教育部高等教育司推荐
国外优秀生命科学教学用书

Introductory Plant Biology

植物生物学 影印版

Ninth Edition

- Kingsley R. Stern
- Shelley Jansky
- James E. Bidlack

Mc Graw Hill Education

高等教育出版社
Higher Education Press

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Kingsley R. Stern
California State University, Chico

Shelley Jansky
University of Wisconsin—Stevens Point

James E. Bidlack
University of Central Oklahoma

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Kingsley R. Stern, Shelley Jansky, James E. Bidlack

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出 版 前 言

随着克隆羊的问世和人类基因组计划的完成，生命科学成为21世纪名副其实的领头学科，生物高新技术产业逐步成为高科技产业的核心。生物科技和生物产业的发展对世界科技、经济、政治和社会发展等方面产生着深刻的影响，这也是我国赶超世界发达国家生产力水平最有前途和希望的领域。生命科学与技术全方位的发展呼唤高等教育培养更多高水平的复合型科技人才。

为此，教育部在《关于加强高等学校本科教学工作　提高教学质量的若干意见》[教高(2001)4号文件]中提出，高等学校要大力提倡编写、引进和使用先进教材，其中信息科学、生命科学等发展迅速、国际通用性强、可比性强的学科和专业可以直接引进先进的、能反映学科发展前沿的原版教材。教育部高等教育司还于2001年11月向全国主要大学和出版社下发了“关于开展‘国外生命科学类优秀教学用书’推荐工作的通知”，有力推动了生命科学类教材的引进工作。

高等教育出版社对国外生命科学教材进行了充分的调研，并委托教育部高等学校生物科学与工程教学指导委员会的专家教授开展了“引进国外优秀生命科学教材及其教学辅助材料专项研究”，并就国内外同类教材进行了比较，提出了具体的引进教材书目。经过版权谈判，目前我社已经购买了Pearson Education，McGraw－Hill，John Wiley & Sons，Blackwell Science，Thomson Learning，Cambridge University Press，Lippincott Williams & Wilkins等出版的15种教材的影印权，学科领域涉及植物学、动物学、生物化学、细胞生物学、遗传学、微生物学、生态学、免疫学、神经科学、发育生物学、解剖学与生理学、分子生物学、普通生物学等。这些教材具有以下特点：(1)所选教材基本是近2年出版的，及时反映了学科发展的最新进展，在国际上使用广泛，具有权威性和时代感；(2)内容简明，篇幅适中，结构合理，兼具一定的深度和广度，适用范围广；(3)插图精美、丰富，既有很强的艺术性，又不失严谨的科学性，图文并茂，与正文相辅相成；(4)语言简练、流畅，十分适合非英语国家的学生阅读。其中11种已入选教育部高等教育司推荐“国外优秀生命科学教学用书”。

考虑到中国国情，为了让学生买得起，同时又能让学生看到原版书彩色精美的插图，我们在引进学生用原版教材时，一方面采用黑白影印，最大限度地降低定价，另一方面随书附赠含有原书彩色插图的光盘，以充分体现原教材的风格、特色，为读者提供方便。

引进国外优秀生命科学教学用书是我社一项长期的重点工作，因此，我们衷心希望广大专家教授和同学提出宝贵的意见和建议，如有更好的教材值得引进，请与高等教育出版社生命科学分社联系，联系电话：010－58581438，E－mail地址：lifescience@hep.com.cn。

高等教育出版社

2002年11月

国外优秀生命科学教学用书
（影印教材）

Introductory Plant Biology (9th ed.)	植物生物学
Zoology (5th ed.)	动物生物学
Biochemistry (2nd ed.)	生物化学
Cell and Molecular Biology (3rd ed.)	分子细胞生物学
Essentials of Genetics (4th ed.)	遗传学基础
Microbiology (5th ed.)	微生物学
Ecology: concepts and applications (2nd ed.)	生态学
Roitt's Essential Immunology (10th ed.)	Roitt 免疫学基础
Neuroscience: Exploring the Brain (2nd ed.)	神经科学
Essential Developmental Biology	发育生物学基础
Understanding Human Anatomy and Physiology (4th ed.)	人体解剖生理学
Gene Cloning and DNA Analysis (4th ed.)	基因克隆和 DNA 分析
Principles of Gene Manipulation (6th ed.)	基因操作原理
An Introduction to Genetic Engineering (2nd ed.)	遗传工程导论
Essential Biology	生物学导论

Preface

This book is designed as an introductory text in botany. It assumes little knowledge of the sciences on the part of the student. It includes sufficient information for some shorter introductory botany courses open to both majors and nonmajors, but it is arranged so that certain sections—for example, "Soils," "Molecular Genetics," "Division Psilotophyta"—can be omitted without disrupting the overall continuity of the course.

Botany instructors vary greatly in their opinions concerning the depth of coverage needed for the topics of photosynthesis and respiration in a text of this type. Some feel that nonmajors, in particular, should have a brief introduction only, while others consider a more detailed discussion essential. In this text, photosynthesis and respiration are discussed at three levels. Some may find one or two levels sufficient, and others may wish their students to become familiar with the processes at all three levels.

Despite eye-catching chapter titles and headings, many texts for majors and nonmajors give relatively minor coverage of the current interests of a significant number of students. This text emphasizes current interests without giving short shrift to botanical principles. Present interests of students include topics such as global warming, ozone layer depletion, acid rain (acid deposition), genetic engineering, organic gardening, Native American and pioneer uses of plants, pollution and recycling, house plants, backyard vegetable gardens, natural dye plants, poisonous and hallucinogenic plants, and the nutritional values of edible plants. The rather perfunctory coverage or absence of such topics in many botany texts has occurred partly because botanists previously have tended to believe that some of the topics not covered in their departmental economic botany courses are more appropriately addressed in anthropology and horticulture courses. I have found, however, that both majors and nonmajors in botany, who may be initially disinterested in the subject matter of a required course, frequently become engrossed if the material is repeatedly related to such topics. Accordingly, a considerable amount of ecological and ethnobotanical material has been included with traditional botany throughout the book—without, however, resorting to excessive use of technical terms.

ORGANIZATION OF THE TEXT

A relatively conventional sequence of botanical subjects is included. Chapters 1 and 2 cover introductory and background information; Chapters 3 through 11 deal with structure and function; Chapters 12 and 13 introduce meiosis and genetics. Chapter 14 discusses plant propagation and biotechnology; Chapter 15 introduces evolution. Chapter 16 presents a six-kingdom system of classification; Chapters 17 through 23 stress, in phylogenetic sequence, the diversity of organisms traditionally regarded as plants, and Chapter 24 deals with ethnobotanical aspects and information of general interest pertaining to sixteen major families of flowering plants. Chapters 25 and 26 constitute an overview of the vast topic of ecology, although ecological topics and applied botany are included in most of the preceding chapters as well. Some of these subjects are broached in anecdotes that introduce the chapters, while others are mentioned in the ecological review summaries and in the human and ecological relevance sections (with which most of the chapters in the latter half of the book conclude.)

AIDS TO THE READER

A chapter outline, review questions, discussion questions, learning online topics, and additional reading lists are provided for each chapter. New terms are defined as they are introduced, and those used more than once are boldfaced and included in a pronunciation glossary. The use of the scientific names throughout the body of the text has been held to a minimum, but a list of the scientific names of all organisms mentioned is given in Appendix 1. Appendix 2 deals with the biological controls and companion planting; Appendix 3 lists wild edible plants, poisonous plants, medicinal plants, hallucinogenic plants, spices, tropical fruits, and natural dye plants. Appendix 4 gives horticultural information on house plants; information on the cultivation and nutritional value of vegetables is included. Appendix 5 gives some metric equivalents.

NEW TO THIS EDITION

In addition to a complete updating of all chapters, based on over 100 reviewers' comments, the following major changes can be found in this edition:

- Chapter 3 (Cells) has been modified to include several rewritten sections, the incorporation of changes suggested by reviewers, more logical organization of topics, and many new photographs and illustrations.
- Chapter 10 (Plant Metabolism) revisions include new sections on energy transfer in the introduction and secondary metabolism, as well as several sections rewritten to simplify complex topics. Additional changes suggested by reviewers were made, a more consistent

use of terminology was introduced, several new/revised figures were added, and a summary table for ATP production in cellular respiration has been included.

- Chapter 13 (Genetics) has been completely reorganized to present molecular genetics first. The chapter now has new sections on cytogenetics, extranuclear DNA and quantitative genetics, a completely revised section on gene expression, revised and expanded content on mutation, new material on Barbara McClintock's discovery of transposable elements, a new illustration on the linkage map of pea, and a new Awareness Box on the Polymerase Chain Reaction.
- Chapter 14 (Plant Propagation and Biotechnology) has also been completely rewritten. This chapter includes a new section on crop plant evolution, including discussions of the origins of agriculture and steps in domestication; a new section on plant breeding, including breeding strategies, gene banks, protoplast fusion and transgenic plants; an updated discussion of the pros and cons of transgenic plants; over 20 new photos, and a new illustration on the origins of crop plants.
- A new feature, Learning Online, can now be found at the end of every chapter. This list of chapter-related topics mimics an identical list on the Online Learning Center, which is linked to crucial information on each of these topics. The links are updated periodically through our database to help students stay on top of their research and study responsibilities.
- Much of the appendix information has received extensive revision, particularly in the area of medicinal plants.
- Glossary definitions have been updated and over 40 new words have been added.

ACKNOWLEDGMENTS

The valuable contributions of Drs. James Bidlack and Shelley Jansky in rewriting Chapters 3 and 10, and 13 and 14 respectively, are gratefully acknowledged. Dr. Martha Phillips' input on Chapter 25 was also much appreciated. All but two of the boxed readings are written by Dr. Daniel Scheirer, whose contributions continue to add value to the text. We also are very grateful to Dr. Manuel Molles for his highlighted summaries of the ecological aspects of each chapter.

Additional persons who read parts of the manuscripts of various editions and made many helpful criticisms and suggestions include Richard S. Demaree, Jr., Robert I. Ediger, Larry Hanne, Donald T. Kowalski, Robert B. McNairn, Patricia Parker, and Robert A. Schlising. Others whose encouragement and contributions are deeply appreciated include Isabella A. Abbott, Donald E. Brink, Jr., Gerald Carr, William F. Derr, Timothy Devine, Beverly Marcum, Robert McNulty, Paul C. Silva, Lorraine Wiley, the faculty and staff of the Department of Biological Sciences, California State University, Chico, my many inspiring students, the Lyon Arboretum of the University of Hawaii, the editorial, production, and design staffs of McGraw-Hill Publishers, and most of all, my family. Special thanks are due the artists, Denise Robertson Devine, Janet Monelo, and Sharon Stern.

Finally, the ninth edition of *Introductory Plant Biology* would not have been possible without the considerable feedback from the following reviewers, to whom I am indebted:

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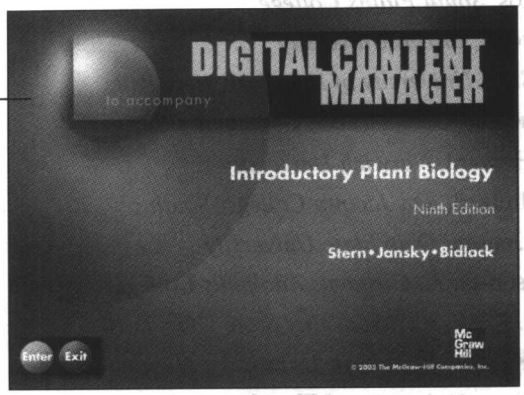

This multimedia collection of visual resources allows instructors to utilize artwork from the text in multiple formats to create customized classroom presentations, visually based tests and/or quizzes, dynamic course web site content, or attractive printed support materials. The digital assets on this cross-platform CD-ROM are grouped within the following easy-to-use folders:

- **Art Library.** Full-color digital files of all illustrations in the book.
- **Photo Library.** Hundreds of discipline-appropriate photos in digital files
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- **Table Library.** Every table that appears in the text is provided in electronic form.
- **Active Art.** These special art pieces consist of key images that are converted to a format that allows instructors to break the art down into core elements and then group the various pieces and create customized images. This is especially helpful with difficult concepts; they can be presented step by step.
- **Animations Library.** Numerous full-color animations illustrating many different concepts covered in the study of botany are provided. The visual impact of motion will enhance classroom presentations and increase comprehension.

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The Amazing Lives of Plants: The Reproductive Lives of Mosses, Pines, Ferns, and Flowers

Available upon adoption, *The Amazing Lives of Plants* includes four independent segments: "Mosses," "Ferns," "Pines," and "Flowers." Their reproductive lives are presented in a vivid, full-color combination of live video footage and sharp animation. Subtitled text makes it easy to cue up for use in lecture, and the pace of the program is suitable for students taking notes.
Videotape (ISBN 0-07-256393-1)
CD-ROM (ISBN 0-07-266394-X)

Transparencies

A set of 100 Transparencies is available to users of the text. These acetates include key figures from the text, including new art from this edition. (ISBN 0-07-290943-9)

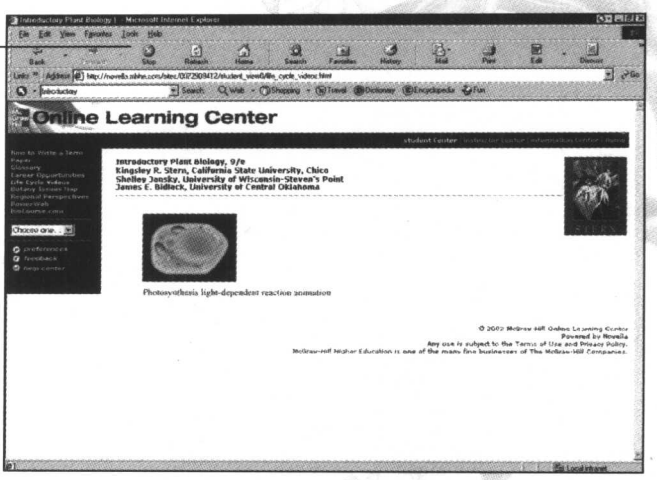
Classroom Testing Software

Available on a cross-platform CD-ROM, this test bank utilizes Brownstone Diploma© testing software to quickly create customized exams. This user-friendly program allows instructors to search for questions by topic, or format; edit existing questions or add new ones; and scramble questions and answer keys for multiple versions of the same test. (ISBN 0-07-290945-5)

Introductory Plant Biology Lab Manual

The laboratory manual that accompanies *Introductory Plant Biology* has been revised according to reviewer feedback. It is written for the student entering the study of botany for the first time. The exercises utilize plants to introduce biological principles and the scientific method. They are written to allow for maximum flexibility in sequencing. (ISBN 0-07-290946-3)

Online Learning Center



The Online Learning Center that accompanies this text provides abundant resources for both instructor and student.

For each chapter of the textbook, students will have access to:

- Chapter Summaries
- Chapter Web links Correlated to each chapter of the ninth edition, these regularly updated URLs provide additional learning opportunities for research, writing papers, or tutorial purposes.
- Practice Quizzing Designed as a study aid, these chapter-by-chapter quizzes help students review text material and prepare for upcoming exams.
- Key Term Flash Cards Yet another great study tool that tests students' knowledge of important botany terms.

Additional resources available to students include:

- Global Botany Issues World Map Updated every six months, a world map is tagged with hot points that link to case studies and articles complete with photos, references back to the text, and additional links to appropriate Internet sites. Past issues are indexed in a convenient chart for easy access.
- Guide to Electronic Research
- Metric Equivalents and Conversions Tables
- Career Opportunities
- Animations
- How to Write a Paper
- Scientific Names of Organisms
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- House Plants and Home Gardening

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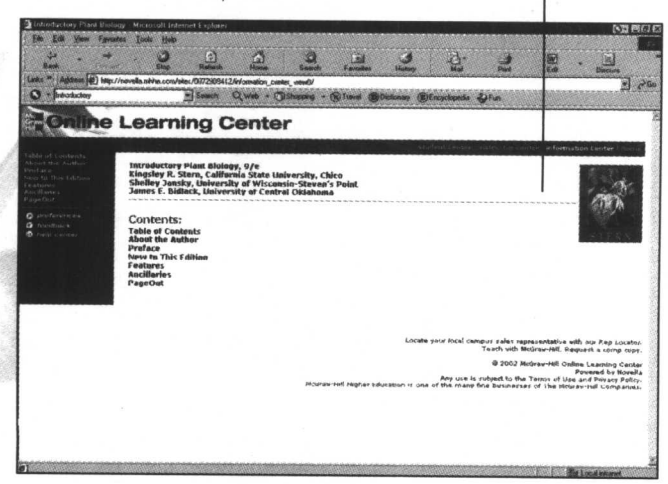

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What a great way to get the information you need quickly and easily! For a nominal fee, students can access PowerWeb for Botany. Here is what you will find:

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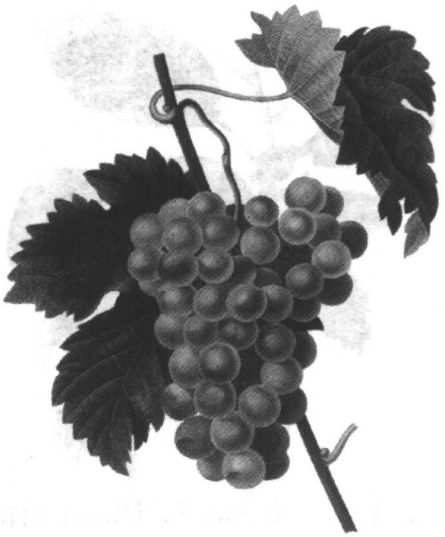

Contents

Steershead (*Dicentra uniflora*), a diminutive relative of bleeding hearts, native to the mountains of the western United States and Canada.

What Is Plant Biology?

Chapter Outline

1

Overview

This chapter introduces you to botany: what it is, how it developed, how it relates to our everyday lives, and what its potential is for the future. The discussion includes a brief introduction to some common questions about plants and their functions, an examination of the scientific method, and a brief look at botany after the invention of the microscope. It concludes with a brief survey of the major disciplines within the field of botany.

Some Learning Goals

1. Understand how humans have impacted their environment, particularly during the past century.
2. Explain briefly what the scientific method is and what hypotheses are.
3. Explain how and why all life is dependent on green organisms.
4. Be able to indicate briefly the particular aspects of botany with which each of the major botanical disciplines is concerned.

Upas trees (*Antiaris toxicaria*), which are relatives of the common fig tree, flourish in the jungles of Java and some of the neighboring islands. There are legendary tales of people having died while sleeping beneath these tall trees or even from merely being downwind from them. Whether or not there is truth to the stories, we do know that upas trees produce a deadly sap, which for centuries has been used to tip poison arrows used in hunting. On the other hand, the cow trees of Venezuela and Brazil (e.g., *Brosimum utile*; *Mimusops huberi*) produce a sweet, nutritive latex that is relished by the natives of the region. Still other plants, such as opium poppies, produce latex that contains narcotic and medicinal drugs (Fig. 1.1). Why do plants such as upas trees produce poisons, while parts of so many other plants are perfectly edible, and some produce spices, medicines, and a myriad of products useful to humans?

In late 1997, a fast-food chain began airing a television commercial that showed a flower of a large potted plant gulping down a steak sandwich. Most of us have seen at least pictures of Venus's flytraps and other small plants that do, indeed, trap insects and other small animals, but are there larger carnivorous plants capable of devouring big sandwiches or animals somewhere in remote tropical jungles?

Occasionally we hear or read of experiments—often associated with school science fairs—that suggest plants respond in some positive way to good music or soothing talk; conversely, some plants are said to grow poorly when exposed to loud rock music or to being harshly yelled at. Do plants really respond to their surroundings, and, if so, how and to what extent?

When a botanist friend of mine invited me to his office to see a 20-gallon glass fish tank he had on his desk, I expected to find a collection of house plants or tropical fish. Instead, I saw what at first appeared to be several small, erect sticks that had been suspended in midair with large rubber bands; there were also beakers of water in the corners. When I got closer, I could see that the "sticks" were cuttings (segments) of poplar twigs that were producing roots at one end and new shoots at the other end. The roots, however, were growing *down* from the tops of the cuttings, and the shoots were growing *upward* from the bottoms (Fig. 1.2). My friend had originally suspended the cuttings upside down, and new roots and shoots were being produced in the humid, lighted surroundings of the fish tank—regardless of the orientation of the cuttings. If I'd seen such bizarre plants in a movie, I might have assumed that the fiction writers had imagined something that didn't exist. There right in front of me, however, were such plants, and they were real! When

Figure 1.1 Immature opium poppy capsules that were gashed with a razor blade. Note the opium-containing latex oozing from the gashes.