

Preface

Plants and algae are essential for life on earth as it exists today. They provide our world with oxygen and food, contribute an essential part of water and nutrient cycling in ecosystems, provide clothing and shelter, and add beauty to our environment. Some scientists believe that if photosynthetic organisms exist on planets beyond our solar system, it would be possible to sustain other forms of life that depend upon them to survive.

Botany today plays a special role in many interests of both major and nonmajor students. For example, in this text, topics such as global warming, ozone layer depletion, acid rain, genetic engineering, organic gardening, Native American and pioneer uses of plants, pollution and recycling, house plants, backyard vegetable gardening, natural dye plants, poisonous and hallucinogenic plants, nutritional values of edible plants, and many other topics are discussed. To intelligently pursue such topics, one needs to understand how plants are constructed, and how they function. To this end, the text assumes little prior knowledge of the sciences on the part of the student, but covers basic botany, without excessively resorting to technical terms. The coverage, however, includes sufficient depth to prepare students to go further in the field, should they choose to do so.

The text is arranged so that certain sections can be omitted in shorter courses. Such sections may include topics such as soils, molecular genetics, and phylum Bryophyta. Because botany instructors vary greatly in their opinions about the depth of coverage needed for photosynthesis and respiration in an introductory botany course open to both majors and nonmajors, these topics are presented at three different levels. Some instructors will find one or two levels sufficient, whereas others will want to include all three.

Both majors in botany and nonmajors who may initially be disinterested in the subject matter of a required course frequently become engrossed if the material is related repeatedly to their popular interests. This is reflected, as intimated above, in the considerable amount of ecology and ethnobotany included with traditional botany throughout the book.

Organization of the Text

A relatively conventional sequence of botanical subjects is followed. Chapters 1 and 2 cover introductory and background information; Chapters 3 through 11 deal with structure and function; Chapters 12 and 13 introduce meiosis, genetics, and molecular biology. Chapter 14 discusses plant propagation and biotechnology; Chapter 15 introduces evolution; Chapter 16 deals with 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 other information of general interest pertaining to 16 major plant families or groups of families. Chapters 25 and 26 present an overview of the vast topic of ecology, although ecological topics and applied botany are included in the preceding chapters as well. Some of these topics are broached in anecdotes that introduce the chapters, while others are mentioned in text boxes as well as the appendices.

Learning Aids

A chapter outline, review questions, discussion questions, and additional reading lists are provided for each chapter. New terms are defined as they are introduced, and those that are boldfaced are included, with their pronunciation, in a glossary. A list of the scientific names of all organisms mentioned throughout the text is given in Appendix 1. Appendix 2 deals with biological controls and companion planting. Appendix 3 includes wild edible plants, poisonous plants, medicinal plants, hallucinogenic plants, spices, tropical fruits, and natural dye plants. Appendix 4 gives horticultural information on house plants, along with brief discussions on how to cultivate vegetables. Nutritional values of the vegetables are included. Appendix 5 covers metric equivalents and conversion tables.

New to this Edition

The thirteenth edition has retained the hallmark style and pedagogy that have made it one of the most enduring and popular introductory plant biology books on the market. At the same time, this edition has undergone many changes to expand upon, revise, and update topics in plant biology. All chapters now incorporate measurable learning outcomes and updated additional readings. For those instructors using Connect Botany, all learning outcomes (LOs) are directly tied to assessment within the question and test banks. In addition, most of the chapters include revisions and updates as suggested by reviewers. Some of the major changes include an introduction to the new classification of plants and plant-related species, integration of biotechnology into several chapters, and inclusion of new featured text boxes addressing key themes of ecology, evolution, and molecular biology throughout the text. These new text boxes provide instructors and students with information that helps them to understand how modern botany affects our everyday lives. Many new photographs have replaced some of the older pictures or have been added within individual chapters. Some of the more interesting components that make this 13th Edition more accurate and up-to-date with our current understanding of plant biology include:

Chapter 1 (What is Plant Biology?): New information on climate change, population dynamics, and alternative energy has been added to many parts of the chapter to make it more engaging and up-to-date. Text boxes on "Who Needs Plants?" as well as "Biology and the Internet" have been extensively re-written and several photographs have been replaced.

Chapter 2 (The Nature of Life): Figures on energy conversion and enzyme action have been replaced to improve accuracy, and a new text box entitled "The Skinny on Fats" has been added.

Chapter 3 (Cells): Many of the figures have been revised; particularly the cell and its components to more accurately represent how these are seen under a microscope. New, modern photographs of microscopes have been added along with a better explanation of confocal electron microscopy. Updated text information now includes discussion of endosymbiotic theory as well as functions of vacuoles.

Chapter 4 (Tissues): The text box on "Chimeras and Variegated Leaves" has been modified to provide more detail. New information has been added on discussion of cell wall thickening in collenchyma cells and tracheary elements, and an improved depiction of lenticels is now shown in the section on periderm.

Chapter 5 (Roots and Soils): Improved photographs of sweet potatoes, cassava, and a soil profile have been incorporated into the chapter. The text has been modified to provide a more accurate description of Casparian strips, lateral root formation, and soil horizons. The sections on parasitic roots and mycorrhizae have been extensively re-written to incorporate new terminology for these topics.

Chapter 6 (Stems): Artwork showing heartwood and softwood has been replaced to show a better representation of the characteristics and location of these parts of woody stems. The section on wood and its uses has been extensively modified so that the figures are better organized and figure legends are easier to read.

Chapter 7 (Leaves): Photographs of thorns and prickles, as well as some modified leaves, have been replaced to show better depiction of these structures.

Chapter 8 (Flowers, Fruits, and Seeds): A photograph of a rare Australian orchid, as well as a more clearly-displayed specimen of *Rafflesia* have been added to the chapter. A new text box on "Goobar Peas" has been incorporated into text, along with a more accurate description of germination.

Chapter 9 (Water in Plants): A sharper opening photograph for the chapter has been added along with more refined artwork to show diffusion and the pressure-flow hypothesis. The section on water potential has been extensively rewritten and a new text box on "Measuring Water Potential and Psychrometry" has been added to the chapter.

Chapter 10 (Plant Metabolism): Artwork has been revised to show a better summary of photosynthesis and respiration, and more details in the Calvin cycle. A new text box has been added on "Photosynthesis, Global Warming, and Tropical Rain Forests" to show applications of metabolic concepts.

Chapter 11 (Growth and Development): New figures have been incorporated to show structures of plant hormones as well as signal transduction and a new text box entitled,

"Plant Hormones—Beyond the Classic Five," has been added. Updated information has also been added about auxin-tryptophan interactions, the role of ethylene in fruit ripening, photoreceptor proteins, and the flowering locus T gene.

Chapter 12 (Meiosis and Alternation of Generations): Descriptions of meiotic phases have been revised to be more accurate, along with new discussions of chiasma and polyploidy. Two new text boxes on "Why Plants Have a Sex Life" and "FISH and GISH Molecular Techniques" have been added.

Chapter 13 (Genetics and Molecular Biology): A new textbox has been added on "Massive DNA Sequencing," along with an improved image of Gregor Mendel.

Chapter 14 (Plant Breeding, Propagation, and Biotechnology): Updated images have been incorporated to provide better explanations of transgenics, plant propagation, and tissue culture. New text has been added to describe the development of golden rice.

Chapter 15 (Evolution): Several parts of this chapter have been revised and updated to include discussions on epigenesis and polyploidy. A new text box on "Our Daily Bread" has been added to describe the domestication of wheat.

Chapter 16 (Plant Names and Classification): This chapter has been extensively rewritten to describe modern classification techniques. Sections on the International Code of Nomenclature of Cultivated Plants and the Phylcode have been added, along with a newly-proposed classification key.

Chapter 17 (Domain (Kingdom) Bacteria, Domain (Kingdom) Archaea, and Viruses): New, three-dimensional depictions of bacteria have been incorporated into the chapter along with improved artistic representations of viruses. A discussion of *Clostridium difficile*, has been added, as well as a new text box entitled "The Social Life of Prokaryotes."

Chapter 18 (Kingdom Protista): Improved images of red algae, *Euglena*, and dinoflagellates have been incorporated to show more accurate depictions of these specimens.

Chapter 19 (Kingdom Fungi): The use of DNA sequence data for classification of fungi is described. New information is also introduced, including use of fungi in cleaning oil spills and treatment of certain tree species to prevent the spread of disease.

Chapter 20 (Introduction to the Plant Kingdom: Bryophytes): New introductory information has been added on the evolutionary origin of plants, along with a summary of bryophyte classification. Artwork for hornworts has been improved and new pictures of hairy cap moss and peat moss have been added to the chapter.

Chapter 21 (The Seedless Vascular Plants: Ferns and Their Relatives): Improved photographs of ferns have been incorporated into the text, along with new evolutionary information about the origin of seedless vascular plants. In addition, a new text box on "Ferns and Fossil Fuels" has been added to the chapter.

Chapter 22 (Introduction to Seed Plants: Gymnosperms): A new photograph of the rare *Wollemi* pine, along with a more modern photograph of a newsprint factory have been added to the text. The introductory paragraph has been updated with new information about molecular analysis of gymnosperms as well as a summary of their current classification. A text box

on "Resilient and Useful Gymnosperms" has been added to show modern uses of pines and related species.

Chapter 23 (Seed Plants: Angiosperms): Improved photographs of snowplant flowers, as well as pollination of other flowers, have been included in the text. A more extensive explanation of angiosperm origin has also been added to the introduction.

Chapter 24 (Flowering Plants and Civilization): The photograph of a poppy capsule has been replaced and a new

text box on "Wild Rice—More than Just Food" has been added to the chapter.

Chapter 25 (Ecology): Topics that address the impact of humans on the biosphere have been reorganized to follow a more logical approach to headings and sub-headings.

Chapter 26 (Biomes): This chapter has been reorganized and rewritten to incorporate world biomes in addition to those found in North America.

Acknowledgements

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