology effectively in the classroom. Teachers who are able to effectively integrate technology at the highest levels do so more through a change in attitude than through improved skills (Knezek and Christensen 2002).

The International Society for Technology in Education (ISTE) updated the recommended technology skills for educators in 2008 to reflect the rapid advances in communications technology over the last decade: "Create a technology-rich activity that takes into considerations the *processes, methods*, or *knowledge* you want students to use or understand at the end of the lesson. Whether the activity is technology-integrated or technology-dependent, teach students how to think critically about the appropriateness of the vehicle used and its purpose in achieving the objective of the lesson. Technology for technology's sake is not effective, and will not take the place of an expert instructor."

How to Use This Book

Integrating This Resource into Your Science Curriculum

Look ahead at the instructional standards you plan to teach to see where you can best use strategies and tools from *Strategies for Teaching Science.* This resource can help you plan which strategies to use and develop lessons that will engage students and increase their understanding of science. The strategies in this resource are divided into five sections, addressing the following strategies:

- Inquiry and Exploration
    - The Scientific Method
    - Scientific Inquiry Skills
- Critical Thinking and Questioning
    - Teaching Critical Thinking Skills
    - Teaching with Discrepant Events
- Real-World Applications
    - Outdoor Experiences
    - Teaching at Museums and Science Centers
    - Science Competitions: Bringing Ideas to Life
- Integrating the Content Areas and Technology
    - Writing and Journaling about Science
    - Reading in Science
    - Integrating the Arts
    - The Mathematics and Science Connection
    - Technology and the Science Classroom
- Assessment
    - Appropriate Measures
    - Formative Assessment
    - Summative Assessment

- Using Backwards Curriculum Design to Create Assessments
- How Do I Know Which Form of Assessment to Use?
- Examples of Formative Assessments
- Examples of Summative Assessments

This resource shows you how to incorporate various science strategies seamlessly into your existing science curriculum. Or, use the sample lessons as models to supplement your science instruction, and be confident that you are providing research-based avenues to access scientific content.

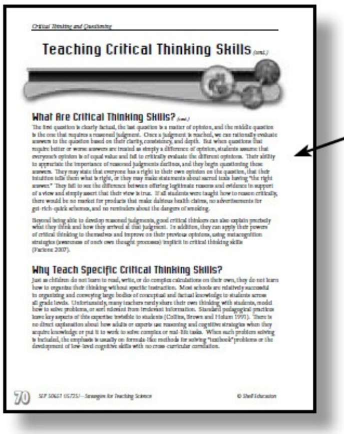
The first section shows how to foster **Inquiry and Exploration** within the science curriculum. Through the use of The Scientific Method and specific Science Inquiry Skills, students practice applying scientific processes in an authentic way.

The next section addresses **Critical Thinking and Questioning**, two areas that are often the most challenging skills to teach. The activities included in the Teaching Critical Thinking section help students activate their synthesis and application abilities; Teaching Discrepant Events shows how motivation is the key to engagement, and the element of surprise is often the most motivating aspect of science instruction.

In **Real-World Applications**, we show how to use Outdoor Experiences and Museums and Science Centers to connect the content to students' daily lives. The idea of increasing relevancy is underscored by using Science Competitions to provide further motivation for discovery.

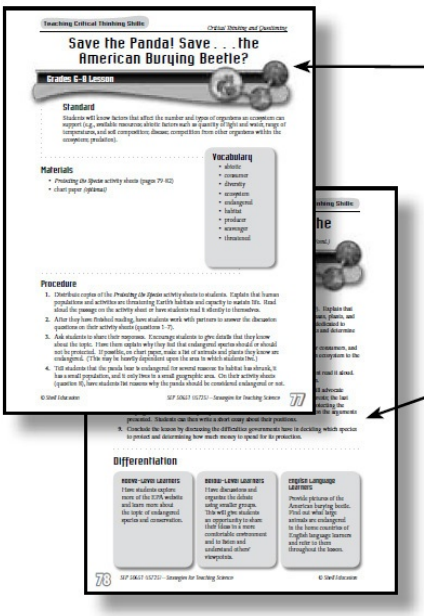
By **Integrating the Content Areas and Technology**, teachers can capitalize on a resource that most students already find intrinsically engaging. Core curriculum areas, such as writing and journaling, reading, the arts, and mathematics, can be woven into science investigations thanks to a variety of applications, technology tools, and websites. Furthermore, technology is a scientific pursuit in its own right, and is a natural fit within a science classroom.

Finally, **Assessment** practices must be both formative and summative, in order to inform and improve instruction to best serve students, and also to gain understanding of student comprehension. A number of examples of each type of assessment will help you plan your own assessments as you embark on incorporating science more substantially in your own classroom.



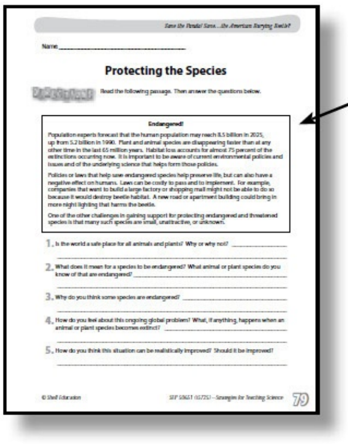
Section Overview Pages

- Each section begins with an overview of the concept. Tips and strategies are described and supported with research.



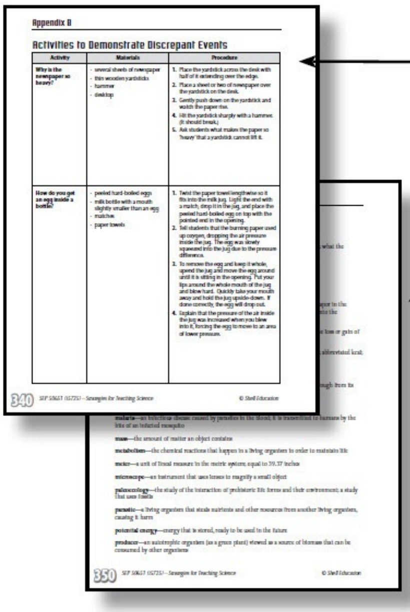
Sample Problems and Lesson Plans

- Each section has sample lessons to concretely illustrate how the strategies can be used with commonly taught topics at each grade level range. Teachers can use the lessons and problems as they are written, or they can reference these models as they begin creating their own lessons and problems.
- Each lesson includes a description of how the strategy benefits different kinds of learners and provides differentiation suggestions.



Student Reproducibles

- All the sample lessons include student pages for teacher use. These pages are needed to fully implement the lessons. Teachers can use many of these pages to write their own lessons.



Appendices

- The appendices provide great supplemental information, such as science-related young adult or adolescent literature, suggested grade-level vocabulary words, and online resources and websites.