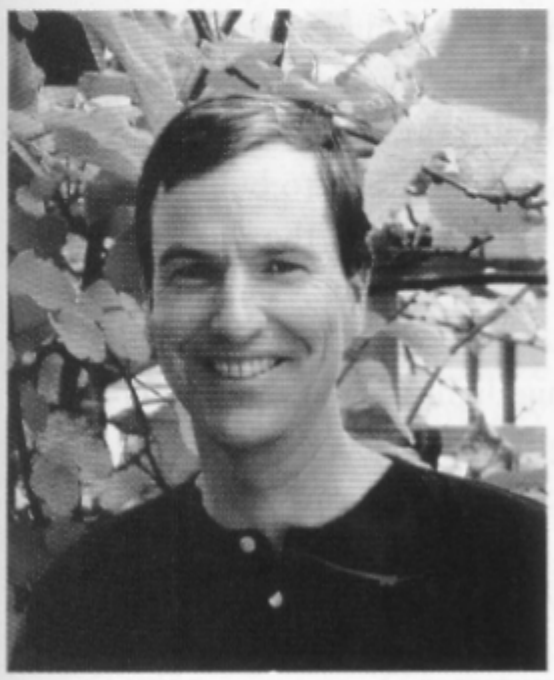
Preface



Scott Freeman received his Ph.D. in Zoology from the University of Washington and was nominated for an Excellence in Teaching Award in 1989. He was subsequently awarded an Albert Sloan Postdoctoral Fellowship in Molecular Evolution at Princeton University to investigate how generation time affects the rate of molecular evolution. Dr. Freeman's research publications explore a range of topics from the behavioral ecology of nest parasitism to the molecular systematics of the blackbird family. As an affiliate faculty member at the University of Washington, he has taught courses in evolution and has played an active role in the redesign of the general biology course. He is currently teaching the majors general biology course using an inquiry-based approach that emphasizes the logic of experimental design and the mastery of core concepts required for success in upper-level courses. Dr. Freeman is the co-author of *Evolutionary Analysis*, which presents evolutionary principles in the same spirit of inquiry that drives research.

Faculty who teach introductory biology may have the most exciting and difficult job on campus. The excitement springs from the breathtaking pace of advances in the biological sciences and the wide array of training and career options that are now open to prospective majors; the difficulty lies in introducing students to an already imposing and rapidly increasing number of facts and concepts.

When I took introductory biology as an undergraduate in 1975, faculty members were coping with the information explosion by extending the length of their introductory courses and using ever-larger textbooks. Today we don't have those options. Course length is capped at one year and most texts already run in excess of 1100 pages. Over the past decade in particular, presenting a fact-based, synoptic overview of what we know about biology has become increasingly untenable.

In short, the information explosion has changed our jobs. Instead of asking students to focus primarily on memorizing facts, more and more instructors are focusing their course on teaching students how to think like a biologist.

Why a New Introductory Textbook?

I wrote *Biological Science* to support professors who want their students to experience a more inquiry-driven approach in introductory biology. My goal was to write a book infused with the questions and the enthusiasm for learning that drive biological research. To help students understand how biologists think, each chapter is built around a series of questions that are fundamental to the topic being addressed. While exploring each question, the presentation incorporates data for students to interpret, offers evidence for competing hypotheses, introduces contemporary researchers, refers to work in progress, and highlights what researchers don't yet know. My aim was to help you teach biology the way you do biology—by asking questions and analyzing data to find answers.

At the same time, I made a strong commitment to covering the basics. We teach students who want to become doctors, researchers, science journalists, teachers, and conservationists. We have an obligation to prepare them for success in upper division courses, MCATs, and GREs, and to introduce the canon of facts and concepts that they must master to major in biology. Instead of listing these facts and concepts in an encyclopedic manner, however, *Biological Science* introduces them in the context of answering a question. In this textbook, facts become tools for understanding—not ends in themselves.

In addition to finding an appropriate balance between covering facts and exploring the scientific process, the level of the presentation is crafted to be appropriate for introductory students. Sections and sub-sections in the text begin with an overview of what question is being asked and end with commentary that helps students pull the material together. Instead of getting lost in the details of how an experiment was done, the text emphasizes why it was done and what the data mean.

Because beginning students are concerned about themselves and their world, most chapters explore how the topic relates to human welfare and all chapters end with an essay inspired by medical, commercial, or environmental concerns.

The Forest and the Trees: Helping Students to Synthesize and Unify

In addition to coping with an enormous amount of content in this course, instructors have to manage its diversity. In *Biological Science*, the emphasis on inquiry and experimentation provides a unifying theme from biochemistry through ecosystem ecology. In addition, the text highlights the fundamental how and why questions of biology. How does this event or process occur at the molecular level? In an evolutionary context, why does it exist?

The majority of chapters include at least one case history of an analysis done at the molecular level. Natural selection is introduced by exploring the evolution of antibiotic resistance via point mutations in the RNA polymerase gene of *Mycobacterium tuberculosis*. In the diversity unit, students learn about extracellular digestion in fungi by exploring experiments on the regulation of cellulase genes. A section of the behavior chapter features research on a gene involved in fruit fly foraging behavior. These are just three of many examples.

Similarly, evolutionary analyses do not begin and end with the evolution unit. Concepts like adaptation, homology, natural selection, and tree thinking are found in virtually every chapter. Unit 1, for example, presents traditional content in biochemistry—ranging from covalent bonding to the structure and function of macromolecules—in the context of chemical evolution and the origin of life. Meiosis is analyzed in terms of its consequences for generating genetic variation and making natural selection possible. Shared mechanisms of DNA repair and pattern formation are explained in the context of gene homologies. The overriding idea is that molecular and evolutionary analyses can help unify introductory biology courses, just as molecular tools and evolutionary questions are helping to unify many formerly disparate research fields within biology.

Supporting Visual Learners

Clear, attractive, and extensive graphics are critical to our success in the classroom. To emphasize the importance of analyzing figures in biology and to support students who learn particularly well visually, the book's art program is both extensive and closely interwoven with the manuscript. Each figure originated with rough sketches that I made while working on the first draft manuscript, which Dr. Kim Quillin then revised to increase clarity and improve appearance.

Throughout this process, our intent was to build an art program that is easy to read and that supports the book's focus on thinking like a biologist. A quick glance through the book should convince you that the art is as distinctive as the text. Color is used judiciously to highlight the main teaching points. Layouts flow from top to bottom and left to right, and extensive labeling lets students work through each figure in a step-by-step manner. Questions and exercises in the captions challenge students to actively interpret the graphics. The overall look and feel of the art is clean, clear, and inviting.

Serving a Community of Teachers

By de-emphasizing the encyclopedic approach to learning biology and focusing more on the questions and experimental tools that make biology come alive, our hope was to offer a book that is more readable and attractive to students and teachers alike. Embarking on an introductory course that launches a career in biology should be exciting, not anxiety-ridden. Learning concepts well enough to apply them to new examples and datasets may be more challenging for some students than memorizing facts, but it is also more compelling. By motivating the presentation with questions, and then using facts as tools to find answers, students of biology may come to think and feel more like the people who actually do biology.

I've always viewed working on this project as a gift, because it was a chance to serve the community of bright, enthusiastic, and dedicated people who teach this course. Thank you for your devotion to biology, for your commitment to your students, and for considering *Biological Science*. Teachers change lives.

Scott Freeman
University of Washington