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About This Publication

The BSCS Center for Professional Development compiled Profiles in Science—A Guide to NSF-Funded High School Instructional Materials, second edition, because we believe that the quality of instructional materials matters in the learning process for students and in the teaching process for teachers. As one of our colleagues so aptly expressed:

Before implementing well-designed instructional materials, I thought my role as a teacher was to take the textbook ... and create a curriculum.

Now, I don’t want to be a curriculum writer. I want to teach—to do the art of teaching.

Profiles in Science, second edition, provides updated profiles on instructional materials designed to help high school science teachers in grades 9–12 focus on “the art of teaching” and student learning. The instructional materials described in this document were developed originally with funding from the National Science Foundation (NSF), and thus have undergone field testing and critical review during their development. The developers of these materials based their work on the National Science Education Standards (NRC, 1996) and Benchmarks for Science Literacy (AAAS, 1993); consequently, these materials are truly “standards based.” The profiles were derived from the instructional materials themselves and checked for accuracy by the developers and publishers of the materials. Profiles in Science includes only those materials designed to be semester-long or full-year programs; we did not include NSF-funded modules or units.

Within Profiles in Science, the instructional materials are organized by discipline—earth science, physical science, life science, and integrated science. There is also a section for materials that are currently under development.

The purpose of Profiles in Science is to help those involved in the review and selection of instructional materials for high-school science become familiar with high-quality, research-based instructional materials. This document is intended to be a source of general information about NSF-funded instructional materials; it is not a source of evaluative data or critical analysis of the materials. Each profile includes the following information:

- a brief overview of the primary goals and principles of the materials;
- a listing of the program’s content by module/unit and chapter;
- a description of the instructional approach;
- information about the alignment with national standards;
- a brief description of the various components offered, including kits and equipment suppliers;
- methods used for assessing student learning;
- information about professional development opportunities; and
- contact information for the developer and the publisher of the materials.

The information included in this document was as accurate as possible at the time of publication. Please contact the developer or publisher of the instructional materials for more detailed information and for examination copies of the instructional materials.

References


Profiles in Science is available on the BSCS website as a downloadable pdf file. You may download, at no cost, one or all of the profiles from the BSCS website: www.bscs.org/Profiles.
Why should I consider *Profiles in Science*?

- Are you interested in a standards-based approach to improving student learning in science?
- Are you looking for ways to incorporate research-based instructional strategies, such as science as inquiry, into your science classroom?
- Would you like to create a classroom environment that promotes learning in science for all students?
- Do you need to generate discussion about the process of curriculum selection and implementation in your school or district?

If you answered yes to any of these questions, then *Profiles in Science* can help you find just the right program to meet your needs.

First, *Profiles in Science* offers the initial information you need in one place, which will save you time in searching for developers and publishers of high-quality high school science programs.

Second, *Profiles in Science* allows you to compare programs before you invest the time and effort in ordering and reviewing the instructional materials.

Third, *Profiles in Science* serves as an excellent awareness tool for teachers, administrators, parents, and other stakeholders who might not be familiar with standards- and inquiry-based instructional materials.

How might I use *Profiles in Science*?

- Engage teachers and administrators in a dialogue about the important features of high-quality instructional materials.
- Increase the awareness of NSF-funded high school instructional materials in all science disciplines.
- Compare instructional materials within a specific science discipline.
- Look across science disciplines and consider materials that might complement each other when offered as part of a comprehensive high school science program.
- Generate interest in standards-based instructional materials among colleagues, parents, and the larger community.
- Provide a basis for comparing current high school instructional materials with NSF-funded materials.

However you choose to use *Profiles in Science*, we hope you find the information valuable as you seek to improve the learning and teaching of science. If you decide to contact developers and/or publishers of the instructional materials, please mention that you learned about the materials through *Profiles in Science*, from the BSCS Center for Professional Development.
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In 2008, BSCS will celebrate its fiftieth year of providing leadership in science education. As one of several research-based curriculum studies created in 1958 by the National Science Foundation, BSCS became a leader in the development of innovative curricula that provide opportunities for students to learn science by doing science through inquiry.

Although BSCS has provided professional development for science teachers and other science educators throughout its 50-year history, the organization has recently expanded its mission to provide greater resources and services in professional development through the BSCS Center for Professional Development. BSCS believes, and research supports, that the sustained implementation of standards-based curriculum, especially those that engage students in scientific inquiry, can transform the learning and teaching of science. To be successful, however, curriculum implementation must be supported by high-quality, ongoing professional development.

The BSCS Center for Professional Development provides professional development opportunities that guide districts through a process of effective curriculum reform, from learning about science as inquiry in the classroom to analyzing instructional materials through the AIM process to building department-, school-, and district-wide professional learning communities. The mission of the BSCS Center for Professional Development is to provide learning opportunities for science teachers and other science educators that transform their thinking and practice resulting in more rigorous, inquiry-based learning opportunities for science students.

One of the hallmarks of the BSCS Center for Professional Development is the BSCS National Academy for Curriculum Leadership (NACL). Through the NACL, BSCS helps schools and school districts build leadership capacity to sustain the implementation of standards-based instructional materials in all science disciplines, such as those described in Profiles in Science.

Interested? See the following page for more information about the NACL.
The BSCS National Academy for Curriculum Leadership (NACL) is a rich, in-depth three-year professional development experience for district leadership teams. Through the NACL, school and district leadership teams build on their capacity to design, implement, and sustain an effective high school science education program using inquiry-based instructional materials.

**Why the NACL? Because . . .**

- Science curriculum matters
- Teaching and learning matter
- Leadership matters
- Professional development matters

Research shows that for students to achieve success in science, they need inquiry-based curriculum aligned with standards and high quality teachers prepared to teach the content.

**The NACL works because of its . . .**

- Annual events and technical assistance over three years
- Research-based design
- Implementation of standards-based curricula
- Committed leadership teams that represent their districts
- Focus on developing professional learning communities with teachers and administrators working together
- Capacity building and ability of leadership teams to use the NACL processes, tools, and strategies throughout their districts

We invite you to join BSCS as a member of NACL. Together we can improve science education through curriculum leadership.

For more information, please contact us at nacl@bscs.org or call 719.531.5550 ext. 119.
NACL Model for Curriculum Implementation

Curriculum implementation is a complex process and involves several stages. The NACL Model for Curriculum Implementation provides a “road map” and some helpful ideas for schools and districts to consider before engaging in the process.

Awareness: Laying the Foundation for Change

In the first stage of the process, a school or district
• builds the awareness that high-quality, inquiry-oriented instructional materials matter in the learning process for students;
• initiates the development of leadership capacity through forming school- and district-based leadership teams; and
• establishes the need for change based on school and district data on student achievement, course enrollment, and teacher capacity.

Selection: Making Evidence-Based Decisions

In the second stage of the process, a school or district
• applies an evidence-based process for evaluating and piloting instructional materials which serves as a professional development strategy prior to implementation;
• develops common understandings among teachers about the characteristics of high-quality, inquiry-oriented instructional materials; and
• builds consensus during the decision-making process by establishing selection criteria based on research and the needs of students and teachers in the district.

Scaling Up: Designing Support for Implementation

In the third stage of the process, a school or district
• designs a transformative professional development program that supports the implementation of high-quality, inquiry-oriented instructional materials;
• incorporates a variety of professional development strategies and evaluation tools; and
• builds the local “improvement infrastructure” that will provide ongoing support within the system for effective implementation.

Sustainability: Monitoring the Capacity for Reform

In the fourth and final stage of the process, a school or district
• improves the capacity of the system to move forward and provide continuous improvement for teaching and learning by developing site-based leadership;
• monitors and adjusts interventions based on data that document student learning, teaching practice, formative classroom assessment, professional development support, and system infrastructure and capacity;
• sustains effective professional development using strategies such as examining student work, collaborative lesson study, and action research; and
• bases professional development on data of teachers’ attitudes about, abilities to use, and understanding of new instructional materials.
Characteristics of Reform-Oriented Instructional Materials

The instructional materials described in this publication were developed to be consistent with the vision of science education suggested in reform documents such as the National Science Education Standards (NRC, 1996), Benchmarks for Scientific Literacy (AAAS, 1993), and Designing Mathematics or Science Curriculum Programs (NRC, 1999). These documents describe high-quality, reform-oriented instructional materials as being standards based, inquiry based, and grounded in contemporary research on learning and teaching. These documents also suggest that quality instructional materials be guided by carefully developed conceptual frameworks and informed by thoughtful and comprehensive field-testing. Since we are suggesting that the instructional materials in this publication look different from traditional materials, it is important for us to first clarify what some of the distinguishing characteristics are before describing the materials themselves.

Reform-oriented instructional materials are standards based in that their science content, instructional approach, and assessment optimize student learning as described in the Standards.

The science content included in the National Science Education Standards (NSES) encompasses important aspects of recent science education reform. Specifically, the NSES suggest that the design of instructional materials reflect a change in emphasis.

<table>
<thead>
<tr>
<th>Less Emphasis On</th>
<th>More Emphasis On</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowing scientific facts and information</td>
<td>Understanding scientific concepts and developing abilities of inquiry</td>
</tr>
<tr>
<td>Studying subject matter disciplines for their own sake</td>
<td>Learning subject matter disciplines in the context of inquiry, technology, science in personal and social perspectives, and history and nature of science</td>
</tr>
<tr>
<td>Separating science knowledge and science process</td>
<td>Integrating all aspects of science content</td>
</tr>
<tr>
<td>Covering many science concepts</td>
<td>Studying a few fundamental science concepts</td>
</tr>
<tr>
<td>Implementing inquiry as a set of processes</td>
<td>Implementing inquiry as instructional strategies, abilities, and understandings to be learned</td>
</tr>
</tbody>
</table>

Adapted from the National Science Education Standards (NRC, 1996)

In addition, standards-based instructional materials often provide assessments that are consistent with the content in the standards as well as other teacher-support resources. In general, the resources provided in the instructional materials are intended to help teachers use effective teaching strategies to create learning environments conducive to the development of scientific reasoning abilities and a conceptual understanding of the content described in the Standards. The NSES assessment may be different from that of more traditional science instruction.
Standards-Based Teaching and Assessment

<table>
<thead>
<tr>
<th>Less Emphasis On</th>
<th>More Emphasis On</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focusing on student acquisition of information</td>
<td>Focusing on student understanding and use of scientific knowledge, ideas, and inquiry processes</td>
</tr>
<tr>
<td>Asking for recitation of acquired knowledge</td>
<td>Providing opportunities for scientific reasoning, discussion, and debate among students</td>
</tr>
<tr>
<td>Assessing scientific knowledge</td>
<td>Assessing scientific understanding and reasoning</td>
</tr>
<tr>
<td>Assessing what is easily measured</td>
<td>Assessing what is most highly valued</td>
</tr>
</tbody>
</table>

Adapted from the National Science Education Standards (NRC, 1996)

Reform-oriented instructional materials are inquiry-based and support inquiry as a teaching strategy, as well as the abilities to do and the understandings about science as inquiry.

Inquiry-based instructional materials are designed to support inquiry as a strategy for teaching science concepts. That is, the materials are intended to help teachers as they engage students in the formulation and pursuit of scientifically oriented questions. Using inquiry as a teaching strategy requires substantial changes in instructional emphases.

Changing Emphases to Promote Inquiry

<table>
<thead>
<tr>
<th>Less Emphasis On</th>
<th>More Emphasis On</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities that demonstrate and verify science content</td>
<td>Activities that investigate and analyze science questions</td>
</tr>
<tr>
<td>Investigations confined to one class period</td>
<td>Investigations over extended periods of time</td>
</tr>
<tr>
<td>Process skills out of context</td>
<td>Process skills in context</td>
</tr>
<tr>
<td>Getting an answer</td>
<td>Using evidence and strategies for developing or revising an explanation</td>
</tr>
<tr>
<td>Science as exploration and experiment</td>
<td>Science as argument and explanation</td>
</tr>
<tr>
<td>Individuals and groups of students analyzing and synthesizing data without defending a conclusion</td>
<td>Groups of students often analyzing and synthesizing data after defending conclusions</td>
</tr>
<tr>
<td>Doing few investigations in order to leave time to cover large amounts of content</td>
<td>Doing more investigations in order to develop understanding, ability, values of inquiry and knowledge of science content</td>
</tr>
<tr>
<td>Concluding inquiries with the result of the experiment</td>
<td>Applying the results of experiments to scientific arguments and explanations</td>
</tr>
<tr>
<td>Private communication of student ideas and conclusions to the teacher</td>
<td>Public communication of student ideas and work to classmates</td>
</tr>
</tbody>
</table>

Adapted from the National Science Education Standards (NRC, 1996)
Inquiry-based instructional materials typically encourage students to develop their own methods for collecting, analyzing, and evaluating scientific data. In addition, students using these materials learn by collaboratively developing, justifying, communicating, and evaluating scientific explanations. Inquiry-based instructional materials also prompt students to think about the nature of scientific inquiry, such as how scientists use evidence and logic to establish and revise knowledge. Therefore, in addition to providing discipline-specific science content, inquiry-based instructional materials aim to help students develop both the abilities to do and understandings about scientific inquiry. Examples of abilities and understandings of inquiry are provided in the table below.

### Examples of Science as Inquiry from the National Science Education Standards

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<th>Abilities to do Inquiry</th>
<th>Understandings about Inquiry</th>
</tr>
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<tr>
<td>Students identify questions that can be answered through scientific investigations.</td>
<td>Scientists’ work involves asking and answering questions and comparing answers with what scientists already know about the world.</td>
</tr>
<tr>
<td>Students design and conduct scientific investigations.</td>
<td>Scientists in different scientific domains employ different methods, core theories, and standards to advance scientific knowledge and understanding.</td>
</tr>
<tr>
<td>Students develop descriptions, explanations, predictions, and models based upon evidence.</td>
<td>Scientists construct explanations that emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories.</td>
</tr>
<tr>
<td>Students communicate scientific procedures and explanations.</td>
<td>Two ways that scientists evaluate the explanations proposed by other scientists are by examining evidence and identifying faulty reasoning.</td>
</tr>
</tbody>
</table>

Adapted from the National Science Education Standards (NRC, 1996)

Reform-oriented instructional materials are grounded in contemporary research on learning and teaching.

The book, *How People Learn* (NRC, 2000), synthesized a large body of research on learners and learning and on teachers and teaching. From this research, several key findings emerged that are summarized in the table below.

### Key Findings from How People Learn

- Students come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of a test but revert to their preconceptions outside the classroom.

- To develop competence in a science discipline, students must (a) have a deep foundation of usable knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application.

- A “metacognitive” approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them.

Adapted from *How People Learn* (NRC, 2000)
When the design of instructional materials is informed by contemporary research findings, such as those discussed in *How People Learn*, the resulting materials tend to share several common characteristics: a) teaching suggestions and numerous student prompts intended to elicit preconceptions and prior knowledge, b) an emphasis on conceptual understanding, higher order thinking, and sensitivity to the processes of knowledge construction, and c) prompts that encourage students to reflect and evaluate their own emerging understanding of science concepts.

**Reform-oriented instructional materials are based on a carefully developed conceptual framework.**

A conceptual framework describes the outcomes (usually content standards or benchmarks) and performance assessments that guide the development of instructional materials. When instructional materials are based on a carefully developed conceptual framework, the content presented in the materials tends to be comprehensive, consistent, and presented in a manner that is logical, coherent, and developmentally appropriate (for examples of how conceptual frameworks can be used to develop quality instructional materials, see AAAS, 2000; BSCS, 1993).

**Reform-oriented instructional materials are revised as a result of thoughtful and comprehensive field testing.**

Instructional materials that have been revised as a result of thoughtful and comprehensive field testing are likely to reflect an enhanced understanding of the needs of both students and teachers. Field-tested materials tend to reflect an understanding of a) how diverse learners might achieve the intended outcomes, b) the prior understandings students should have to progress coherently through the content, c) the understandings that teachers will need to possess or develop to facilitate student learning, and d) the resources (for example, time, materials, facilities) necessary to implement the instructional materials.

**Summary**

The instructional materials described in this publication are designed to be consistent with current science curriculum reform efforts. Specifically, reform-based instructional materials can be characterized by

- presenting content in a coherent way; and
- representing a tested product for students and teachers.

However, since *Profiles in Science*, is not a source of evaluative data or critical analyses of these instructional materials, it is for you to determine the degree to which these instructional materials address and incorporate the characteristics presented.

**References**


Comprehensive, inquiry-based coverage of principles required for meeting integrated science frameworks.

At a Glance

It’s About Time offers two innovative core curriculums—Coordinated Science for the 21st Century and Integrated Coordinated Science for the 21st Century. Both courses have been assembled from our proven inquiry-based programs in each of the four basic content areas. The activities in these project-based programs offer an instructional approach that engages all students in the learning of science.

Coordinated Science for the 21st Century is composed of 15 chapters and Integrated Coordinated Science for the 21st Century contains 10 chapters. Both programs meet nationwide frameworks. Each course is divided into four units, which are based on our four proven programs—Active Physics, Active Chemistry, Active Biology, and EarthComm.

Every chapter of the integrated science curricula was designed to be independent of any other discipline.

Contact Information

For review copies or to place an order, contact the publisher.

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Discipline Physics/Chemistry/Biology/Earth Science
Grade Level 9, 10, 11, or 12
Developer AGI/AAPT/AIP/Dr. Arthur Eisenkraft
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chapter. For this reason, the chapters can be taught in any order. The materials are written with the flexibility to be appropriate for all students, from special education to honor students.

The integrated programs were written by a dedicated team of physicists, chemists, and high school teachers and supported by prominent technical editors, educational technology specialists, cognitive scientists, and mathematics curriculum specialists. The American Geological Institute, the American Association of Physics Teachers, and the American Institute of Physics were also instrumental in their development. Active Chemistry and Active Physics are projects directed by Dr. Arthur Eisenkraft, past president of NSTA.
Century and Integrated Coordinated Science for the 21st Century focus attention on the development of a complete high school integrated science curriculum.

Instructional Design

Each chapter in the integrated curricula begins with a Scenario, a realistic event or situation the student might actually have experienced or can imagine participating in at home, in school, or in the community. A Chapter Challenge is then presented where students are given a problem they will soon be expected to complete using knowledge they will gain in the chapter.

The Chapter Challenge is the heart and soul of the integrated programs. Each activity begins with a What Do You Think? question that elicits students’ prior understandings. Eliciting prior understandings helps teachers learn what their students think about the topic and engages students in thinking about the goal of inquiry to be addressed in the Investigate section of the activity, where students do hands-on experiments.

After students complete the activity, they will relate it to the larger Chapter Challenge in the Reflecting on the Activity and the Challenge section. The activity concludes with a Science To Go assignment that provides additional questions and problems that can be completed outside of class. The Chapter Assessment is the return to the Chapter Challenge. The students are able to review the chapter as they discuss the synthesis of the information into the required context of the challenge. The Science You Learned section provides students with a sense of accomplishment and serves as a quick review of all that was learned in the preceding weeks.

As students work together in small groups, they acquire the knowledge and information needed to address the series of challenges presented through the chapter scenarios. The curriculum encourages students to use the same set of inquiry processes as scientists. The Activities associated with each chapter introduce relevant events, scenarios, and real-life challenges that are pertinent to the student’s everyday life. The curriculum follows the seven-stage learning cycle model: Elicit, Engage, Explore, Explain, Elaborate, Evaluate and Extend.

Standards Alignment

It’s About Time provides a chart on its Web site that correlates the integrated curricula to the National Science Education Standards (NSES). A correlation chart is also found within the Teacher’s Edition. The integrated programs were designed and developed to provide teachers with instructional strategies that model the science teaching standards. These programs facilitate learning while developing students as self-directed learners. They also engage teachers in an ongoing assessment of their teaching and students’ understanding. Other content standard strengths include science as inquiry and the unifying concepts and processes. Correlation of the content standards addressing science and technology and science in personal and social perspectives is dependent on the actual chapter used.

Components

The Student Text, Teacher’s Edition, Integrated Science Kits, test generator, CD-ROMs, spreadsheets, and videos are all available from the publisher.

Student Text

Coordinated Science for the 21st Century and Integrated Coordinated Science for the 21st Century combine proven chapters from our existing Active Physics, Active Chemistry, EarthComm, and Active Biology courses. These project-based, guided inquiry courses will involve students in a series of real-life scientific challenges and promote learning. The chapters are divided into the following sections:

- **Scenario**—begins the chapter with a realistic event or situation in science.
- **Challenge**—presents students with the problem they will soon be expected to solve.
- **Goals**—provides students the goals that they should achieve through inquiry.
• **What Do You Think?**—encourages students to share their current understandings and reasoning of the topic.

• **Investigate**—presents activities that encourage students to work through problems by themselves, in small groups, or with the whole class.

• **Reading Sections**—provide text and illustrations for greater insight or a new perspective into the activity topic.

• **Reflecting on the Activity and the Challenge**—prompts students to consider how inquiry helps solve the challenge.

• **Science to Go**—has questions on key principles and concepts introduced in activities.

• **Inquiring Further**—provides more challenging or in-depth problems, questions, and exercises.

• **Chapter Assessment**—asks students complete the challenge they were presented at the beginning of the chapter (using the activities as a guide).

• **Science You Learned**—lists terms, principles, and skills from the chapter.

• **Science at Work**—features real people in real jobs, demonstrating how the principles learned are being applied everyday, everywhere.

**Teacher’s Edition**
The Teacher’s Edition is a multi-volume set, offering the following features:

• **Perforated and three-hole punched**—allows for individual customizing.

• **Introduction**—provides an outline of the “big ideas” as well as goals and expectations for the program. Also offers additional notes on what teachers can expect to happen in the classroom and some hints for managing collaborative group learning and organizing materials and supplies.

• **Chapter Overviews**—provide an outline of the themes and specific content of each chapter. Also includes an extensive list of materials and sample assessment rubrics for the Chapter Challenges and key components of the curriculum design.

• **Activity Prefaces**—offer background information on the science content being taught, plus a careful guide through all of the preparations. Sample answers for all questions, including the What Do You Think? questions, are included, as are correlations to the NSES.

• **Reproducible Pages**—including blank data tables and copymasters of key diagrams and maps that appear in the Student Text.

The Teacher’s Edition also includes assessments, evaluation criteria, scientific content, graphs, and diagrams.

**Software**
It’s About Time offers a selection of software to accompany the integrated programs. Computer software programs make use of various interfacing devices and include the following:

• Test Generator

• Constructing Physics Understanding (CPU)

• GETIT CD-ROM (PC Version Only)

• EarthView Explorer CD-ROM

**Videos**
Videos capture students’ attention while exploring a variety of the physics topics. It’s About Time offers a Sports Content Video and Transportation Content Video. Each video is sold separately.

**Professional Development Materials**
Web-based teacher enhancement for the curricula is available through the It’s About Time Web site. The Internet site supports the adoption and implementation of the programs. Each chapter has its own Web page, and each activity includes background information about major topics covered.

**Assessment**
For the culmination of each chapter, students are required to demonstrate the usefulness of their newly acquired knowledge by adequately meeting the challenge
posed in the chapter introduction. The Chapter Challenge forms the focus of chapter activities and content as well as the final assessment. The final Chapter Challenge assessment asks students to tie together all they have learned throughout the activities. Teacher assessment tools are included with the student print materials, such as sample assessment rubrics for the Chapter Challenges, key components of each activity, and chapter tests.

**Professional Development**

It’s About Time is committed to working with school systems to assist in the process and help implement our standards-based programs. The publisher provides a full range of professional development services. The Professional Development Department will work with each district to design a customized implementation plan that addresses each district’s unique needs.

**Equipment Suppliers**

The hands-on materials necessary to do each of the integrated activities have been specially designed and packaged. It’s About Time’s Kit Division will work with each school or district closely to plan a package that will fit their needs. The publisher also offers training sessions for the instructional staff on various topics related to equipment and its use in the classroom. Many items in the kits are custom-made, and items can be purchased as group kits or individually. Each kit is designed to serve 28–35 students.