

# 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 could 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 and genetics. 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 the ecological review summaries, in the human and ecological review sections, and in the extensive 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 twelfth 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. Most of the chapters include new opening photographs, revisions as suggested by reviewers, and updated additional readings. 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 twelfth edition more accurate and up-to-date with our current understanding of plant biology include the following:

Chapter 1 (What Is Plant Biology?): Several new images have been added, including a new picture of residue floating on the water as an example of pollution as well as a

more typical picture of a tropical rain forest in Costa Rica. New text has been added on the use of ethanol in vehicles and the sources of ethanol, such as corn, switchgrass, and wood chips.

Chapter 2 (The Nature of Life): The chapter has been revised to provide a more detailed explanation about how genetic makeup and environment affect the growth of plants.

Chapter 3 (Cells): An improved introductory statement has been provided to explain how plant cells are composed of cell walls and membrane-bound organelles. In addition, the information for adjacent cells has been revised to show location of ribosomes and dictyosomes, as well as a more accurate explanation of plasmodesmata.

Chapter 4 (Tissues): Revisions for this chapter include a new ecological review on chimeras, with examples of variations in leaf color and thornless blackberries.

Chapter 5 (Roots and Soils): To make the chapter content more accessible, the images and diagrams in this chapter have been rearranged so that their descriptions are closer to the actual figures.

Chapter 6 (Stems): A new photograph showing false tree rings has been added, along with an ecological review to explain dendroclimatology and how tree rings are studied to provide a temporal record of environmental conditions.

Chapter 7 (Leaves): New text has been added to describe evolution and variation in leaf morphology. The chapter also includes a new photograph on autumnal colors of leaves.

Chapter 8 (Flowers, Fruits, and Seeds): New text has been added on seed dispersal, along with an emphasis on the evolutionary trends in dispersal mechanisms.

Chapter 9 (Water in Plants): A new photographic image to illustrate the action of diffusion from incense has been added. In addition, a definition and description of hydroponics is now included in the chapter.

Chapter 10 (Plant Metabolism): A new, more detailed diagram of the Calvin cycle has been provided to show greater detail of the reactions that take place in the light-independent reactions.

Chapter 11 (Growth): Learning goals have been revised to more accurately represent what is described in the chapter. New text has been added to provide a modern explanation of how mRNA is involved in stimulation of flowering. A new picture of a pineapple field has been added as an example of how temperature can be used to predict the best time for harvest of some crops.

Chapter 12 (Meiosis and Alternation of Generations): New terminology has been introduced in this chapter to distinguish between use of "n" and "x" for alternation of generations and ploidy number, respectively.

Chapter 13 (Genetics): New text has been added to describe transposable elements and how certain transposons might allow plants to tolerate stress. A discussion of the United States Plant Genome Initiative has also been integrated into the chapter.

Chapter 14 (Plant Breeding and Propagation): The text and figure on making transgenic plants have been revised to improve the accuracy of the chapter.

Chapter 15 (Evolution): A new section called "An Introduction to Evolution" has been added to include topics such as evolutionary agriculture, evolutionary medicine, species extinction and invasion, and biotechnology and evolution. Additional information has also been added to present the three revolutions of evolutionary thought as well as a discussion of macroevolution. Two new photos have been added to accompany these topics.

Chapter 16 (Plant Names and Classification): A new section titled "The Species Concept" has been added to present the morphological, interbreeding, ecological, cladistic, eclectic, and nominalistic components of speciation.

Chapter 17 (Domain (Kingdom) Bacteria, Domain (Kingdom) Archaea, and Viruses): New information on tuberculosis and on *E. coli* strain O157:H7 (accompanied by a picture) has been added to show how certain bacteria can cause problems in human populations. A new photograph of bacteria growing in hot springs has also been added to the chapter.

Chapter 18 (Kingdom Protista): New photographs, including a living diatom, a giant kelp showing air bladders, and a diatomaceous earth quarry, have been added to the chapter.

Chapter 19 (Kingdom Fungi): Up-to-date photographs have been added of a morel, ergotized barley, and a fly agaric mushroom. New text has also been added on the topic of chytridiomycosis.

Chapter 20 (Introduction to the Plant Kingdom: Bryophytes): Photographs of a female gametophyte and a leafy liverwort have been replaced to more clearly show structures described in the text, and an inset of a moss sporocyte has been added to the moss life cycle.

Chapter 21 (The Seedless Vascular Plants: Ferns and Their Relatives): A picture of a *Lycopodium* gametophyte has been added and the photo of a branched horsetail has been replaced to show more clarity and detail. Text on the life cycle of a fern has been modified to explain development of the sporophyte generation.

Chapter 22 (Introduction to Seed Plants: Gymnosperms): More detailed pictures, of a fascicle of pine needles and of a female cycad, have been added. The life cycle of a pine has been modified to show additional structures after fertilization.

Chapter 23 (Seed Plants: Angiosperms): A new Plant Sciences Inquiry Box has been added to explain the difference between "n" and "x" in plant life cycles. Incorporation of "n" and "x" terminology is now woven throughout this chapter and others. New pictures of carrion flower and hummingbird pollination have also been added.

Chapter 24 (Flowering Plants and Civilization): This chapter features a new photograph showing more detail of a poppy capsule. Text has also been added to provide more up-to-date statistics for tobacco, tomato, and potato production in the United States and the world.



Chapter 25 (Ecology): This chapter has been significantly revised and updated to include new photographs as well as discussions of communities; the effect of soil mineral content on plant species distribution; trophic efficiency; allelopathy; life histories; the water, carbon, and nitrogen cycles; succession, using Mount St. Helens as an example; climate change and its potential implications; wind, water, and soil erosion; land reclamation; loss of biodiversity; acid rain; wetlands; species invasions; and land restoration.

Chapter 26 (Biomes): An updated photo with a better depiction of a prairie setting with little bluestem has been incorporated into the chapter.

## ACKNOWLEDGMENTS

Over 200 reviewers for the past few editions, along with more than 20 reviewers for this twelfth edition, have helped to revise and update *Stern's Introductory Plant Biology*. In particular, Roger del Moral, who has been a respected reviewer of this book, rewrote and added many new sections for Chapter 25 on Ecology. Others who have read parts of the manuscripts of various editions and made many helpful suggestions in the past include Richard S. Demaree, Jr., Patricia Edelmann, Robert I. Ediger, Larry Hanne, Donald T. Kowalski, Robert B. McNaim, and Robert Schlising. Additional appreciated encouragement and contributions were made by 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, colleagues at the University of Central Oklahoma, and the Lyon Arboretum of the University of Hawaii, as well as the editorial, production, and design staffs of McGraw-Hill Publishers.

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