

RESULTS

with

BIOLOGY: THE DYNAMICS OF LIFE



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With the development of the **National Science Education Standards** in 1995, educators throughout the United States have been inspired to raise the academic bar. It is more important than ever to ensure that our schools are reaching for the highest in science academic achievement so that all children will be prepared to explore current and future frontiers of science and technology.

From the most microscopic genetic component to the most complex interaction in an ecosystem, the study of biology allows us to learn about every aspect of life. Students who can master the fundamental concepts in fields such as genetics, biotechnology, terrestrial and marine ecology, botany, zoology, medicine, and anatomy and physiology will have the depth and breadth of knowledge to make critical decisions that range from their own personal health and welfare to decisions about land use and other governmental policies. It is imperative that our schools impart this knowledge as well as the skills necessary to critically evaluate evidence that is labeled “scientific.” We need to look at schools that are engaging their diverse student populations and producing results, and use those as models for the rest of the country.

This report describes eight schools that have been successful in teaching biological concepts, as evidenced by student performance on assessments, feedback from students and parents, and responses from teachers. These results demonstrate the benefits of an effective biology curriculum program as well as successful teaching practices.

The schools that use the biology program described here share several other critically important characteristics.

- All show improved student performance.
- All have created exciting climates within their schools to encourage learning.
- All monitor student progress during the school year to ensure effective instruction.
- All demonstrate the importance of maintaining high expectations for all students, not just the brightest or most privileged.

The leaders and teachers of the schools described herein are eager to share their results and to see their practices and experiences spread to many other schools. Please feel free to contact the people identified in each article. We’ve provided telephone numbers, fax numbers, addresses, and e-mail addresses whenever possible to make communication as easy as possible.

Let’s learn from the example set by these schools. In doing this, we can help our children become the successful learners they need to be to face the challenges and promises of the twenty-first century.

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Introduction

Results. More than at any time in recent history, attention is being focused on the results our schools produce. With the *No Child Left Behind Act* of 2001, expectations have been raised and student performance standards have been identified for virtually every school subject. Science education is guided by the National Research Council's 1995 *National Science Education Standards*. 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 before, science teachers and administrators are being called upon to challenge their students to become inquisitive and active science learners. To achieve the high goals set by the *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 an inquiry-based curriculum that supports the *Science Standards*.

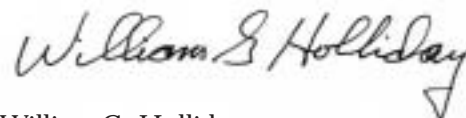
Biology: The Dynamics of Life:

- **Fully supports the National Science Education Standards' Content Standards.** The *Teacher Wraparound Edition* includes linkage charts at the beginning of each chapter to show clearly which Content Standards are met in each lesson.
- **Provides a balance of explicit and implicit teaching strategies.** It combines the best of research on "reform" curricula with the best of "traditional" curricula, incorporating more active involvement on the part of students in making sense of important scientific ideas.
- **Includes opportunities for inquiry, scientific discussion and debate, and problem-solving.** The authors of *Biology: The Dynamics of Life* believe that conceptual understanding and basic skills are not opposing interests; they go hand-in-hand and support each other. The text includes MiniLabs, Problem-Solving Labs, and BioLabs, as well as more traditional Vocabulary Review, Constructed Response, and Standardized Test Practice Sections.

- **Offers a variety of instructional methods designed especially for all students—** reading, writing, graphics, hands-on labs, and much more. Resources include: Inclusion Strategies, Intervention and Remediation supplements, *BioChallenges and Enrichment* and Challenge Activities, and Daily Intervention.
- **Offers 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: Virtual Labs CD-ROM, Guided Reading Audio Summaries in English and Spanish, ExamView® Pro Test Bank, Interactive Chalkboard CD-ROM with Image Bank, Vocabulary PuzzleMaker Software, MindJogger Videoquizzes, and VideoLabs.

This report shares the stories of eight different schools that have implemented *Biology: The Dynamics of Life*. The common characteristic shared by all is results; all have implemented programs of instruction in science that have enabled them to raise the performance of their student populations to exemplary levels. It is undoubtedly true that there is not one way for all children to learn, but it is essential that all children learn to meet the challenges of our ever-changing world.

We encourage you to explore how *Biology: The Dynamics of Life* can support excellence in standards-based scientific teaching and help our children be prepared for and productive in the twenty-first century.



William G. Holliday
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Bay Shore Senior High School

Bay Shore Union Free School District, Bay Shore, New York

Bay Shore Senior High School serves the community of Bay Shore, New York, located on Long Island on the urban fringe of New York City. The Bay Shore Union Free School District is famous for its cultural arts education. All students receive education in art, dance, music, and theater at the elementary, middle, and high school levels. In 2002, the Music Teachers National Association and the National School Boards Association named Bay Shore one of the “Top 100 Communities for Music Education in America” for the third consecutive year.

Bay Shore Senior High School extends these high standards in cultural arts to all areas of its students’ education. It serves a diverse, multicultural population of approximately 1,750 students—57% Caucasian, 21% African-American, 20% Latino, and 2% Asian/Pacific Islander. Each year, Bay Shore students consistently score above state and national averages on SAT tests, and many students go on to prestigious universities, such as Harvard, Columbia, Brown, MIT, and Yale.

Raising the Bar

Bay Shore Senior High School Science teachers Bill Paleologopolos and Denise Kaplar recall reviewing new biology textbooks in 2000 for approximately 450 students in their 9th- and 10th-grade Living Environment classes. Ms. Kaplar explains, “At that time, the New York State curriculum was changing, and they added a Living Environment Regents Exam that would begin in June of 2001.” Mr. Paleologopolos elaborates, “We needed a text that would meet all of the New York State mandated content, plus we wanted really strong teacher resources. Also, we wanted something with a high reading level—something that would be challenging for our students, but still appropriate.” After reviewing several possible texts, a

group of Bay Shore’s teachers decided that Glencoe’s *Biology: The Dynamics of Life* had all the qualities they were seeking.

Responding to Diversity

One of the aspects of *Biology: The Dynamics of Life* that appealed to Ms. Kaplar and Mr. Paleologopolos was its ability to reach students with different learning styles. Mr. Paleologopolos comments, “We use this text for general science classes as well as for Regents Level [honors] classes, and it works very well. Each unit provides guides for reaching all different types of learners—kinesthetic, verbal/linguistic, logical,



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visual/spatial, auditory/musical, interpersonal, intrapersonal, and naturalist. A good teacher wants to use at least two different approaches in each daily lesson to reach all students.”

Ms. Kaplar adds, “The students really enjoy *Dinah Zike’s Teaching Science with Foldables™*. It’s a different way to present materials and take notes.”

Biology: The Dynamics of Life also allows Ms. Kaplar and Mr. Paleologopolos to reach their ESL students with supplementary materials.

Mr. Paleologopolos explains, “We use all the accompanying workbooks. We have a fairly large Spanish-speaking population, so all the Spanish resources really help us.”

Making Science Come Alive

With *Biology: The Dynamics of Life*, Ms. Kaplar and Mr. Paleologopolos reportedly have found that their students are more engaged in their Living Environment classes. Mr. Paleologopolos relates, “I’ve seen increased interest in science classes due to some of the Biology & Society articles in the book. And also, the visual aids are excellent. This book provides not only labs, but interdisciplinary activities that include demonstrations, so science seems more real to the students. Some of the CD-ROM activities are just excellent. We even went on the Glencoe Web site to take a virtual tour of Yellowstone National Park, and they loved that. They definitely see science as more relevant to their lives now.”

Ms. Kaplar adds, “This text is easy to read for the students, and it has beautiful pictures. Most of the kids can go home and use the book on their own to reread something I’ve gone over in class. Sometimes, I use the ‘In the News’ articles from the Web site to create homework assignments. The kids do have a positive attitude about science class now. They’re intrigued with *Biology: The Dynamics of Life*.”

Improving Science Scores

The students’ engagement with their Living Environment program shows in their standardized test scores. In 2001, the first year that the New York State Regents Examination on Living Environment was administered, 90% of Bay Shore’s students scored a 65 or above, better results than the 84% across the state with similar scores. In 2002, that percentage increased to 92% compared with 86% across the state. In addition, Bay Shore High School was proud that several students competed in the New York State Science Olympiad program and finished in the top 20 schools in the state.

Parental Involvement

Bay Shore High School also prides itself on community and parental involvement. The National School Boards Association named Bay Shore’s district as a model for public engagement. Through their Parent Faculty Association, the Business Advisory Committee, and the School Improvement Team, Bay Shore parents are actively involved in their children’s education. Mr. Paleologopolos says, “We show *Biology: The Dynamics of Life* on the first day of school and at parent-teacher conferences. Most of the parents have been impressed with it. They think it’s useful for their children, and many of them comment that they read it together. They’re able to pick it up and read and get some knowledge from it themselves!”

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Hillside High School

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illside High School serves the urban, ethnically diverse community of Hillside, New Jersey (pop. 21,747), located just 4 miles southeast of Newark, NJ, and 21 miles southwest of New York City. Serving almost 900 students (80% of whom are minorities), it is the only high school in the district, and prides itself as a rigorous academic alternative to the traditional high school program. It has implemented College

Preparatory Schools (several autonomous schools) within the high school. College Preparatory Schools include programs in engineering, multimedia, and the performing arts. Hillside Public Schools believe “there’s no better way to engage students in learning than to challenge them academically.” Over 50% of Hillside graduates are college bound, some attending nearby universities, such as Seton Hall, Rutgers, and the University of Medicine and Dentistry of New Jersey.

In 1996, Hillside High School was searching for a new textbook for their 9th- and 10th-grade college prep and College Honors Biology class. Joseph Diorgi, Science Department Chair, explains, “We had a different clientele of students and we needed a book that was best for them. After reviewing several biology textbooks, we chose Glencoe’s *Biology: The Dynamics of Life*. We thought the kids could relate

to how the material was presented with pictures and graphics, not just words, and it provided opportunities for good critical thinking. It also aligned well with our state and district standards.”

Teaching with *Biology: The Dynamics of Life*

Hillside’s biology teachers unanimously find *Biology: The Dynamics of Life* very easy to use. Teacher Teresa Tenreiro says, “Using Glencoe’s *Biology: The Dynamics of Life* has been helpful in focusing on the various learning styles in my classroom. The teaching techniques outlined in the *Teacher Wraparound Edition* are easy to use and implement. There is plenty between the book and the supplementary materials for me to pick and choose from for whatever works best for my students.” Colleague Carriann Mulligan agrees, “Various teaching techniques and activities are provided in each chapter of *Biology: The Dynamics of Life* that meet the differing needs of students, so no student is left behind floundering.” Mr. Diorgi sums it up, “No matter how you want to teach or who you want to teach to, there is no problem using this book.”

One of the four guiding principles of the *Science Standards* is that learning science should be an *active* process. Teaching Standard A states that, “Teachers of science should plan an inquiry-based science program for



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their students.” Hillside’s Science Department believes that *Biology: The Dynamics of Life* makes achieving Teaching Standard A easy. “This program has so many hands-on activities in each chapter to choose from; I wish I had time to do them all, because kids learn by being actively involved and they like it,” says Ms. Mulligan. Ms. Tenreiro agrees and thinks that the text incorporates inquiry learning “really well, especially through the use of the MiniLabs.”

Student-friendly Textbook

Hillside’s selection of *Biology: The Dynamics of Life* has been reaffirmed after using the text for the past eight years. Mr. Diorgi says, “Kids used to be negative about using their previous biology text, but not with this text; they understand the text and know how to use it. This is because Glencoe presents the material in a more interesting way so the students can relate to it themselves. If kids understand how it relates to them or their community, they then feel it is important.” Ms. Tenreiro concurs, “My students not only like looking through the book at all the pictures, but they like the questions and activities.” Ms. Mulligan believes the students like the textbook because “it is more readable and written in a manner they can comprehend, with a lot of illustrations and graphs.”

Not only is the text student-friendly, but Ms. Mulligan reports, “Parents seem to love the book. They think it is really self-explanatory and that the illustrations within support the material.”

Assessing Student Performance

Although New Jersey does not have a state proficiency test for biology, Hillside staff still believe they achieve positive results with *Biology: The Dynamics of Life*. Ms. Mulligan uses the many assessment strategies provided with the program to assess student understanding of the material, such as the hands-on activities, regular labs and

MiniLabs, chapter tests, and the *Reinforcement and Study Guide*. She believes that with this program there is “something you can use to test exactly what you want.” She also shares, “Overall, I am impressed with my students’ performance. I have seen improvement in the critical-thinking skills of my students with this textbook. It provides questions that encourage the students to compare and infer, and develop critical-thinking skills that they will need to pass their graduation exam and do well on their SATs. I believe they go from being minimal critical thinkers to more comfortable critical thinkers after using this text for one year.”

As department chair, Mr. Diorgi looks at another criterion to assess student performance. “I have noticed that since we have implemented *Biology: The Dynamics of Life*, more of our students have an increased willingness to take classes in Anatomy and Physiology, because they become interested in it with this text, instead of going into something like Earth Science. In particular, I think the students are enthralled with the human body chapters in the text. I believe this program prepares them well for these more advanced sciences.”

A Teacher’s Last Word

Ms. Mulligan sums up her opinion of *Biology: The Dynamics of Life*, “Overall, this book is one of the best I have seen in a high school setting. It is well-rounded, and hits every level, special education through honors, because of the way the information is presented and the wealth of supplementary materials. For districts that don’t have a lot of money to buy different levels of texts, this would be the perfect book.”

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John F. Kennedy High School

Anaheim Union High School District, La Palma, California

John F. Kennedy High School is one of eight comprehensive high schools in the Anaheim Union High School District of Orange County, California. Kennedy opened its doors in 1964 and has a current enrollment of 2,100 students in grades nine through twelve. As is true of all Orange County schools, John F. Kennedy High School is proud of its diversity and strong sense of community. Kennedy's student body is comprised of 40% Caucasian students, 28% Asian-American, 19% Latino, 8% Filipino-American and other Pacific Islander, and 5% African-American. John F. Kennedy High School's mission is to develop capable young people by empowering their students with the knowledge, attitudes, learning skills, and vocational abilities necessary to become contributing members of a global society.

Updating Curricula

John F. Kennedy biology teacher Alan Chen recalls the process to choose a new textbook for the 2001–2002 school year. “We had selected two biology teachers from each school in our district to be on the adoption committee,” he explains. “Every seven years, we go through an adoption cycle. This is especially important with science texts, because they become outdated very quickly. All the publishers had sent samples of their texts, and we looked at many. Our job was to go through the texts and software ahead of time, and then we voted at the district-wide meeting. We picked Glencoe's *Biology: The Dynamics of Life* as our top choice, and our second choice became our supplementary text.” According to Mr. Chen, two of the main reasons for choosing *Biology: The Dynamics of Life* were its alignment with California State Content Standards and its ability to reach students of differing abilities.

Reaching Every Learner

Mr. Chen, who teaches Honors Biology in 9th and 10th grades and Advanced Placement Biology in 11th grade, explains how *Biology: The Dynamics of Life* has lent itself to easily teaching different levels of learners at John F. Kennedy High School. “It's very adaptable,” he states. “Problems are included with three different difficulty levels. Some worksheets, for example, are easier and some are more advanced and that helps me work with all students. The *Biology: The Dynamics of Life Teacher Wraparound Edition* also has lots of great suggestions for different learning styles, like visual learners or ESL learners.”

Cari Burnett, a second-year biology teacher at John F. Kennedy, agrees with Mr. Chen that *Biology: The Dynamics of Life* allows her to reach all her students. “The *Teacher Wraparound Edition* offers lots of options for

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'tweaking' examples for different types of learners, while still giving what the mainstream kids need," she says. "Since I'm a new teacher and have only taught out of Glencoe's *Biology: The Dynamics of Life*, I can't really say how students responded to the last textbook. But lots of students have told me that this is the first time science made sense to them and the first time they're doing well in a science class. Some of that is the teacher, but some of it is the textbook, too. *Biology: The Dynamics of Life* is simple and student-friendly, without leaving out important details."

Supporting Teachers

Both Mr. Chen and Ms. Burnett are pleased with the great variety of materials that *Biology: The Dynamics of Life* offers to support their teaching. Ms. Burnett explains, "I was extremely pleased with how easy it's been to use *Biology: The Dynamics of Life* in the classroom. It offers so many supplementary materials that were great resources to me as a new teacher. I love the MiniLabs and the end-of-chapter labs because they are easy to connect to the concepts we've been learning. I use the MindJogger Videoquizzes, and the students love that! They love the competition of the game show format. And the *Section Focus Transparencies* are great; they cover everything I need to diagram or show. The text also does a great job of aligning with our state standards; there is a list at the beginning of each chapter, so that helps me make sure I'm meeting all the standards."

Mr. Chen echoes Ms. Burnett's thoughts, saying, "Every year, I discover new things in the Glencoe packet. It's so easy to use, because all the materials you need are in front of you. The difficulty is to pick and choose, because it's kind of like being a kid in a candy store. The only bad thing is that there's not enough time to use all the cool materials!"

A Solid Foundation

Because Mr. Chen teaches honors classes, he can see firsthand whether or not students are being prepared by *Biology: The Dynamics of Life* for more advanced Biology courses. He explains, "After Honors Biology, I'm fortunate that a lot of my students come back, and I see them again in Advanced Placement Biology, which is very intense. With *Biology: The Dynamics of Life*, they've learned so much in 9th and 10th grade that I don't have to teach it all over again; I can just review. I really like that, because I want the students to retain the material they're learning." He also comments that the Design Your Own Labs help prepare students for college-level biology: "College classes these days want students to be able to design their own labs, and most texts don't prepare my students for this kind of higher-level science. *Biology: The Dynamics of Life* gives them suggestions, and they design their own labs, hypotheses, and variables. The kids really like getting to be scientists."

Lessons Learned

Ms. Burnett adds a bit of advice to teachers just beginning to use *Biology: The Dynamics of Life*. "Give yourself enough time as a teacher to review the many options the program offers," she says. "Try to order the materials ahead of time, if at all possible. Having the materials ahead of time allows you to use what Glencoe offers you, and there are so many options to choose from!"

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John Glenn High School

John Glenn School Corporation, Walkerton, Indiana

Walkerton is a small community of 2,274 residents in St. Joseph County, Indiana. It lies 96 miles east of Chicago and 26 miles from Lake Michigan in the north central part of the state. Walkerton's central position gives it ready access to many cities, among them the County Seat and principal city of South Bend. John Glenn High School, Walkerton's only high school, has grown with the community over the years—from 23 teachers and 360 students in 1968, to 36 teachers and 570 students in 2003. Their student body is 97% Caucasian, 2% Latino and 1% African-American. John Glenn strives to prepare students for their academic futures and has increased their graduation rate from 70% in 1968 to 90% in 2003. Many of John Glenn's students go on to one of Indiana's nearby universities—University of Notre Dame, Indiana University–South Bend, Saint Mary's College, and Davenport University, among others.

Transitioning to Biology: The Dynamics of Life

Science Department Chairperson Kay Freehauf remembers the process of reviewing textbooks in 1999 for the approximately 150 students in 9th- and 10th-grade Biology classes. Having taught at John Glenn since 1981, Ms. Freehauf has had extensive experience reviewing textbooks for adoption. “Glencoe’s *Biology: The Dynamics of Life* was on the Indiana state adoption list that year,” she recalls. “Many of those textbooks seemed almost the same to me, but what interested me the most about *Biology: The Dynamics of Life* were all the supplementary materials. We also were attracted to the organization of the text. The chapters are outlined very well, with objectives listed at the beginning of the chapter, questions at the end of each section, and a good review at the end of each chapter.”

Biology teacher Dan Kaser, who has taught at John Glenn since 1994, agrees with Ms. Freehauf's recollections, “I think when I first looked over *Biology: The Dynamics of Life*, it was the quality of the supplemental materials which made me look at it harder than the others. Also, the text seemed to read better and have a good flow from one topic to the next. Other biology books seemed choppy in comparison. Glencoe tends to follow general themes throughout the whole book, and there are just more materials that allow the kids to demonstrate their overall understanding of the concepts. *Biology: The Dynamics of Life* was also superior in terms of the graphics, graphs, and photographs it incorporates. Kids are just more visual these days; they won't respond as well to a page with only text.”

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Responding to Various Learning Styles

Ms. Freehauf and Mr. Kaser both feel that *Biology: The Dynamics of Life* provides them with many tools to engage students with a variety of learning styles. Ms. Freehauf states, “It’s flexible and accommodating for various learning styles, because there are so many different worksheets, transparencies, and labs. I use the *Basic Concepts Transparencies Book* because it always has an overhead that I can use as a class project. It gives the visual learners something to look at. The labs are also a great way to incorporate inquiry learning. They are easy to set up, and the materials are cheap.”

Mr. Kaser adds, “Some teachers just use a text without supplementary materials, but with this program, everything meshes so well that integrating the text and the extra materials into the classroom is what makes it so successful. I think critical-thinking and problem-solving skills really pay off for kids down the road. That’s why I wanted to adopt this Glencoe text, because it’s more appropriate for teachers who want to use those practices in their classroom.” Mr. Kaser has taken advantage of many of *Biology: The Dynamics of Life’s* supplementary materials—English Guided Reading Audio Summaries CD-ROM; *Basic Concepts, Section Focus and Reteaching Skills Transparency Books*; *BioChallenges and Enrichment*; *Laboratory Manual*; and *Reinforcement and Study Guide*.

Mr. Kaser also appreciates *Biology: The Dynamics of Life’s* multiple opportunities for incorporating inquiry learning and hands-on activities. “The first year I was using *Biology: The Dynamics of Life*, I was finishing up my Master’s Degree and had to do a thesis,” he says. “I compared classes using performance-based activities to those using only worksheets, and I found that the classes using more hands-on activities saw an increase in comprehension, test scores, and did better on essay answers.”

Assessing Learning

Both Ms. Freehauf and Mr. Kaser appreciate the ease of using *Biology: The Dynamics of Life’s* ExamView® Pro Test Bank CD-ROM. Mr. Kaser explains, “It’s very user-friendly for generating your own tests. With a lot of publishers’ tests, you have no flexibility with them. But with Glencoe’s, I can use the provided questions and also work in my own questions.” He adds, “The test questions are not simple. They are higher-order thinking questions that kids can’t just memorize the answers to. In order to successfully answer the questions, they have to really understand and apply the information. I don’t see other publishers doing that. These critical-thinking questions help prepare the kids for the ISTEP [Indiana Statewide Testing for Educational Progress] test that they have to pass in order to graduate.”



Rob Gager/Taxi/Getty Images

The practice with critical thinking that students are receiving with *Biology: The Dynamics of Life* seems to be paying off. In the 2003–2004 school year, 73.8% of the 10th-grade students taking the ISTEP at John Glenn passed, compared to the state average of 68.2%. This also reflected an improvement from the 69.3% of 10th-graders that passed the ISTEP in the 1999–2000 school year. With *Biology: The Dynamics of Life*, John Glenn High School hopes to see their numbers continue to rise.

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Lakewood High School

Lakewood City School District, Lakewood, Ohio

Lakewood High School is a large public high school located in the picturesque community of Lakewood, Ohio, about 10 minutes west of downtown Cleveland, on the shores of Lake Erie. With over 200 courses and 65 extracurricular activities, Lakewood High School offers the widest variety of academic and extracurricular programs available in northern Ohio. Ninety-five percent of Lakewood's students are Caucasian, 2% are African-American, 2% are Latino, and 1% is Asian/Pacific Islander. Lakewood High School is proud of its 2,335 students—and with good reason. One-hundred percent of their college-bound students pass proficiency tests, scoring well above national averages on ACT and SAT tests, and 35% of their college-bound students receive 1.5 million dollars in scholarship assistance to the colleges of their choice each year.

Supporting Excellence

Science Department Chair Robert Edwards remembers when Lakewood High School was ready to adopt a new science textbook for its 420 students in 10th-grade biology classes, to begin with the 2000–2001 school year. “The copyright on our old biology text was 1987. Due to budget cuts, we had missed one adoption cycle and had been using that same text for 11 years,” he states. Mr. Edwards and Helen Smith, Biology and Anatomy teacher, were both members of a selection team of teachers at Lakewood High School that reviewed sample texts. According to Mr. Edwards, “We wanted something that would be attractive to the kids and that would be easy to read. We needed a text that aligned well with the Ohio state standards. Also, we wanted a text where the look and sequence of topics were appropriate and made common sense.” Mr. Edwards, Ms. Smith, and the other teachers on the selection team reached an agreement that Glencoe's *Biology: The Dynamics of Life* had all the features of an ideal textbook to support their students' learning.

Integrating Technology

According to its Web site, the mission of Lakewood High School's district, Lakewood City Schools, is to “develop responsible citizens, who are critical and creative thinkers, committed to life-long learning, invested in a diverse society, and prepared for technological and global opportunities.” A large part of achieving this mission is Lakewood City Schools' commitment to the use of technology to enhance and integrate their curriculum. Mr. Edwards and Ms. Smith recognized that *Biology: The Dynamics of Life* offered multiple techniques and opportunities for incorporating technology in the biology classroom. Ms. Smith explains, “I have taken my students to the computer lab each year to introduce them to the *Biology: The Dynamics of Life* online study tools. Our library put a direct link from the school's Web site to Glencoe's Web site. I also give parents the Web site at my

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parent-teacher conferences and encourage them to use it." In addition to the Glencoe online study tools, Mr. Edwards and Ms. Smith both have taken advantage of the *Biology: The Dynamics of Life* Vocabulary PuzzleMaker CD-ROM, the MindJogger Videoquizzes, and the *Laboratory Manual*. Mr. Edwards comments, "We've used quite a few of the labs. Our original intention was to keep using the labs from our old textbook, but most of our teachers have gone to the Glencoe labs...About a third of the labs are done in a real inquiry style, which keeps the students interested." He also comments on how much students enjoy the MindJogger Videoquizzes: "It's a really good review which the kids enjoy. It gets real rowdy when they play the game show."

Engaging Students

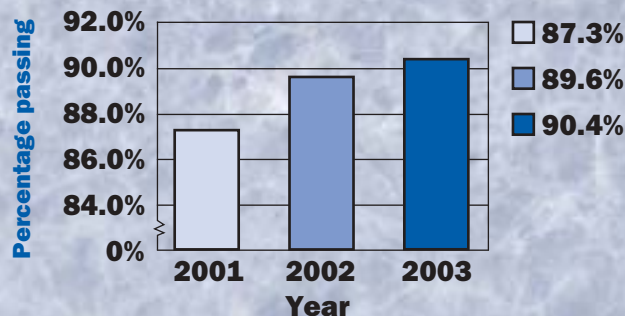
For both Mr. Edwards and Ms. Smith, much of their success with *Biology: The Dynamics of Life* is due to its high-quality graphics that appeal to students. As Ms. Smith comments, "I find, with *Biology: The Dynamics of Life*, that it's easier to engage the students. It's attractive and engaging. Students are more willing to bring it to class and use it than our last text." Mr. Edwards adds, "Our last text was very intense reading with only small pictures. The Glencoe text has lots of pictures and diagrams. It's a lively, attractive book that makes kids want to learn. I can point to the diagrams when a concept is difficult to understand. Sometimes, a picture is worth a thousand words."

Preparing for the Future

According to the Ohio State Board of Education's records, Lakewood High School's 10th-grade students are continuing to build upon their excellence in science. In 2003, 90.4% passed the 10th Grade Science Proficiency Test, compared to 89.6% in 2002 and 87.3% in 2001, earning a "Continuous Improvement" rating.

Lakewood also is continuing to build upon its exemplary School Report Card Scores. The 2001 Report Card shows Lakewood City

Percentage Passing 10th Grade Science Proficiency Test—Lakewood High School



Schools earning a score of 21, up three points from 2000, and the 2002–2003 Report Card will reflect an additional two point increase. Ms. Smith explains that the increase in test scores can't be attributed only to *Biology: The Dynamics of Life*. "Our results are a combination of the book and our teaching," she explains. "The students are testing better now, and we're focusing more on our state standards. But the text has made it easier for us, because it correlates so well to the science standards."

Mr. Edwards feels that *Biology: The Dynamics of Life* is preparing students for more advanced science classes in the future. "It does a very good job of getting the kids ready for Chemistry, and about 95% of our Biology students go on to take Chemistry. Some also take Horticulture and Anatomy, and it prepares them for those subjects as well, because it covers everything—botany, anatomy, all of it." With help from Glencoe's *Biology: The Dynamics of Life*, Mr. Edwards and Ms. Smith plan on continuing the trend of excellence at Lakewood High School. After 2003, Ohio will be implementing a new proficiency test strongly based on standards, and as Mr. Roberts says, "We're counting on Glencoe."

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La Quinta High School

Desert Sands Unified School District, La Quinta, California

The city of La Quinta is located in Riverside County, the fourth-largest and fastest-growing county in California. By 1992, the county was home to over 1.3 million residents. La Quinta is nestled at the base of the Santa Rosa Mountains 30 minutes from Palm Springs in the Coachella Valley. La Quinta's population is over 30,000, with an additional 12,000 seasonal residents in the winter and spring months.

La Quinta High School is one of five high schools in the Desert Sands Unified School District, and serves over 2,500 multiethnic students in grades nine through twelve with diverse socioeconomic and cultural interests. It is one of the newest high schools in the Coachella Valley, opening its doors in the Fall of 1994. Recognized since 1999 as a California Distinguished School, accredited by the Western Association of Schools and Colleges, and the only International Baccalaureate high school in the area, the school is renowned for its academic programs and cutting-edge curriculum. The academic program focuses on the college-bound student, thus, the graduation requirements reflect the prerequisites for admission to the University of California and the California State University systems. Over 90% of La Quinta High School graduates pursue higher education. Over 55% of each graduation class enrolls directly in four-year colleges and approximately 35% in community colleges.

Textbook Adoption

In October 1998, the *Science Content Standards for California Public Schools, Kindergarten Through Grade Twelve* were adopted by the California State Board of Education. In 2000, La Quinta's Science Department was selecting a biology textbook for 10th–12th graders for the first time since the *Content Standards* were adopted. Department Chair Elizabeth Biller recalls, "We looked at several publishers' materials. Teachers were invited to complete rating sheets for each product, scoring items such as coverage of content standards, readability, graphics, resources, organization, etc. The book did an excellent job of covering our state standards, and scored better than others overall. Specifically appealing to our teachers were the section previews, clarity of objectives, and units of instruction that allowed easy access for a variety of kids, as well as the abundance of resources available to them.

Teacher David Drake shares, "I recommended the text based on what I saw in it. The content was really geared for my students, not too tough and not too easy. It was more up-to-date than other texts and the graphics and reading level were much better. It also had better resources." Bob Finnell adds, "*Biology: The Dynamics of Life* is packed full of good information. It's more student-friendly because it is easier to read and easier to understand. The textbook really gets the content

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across to the kids. It's better than other books." *Biology: The Dynamics of Life* was implemented in the classroom beginning in the 2001–2002 school year.

Teaching with Technology

Ms. Biller believes the technology materials provided with *Biology: The Dynamics of Life* "serve the teachers well." She comments, "The teachers really, really, really like the CDs and the flexibility of the test-making program. I think that having access to technology is important with this program, because some of the activities best liked by teachers and students alike would not be available without it." La Quinta High School has an average of three students per computer, compared with the statewide average of 6.9 students per computer. At La Quinta, technology reportedly plays an important part in education.

Mr. Finnell uses technology materials such as ExamView® Pro Test Bank to help him prepare for class. His students use the Virtual Labs CD-ROM to practice skills. He states, "Kids love these and are very adept at them. They motivate the kids and get them excited, and most importantly they help them learn." Mr. Finnell also uses some of the other media resources, such as the BioLab Videos, and the MindJogger Videoquizzes. He says his students also love these and are motivated to learn.

Positive Student Attitudes

Biology teachers at La Quinta report that their students' attitudes toward biology have changed from the beginning of the year to the end. Mr. Finnell says, "At the end of the year, they seem to appreciate biology more and some even want to come back for more. I think the text's friendliness and active engagement of the students has contributed to this attitude change." Mr. Drake reports similar findings: "My kids like biology now. In the past, I would say the typical student did not like science, but



Brand X Pictures/Getty Images

since implementing *Biology: The Dynamics of Life*, I notice a lot more students interested, engaged, and, as a whole, their grades have gone up. I think all the resources with the text are the key because they allow you to do so many things."

Seeing Academic Success

California Public Schools uses the Academic Performance Index (API) to measure the academic performance and growth of schools. The statewide API performance target for all schools is 800, and a school's growth is measured by how well it is moving toward or past that goal. La Quinta's API score in 2001–2002 was 653, and improved to 675 in 2002–2003. Ms. Biller believes that *Biology: The Dynamics of Life* was a "contributing factor." Mr. Finnell believes that the text helps students become better readers, which helps them perform better on tests.

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Northampton Area High School

Northampton Area School District, Northampton, Pennsylvania

Northampton Area High School is located in a small town (pop. 9,405) in the Lehigh Valley, about 50 miles north of Philadelphia. The area is rich in limestone and became a hub for cement manufacturing, which is why the school boasts itself as the “Home of the Concrete Kids.” It is the only high school in the district and serves almost 1,700 predominately Caucasian students in grades nine through twelve. The school district’s mission is “to educate ALL, for ALL can learn.”

In 1999, Northampton Area High School’s Science Department conducted their curriculum review. Department Chair Glen Young arranged for a handful of major publishers to present at an in-service for his biology teachers. Glencoe presented *Biology: The Dynamics of Life*. Mr. Young remembers, “Most importantly, we were looking for a book that was aligned with our state science standards. But we also wanted a book that we could use with our 500 10th-graders who are heterogeneously grouped. We didn’t want a traditional ‘facts and stats’ book, or an introduction to biology.”

After the publishers’ presentations, Science Department staff reviewed all the materials and selected *Biology: The Dynamics of Life*. Mr. Young recalls some of the reasons why his staff chose *Biology: The Dynamics of Life*: “The book is teacher- and student-friendly. It is well organized with a nice blend of academic science data and activities. It is very visual on every page. And most importantly, it aligned with our state science standards exactly. Even the order in the book matches our standards. For example, one of our science standards is environment/ecology, and most texts we looked at had it thrown in the back of the book, but Glencoe’s *Biology: The Dynamics of Life* has it right in the beginning of the text, and the information is quite expanded.”

Positive Teaching Experiences

Mr. Young believes the school’s five biology teachers are “happy with *Biology: The Dynamics of Life* because of its nice mix of activities, visuals, teacher materials, available technology, including online resources, and its overall friendliness.” Teacher Melissa Davis says, “*Biology: The Dynamics of Life* is absolutely easy to use and works well for both my advanced and general classes.” One feature of the textbook that Ms. Davis particularly likes is the MiniLabs. “They are a great way to introduce a topic or even review a topic and only take about 15 minutes.” Ms. Davis also comments, “I just really like the way the book is organized. I am an organization freak and everything in this book is so easy to find and use. I even use some of the materials and visuals from this book for the Genetics course I teach.”

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Fellow teacher Becky Stroup echoes Ms. Davis, “I think *Biology: The Dynamics of Life* is very, very easy to use and helps me reach students that are at different levels. The labs are excellent for hands-on learners, and the pictures and visuals are absolutely necessary for all learners, I think.” Ms. Stroup uses the online reviews, games, quizzes and tests frequently. “My students are very into computers, so they love any of that. Most of them have a computer at home, so they do a lot of review at home on the Web site.” She also uses the transparencies, which she thinks “really help students to learn the more conceptual biological topics,” and the *Basic Concepts Transparency Book*, because it is “especially good for vocabulary development. *Biology: The Dynamics of Life* just has a lot of different activities that give the students practice and helps them with their problem-solving skills.”

State testing in Pennsylvania had not been implemented as of the 2003–2004 school year, so student performance data is unavailable. However, Ms. Davis and Ms. Stroup believe *Biology: The Dynamics of Life* provides many appropriate tools and opportunities to assess student learning through the various worksheets, chapter tests and MiniLabs. “The MiniLabs and the Web links are an especially easy way to see if my students are understanding the material,” says Ms. Davis. Though Ms. Stroup primarily assesses students the “traditional” way, by using the test bank to create tests, she says, “The chapter and section assessments are great for the students to assess their own knowledge as we go along.” And, as Ms. Davis does, Ms. Stroup uses the labs to observe and assess how well her students are learning. “*Biology: The Dynamics of Life* definitely gives a good variety of tools for assessment, and I try to grab a little bit from everything.”

Student and Parent Response

Finding a biology text that students and parents like to use is important. *Biology: The Dynamics of Life* seems to be just the right book for Northampton. Students of Ms. Davis have told her they enjoy the book and find it easy to use. Ms. Stroup says, “There are definitely aspects where they are very interested in the text.” Parents from Ms. Stroup’s class have attended open house nights and told her “the book is very readable and easy to understand, so they can pick it up and study with their child.” Both teachers have had parents tell them that that they really enjoy the online resources. Ms. Davis shares, “Parents like that students can do a lot of work online from home so that, when they are absent, they do not fall behind.”

Keys to Success

Mr. Young believes it is important to “give teachers time to familiarize themselves with all the teacher resources, supplementary resources, and online resources, so they can better implement the program in the classroom. *Biology: The Dynamics of Life* provides a rich supply of teacher support materials and can be a very interactive program if all of it is used.” Ms. Stroup agrees and makes the following suggestion to other teachers: “Use as much of the materials provided with *Biology: The Dynamics of Life* as you can. Everyone has his or her own teaching style, of course, but to reach every student, you need to use a variety of methods, and this program provides them.”

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Willowbrook High School

DuPage High School District 88, Villa Park, Illinois

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illowbrook High School opened in 1959 in Villa Park, Illinois (pop. 22,075), a western suburb of Chicago. It is one of two high schools in DuPage High School District 88, serving over 2,000 students. Willowbrook High School has a 21st-century vision for itself: “A learning community that welcomes, excites, and challenges,” and uses a T.E.A.M.S. Cycle as a process to increase student achievement. T.E.A.M.S. stands for:

- Target opportunities to improve student learning.
- Examine best practices and current research for best solutions.
- Apply new knowledge to develop and implement an action plan.
- Modify, based on evaluation.
- Share and celebrate results with others.

Meeting Student Needs

In 1998, Willowbrook High School realized that it was not meeting the needs of its 375 9th-grade core Biology students. Carlene Hougen, Science Department Chair, remembers, “I had complaints from our instructional resource center and Title I resource center that even adults had trouble reading our biology textbook. The book was really difficult for students to comprehend because the information was not presented clearly. There were also a few errors in the book.” So, Mrs. Hougen made requests to several publishers for a preview copy of their newest biology programs to review with her department. *Biology: The Dynamics of Life* was one of the books that they previewed.

Mrs. Hougen said her department was looking for the following qualities in a biology text for their students: mapped to the Illinois State Science Standards; engaging to students; information presented in short segments and reinforced with diagrams, pictures, and data tables; information to help students learn vocabulary and understand root words; supplementary materials such as a study guide, reinforcement activities, and lab manuals; and written at the appropriate reading level. Mrs. Hougen says, “We liked *Biology: The Dynamics of Life* right away. The approach of the book is excellent! It has all the qualities we were looking for. It also starts with the ecological material first and continues with it throughout the book. We also like that chapters are broken into sub-units, which means the material is presented in smaller pieces so the student doesn’t lose interest and the teacher can assess learning throughout the chapter. And there are so many hands-on activities and materials for visual reinforcement.”

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Willowbrook pilot tested *Biology: The Dynamics of Life* in the 1998–99 school year, found it to be successful with teachers and students, and implemented it fully in the 1999–2000 school year.

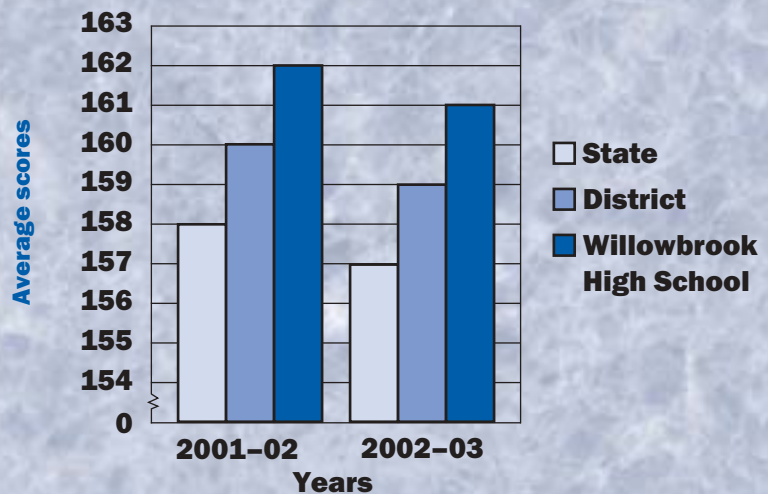
Measuring Success

In Illinois, the Prairie State Achievement Examination (PSAE) measures the achievement of 11th-grade students relative to the Illinois Learning Standards for reading, writing, mathematics, science, and social science. Mrs. Hougan believes that *Biology: The Dynamics of Life* prepares students very well for the PSAE. “Our students are only required to take two years of science, so we have to meet the standards with this book, and I believe we do.” For the 2001–02 and 2002–03 school year, Willowbrook students’ science scores on the state test have been above the average score in the state of Illinois, and have been higher than other students in their district, as shown in the graphs on this page.

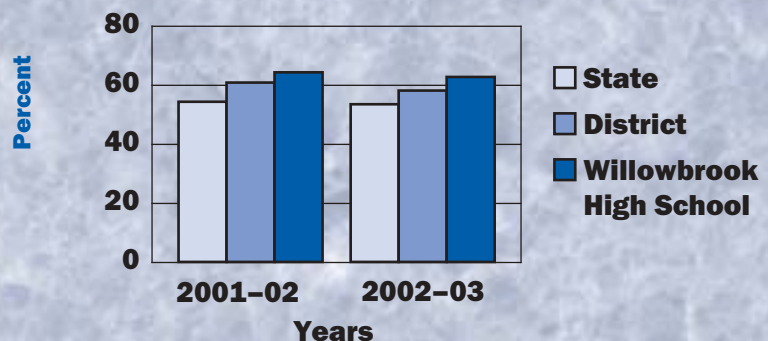
A Teacher’s Thoughts

Mrs. Hougan says, “We love *Biology: The Dynamics of Life* and highly recommend it. It is a readable book that provides students with the information they need to be a critical thinker in today’s society. This program also provides the teacher with the appropriate resources to meet the needs of a wide range of students. This is a user friendly text and program.”

Prairie State Achievement Examination (PSAE) Average Score Comparison



Prairie State Achievement Examination (PSAE)—Percent Meeting or Exceeding Comparison



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Other Comments on *Biology: The Dynamics of Life*

Ease of Use/Flexibility

Glencoe has far better teaching materials than other publishers; they are teacher-friendly. The materials are so much richer than other publishers, and more in-depth.

*Rosanne Magarelli, Teacher
Powell Junior High School, AZ*

I use the *Science Inquiry Lab Manual*. The labs are at the appropriate level, easy to follow and there are multiple labs to choose from. I couldn't live without the ExamView® Pro Test Bank CD-ROM. It's a wonderful tool to make multiple versions of tests. It's easy to use, too, and in a good user-friendly format. Glencoe's *Biology: The Dynamics of Life* is a very good tool with a lot of resources to help students succeed. I like the book, and I enjoy using it.

*Tami Ellis, Teacher
Fort Walton Beach High School, FL*

I like the BioDigests; they're very well-written. The curriculum lays out the whole program for the instructor, and we can select enrichment activities as we cover the topics. BioDigest is great to touch on a theme when there's not enough time to do an in-depth study. I like the Focus On Sections, too; they're very interesting and have current topics that bring biology into the students' lives in a meaningful way. The previous book that we used didn't have all of the classroom resources—such as concept mapping. We have a whole booklet on that. It's easy to use, because you have so many resources, like scheduling; we are on block scheduling, so that was helpful. Lesson plans are included so it helps to organize the curriculum. If I needed help, I went online to the Web site. I have it bookmarked! And I've gone there many times not only for help but also for interesting activities. The Spanish resources are great too, especially in Florida.

*Patricia Murphy, Teacher
Palm Beach Gardens High School, FL*

Glencoe's *Biology: The Dynamics of Life* has a lot of small chapters, which is helpful because you can cover a chapter within a week to a week-and-a-half. It makes it easier to read for students, and they don't get overwhelmed. The review questions are ideal for homework and align with the information in the summary tests. *Biology: The Dynamics of Life's* simplistic approach to biology doesn't overwhelm students with too many goals in each unit and in follow-up activities. The teacher's manual is also nice. It is easy to use and comes with a lot of supplements.

*Christal Hatcher, Teacher
John Marshall High School, OH*

Biology: The Dynamics of Life has great user-friendliness. It's highly readable and it has great ancillary materials, like workbooks and transparencies. The *Content Mastery* questions for each chapter are just the right length.

Margaret Noble Kain, PhD, Teacher
North High School, AZ

Biology: The Dynamics of Life offers suggestions on how different learning styles can be addressed, how to reteach students who didn't learn the first time, and suggestions for cooperative learning activities.

Jessie Rucker, Science Department Chair
Curie Metropolitan High School, IL

High-Quality Visuals/Examples

Biology: The Dynamics of Life has numerous photographs and graphics. From a teacher's point of view, that makes it easier for me to help the students understand the concepts. The students enjoy the pictures; as they allow them to visualize concepts. They also enjoy the labs, especially designing their own labs. They're confused the first few times; they're used to someone saying, 'do this and this and this.' With some of the labs, you can just get them started and then they run with it, and discover the concepts themselves.

Patricia Murphy, Teacher
Palm Beach Gardens High School, FL

The visuals are excellent and make the material much more digestible and even compelling for the students. The scientific pictures of what a scientist would see under the microscope gives the students assurance of what is accurate. The visuals are like a mini-field trip. Glencoe has gone a step further than others and made biology comprehensible. I think the book lets the students take command of their education.

Rosanne Magarelli, Teacher
Powell Junior High School, AZ

Biology: The Dynamics of Life is simple for students and has colorful pictures which help stretch the imagination. I use overheads to show highlights of the chapter. For example, they have diagrams of the cell membrane which highlight the organelles. In all, visual learning helps emphasize the content in the text.

Christal Hatcher, Teacher
John Marshall High School, OH

Biology: The Dynamics of Life has graphics to help students understand how vocabulary terms are linked together at the end of the text. I often refer to the appendices. For example, when we were discussing the topic on atomic structure, it was helpful to have the periodic table available to students in the appendices. It includes a good glossary. It also has an excellent diagram of a microscope that helps to introduce how to use the microscope. There's a biology digest that gives additional information, too. This semester I'm focusing on careers and there's information on careers in biology. This helps students to think about their life goals.

Jessie Rucker, Science Department Chair
Curie Metropolitan High School, IL

Content/Skills-Building

I like how the program assesses knowledge and skills...at higher-thinking levels.

Rosanne Magarelli, Teacher
Powell Junior High School, AZ

The MiniLabs in *Biology: The Dynamics of Life* are excellent. They are quick and can be done in a short period. The chapter assessments cover important principles. I also like the vocabulary at the beginning of each section, so students know words they'll need to understand by the end of the chapter. I also liked the assessing knowledge and skills sections at the end of the chapters, because they are so similar to questions on standardized tests. If the students take advantage of the content in the text and all the supplementary materials, such as: the Internet, videos, etc., they will be well prepared for PSAT/ACT tests and college. The reason is that there are critical thinking questions related to graphs and tables which is common on standardized tests.

Jessie Rucker, Science Department Chair
Curie Metropolitan High School, IL

I feel the text is extremely well-organized, and the chapters are the right length. I like the pictures given with examples; they are pertinent, clear, and visually attractive. I like the review in the book when scientists and diseases are highlighted. It has good thought-provoking questions. The transparencies are clear and concise. It's a comprehensive, well-organized and carefully constructed textbook with excellent supplementary materials. The ease of reading and gaining information, providing recall and retaining information, suits all students well.

Margaret Noble Kain, PhD, Teacher
North High School, AZ

The *Reinforcement and Study Guide* is very good at bringing out important parts of each section, and allows students to see different ways of asking questions. It's also great for vocabulary skills.

Tami Ellis, Teacher
Fort Walton Beach High School, FL

With *Biology: The Dynamics of Life*, my students' skills have improved, because the approach to learning has changed. Now we use other sources such as the Internet. There are lots of opportunities. We can show how a cell works. We couldn't do that before. We have been exposed to more with the new technology but we also use the text as a basic learning tool.

*Christal Hatcher, Teacher
John Marshall High School, OH*

I have seen a considerable amount of improvement in my students each year that we've been using Glencoe's *Biology: The Dynamics of Life*. A student who came in at the beginning of the year turned in very little work. He felt he couldn't do it. Once he gave it a try, he got good grades and became my most improved student. This all happened from the first quarter to the third quarter of the year. Glencoe should get credit for that major improvement. That was the most improvement I've seen in my 17 years of teaching.

*Paul Wordell, Teacher
Lincoln West, OH*

Student/Parent Response

With MiniLabs included in the chapter, you can reach a lot of kids that might not be reached if it were just a traditional style of material. I find the MiniLabs to be very useful. They don't take a lot of time, but they allow kids to think and come up with answers based on their observations.

*Paul Wordell, Teacher
Lincoln West, OH*

Biology: The Dynamics of Life offers a connection to biology along with chapters that expand the imagination. The labs are easy for students to read and understand. Parents think we're doing pretty weird things, pretty different, but it's positive feedback. In the insect collecting exercise, students have to collect a certain number of insects and often parents and other family members get involved with the project too!

*Christal Hatcher, Teacher
John Marshall High School, OH*

It's an excellent book for high school biology students. It is very thorough, holds students' attention, and has excellent graphics. It aligns with state goals and learning standards. It aids students in building the skills they will need to perform well on standardized tests and in college.

*Jessie Rucker, Science Department Chair
Curie Metropolitan High School, IL*

Appendix

Research Supporting Content and Instruction in *Biology: The Dynamics of Life*: A Selected Annotated Bibliography

The following descriptions of research provide a brief overview of findings in biology and science education. Each of these, along with additional research, has played a role in informing the development of *Biology: The Dynamics of Life*. The authors of *Biology: The Dynamics of Life* continue to update the program as new studies are published and new research on instructional methods becomes available. The sum of the knowledge revealed by these studies continues to support and enhance the philosophy of this program.

American Association for the Advancement of Science (AAAS), Project 2061. (1993). *Benchmarks for Science Literacy*. Washington, DC: AAAS.
<http://www.project2061.org/tools/bsl/default.htm>

This document outlines the fundamentals of science literacy and provides a solid foundation upon which national and state science standards were based.

Armbruster, B. B. (1996). Considerate texts. In D. Lapp, J. Flood, & N. Farnan (Eds.). *Content area reading and learning: Instructional strategies*. Needham Heights, MA: Allyn & Bacon, 47–57.

Comprehension is improved when main ideas appear prominently in introductions, summaries, and headings, not buried within paragraphs.

Banks, J. A. (2001). *Cultural Diversity and Education: Foundations, Curriculum and Teaching*. Boston: Allyn and Bacon. (4th edition of *Multicultural education: Theory and practice*.)

Effective strategies include using examples from many cultures, helping students understand implicit bias, and using a variety of teaching skills for diverse groups.

Barr, B. B. (1994). Research in Problem-Solving: Elementary School. In D. L. Gabel (Ed.), *Handbook of Research on Science Teaching and Learning*. New York: Macmillan, 237–247.

Problem solving is supported by student-generated questions related to discrepant events, guidance in asking productive questions, activities causing students to reflect on strategies they used, helping students evaluate their hypotheses, and social interaction related to the problem before experiment.

Barton, M. L., & Jordan, D. L. (2001). *Teaching reading in science: A supplement to the Second Edition of Teaching Reading in the Content Areas Teacher's Manual*. Aurora, CO: Mid-continent Research for Education and Learning.

This resource describes some of the latest research on reading and learning science and provides tips for helping students to utilize textbooks more effectively.

Black, P., & William, D. (1998). Assessment and classroom learning. *Assessment in Education*, 5(1): 7–74.

There is no single, simple method for formative assessment; a variety of approaches are successful. An extensive research review indicates that formative assessments produce significant learning gains. Achievement gains associated with formative assessment are greater than most other interventions. Student self-assessment increases understanding of science concepts and critical thinking ability.

Bransford, J. D., Brown, A. L., & Cocking, R., (Eds). (1999). *How People Learn: Brain, Mind, Experience, and School*. Washington, DC: National Academy Press.
<http://books.nap.edu/books/0309070368/html/index.html>

Students need to understand major concepts, build a base of factual information, and know how to apply their knowledge. Class discussions help students develop language for expressing science concepts, making ideas explicit, and providing reasoned arguments. Effective problem solvers constantly monitor their understanding and adjust their strategies as they work.

Center for Science, Mathematics, and Engineering Education (CSMEE). (2000). *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning*. Washington, DC: National Academy Press.

Meta-analyses done in the 1980s on the inquiry-based curriculum projects of the 1960s and 1970s (e.g. BSCS), show that inquiry-based teaching produced positive results in cognitive achievement, process skills, and attitudes toward science. Additionally, students can do investigations prior to learning vocabulary. As they build explanations for their observations, the names (vocabulary) for the concepts become useful and meaningful. The words are symbols for their understanding.

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: Erlbaum, 229–254.

Attractive, relevant-to-students presentations of key concepts motivate students to learn.

Dickson, S. V., Simmons, D. C., & Kameenui, E. J. (1995). *Text organization and its relation to reading comprehension: A synthesis of the research*. (Technical Report No. 17). Eugene, OR: National Center to Improve the Tools of Education, University of Oregon.

A synthesis of research finds the following characteristics assist reading comprehension:

- Page layout that makes the organization of the content evident
- A consistent pattern within each lesson or chapter
- Providing students with explicit instruction on the text structure.

Education Trust. (1999). *Dispelling the myth: High poverty schools exceeding expectations*. Washington, DC: The Education Trust.

Higher achievement is associated with the use of simulation and application software.

Fellows, N.J. (1994). A window into thinking: Using student writing to understand conceptual change in science learning. *Journal of Research in Science Teaching*, 31(9), 985–1001.

Writing is a powerful classroom assessment tool, enabling science teachers to see how well students understand concepts and whether they have misconceptions.

Gabel, D.L. (Ed.). (1994). *Handbook of research on science teaching and learning: A project of the National Science Teachers Association*. New York: Macmillan.

This resource provides an overview of seminal research in science teaching and learning.

Good, T. L. & Brophy, J. E. (2003). *Looking in classrooms*. Boston: Pearson Education, Inc.

Questions that require students to analyze or apply information produce more learning than questions that ask students to simply recall or recognize information.

Griffin, C., Simmons, D. C., & Kmeenui, E. J. (1992). Investigating the effectiveness of graphic organizer instruction on the comprehension and recall of science content by students with learning disabilities. *Journal of Reading, Writing & Learning Disabilities International*, 7(4), 355–376.

Graphic organizers are highly effective. They combine the linguistic mode (words) with the nonlinguistic mode (symbols, lines, arrows). They can be used with descriptive, time-sequence, process, generalization, and concept patterns.

Helgeson, S. L. (1994). Research in Problem-Solving: Middle School. In D. L. Gabel (Ed.), *Handbook of Research on Science Teaching and Learning*, New York: Macmillan, 248–268.

For effective problem solving, integrate science process skills and content over several weeks, using hands-on, inquiry activities and concentrate on problem-solving skills. Improving students' problem-solving skills leads to a more positive attitude and to self-confidence in students' science abilities.

Hodson, D. (1998). *Teaching and learning science: Towards a personalized approach*. Buckingham, United Kingdom: Open University Press.

Writing helps students connect science knowledge, inquiry processes, values, and vocabulary with everyday language and students' experiences.

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.

Pronunciation and other decoding skills are prerequisites to comprehension.

Jonassen, D., & Carr, C. (2000). Mindtools: Affording multiple knowledge representations for learning. In S. LaJoie (Ed.), *Computers as Cognitive Tools*, Mahwah, NJ: Lawrence Erlbaum Associates, 165–196.

Computer technology offers several kinds of tools for learning—organization tools (databases, concept mapping), dynamic modeling tools (spreadsheets, modeling software), knowledge construction tools (hypermedia), and conversation tools (e-mail and online discussion). Using technology to process and manipulate information, frees students to reflect on what they know and use higher-order thinking skills.

Lee, O., & Fradd, S. H. (1998). Science for all, including students from non-English language backgrounds. *Educational Researcher*, 27(4), 12–21.

ELL students benefit from authentic communication (explain, summarize, etc.) and a variety of communication, including writing, speaking, drawing, using tables, and making graphs.

Lemke, J. (2002). Teaching All the Languages of Science: Words, Symbols, Images, and Actions. <http://academic.brooklyn.cuny.edu/education/jlemke/papers/barcelon.htm>. Drawing can powerfully express spatial and quantitative meaning; verbal forms (reading, writing and speaking) are better for reasoning.

Marzano, R. J., Pickering, D. J., & Pollock, J. E. (2001). *Classroom Instruction that Works*, Alexandria, VA: Association for Supervision and Curriculum Development.

This resource describes effective methods of teaching and classroom management that apply to all disciplines. Some key components that apply to *Biology: The Dynamics of Life*:

- Cooperative learning has a highly positive effect when compared with strategies in which students compete with each other and strategies in which students work on tasks individually.
- When practicing processes, have students state the subcomponent they will practice and set criteria for success; provide a variety of activities; have students self-assess, and provide feedback on only the targeted skill.
- Focused practice, in which one aspect of a complex, multi-step process is targeted, is effective when practicing scientific inquiry.
- In addition to the teacher's modeling of the skill or process, guided practice, and independent practice, students need to understand how the skill or process works.

Marzano, R. J. (2000). *A new era of school reform: Going where the research takes us*. Aurora, CO: Mid-continent Research for Education and Learning. <http://www.mcrel.org/topics/productDetail.asp?productID=81>.

The many variables that make up teacher effectiveness are grouped into three categories: instruction strategies, curriculum design, and classroom management. Effective curriculum design includes clear and organized learning objectives as well as well-spaced and paced activities that help students meet objectives.

Matthews, B. (2004). Promoting emotional literacy, equity and interest in science lessons for 11–14 year olds: The improving science and emotional development project. *International Journal of Science Education*, 26(3), 281–308.

Students can increase their interest in science, as well as develop social and emotional skills, through collaborative group work in mixed-gender groups.

Minstrell, J., & van Zee, E. H. (editors)(2000). *Inquiring into Inquiry Learning and Teaching in Science*. Washington, DC: American Association for the Advancement of Science.

A review of the research indicates that inquiry-based teaching can result in scientific literacy, familiarity with science processes, vocabulary knowledge, conceptual understanding, critical thinking, and positive attitudes toward science.

National Institute of Child Health and Human Development. (2000). Report of the National Reading Panel. *Teaching Children to Read: An Evidence-Based Assessment of the Scientific Research Literature on Reading and Its Implications for Reading Instruction: Reports of the Subgroups* (NIH Publication No. 00-4754). Washington, DC: U.S. Government Printing Office, 4-52. <http://www.nichd.nih.gov/publications/nrp/report.htm>

A variety of comprehension strategies have been shown to significantly improve comprehension—comprehension monitoring, cooperative learning, graphic organizers, question answering, question generation, and summarizing. Learning vocabulary in context is valuable.

National Research Council. (1996). *National Science Education Standards*. Washington, DC: National Academy Press. <http://www.nap.edu/readingroom/books/nse/html/>.

The *National Science Education Standards* provide the foundation for state science standards. The national standards describe content standards as well as standards for teaching, professional development, and assessment.

National Research Council and the Institute of Medicine. (2004). *Engaging schools: Fostering high school students' motivation to learn*. Committee on Increasing High School Students' Engagement and Motivation to Learn. Board on Children, Youth, and Families, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press. <http://www.nap.org>

Students are motivated by instruction connected to their pre-existing understandings, interests, and real-world experiences, active involvement in problem solving and real-world applications, and varied instruction that is appropriately challenging.

Palincsar, A. S., & Brown, A.L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction*, 2, 117–175.

To teach comprehension strategies, make readers aware of their own cognitive processes, guide readers, and model the strategies, and have readers practice these strategies until they are internalized. Reciprocal teaching by students is effective. Students predict, ask questions about the text, seek clarification, and summarize.

Pressley, M. (2002). *Reading instruction that works: The case for balanced teaching*. 2nd Ed. New York: Guilford Press.

Effective comprehension strategies include questioning, visualizing, clarifying, elaborating, inferring, concluding, summarizing, and predicting.

Reid, D. J. (1990). The role of pictures in learning biology: Part 2, picture-text processing. *Journal of Biological Education*, 24, 4, 251–258.

Learning biology is enhanced by pictures that contain information that also is presented in the text.

Rivard, L.P. (1994). A review of writing to learn in science: Implications for practice and research. *Journal of Research in Science Teaching*, 39(8), 969–983.

Meaningful writing tasks leads to improved student learning in science. Students increase their understanding when they put concepts into their own words. Writing is a tool for making sense of new information. Authentic writing tasks in which students communicate with a real audience, rather than a teacher, are more effective.

Rosebery, A., Warren, B., & Conant, F. (1992). *Appropriating scientific discourse: Findings from language minority classrooms* (Working paper 1–92). Cambridge, MA: TERC.

ELL students can learn science inquiry and concepts while learning English. Through scientific inquiry, students develop abilities in reasoning, observation, and logical analysis.

Sadler, D. Royce. (1989). Formative Assessment and the Design of Instructional Systems, *Instructional Science*. 18, 119–44.

Self-assessment by pupils is an essential component of formative assessment. Students need to know the learning objective, their current level of understanding, and steps to take to reach the objective.

Saul, E. W. (Ed). (2004). *Crossing Borders in Literacy and Science Instruction: Perspectives on Theory and Practice*. Newark (DE): International Reading Association and Arlington (VA): National Science Teachers Association.

These authors discuss the latest research on how to teach reading and other literacy strategies while teaching science.

Schwab, J. (1966). *The Teaching of Science*. Cambridge, MA: Harvard University Press.

By reading and discussing reports of scientific research, analyzing the process and evaluating alternative experiments or explanations, students build an understanding of scientific inquiry as it is used by scientists.

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.

This study suggests that students with learning disabilities learn more with an inquiry-oriented approach.

Shymansky, J. A., Kyle, W. C., & Alport, J. M. (1983). The Effects of New Science Curricula on Student Performance. *Journal of Research in Science Teaching*, 20(5), 387–404.

Inquiry-based teaching leads to enhanced critical thinking, inquiry abilities, and positive attitudes toward science.

Stadler, H., Benke, G., & Duit, R. (2001). How do boys and girls use language in physics classes? In H. Behrendt, H. Dahncke, R. Duit, W. Graber, M. Komorek, A. Kross, P. Reiska, (Eds.) *Research in Science Education—Past, Present, and Future*. Dordrecht, Boston, London: Kluwer Academic Publishers.

Students strengthen their understandings of concepts and vocabulary when they reformulate their understandings using everyday language and personal analogies.

Texley, J. & Wild, A. (2004). *NSTA Pathways to the Science Standards: Second High School Edition*. Arlington, VA: NSTA Press.

This resource describes an overview of successful practices for high school science education, including incorporating science standards, assessment, professional development, and teaching methods.

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

High-quality visuals encourage students' mental images that help them recall information better than does text or lower-quality visuals.

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