

Preface to Instructors

Since its inception, *Biological Science*'s unique emphasis on the process of scientific discovery and guiding students to think like biologists has placed this book at the forefront of change in the way we teach biology. The Seventh Edition embraces this legacy and continues to exemplify the principles outlined in the *Vision and Change in Undergraduate Biology Education* report. As in previous editions, the cutting-edge biology in the Seventh Edition is pitched at exactly the right level for introductory students and is as accurate and exciting as ever for instructors and students alike. New findings from education research about ways to increase student engagement in the learning process continue to inform and inspire the coauthor team. The Seventh Edition introduces novel approaches that will allow instructors to attain an appropriate blend of both content and skill development in the classroom. Innovative features new to this edition offer students even more opportunities to actively apply concepts in new situations; evaluate experimental design, hypotheses, and data; synthesize results; and make and interpret models. For instructors, additional resources are provided to help align course activities and learning goals with their assessment strategies.

Core Values

In the Seventh Edition, the coauthor team has strived to extend the vision and maintain the core values of *Biological Science*—to provide a book and online resources for dedicated instructors who embrace the challenge of helping students achieve higher levels of learning, and to provide a book that helps students each step of the way in learning to think like scientists, regardless of their starting point in the process. The Seventh Edition provides tools to help students build their cognitive mastery in both transferrable skills and biology content—to learn at the level called for by the National Academy of Sciences, the Howard Hughes Medical Institute, the American Association of Medical Academies, and the National Science Foundation. Reports such as *Biology 2010*, *Scientific Foundations for Future Physicians*, and *Vision and Change* all place a premium on fundamental skills and concepts as well as connecting core ideas across all levels of biology.

What's New in This Edition

Many of the new or expanded features in the Seventh Edition are designed to seamlessly intertwine delivery of cutting-edge biology content with development of students' skills in data analysis and quantitative model-based reasoning, in an engaging and relevant way. Students will receive initial instruction in biology content and transferrable skills, followed by opportunities for lots of practice in applying knowledge and skills to new contexts. The ultimate goal is for students to learn to construct their own knowledge and think like biologists.

- **Integrative End-of-Unit Case Study** Introduced in Chapter 1 and then revisited throughout the book, the end-of-unit case study "Mystery of the Newt" features a cliff-hanger tale of poisonous newts and resistant garter snakes. The unfolding story illustrates how biology concepts and the various subdisciplines of biology (genetics, evolution, physiology, ecology, etc.) are connected across multiple levels from molecules and cells to ecology and evolution. Each unit concludes with a two-page spread that focuses on contemporary biological elements and poses questions relevant to the unit and the case study. By highlighting the practice of science, we hope to encourage students to envision themselves as scientists. The end-of-unit case study is supported by Ready-to-Go teaching modules with instructional resources that include in-class clicker questions and activities and related Mastering™ Biology questions for pre- and post-class assignments to promote critical thinking and student engagement in the classroom.
- **Interactive Figure Walk-through Videos** Twenty-five figure walk-through videos have been added throughout the text to help students with unpacking complex figures and to cultivate better engagement with the text and other scientific sources. The videos will help students to better understand quantitative and modeling skills, as well as key concepts, by breaking down the information in figures step-by-step. Interactive figures are embedded in Pearson's new and engaging eText for practice at the initial point of learning and included in assignable Mastering Biology activities to help students practice working with visuals.
- **Three New Making Models Boxes** Reports like *Vision and Change* cite the importance of developing model-based reasoning skills. To help attain this goal, Making Models boxes were introduced in the Sixth Edition to explicitly teach students how to use visual models in learning and doing biology. In the Seventh Edition, three new Making Models boxes have been added: Tips on Drawing Carbohydrates (Ch. 5); Tips on Drawing Arrows (Ch. 40); and Tips on Drawing Immune System Processes (Ch. 48). Each Making Models box has three components: instruction in interpreting or creating a specific type of model, an example of that type of model, and an application question so that students can immediately practice their skills. Additionally, whiteboard-style videos allow students to watch and interact with a dynamic presentation of modeling. These videos are embedded in the eText, accessible in the Study Area of Mastering Biology, and integrated in assignable Mastering Biology activities that test students' understanding of models. Lastly, there are test bank questions aligned with the Making Models activities.
- **Enhanced Interactive eText** New and expanded features in the Seventh Edition have been designed not only to enhance

the print text but also to make full use of the new, embedded Pearson eText platform. The eText presents over 250 videos and animations that have been carefully selected to support content in the text. Resources include whiteboard Making Models videos, interactive Figure Walk-through videos, HHMI Biointeractive videos, and BioFlix® Animations and Tutorials that engage students, help them learn, guide them in completing assignments, and bring biology to life.

- **In-Text Learning Objectives** To help students navigate content, a Learning Objective now appears at the beginning of each section of a chapter. Each Learning Objective makes it clear up front what fundamental content students should expect to learn in a particular section and what they should be able to do with what they've learned.
- **Key New Content** Introduced in the Sixth Edition, end-of-chapter Put It All Together case studies engage students by asking them to connect what they've learned in the chapter to an example of contemporary, relevant research. New case studies have been added that are updated for more recent developments, relevancy, and alignment with chapter content: Ch 30: "Why aren't comb jellies the most diverse animals on Earth?"; Ch 31: "How could you count all the bees, beetles, and butterflies in one forest?"; and Ch. 33: "How does Zika virus cause birth defects?" Also new to the Seventh Edition is a heavily revised Chapter 20, which includes expanded coverage of CRISPR-Cas gene editing and synthetic biology. In addition, coverage of climate change and other human impacts, as an important context for biological systems, is woven throughout relevant chapters, especially in the ecology unit. There is also an increased emphasis on systems biology and big data; for example, in the ecology unit students explore social networks and community networks.
- **Expanded Assessment Matrix** Introduced in the Sixth Edition, an assessment matrix for each chapter identifies for instructors how each question is related to learning objectives, Bloom's level, common misconceptions, and *Vision and Change* core concepts and competencies. New to the Seventh Edition, all in-text and test bank questions are integrated and tightly aligned to two levels of learning objectives: broader "big picture" objectives and more granular supporting objectives. We hope this tool will assist instructors in selecting the most appropriate assessment items to align with the goals of their course.

Hallmark Features of the Text

While we are excited to introduce the new features of the Seventh Edition, we are committed to strengthening the hallmark features that make this book unique.

- **Road Maps** Each chapter opens with a concept map that visually groups and organizes information to help students anticipate key ideas as well as recognize meaningful relationships and connections among ideas.
- **Big Picture Spreads** While the Road Maps help students look forward as they engage with a chapter, Big Picture concept maps, typically found at the end of a unit, help students review content. Words and visuals are integrated to help

students synthesize information about challenging topics that span multiple chapters or units. Related activities are available in Mastering Biology to help students work on higher-order problems while synthesizing key ideas.

- **BioSkills** Instructors recognize that biology students need to develop foundational science skills in addition to content knowledge. Since the Third Edition, *Biological Science* has provided a unique, robust set of materials and activities to guide students who need extra help with the skills emphasized in the book. The BioSkills materials reside between Chapters 1 and 2 to emphasize their importance as a resource for success in doing biology, and to make it easier for students to access them throughout the course. The BioSkills are presented in five broad categories: Quantifying Biology, Using Common Lab Tools, Visualizing Biology, Reading Biology, and Monitoring Your Own Learning. BioSkills include practice questions, are cross-referenced throughout the text, and can be assigned online in Mastering Biology.
- **Opportunities for Practice** "Blue Thread" questions, integrated throughout the text, are designed to help students identify what they do and do not understand. Students are encouraged to think like biologists and practice engaging with content at a higher level. The idea is that if students really understand a piece of information or a concept, they should be able to do something with it. As in the Sixth Edition, all questions in the text are assigned a Bloom's taxonomy level to help both students and instructors understand whether a question requires higher-order or lower-order cognitive skills. A substantial proportion of questions are higher order. In addition, skill-based question tags help students and instructors identify opportunities to practice key skills. Questions are tagged to indicate the following: *Process of Science* questions explore the application of the scientific process; *Model* questions ask students to interpret or construct visual models; *Society* questions explore the relationship between science and society; *Quantitative* questions help students perform quantitative analysis and use mathematical reasoning; and *Think Carefully* questions address topics that students often have common misconceptions about, and the answers to these questions include information that addresses the misconception.
- **In-text "You Should Be Able To" questions** These questions focus on topics and concepts that professors and students have identified as most key or difficult in each chapter.
- **Caption questions and exercises** Students are challenged to examine the information in a figure or table critically—not just absorb it.
- **Check Your Understanding boxes** One to three tasks are presented that students should be able to complete in order to demonstrate a mastery of learning objectives.
- **End-of-chapter questions** Questions are organized in three levels: Test Your Knowledge, Test Your Understanding, and Test Your Problem-Solving Skills—so students can build from lower- to higher-order cognitive levels of assessment.

- **Put It All Together Case Studies** Case studies added in the Sixth Edition briefly introduce contemporary biology research in action, followed by questions that ask students to apply the chapter's content and skills to the research topic. Instructor resources include clicker questions to give instructors the opportunity to use the case studies as discussion prompts in the classroom. An enduring feature of this text is its emphasis on experimental evidence—on teaching how we know what we know. The case studies expand this emphasis, requiring students to evaluate real data and to see how ongoing scientific research is related to core biological ideas.
- **Focus on Real Data** Students now have expanded opportunities to develop skills in working with real data from the primary literature. Sources of the data presented in research boxes, graphs, end-of-chapter case studies, and the end-of-unit case studies are cited to model good practice for students and to provide a resource for students and instructors who wish to evaluate the original data more deeply.
- **Illustrated Summary Tables** The art program is enhanced by illustrated summary tables that deliver content in a streamlined way and facilitate comparison and analysis by students. Photographic summary tables in Unit 5, for instance, illustrate the diversity of life. These tables make subject areas more accessible to visual learners and reinforce a chapter's key concepts.

Integration of Media

The textbook continues to be supported by Mastering Biology, the most powerful online homework, tutorial, and assessment system available. Tutorials follow the Socratic method, coaching students to the correct answer by offering feedback specific to a student's errors or misconceptions as well as supplying hints that students can access if they get stuck. Instructors can associate content with publisher-provided learning outcomes or create their own. Highlights include the following:

- **eText** The new eText provides an engaging learning experience for students. We have integrated over 250 videos and animations, including Making Models videos, Interactive Figure Walk-through videos, BioFlix animations, and data visualizations. The eText is accessible on computers, tablets, and smart phones.
- **Interactive Figure Walk-through Videos** Twenty-five figures that students find challenging to interpret are now enhanced with brief videos that break down the art and provide explanatory narration to help students better understand key concepts and to develop critical thinking skills. The videos are in the eText and included in assignable activities in Mastering Biology that allow students to apply what they've learned.
- **Making Models Activities** Forty-six whiteboard videos bring the Making Models feature from the book to life to help students develop their visual modeling skills. The videos are in the Study Area and are also included in assignable activities that allow students to practice modeling and apply their understanding to new situations.

- **Case Study Questions** Put It All Together case study questions from the end of each chapter are assignable in Mastering Biology.
- **Solve It Tutorials** These activities allow students to act like scientists in simulated investigations. Each tutorial presents an interesting, real-world question that students will answer by analyzing and interpreting data.
- **Experimental Inquiry Tutorials** The call to teach students about the process of science has never been louder. To support such teaching, there are 10 interactive tutorials on classic scientific experiments—ranging from Meselson–Stahl on DNA replication to the Grants' work on Galápagos finches and Connell's work on competition. Students who use these tutorials should be better prepared to think critically about experimental design and evaluate the wider implications of the data—preparing them to do the work of real scientists in the future.
- **BioFlix Animations and Tutorials** BioFlix are movie-quality, 3-D animations that focus on the most difficult core topics and are accompanied by in-depth, online tutorials that provide hints and feedback to guide student learning. Eighteen BioFlix animations and tutorials tackle topics such as meiosis, mitosis, DNA replication, photosynthesis, homeostasis, and the carbon cycle.
- **HHMI BioInteractive Short Films Activities** Documentary-quality movies from HHMI are available in Mastering Biology with assignable questions to make sure students understand key ideas.
- **Galápagos Evolution Video Activities** These incredible videos, filmed on the Galápagos Islands by Peter and Rosemary Grant, bring to life the dynamic evolutionary processes that have an impact on Darwin's finches on Daphne Major Island. Six videos explore important concepts and data from the Grants' field research, and assignable activities keep students focused on the important take-home points.
- **GraphIt! Activities** These activities use real data to help students explore important topics while developing skills to read, interpret, and create graphs.
- **End-of-Chapter Questions** A broad range of end-of-chapter questions are available to assign in Mastering Biology.
- **Blue Thread Questions** Over 500 questions based on the Blue Thread questions in the textbook are assignable in Mastering Biology.
- **Big Picture Concept Map Tutorials** An engaging concept mapping tool is the basis for highly interactive, challenging concept map activities based on the Big Picture figures in the textbook. Students build their own concept maps, which are automatically graded, and then answer questions to make sure they understand key ideas and make important connections.
- **BioSkills Activities** Activities based on the BioSkills content in the textbook are assignable in Mastering Biology, including activities to support the new BioSkills.
- **Reading Quiz Questions** Every chapter includes reading quiz questions that can be assigned to ensure students read

the textbook and understand the basics. These quizzes are perfect as a pre-lecture assignment to get students into the content before class, allowing instructors to use class time more effectively.

In addition, a few tools are of particular help to busy instructors.

- **Ready-to-Go Teaching Modules** Based on key topics that students struggle with, these modules provide instructors with assignments to use before class, in class, and after class. New modules will support the integrative end-of-unit case study about newts to help instructors engage students with a range of activities for in class and outside of class.
- **Early Alerts** A powerful algorithm looks at student performance and behavior to help identify struggling students as early as possible in the course. Instructors are notified and can easily e-mail students from the Early Alerts dashboard to offer additional help to get students back on track.

- **Vision and Change Filters** All content in Mastering Biology is tagged to the *Vision and Change* core concepts and core competencies, so instructors can identify assessment items in every chapter that are related to *Vision and Change*. Instructors can also sort items by the learning outcomes for this book.

Serving a Community of Teachers

All members of the coauthor team are motivated by a deep commitment to students and to supporting the efforts of dedicated teachers. Our passion in life is doing and teaching biology. At various points along our diverse paths, we have been inspired by our own teachers when we were students, and now we are inspired by our colleagues as we strive to become even better teacher-scholars. In the tradition of all previous editions of *Biological Science*, we have tried to infuse this textbook with the spirit and practice of evidence-based teaching. We welcome your comments, suggestions, and questions.