

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 fourteenth edition is an exciting one, with dozens of new/replacement photographs and updates in the text to make it a modern textbook with great new topics. Most of the major changes in the book have been made as a result of new discoveries and technologies in plant biology. This edition still retains the hallmark style and pedagogy that make it one of the most enduring and popular introductory plant biology books on the market, and it now has a more contemporary look and presentation style. All chapters incorporate measurable learning outcomes and updated additional readings. For instructors using Internet resources such as Connect and the textbook website offered by McGraw-Hill, all learning outcomes are directly tied to assessment within the question and test banks. With encouragement from reviewers, the new material has been eloquently incorporated directly into the textbook narrative and as text boxes, to provide a blend of historically important principles as well as modern developments in plant biology. Some of the more interesting components that make this fourteenth edition more accurate and up-to-date with our current understanding of plant biology include:

Chapter 1 (What Is Plant Biology?): The scientific method section has been extensively revised. The Plant Biology and the Internet text box has been updated with information about how the Internet has affected the scientific community.

Chapter 2 (The Nature of Life): New examples have been added and text has been updated and revised for clarity.

Chapter 3 (Cells): Several photographs have been replaced with higher-quality images.

Chapter 4 (Tissues): The introduction has been rewritten in language relevant to today's college students. A flowchart has been added to show how meristems give rise to tissues. Trichomes have been defined and added to the index.

Chapter 5 (Roots and Soils): The soil profile caption has been enhanced.

Chapter 6 (Stems): The caption for the cover image has been expanded.

Chapter 7 (Leaves): Some discussion on incorporation of plant pigments in photovoltaic cells has been added to the introduction.

Chapter 8 (Flowers, Fruits, and Seeds): The role of respiration in seed germination is described in more detail.

Chapter 9 (Water in Plants): The description of active transport has been revised.

Chapter 10 (Plant Metabolism): A more straightforward introduction is provided at the beginning of the chapter.

Chapter 11 (Growth and Development): The distinction between determinate and indeterminate growth has been clarified. The caption for the photograph on photoperiodism has been expanded.

Chapter 12 (Meiosis and Alternation of Generations): The introduction has been re-written to describe the consequences of meiosis and how it results in variability when farmers save seeds from hybrid crops. The distinction between x (ploidy) and n (gametophyte versus sporophyte generation) has been clarified. The idea that the sporophyte becomes more dominant in advanced plant lineages is introduced.

Chapter 13 (Genetics and Molecular Biology): The description of a DNA molecule has been enhanced. The description of $2n$ gametes has been expanded. The role of the monohybrid cross in illustrating the law of segregation is discussed. A section has been added to describe genetic engineering technologies to develop herbicide-resistant plants.

Chapter 14 (Plant Breeding, Propagation, and Biotechnology): A new text box on "genome editing," as a clever method for recombinant DNA technology with endless possibilities, has been added to the chapter. Additional updates on transgenic plants and rewording of the text has also been completed to make the content more current.

Chapter 15 (Evolution): Some strategic rewording of the text was done to provide a more straightforward presentation of evolutionary concepts.

Chapter 16 (Plant Names and Classification): More precise information is presented to show the global estimate of existing species to be about 8.7 million, and some other tactical changes were made in the text to bring it up to date.

Chapter 17 (Domain (Kingdom) Bacteria, Domain (Kingdom) Archaea, and Viruses): Some of the information on human diseases (such as AIDS and tuberculosis), as well as human uses of archaeobacteria (such as methane production) has been updated. Additionally, a text box on cyanobacteria and algae blooms has been added to the chapter to show the huge impact algae can have on ecosystems.

Chapter 18 (Kingdom Protista): Two important and innovative text boxes have been added to this chapter—one on green plant phylogeny and another on biofuels made from algae. The text box on green plant phylogeny, in particular, is an exciting new topic presented to introduce readers to the new approaches being used in taxonomy using DNA technology. Other modifications have also been made to this chapter to focus on the basic differences among life cycles and how these can be used to describe and distinguish among the algae phyla.

Chapter 19 (Kingdom Fungi): More direct language was incorporated into this chapter to make concepts easier to understand. A great new picture of a puffball was also added to the chapter.

Chapter 20 (Introduction to the Plant Kingdom: Bryophytes): Antheridiophores and archegoniophores have been more accurately described and pointed out in one of the figures. Additionally, the important feature of hornworts having stomata has been added to the section on Phylum Anthocerotophyta.

Chapter 21 (The Seedless Vascular Plants: Ferns and Their Relatives): The concept that seedless vascular plants are sporophyte dominant, and the spores produced germinate into a free-living gametophyte generation, is emphasized at the beginning of the chapter. More direct language was also incorporated into this chapter to make it more straightforward.

Chapter 22 (Introduction to Seed Plants: Gymnosperms): The phrase "common ancestor" is introduced in this chapter to convey the more modern approach to plant classification using DNA technology. New information is also presented on the production of paclitaxel (also known by its trade name Taxol) from new lines (derived from tissue culture) of yew trees.

Chapter 23 (Seed Plants: Angiosperms): More direct language was incorporated into this chapter to make it more straightforward and easier to understand.

Chapter 26 (Biomes): Some of the climatological data and specific information about biomes have been updated.

Appendix 2 (Biological Controls): The introduction has been rewritten to discuss the consequences of improper use of pesticides. The section on the use of resistant plant varieties has been updated. The section on the control of weeds has also been updated.

Appendix 4 (House Plants and Home Gardening): This appendix has been extensively updated. New information is presented on LED lights, transplanting of seedlings, direct seeding, temperature and seed germination, the effect of overwatering on root growth, fertilizer application, pest control, and inoculation of soil with *Rhizobia*.