Preface

The two years since the first edition of *BioInquiry* appeared have been a busy time for the biology community. The human genome has been nearly entirely sequenced, a biotechnology firm announced that it has cloned human cells for use in research, and the United States and other countries have been threatened with the prospect of biological warfare. These events underscore the importance of basic biological understanding for all concerned citizens. The ever-changing field of biology and the issues it encompasses also remind us that factual knowledge is not enough. The body of information about the living world is growing at an unprecedented rate, and some facts that seemed sure to us a decade ago are giving way to new particulars. More than ever, we need to apply a broad, conceptual understanding of biology to make sense of the nature of life. This is the philosophy embraced by many of us teaching introductory biology, and the reform movement we have witnessed among teachers of introductory college courses has been nothing short of a revolution.

Even so, most teaching materials continue to move in the opposite direction. Most textbooks are getting longer and more fact laden. In many books, accumulated knowledge of biology is not explained as an integrated whole, but instead is presented in bite-sized modules. The computer materials that accompany these texts are regurgitations of the facts presented in the books. In the first edition, the authors of *BioInquiry* mapped a strategy for developing teaching materials that both told the engaging story of discovery in biology and incorporated computer technology to enhance learning without intimidating students or bogging them down in unnecessary detail. We wanted our materials to be accurate; we wanted them to be timely; but most of all, we wanted *BioInquiry* to convey the fun and excitement of one of the most rapidly moving, fascinating fields of science. When students finish with *BioInquiry*, we told ourselves, we want them to be informed citizens capable of understanding the scientific method and making rational judgments on the many biology-related issues that our society faces in this new millennium. As authors, we interpreted the success of the first edition of *BioInquiry* as a vote of confidence from our colleagues at colleges and universities around the country, and we have extended our philosophy into this, the second edition.

Breaking From Tradition

BioInquiry is a bold new approach, different in important ways from traditional methods of teaching the life sciences. Conventional pedagogies follow the order of biological *analysis*. This has always meant starting with chapters on the atom and working toward ever larger entities—biomolecules, DNA, genes, cells, organisms, and so forth—ending finally with the largest levels of organization, ecosystems and the biosphere. Many students, however, find this approach unsatisfying. Chemistry seems abstract to beginning students, and it may be several weeks before they encounter their first truly biological idea. Rather than present biology as a series of analytical levels of organization, *BioInquiry* takes students on an intellectual journey that follows the order of biological *understanding*.

Most biologists agree that the real story of modern biology began with Darwin's theory of evolution by natural selection, and we believe introductory courses should not teach otherwise. Hence, our story begins with Darwin and the enduring question of why there are so many different living things. Because Darwin's theory provided an intellectual environment ripe for the rise of classical genetics, our chapter on evolution (Chapter 2) guides students through a process of discovery to Mendelian genetics (Chapter 3). From Mendel's garden came insights that led biologists to discover cells (Chapter 4), chromosomes (Chapter 5), and ultimately DNA and modern molecular biology (Chapter 6).

The connections between Darwinian evolution and Mendelian genetics lead to population genetics, explored in Chapter 8. Next come descriptions of the great diversity of life (Chapter 9) and of energy constraints (Chapter 10) that have given rise to the many ways in which organisms have evolved to adapt to the challenge of life. Then we turn to adaptation: animal physiology (Chapter 11);

human physiology (Chapter 12); and plant form and function (Chapter 13). We end with chapters on animal behavior (Chapter 14), population ecology (Chapter 15), and community ecology (Chapter 16) to illustrate how organisms interact with each other and their environments.

The decision to organize *BioInquiry* this way means that chemistry and the properties of the atom are neither our starting point nor chapters by themselves. Instead, chemistry is introduced in the text where it is most relevant, and it is also compiled in an appendix and as a series of visual exercises on the *BioInquiry* CD. Students can turn to the Chemistry Review whenever they need to enlighten an important biological concept. Students and instructors using the first edition of *BioInquiry* applauded this treatment of the subject.

Another break with tradition is in the topics we chose to include and those we chose to omit or abbreviate. For example, we spend several pages of the textbook on the conceptual topic of the cell cycle but provide only the level of detail on the topics of DNA replication and repair that we believe is appropriate for non-majors. Those wishing to learn more about the detailed mechanisms of these processes are directed to the *BioInquiry* web-based exercises. Likewise, the chapter on cellular energetics develops many important ideas about energy but directs the student to the CD and the web to learn the detailed steps of photosynthesis, glycolysis, and Krebs cycle.

These tough and sometimes controversial decisions were made in the spirit of educational reform, and we believe they reflect the manner in which educators are taking new, more conceptual approaches to biology.

Making Connections in Biology

The organization of chapters in *BioInquiry* emphasizes methods and theoretical foundations of ideas, and minimizes isolated facts—an approach we believe makes biology more meaningful and accessible to introductory students. Concepts are given a place in the history of ideas and are connected historically and intellectually to illuminate their importance.

First and foremost, *BioInquiry* stresses the integration of ideas by making connections among the important ideas that form our understanding of the living world. Throughout *BioInquiry* we have tried to give students an appreciation of the debates and difficulties that characterize the advance of scientific understanding and the satisfaction of seeing how new theories bring together—in other words, connect—our ideas.

Second, we have worked hard to ensure that the textbook and the electronic media work together to complement the central ideas of the field. This dual pedagogy—textbook and electronic media—is a significant departure from more traditional, text-centered materials that include supplementary CDs and web sites. For example, in *BioInquiry* students find that topics covered in electronic media are not identical, but are closely related, to the material in the textbook. The content in the text and media was developed simultaneously, is organized in the same way, and shares the same look. But we have used each medium to its greatest advantage to connect and enrich the central ideas in new ways. As such, it is not appropriate to call *BioInquiry* a textbook; it is a learning system.

The BioInquiry Pedagogy

The *BioInquiry* textbook is intended to be readable, introductory, and motivational. Where appropriate, it is historical. Here students get a sense of the origin of ideas in biology. The reading style is engaging to encourage students to read. Icons in the margins direct students to related topics on the CD. Each major section of the text ends with a "Piecing It Together" section, where key concepts are summarized. Throughout the text, key terms are in boldface type the first time they are defined in each chapter. These terms are defined in the glossaries found at the end of the text and on the CD. Each chapter ends with a set of review questions to assist students in self-assessment.

For many students, learning is enhanced by visualizing biological concepts. The electronic media—the integrated CD and web site—is uniquely suited to animation, interactivity, and step-by-step progression. Students use virtual reality to go inside a cell, inside a membrane, watch mitosis, and analyze data from key experiments. Interactivity is encouraged by allowing students to design virtual experiments and analyze their data. Students work through concepts at their own pace, one step at a time. They can back up and repeat steps as necessary or jump ahead when they are ready. The media also walks students through key experiments, such as Mendel's work with sweet peas and Pasteur's experiments disproving spontaneous generation. Students are guided along a path of discovery, asked to make decisions, and to analyze data.

Web modules are sets of questions included on electronic media that lead students beyond the text. Each module begins with an introductory paragraph followed by a series of open-ended questions that can be answered by exploring the World Wide Web. This affords the opportunity to explore up-to-the-minute advances in biological research. From the media, students can download worksheets to record their findings and conclusions. When a worksheet has been completed, the student will have learned a new facet of the topic introduced in the text. Instructors wishing to explore a topic in depth can use the *BioInquiry* electronic media to add texture and detail. Students' energies are focused on ideas and not materials. How these ideas are presented remains the prerogative of the instructor.

Self-Assessments

There are several pathways to self-assessment built into *BioInquiry*. Questions at the end of each chapter ask

students to recall what they have learned and to synthesize the ideas covered in the text. After each topic on the media, students are presented with a summary paragraph drawing together the lessons of the topic. The summary also includes questions or directs students to a Self-Test section, allowing students to evaluate their progress as they work.

Changes in the Second Edition

This edition of *BioInquiry*, as with the first edition, was a community effort. We have taken the comments and suggestions of our users to heart in planning changes, without letting go of the important reforms we pioneered in the first edition. For example, one area in which we believe students need more background is DNA technology. Many "hot button" issues in the popular press involve biotechnology, and informed citizens need the conceptual framework on which to make fair evaluations of the risks and promises of this controversial field. We expanded our discussion of DNA technology into an entire chapter and illustrated the connections between basic DNA science (presented in Chapter 6) and biotechnology in an entirely new Chapter 7. We took great pains to show both sides of controversial issues and to provide opportunities for individual professors to explore more than just the scientific dimensions of the field.

Our chapter on biodiversity (Chapter 9) has been entirely reworked to expose students to more kinds of living organisms, while maintaining our commitment to evolution as a unifying theme in biology. Our chapter on cells (Chapter 4), too, has been reworked after students in our own classes told us that the topics covered in that chapter needed to flow more logically. We moved more of the chemistry out of our discussion of cells, allowing students (and their instructors) to bring in chemical principles as needed from the new Chemistry Review appendices. Finally, we updated all of our chapters to reflect new findings from the Human Genome Project and newly emerging ideas on such topics as anthrax, stem cells, and cloning.

This edition of the *BioInquiry* CD has new interactivities, including determining divergent and convergent patterns in evolution; using biotechnology tools to solve a murder mystery and research plants; identifying organisms in a biodiversity exercise; and exploring several cases of homeostatic imbalances.

Supplements

With *BioInquiry*, second edition, we offer the following supplements to assist both the teacher and the student.

Instructor's Manual and Test Item File by Joel Piperberg, Millersville University, offers lecture and CD-ROM outlines, teaching ideas, sample test questions, tips on using *BioInquiry* in large classrooms, annotated bibliographies, lab ideas, answers to review questions from the book, transparency masters, and over 2,000 questions pertaining to both the text and its accompanying CD.

Computerized Test Bank is an electronic test generator that will simplify your test creation in class.

Instructor's Resource CD includes the Instructor's Manual and Test Item File, and PowerPoint slides.

Presentation Tools on the *Instructor's Resource CD* include all line art from the text as both PowerPoint slides and individual jpeg files, as well as videos, animations, and photos.

Transparencies provide 100 full color line art from the text.

Take Note! is a notebook that lets students take notes directly on 8½" × 11" black and white versions of the textbook illustrations. All the illustrations from the transparency set are included. This notebook substantially reduces time spent in class copying illustrations.

The Book Web Site. Be sure to visit the *BioInquiry* web site at: *http://www.wiley.com/college/bioinquiry* to access materials to supplement your biology course.

A Deep Debt of Gratitude

We are keenly aware of our debt of gratitude owed to all who have supported us during the development of *BioInquiry*. First among them is the terrific team of editors at John Wiley & Sons. David Harris, our first editor, was perhaps the most influential force in the development of *BioInquiry*. Although David is now engaged in other reform projects at Wiley, we have been fortunate to have Wiley's new Biology editor on our team, Keri Witman. Keri has been a source of boundless energy and revolutionary ideas, and her ever-present enthusiasm has kept us excited about bringing new and better teaching materials to introductory biology classrooms. We realize we are extremely lucky to have Keri on our team.

We are also indebted to Suzanne Thibodeau, our developmental editor. Suzanne's uncanny attention to detail and her wonderful way of pushing us to meet our deadlines have contributed to the timely production of what we believe is a high-quality product. We are grateful, too, to Jeanne Payne, Martha Beyerlein, and Linda Muriello for overseeing the tedious but crucial details of an integrated text and media learning system. It goes without saying that any errors that remain are entirely the responsibility of the authors.

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