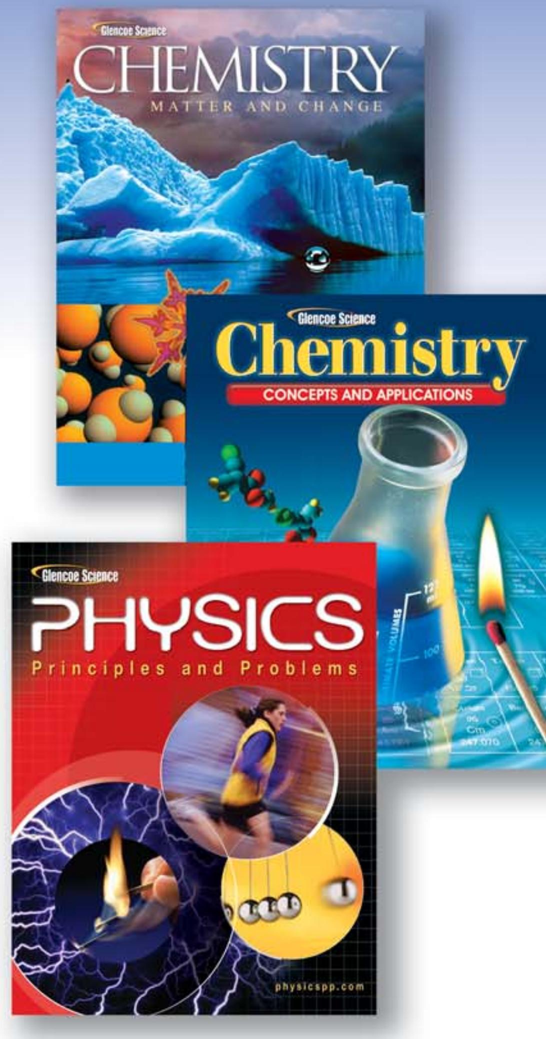
Glencoe Science White Paper

Research-Based Strategies Used to Develop



- *Chemistry: Matter and Change*
- *Chemistry: Concepts and Applications*
- *Physics: Principles and Problems*

RAISING THE BAR

The National Science Education Standards

The National Science Education Standards consist of four overarching principles **(Figure 1)** and a total of 50 specific standards in the areas of Science Teaching, Professional Development for Teachers of Science, Assessment in Science Education, Science Content (broken down by topic area and grade levels), Science Education Program, and Science Education System. To say that the Science Standards have raised the bar for science education in the United States is truly an understatement. Never before has science education been guided by a national set of principles and standards. Never before have our science education goals been set this high. And never before have science teachers and administrators been this challenged to meet goals of excellence in science programs.

Science teachers always have worked to motivate students to read science texts, coordinate visual and verbal information, and study using effective, research-proven strategies. However, teachers have limited resources and must choose how much time and energy to devote to helping students develop these strategies while still allowing them to become self-reliant and independent learners. Administrators and teachers are challenged to reach multiple goals, simultaneously helping students to:

- understand and remember standards-based science and apply it to new contexts,
- perform well on high-stakes achievement tests,
- prepare to succeed in their next science course, and
- become productive and scientifically literate citizens.

The Science Standards describe a vision of the scientifically literate person and present criteria for science education that will allow that vision to become reality. But now, more than ever, science educators are struggling to find appropriate resources to help them meet the ideals set by the Science Standards. This paper focuses on the Science Standards as they apply to high school, as well as the resources now available to those involved in high school chemistry and physics education.

Figure 1

Science Standards' Four Principles

- Science is for all students.
- Learning science is an active process.
- School science reflects the intellectual and cultural traditions that characterize the practice of contemporary science.
- Improving science education is part of systemic education reform.

For more information, see the National Research Council's *National Science Education Standards* (1996) available at www.nap.edu.

Figure 2

Statements on Inquiry Learning and Laboratory Activities

NSTA Position Statement – *The National Science Education Standards:*
The National Science Teachers Association strongly supports the National Science Education Standards by asserting that:

- Teachers, regardless of grade level, should promote inquiry-based instruction and provide classroom environments and experiences that facilitate students' learning of science…
- Inquiry should be viewed as an instructional outcome (knowing and doing) for students to achieve in addition to its use as a pedagogical approach…
- Science programs should provide equitable opportunities for all students and should be developmentally appropriate, interesting and relevant to students, inquiry-oriented, and coordinated with other subject matters and curricula.

(Adopted by the NSTA Board of Directors, January 1998. For more information, see www.nsta.org.)

American Chemical Society Committee on Education – *Science Education Policies for Sustainable Reform* (2001):

Science curricula need to be challenging to the students, and based on the "real world" of student interactions with nature…Inquiry-based learning and laboratory experiences are essential components of chemistry instruction.

(For more information, see www.chemistry.org.)

AAPT Committee on Physics in High Schools Position Paper – *The Role of Laboratory Activities in High School Physics:*

Theory and research suggest that meaningful learning is possible in laboratory activities if all students are provided with opportunities to manipulate equipment and materials while working cooperatively with peers in an environment in which they are free to pursue solutions to problems that interest them…The role of the laboratory is central in high school physics courses since students must construct their own understanding of physics ideas. This knowledge cannot simply be transmitted by the teacher, but must be developed by students in interactions with nature and the teacher. Meaningful learning will occur where laboratory activities are a well-integrated part of a learning sequence.

(Approved by the AAPT Executive Board, November 1992. For more information, see www.aapt.org.)

CHANGING PEDAGOGY: INQUIRY-BASED SCIENCE LEARNING

To support the Teaching, Professional Development, Assessment, Content, Program, and System Standards, the Science Standards begin with the four guiding principles. One principle stressed consistently throughout the standards is that learning science should be an active process.

Teaching Standard A:
Teachers of science plan an inquiry-based science program for their students.

Content Standards—(Grades 9–12)
Science as Inquiry/Content Standard A:
As a result of activities in grades 9–12, all students should develop

- Abilities necessary to do scientific inquiry.
- Understandings about scientific inquiry.

Science Education Program Standard B:
The program of study in science for all students should be developmentally appropriate, interesting, and relevant to students' lives; emphasize student understanding through inquiry; and be connected with other school subjects.

This stress on inquiry learning, through laboratory activities and other methods, has been echoed in the position statements of the National Science Teachers Association, the American Association of Physics Teachers, and the American Chemical Society Committee on Education, shown in **Figure 2,** all of which strongly support the Science Standards. The repeated recommendations to use an inquiry approach reflect the growing trend toward constructivism in science education. Constructivism is based on the concept that students construct their own knowledge in a process that is both individual and social. Research shows that teachers cannot simply transfer knowledge to students by lecturing or assigning readings. Students have to take an active role in their own learning. To accomplish this, science programs must include ample opportunities for students to explore, experiment, question, debate, discuss, and discover.

This is not to say that teachers are removed from the educational process. Rather, the learning experience should include an appropriate balance of explicit and implicit instruction. Implicit instruction occurs when students figure out for themselves how to grapple with problems and construct conceptual knowledge (Pressley et al., 1992; Shulman & Keislar, 1966). This is encouraged when students engage in project-based and subject-integrated science activities, open-ended science labs, and science fair projects. Explicit instruction occurs when teachers and textbook authors clearly explain science concepts and problem-solving strategies to students in a direct, low-inference fashion (Duffy, 2002).

Explicit instruction also provides students with needed background knowledge on how, why, and when to use learning and studying strategies. This leads to learner independence (Zimmerman, 1998, 2000, 2001) and productive dispositions toward achievement (Alderman, 1999). Explicit instruction is critical to good science teaching. Exclusively using implicit instruction often fails to equip developing students with the necessary reading, writing, and studying strategies (Graham & Harris, 1994, 2000).

Teachers, curricula directors, and administrators are left with a difficult task: How can we design a science program that provides the right balance of implicit and explicit instruction and includes a curriculum with the proper age-appropriate content and ample opportunities for exploration and inquiry learning?

History of the Science Reform Movement

- **1983** – National Commission on Excellence in Education releases *A Nation at Risk: The Imperative for Educational Reform. A Nation at Risk* sparks a wealth of studies and evaluations comparing U.S. students' skills in literacy, science, and mathematics to students in other countries.
- **1986** – American Association for the Advancement of Science launches "Project 2061" to develop a high level of science literacy among all U.S. citizens.
- **1989** – "Project 2061" publishes *Science for All Americans*, which outlines the knowledge and characteristics necessary for a scientifically literate citizen.
- **1990** – National Governors' Association and President Bush release the National Education Goals during the State of the Union Address. Goal Four states: "…by the year 2000, U.S. students will be first in the world in science and mathematics achievement."
- **1991** – National Research Council begins coordination of the development of *National Science Education Standards.* NRC convenes a National Committee on Science Education Standards and Assessment and a Chair's Advisory Committee that begin development of national content, teaching, and assessment standards in science education.
- **1993** – "Project 2061" publishes *Benchmarks for Science Literacy*, which establishes minimum goals for what students should know and be able to do at various grade levels in a number of content areas.
- **1995** – National Research Council publishes the *National Science Education Standards.*

For more detailed information on the history of the science education reform movement, see *NSTA Pathways to the Science Standards: Guidelines for Moving the Vision into Practice, Second High School Edition* (2004) available at www.nsta.org.

SUPPORTING THE SCIENCE STANDARDS

One of the concepts explained in the Science Standards is that the Standards are meant to serve as descriptive ideals and guidelines. They represent what can be accomplished, but leave the specifics of implementation to others. The responsibility for putting the vision of the *Science Standards* into action belongs to everyone with an interest in science education: teachers, students, administrators, supervisors, policymakers, assessment specialists, scientists, teacher educators, parents, businesses, local community members, curricula developers and publishers. Glencoe/McGraw-Hill, one of the nation's largest textbook developers, has risen to the challenge of the Science Standards and created inquiry-based programs for high school chemistry and physics.

Chemistry: Concepts and Applications, *Chemistry: Matter and Change*, and *Physics: Principles and Problems* respond to the need of science educators for curricula that accomplish multiple goals. To help educators reach the Science Standards goals, such curricula must:

- Support the recommended Content Standards,
- Give students consistent opportunities for active and extended science inquiry,

The Inquiry Teaching Approach

Teaching science using an inquiry approach means teachers must go far beyond merely lecturing students and encouraging them to memorize fact-based lecture notes and textbook explanations in preparation for exams. Rather, students should be allowed to experience the scientific process as scientists do, developing critical-thinking and problem-solving skills through the use of engaging activities and active learning strategies. Both the *National Science Education Standards*' Teaching Standards and Content Standards put high value on inquiry as an important component of science teaching and learning.

According to the National Research Council's Committee on Developing the Capacity for Selecting Effective Instructional Materials,

> The *Standards* encourage teachers to engage students in the process of scientific inquiry by directing them to ask questions about the natural world, design experiments to answer these questions, interpret the experimental results, and discuss the results with their peers. Such inquiry-based teaching enhances student understanding of scientific concepts and it is intended to equip all students with the analytical skills they will need in the future to interpret the world around them (p. 6).
>
> (For more information, see *Selecting Instructional Materials: A Guide for K–12 Science*, available at www.nap.edu.)

According to the National Science Teachers Association's *Pathways to the Science Standards: Guidelines for Moving the Vision into Practice, Second High School Edition* (2004),

> *Foster Continuing Inquiry.* Through questioning, self-assessment, and redesign of traditional hands-on experiences to open-ended ones, constructivist teachers must constantly arrange learning environments that challenge students to create more accurate knowledge for themselves. Constructivist research may be disconcerting to traditional lecture-oriented education programs, but it presents strong empirical data for what we regard as 'best practice' in science education.

For more detailed information on the inquiry teaching approach, see *NSTA Pathways to the Science Standards: Guidelines for Moving the Vision into Practice, Second High School Edition* (2004) available at www.nsta.org.

- Provide opportunities for scientific discussion and debate,
- Provide various tools to regularly assess student understanding, and
- Connect science to other areas of learning, including natural phenomena and science-related social issues that students discover in everyday life.

The approach of all three programs allows students to discover concepts within each of the Content Standards, giving them opportunities to make connections between chemistry and physics concepts and the real world. All three programs' *Teacher Wraparound Editions* include Chapter Organizers at the beginning of each chapter, which clearly outline the Science Standards covered in each section.

REACHING THE SCIENCE STANDARDS—RESEARCH-BASED STRATEGIES

To fulfill the characteristics of standards-supporting curricula, *Chemistry: Concepts and Applications*, *Chemistry: Matter and Change*, and *Physics: Principles and Problems* were developed using six specific, research-based instructional strategies. These strategies support inquiry-based instruction by providing ideas for and examples of how scientific inquiry can be conducted and by providing information to support student inquiry. The six strategies are as follows:

1. Using prior knowledge to learn new information and correct misconceptions

When students recall previously learned information, they can learn new, related information more effectively. Strategies to do this include: 1) recalling information, asking questions, and using analogies; and 2) elaborating on information from the textbook or teacher. In-text questions that ask students to use prior knowledge may remind them of information already in their long-term memory that, for some reason, is not easily remembered (Bransford, 1979; Pressley & McCormick, 1995). This research-based strategy also is central to successful reading and writing performances (Guthrie & Alvermann, 1999; Holliday et al., 1994).

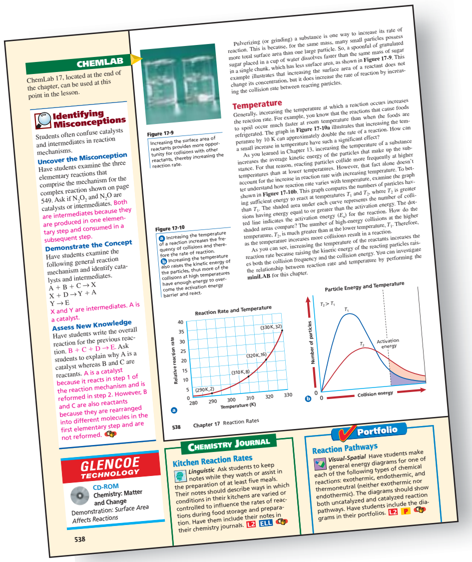


Figure 3 Strategies to help address students' misconceptions about science are included in each *Teacher Wraparound Edition.*

Chemistry: Concepts and Applications, *Chemistry: Matter and Change*, and *Physics: Principles and Problems* each reference information previously explained to facilitate learning of new information. All three programs often refer to concepts from previous chapters, different branches of science, other school subjects, and students' personal experiences to make chemistry and physics more relevant.

Another advantage of using prior knowledge and linked topics to learn new information is that it provides an opportunity to correct misconceptions. Effective teaching elicits students' prior conceptions and provides opportunities to extend or challenge those understandings (Donovan et al., 1999). With *Chemistry: Concepts and Applications*, *Chemistry: Matter and Change*, and *Physics: Principles and Problems*, students learn to recognize their prior conceptions and evaluate them using scientific evidence. Each program's *Teacher Wraparound Edition* includes sections on misconceptions that suggest strategies for eliciting and correcting students' misconceptions about specific ideas covered in each chapter, as seen in **Figure 3.**

2. Practicing important tasks

Providing students with opportunities to practice important tasks has long been considered a successful strategy to improve understanding and memory. Giving students individual feedback on their practice helps in monitoring and fostering science learning (Baker, 1991). Practicing helps students acquire additional information as they search and productively struggle, with teacher help, for the understanding and application of science information. *Chemistry: Concepts and Applications*, *Chemistry: Matter and Change*, and *Physics: Principles and Problems* were designed with the philosophy that practice is absolutely necessary for learning to occur.

Chemistry: Concepts and Applications, *Chemistry: Matter and Change*, and *Physics: Principles and Problems* have a variety of features to allow for extensive practice in scientific skill development and test preparation. These features include: example problems (as shown in **Figure 4A**), practice problems, problem-solving strategies, challenge problems, embedded reading and writing exercises, and multiple laboratory activities (including Launch Labs, Problem-Solving Labs, Mini Labs, ChemLabs, Try at Home Labs, Discovery Labs, Physics Labs, Design Your Own Physics Labs, and Internet Physics Labs). These opportunities for practice allow students to fine-tune their problem-solving abilities and learn new information, which will be indispensable for solving problems on standardized tests. All three texts also offer Standardized Test Practice sections that review and reinforce content in a standardized format.

3. Using high-quality visuals to communicate, organize, and reinforce science learning

Visuals—such as complex diagrams and elaborate line drawings—used in conjunction with verbal descriptions increase students' chances of learning, understanding, and remembering relationships and subtle properties of science concepts and problems. Visuals often are the only way to effectively communicate the central concepts needed to understand chemistry and physics. Students are able to organize and group ideas when visuals illustrate different and common characteristics (Hegarty et al., 1991). Also, the mental images that high-quality visuals stimulate are an indispensable tool for recalling information, especially compared to information presented with only text or lower-quality visuals (Willows & Houghton, 1987).

Chemistry: Concepts and Applications, *Chemistry: Matter and Change*, and *Physics: Principles and Problems* were designed with consistent, clear structures and easy-to-follow page layouts with effective use of color, graphics, and fonts. They include high-quality charts, tables, diagrams, art, and photographs, as shown in **Figure 4B.** Visuals often are accompanied by caption questions and ideas for effective use of models and demonstrations.

Each text also is accompanied by an array of supplementary materials that allow for the use of visuals, including: Interactive Chalkboard CD-ROMs, Virtual Labs CD-ROMs, WebQuest online research projects, Internet Labs, and other online resources at chemistryca.com, chemistrymc.com, and physicspp.com.

4. Motivating all students to achieve

Students are motivated to learn when materials provide explicit, attractive, relevant-to-student presentations of key concepts (Alderman, 1999; Corno, 1994). Motivational strategies also can include long-term projects of real-world relevance, and carefully constructed problem-solving activities that require effort, persistence, and flexibility. Effective strategies also include using examples from many cultures, using a variety of teaching techniques, and incorporating cooperative learning activities (Banks, 2001; Winzer & Mazurek, 1998). Research has shown that the inquiry learning and cooperative learning approaches work well for all students, including English-Language Learners and those with learning disabilities (Rosebery et al., 1992; Stoddart, 2002; Scruggs et al., 1993). Such motivational strategies will stimulate scientific curiosity and instill confidence through scientific exploration and discovery. Group activities also promote positive attitudes toward learning by building a community of learners (Brown & Campione, 1994).

Chemistry: Concepts and Applications, Chemistry: Matter and Change, and *Physics: Principles and Problems* provide students with exciting opportunities to explore chemistry and physics from many different perspectives, shown in **Figure 4C.** Many features—How It Works, Why It's Important, Technology and Society, Future Technology, Problem-Solving Labs, Discovery Labs, Consumer Chemistry, Applying Chemistry, and Applying Physics—encourage student curiosity and link chemistry and physics topics to everyday life. In all three programs, group activities, discussions, and multiple labs help students become part of an engaged community of learners.

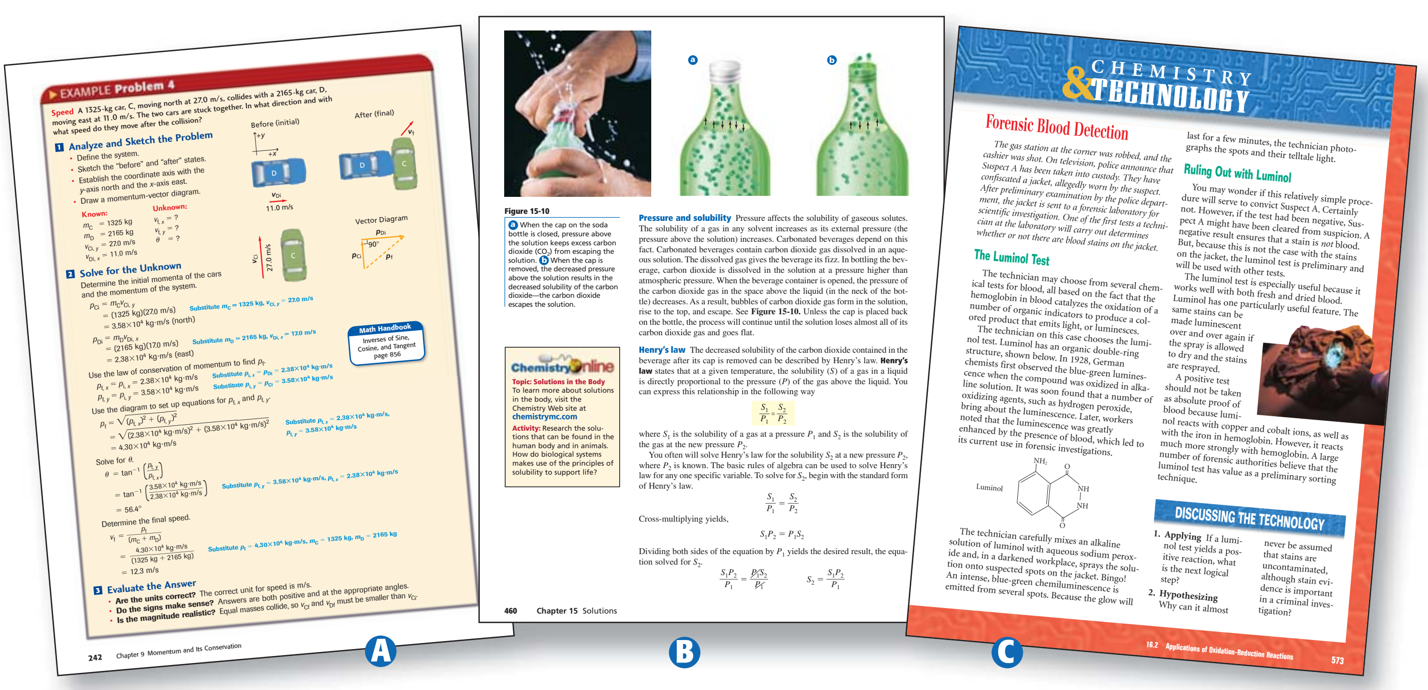
All three programs also include multiple strategies in the *Teacher Wraparound Editions* for reaching all students, including English-language learners, struggling students, and gifted students. Elements include: Differentiated Instruction, Visual Learning, Cultural Diversity, Challenge Activities, and Helping Struggling Students. *Forensics Laboratory Manuals* allow all students to explore chemistry and physics topics in fun and engaging ways.

Figure 4

A Example Problems provide students with opportunities to practice important tasks.

B High-quality illustrations and photos help communicate concepts.

C Relevant activities and topics, such as Chemistry and Technology features, motivate students to achieve.



5. **Developing reading comprehension strategies and mathematical skills**

Success with scientific skills is strongly tied to competency in reading and mathematics. Important reading and decoding strategies include: 1) pronunciation and word origin guides to facilitate decoding of unfamiliar words; 2) questions and practice items for self-assessment of reading comprehension and conceptual understanding; and 3) reading exercises designed for students to solve verbally presented problems and comprehend complex prose. Students need to read from textbooks that are challenging and that contain science vocabulary compatible with their prior knowledge and academic abilities (Guthrie & Alvermann, 1999; Holliday et al., 1999). Students also need pronunciation and other language-learning information to decode words, a prerequisite to reading comprehension (Pressley & Block, 2002). Students must have opportunities to engage in writing (Graham & Harris, 2000) and establish reading comprehension strategies such as questioning, visualizing, clarifying, elaborating, inferring, concluding, summarizing, and predicting (Pressley, 2002). These reading, decoding, and writing skills help students to remember important ideas needed to learn new information, understand information required to practice important tasks, and develop verbal skills needed to perform well on achievement tests and later in life. Another area strongly related to science learning is mathematics. Mathematical concepts, such as ratio, rates, proportion, percent, measurement, graphing, data analysis, statistics, and probability are crucial in the development of scientific reasoning (Lehrer, 2003).

Chemistry: Concepts and Applications, *Chemistry: Matter and Change*, and *Physics: Principles and Problems* were designed with thorough and consistent integration of reading and mathematics skills. All three programs incorporate reading and writing development sections, such as: Vocabulary, Word Origin, Portfolio, Reading Chemistry, Writing in Chemistry, Writing in Physics, Chemistry Journal, and Glossaries (refer to **Figure 5**). Supplementary materials, such as Vocabulary PuzzleMaker software and the *Reading and Writing in the Science Classroom* handbook offer further ideas for incorporating reading and writing activities. Mathematical concepts also are incorporated into each chapter of the three programs, through such features as: Critical Thinking, Reinforcement, Practice Problems, Connecting Math to Physics, Problem Solving Strategies, and references to Computations with the Calculator and Math Handbook Appendices.

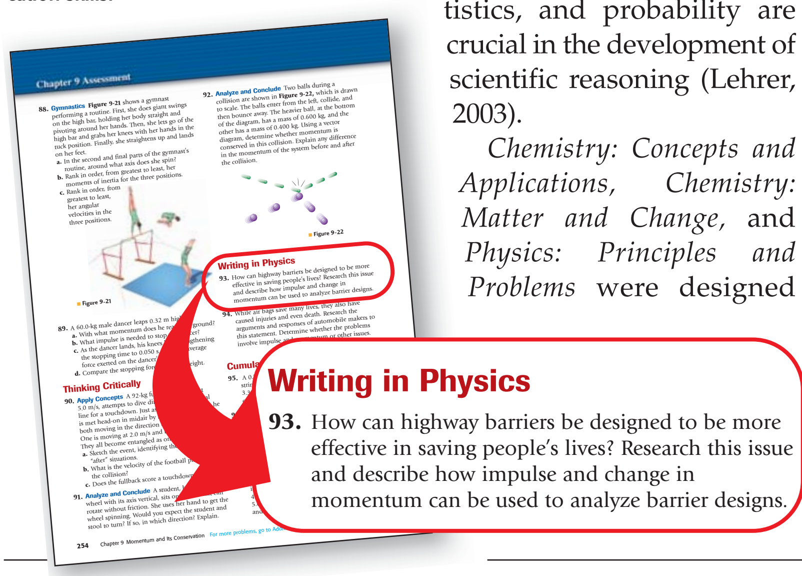


Figure 5

Writing activities help students develop comprehension and communication skills.

6. **Learning by using study strategies**

According to the research literature, there are no shortcuts to learning, but study strategies help students understand, organize, remember, and apply new information presented in science textbooks (Bransford, 1979; Corno, 1994). Study strategies used to learn from textbooks include concept mapping, highlighting, outlining, note taking, summarizing, and underlining (Peverly et al., 2003). These study skills promote learner activity, improve metacognition, and provide an effective form of review for tests (Hattie et al., 1996; Carter & Van Matre, 1975).

Study strategies and organizational tools offered in *Chemistry: Concepts and Applications*, *Chemistry: Matter and Change*, and *Physics: Principles and Problems* include Chapter Study Guides, Section Reviews, Test-Taking Tips, Standardized Test Practice, concept maps, outlines, and tables. Supplemental materials such as *Study Guide for Content Mastery*, *Mastering Concepts in Chemistry*, *Supplemental Practice Problems*, *Solving Problems: A Chemistry Handbook*, and online Self-Check Quizzes offer additional studying assistance.

VERIFYING LEARNING—ASSESSMENTS OF STUDENT UNDERSTANDING

Another key concept stressed in the Science Standards is the importance of continuously assessing student understanding.

Teaching Standard C:
Teachers of science engage in ongoing assessment of their teaching and of student learning. In doing this, teachers use multiple methods and systematically gather data about student understanding and ability.

Assessment provides opportunities for feedback, and research has shown that the most improvement occurs when feedback is given often and immediately following tests or activities (Bangert-Drowns et al., 1991). *Chemistry: Concepts and Applications, Chemistry: Matter and Change,* and *Physics: Principles and Problems* offer teachers many choices to probe students' understanding of key concepts and skills. Assessment features include: Section Assessments, Chapter Assessments, Standardized Test Practice, Portfolios, and Daily Intervention. Supplemental materials such as *Performance Assessment in the Science Classroom* and the Exam*View*® Pro Testmaker CD-ROM provide additional support for ongoing assessment.

REACHING EVERY LEARNER—SCIENCE FOR ALL STUDENTS

Another key principle of the National Science Education Standards is that science is for all students. *Chemistry: Concepts and Applications, Chemistry: Matter and Change,* and *Physics: Principles and Problems* offer a variety of instructional methods for all ability levels—reading, writing, graphics, hands-on labs, and much more.

- Differentiated Instruction elements in each *Teacher Wraparound Edition* provide ideas to engage all students, including gifted students, English-language learners, and students with special needs.
- Intervention and Remediation: Check for Understanding features in each *Teacher Wraparound Edition* and supplements such as *Supplemental Problems* and *Mastering Concepts in Chemistry* each offer additional assistance for struggling learners.
- *ELL Strategies for Science* offers specific strategies for integrating science and language learning.
- Enrichment and Challenge: Each program creates opportunities for gifted students to enrich their learning. Supplements such as *Pre-AP/Critical Thinking Problems, Additional Challenge Problems,* Enrichment worksheets, and *Forensics Laboratory Manuals* offer a variety of ways to extend challenges to gifted students.

Chemistry: Concepts and Applications, Chemistry: Matter and Change, and *Physics: Principles and Problems* each are complemented by a full line of multimedia resources that offer a range of technology options to enhance skills, promote critical thinking, and connect the classroom to the world in which students live. Multimedia resources include MindJogger Videoquizzes, Interactive Chalkboard CD-ROM, Exam*View*® Pro Testmaker, StudentWorks™ CD-ROM, and TeacherWorks™ CD-ROM. By offering such diverse resources and learning tools, these programs ensure that every student can reach the goals set by the National Science Education Standards.

SUMMARY

The National Science Education Standards have provided a new gold standard in science education. More than ever before, high school science teachers and administrators are being called upon to challenge their students in becoming inquisitive and active science learners. To achieve the high goals set by the Science Standards, educators and others involved in science education reform will need to use an array of state-of-the-art strategies and tools. Their toolbox must include inquiry-based curricula that support the Science Standards in every way. Glencoe/McGraw-Hill is proud to offer *Chemistry: Concepts and Applications, Chemistry: Matter and Change,* and *Physics: Principles and Problems.* With their focus on inquiry learning and continuous assessment, teachers can achieve the goals set by the National Science Education Standards, now and in the coming years.

Examples of Research Strategies in *Chemistry: Concepts and Applications*, *Chemistry: Matter and Change*, and *Physics: Principles and Problems*

Learning Strategy	Select Examples from *Chemistry: Concepts and Applications* (CCA), *Chemistry: Matter and Change* (CMC), and *Physics: Principles and Problems* (PPP)
Using prior knowledge to learn new information and correct misconceptions	**CCA–Student Edition (SE):** 71, 153, 190, 692; **Teacher Wraparound Edition (TWE):** 18, 38, 303, 486, 711 **CMC–SE:** 92, 234, 489; **TWE:** 56, 352, 538 **PPP–SE:** 119, 327, 342, 431; **TWE:** 155, 263, 489, 643 **Interactive Chalkboard CD-ROM** **Section Focus Transparencies**
Practicing important tasks	**CCA–SE:** 122, 328–329, 408; **TWE:** 313, 617 **CMC–SE:** 29, 519, 707, 775; **TWE:** 60, 104, 268, 672 **PPP–SE:** 332–333, 418, 572, 721; **TWE:** 214, 345, 543, 564 **Interactive Chalkboard CD-ROM** and **Video Labs**
Using high-quality visuals to communicate, organize, and reinforce science learning	**CCA–SE:** 152, 464, 602; **TWE:** 574, 711 **CMC–SE:** 418, 522, 534; **TWE:** 264, 292, 453 **PPP–SE:** 226, 484, 582, 724; **TWE:** 315, 407, 567 **Virtual Labs CD-ROM, Video Labs, Interactive Chalkboard CD-ROM, StudentWorks™ CD-ROM** **Teaching Transparencies**
Motivating all students to achieve	**CCA–SE:** 128, 659, 868; **TWE:** 391, 469, 556 **CMC–SE:** 210, 302, 660, 959; **TWE:** 188, 338, 402, 651 **PPP–SE:** 110, 160, 173, 450; **TWE:** 288, 353, 356, 388, 505 ***Forensics Lab Manual***
Developing reading comprehension strategies and mathematical skills	**CCA–SE:** 403, 544, 690, 707; **TWE:** 398, 555, 631 **CMC–SE:** 52, 121, 204, 887; **TWE:** 121, 260, 284 **PPP–SE:** 272, 441, 460, 630, 742, 745; **TWE:** 106, 151, 244, 260 **Vocabulary PuzzleMaker** ***Reading and Writing in the Science Classroom, English-Language Learner's Strategies for Science***
Learning by using study strategies	**CCA–SE:** 202, 224, 508, 521; **TWE:** 370, 395 **CMC–SE:** 205, 351, 526; **TWE:** 21, 389 **PPP–SE:** 221, 380, 478; **TWE:** 391, 624
Verifying learning with assessment	**CCA–SE:** 508, 521; **TWE:** 305, 509, 779 **CMC–SE:** 65, 205, 306–311, 351, 526; **TWE:** 85, 97, 128, 203 **PPP–SE:** 499, 545; **TWE:** 75, 145, 358, 823 ***Performance Assessment in the Science Classroom*** **Online quizzes at chemistryca.com, chemistrymc.com, physicspp.com** **Exam*View*® Pro Testmaker, Vocabulary PuzzleMaker**

REFERENCES

Alderman, M.K. (1999). *Motivation for achievement.* Mahwah, NJ: Lawrence Erlbaum Associates.

Baker, L. (1991). Metacognition, reading, and science education. In C.M. Santa & D.E. Alvermann (Eds.), *Science learning: Processes and applications.* Newark, DE: International Reading Association, pp. 2–13.

Bangert-Drowns, R.L., Kulik, C.C., Kulik, J.A., & Morgan, M. (1991). The instructional effects of feedback in test-like events. *Review of Educational Research,* 62(2), 213–238.

Banks, J.A. (2001). *Cultural diversity and education: Foundations, curriculum and teaching. (Fourth Edition of Multiethnic education: Theory and practice.)* Boston, MA: Allyn and Bacon.

Bransford, J.D. (1979). *Human cognition: Learning, understanding, and remembering.* Belmont, CA: Wadsworth Publishing.

Brown, A.L. & Campione, J.L. (1994). Guided discovery in a community of learners. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and classroom practice,* pp. 229–270. Cambridge, MA: The MIT Press.

Carter, J.F. & Van Matre, N.H. (1975). Note taking versus note having. *Journal of Educational Psychology,* 67(6), 9-00-904.

Corno, L. (1994). Student volition and education: Outcomes, influences, and practices. In B.J. Zimmerman and D.H. Schunk (Eds.), *Self-regulation of learning and performance.* Hillsdale, NJ: Lawrence Erlbaum Associates, pp. 229–254.

Donovan, M.S., Bransford, J.D., & Pellegrino, J.W. (Eds.) (1999). *How people learn: Bridging research and practice.* Washington, DC: National Academy Press.

Duffy, G. (2002). In the case for direct explanation of strategies. In C.C. Block, & M. Pressley (Eds.), *Comprehension instruction: Research-based best practices.* New York, NY: Guilford Press. pp. 28–41.

Graham, S., & Harris, K.R. (1994). Implications of constructivism for teaching writing to students with special needs. *Journal of Special Education,* 28, 275–289.

Graham, S., & Harris, K.R. (2000). The role of self-regulation and transcription skills in writing and writing development. *Educational Psychologist,* 35, 3–12.

Guthrie, J.T., and D.E. Alvermann (Eds.) (1999). *Engaged reading: Processes, practices, and policy implications.* New York, NY: Teachers College Press.

Hattie, J., Briggs, J., & Purdie, N. (1996). Effects of learning skills interventions on student learning: A meta-analysis. *Review of Educational Research,* 66(2), 99–136.

Hegarty, M., Carpenter, P.A., and Just, M.A. (1991). Diagrams in the comprehension of scientific texts. In R. Barr, M.L. Kamil, P. B. Mosenthal & P. D. Pearson (Eds.), *Handbook of reading research* (vol 2). New York, NY: Longman.

Holliday, W.G., Yore, L., & Alvermann, D.E. (1994). The reading-science learning-writing connection: Breakthroughs, barriers, and promises. *Journal of Research in Science Teaching,* 31, 877–894.

Lehrer, R. (2003). Developing understanding of measurement. In Jeremy Kilpatrick, W. Gary Martin, and Deborah Schifter (Eds.), *A research companion to principles and standards for school mathematics,* pp. 179–192. Reston, VA: NCTM.

National Research Council (1996). *National Science Education Standards.* Washington, DC: National Academy Press.

Peverly, S.T., Brobst, K.E., Graham, M., Shaw, R. (2003). College adults are not good at self-regulation, note taking, and test taking. *Journal of Educational Psychology,* 95, 335–346.

Pressley, M. & Block, C.C. (2002). Summing up: What comprehension instruction could be. In M. Pressley & C.C. Block (Eds.), *Comprehension instruction: Research-based best practices.* New York, NY: Guilford Press, pp. 83–92.

Pressley, M. & McCormick. C. (1995). *Cognition, teaching and assessment.* New York, NY: HarperCollins College Publishers.

Pressley, M. (2002). *Reading instruction that works: The case for balanced teaching.* New York, NY: Guilford Press.

Pressley, M., Harris, K. R., and Marks, M. B. (1992). But, good strategy instructors are constructivists! *Educational Psychology Review* 4, 3–31.

Rosebery, A.S., Warren, B., & Conant, F.R. (1992). Appropriating scientific discourse: Findings from language minority classrooms. *The Journal of the Learning Sciences,* 2(1), 61–94.

Scruggs, T.E., Mastropieri, M.A., Bakken, J.P. & Brigham, F.J. (1993). Reading versus doing: The relative effects of textbook-based and inquiry-oriented approaches to science learning in special education classrooms. *The Journal of Special Education,* 27(1), 1–15.

Shulman, L.S., & Keislar, E.R., (Eds.) (1966). *Learning by discovery: A Critical Appraisal.* Chicago, IL: Rand McNally & Company.

Stoddart, T., Pinal, A., Latzke, M., & Canaday, D. (2002). Integrating inquiry science and language development for English language learners. *Journal of Research in Science Teaching,* 39(8), 665–687.

Texley, J. and Wild, A. (Eds.) (2004). *NSTA Pathways to the Science Standards: Guidelines for Moving the Vision into Practice, Second High School Edition.* Arlington, VA: NSTA Press.

Willows, D. M., & Houghton, H.A. (1987). *The psychology of illustrations: Basic research* (vol 1). New York, NY: Springer-Verlag.

Winzer, M.A. & Mazurek, K. (1998). *Special education in multicultural contexts.* Upper Saddle River, NJ: Merrill.

Zimmerman, B.J. (2001). Theories of self-regulated learning and academic achievement: An overview and analysis. In B.J. Zimmerman & D.H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives.* Mahwah, NJ: Erlbaum.

Zimmerman, B.J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P.R. Pintrich & M. Zeidner (Eds.), *Handbook of Self-Regulation.* San Diego, CA: Academic Press, pp. 13–39.

Zimmerman, B.J. (1998). Academic studying and the development of personal skill: A self-regulatory perspective. *Educational Psychologist,* 3, 73–86.

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