BRIEF TABLE OF CONTENTS

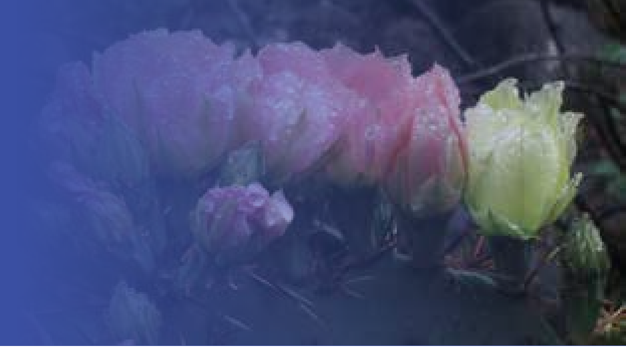


TABLE OF CONTENTS

PREFACE

The preparation of this *Sixth Edition* of *Botany* had two objectives: first, to emphasize the interactions between plants and other organisms, and second, to make plant biology more accessible and relevant to students and other readers.

The emphasis on plant interactions with the biosphere began several editions ago, as the reality of global climate change became clear. Previous editions explored the role of plants in the removal of greenhouse gases and also the loss of many forests by human activities. While thinking about the interrelationships of plants and people, I suspected that students would be interested in the ways in which plants interact with all other organisms. I believe it is more realistic and engaging to examine plant biology as one aspect of the set of all the interactions of organisms and Earth. To take a reductionist view of plant biology as just the anatomy, metabolism, and evolution of isolated plants is to miss out on many of the richest aspects of plant biology.

Consequently, in this *Sixth Edition*, a new *Chapter 26: Community Ecology* has been added to introduce students more fully to interactions between plants and their surroundings. Also, several existing chapters have had new material added to emphasize these interactions; for example, there is a new discussion about ways in which plants detect attacks by fungi in *Chapter 14*: *Development and Morphogenesis*.

Making plant biology more accessible to students and everyone else was the reason I originally began writing this book 30 years ago. It has also been a primary concern in every new edition. Some reviewers and professors have felt that previous editions of *Botany* were too difficult for their students, and, to address their concerns, I have added a new *Chapter 2: Overview of Plant Life*. This is structured to provide a broad introduction to topics such as plant structure, metabolism, genetics, diversity, evolution, and ecology. An entire chapter was dedicated to this so that fundamental principles could be presented with just enough depth and breadth that any student or reader would obtain enough of an overview to feel ready to tackle any other part of the text. Many students will already be so familiar with plants that certain portions of *Overview* will be unnecessary, but they might benefit from other parts. For some students, all of *Overview* may be a valuable aid. Either way, it is meant to welcome everyone into the world of plant biology. I want all people to feel included in this book; I do not want any part to be a barrier to anyone.

Several other elements make this *Sixth Edition* more accessible. First, a *Pronunciation Guide* has been added for those words that have made many of us feel uncertain: people will feel more comfortable with *xylem*, *allele*, or *Rosaceae* if they are confident they are pronouncing these words correctly. Also, every chapter now opens with two new elements, a list of *Learning Objectives* and a few *Did You Know?* facts. The first is designed to allow students to see the important topics immediately, the second is designed to attract their interest. All chapters now end with a new section entitled *At the Next Level*, which presents more advanced topics that some students might want to explore on their own.

A new *Chapter 24: Ethnobotany: Plants and People* has been added to both emphasize interactions between plants and other organisms (us humans) and to make the book more relevant to each reader's life. Among the typical topics such as food and fibers, *Box 24-3 Plants and People: Natural Drugs, Endangered Species, and Women's Rights* discusses modern ethnobotanical problems that result from our increasing knowledge of plants and the cures they may provide. This new chapter does not replace the numerous *Plants and People* boxes that have been developed in previous editions; those are all still present here.

One of the aims of this book is to encourage students to think about the intersection between the scientific world and themselves, including their religious beliefs. This has been an important part of *Botany* from the very first edition with the sections *The Scientific Method* and *Areas Where the Scientific Method is Inappropriate*. In this *Sixth Edition*, *Box 2-4 Botany and Beyond: Noah's Flood and Population Biology* points out that studies of the *Bible* led directly to the establishment of two critically important scientific disciplines: population biology and demography. *Box 17-1 Botany and Beyond: Species Are Populations, Not Types* discusses how our modern concept of species has changed from our original concept that had been based on *Genesis*. The relationships between science and religion are touched on only occasionally, but I do not want students to think there is a complete gulf between their biology classes and their religious lives. Perhaps some instructors will use these sections of *Botany* to lecture more expansively on science and religion.

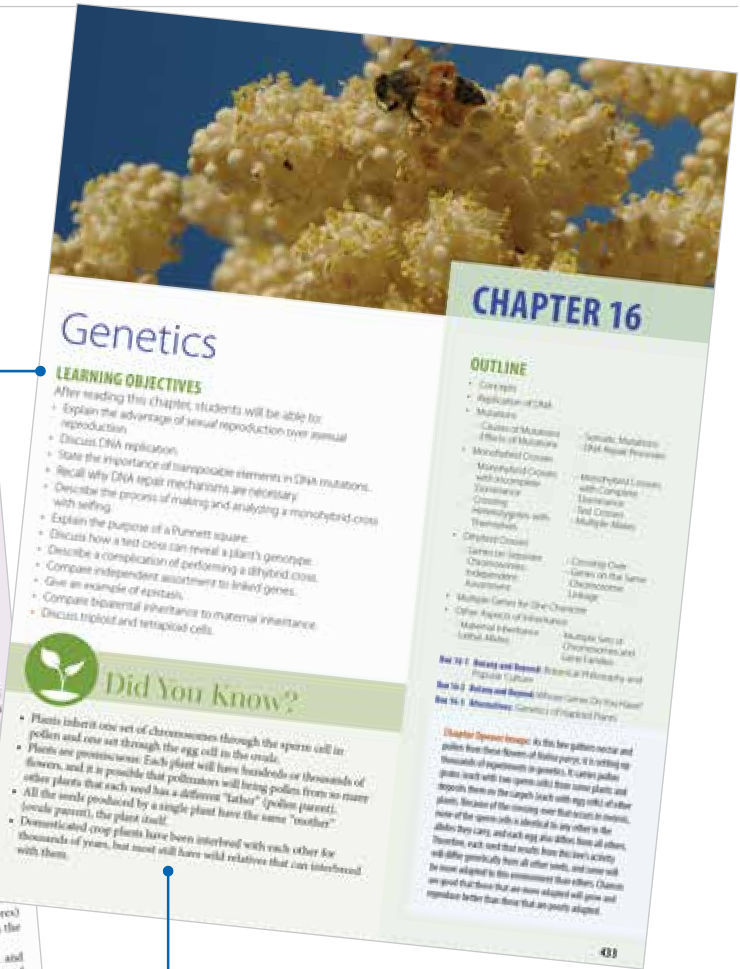
My ultimate goal is to teach about life in general. Every topic mentioned in this book should help the reader to more fully understand human biology, indeed to understand all of biology. No organism exists isolated from all others; instead we all share one biology that encompasses all organisms. We are all in this together.

THE STUDENT EXPERIENCE

The sixth edition of *Botany: An Introduction to Plant Biology* was designed with the student in mind and is packed full of features and elements to help engage, elaborate, and enhance the learning experience.

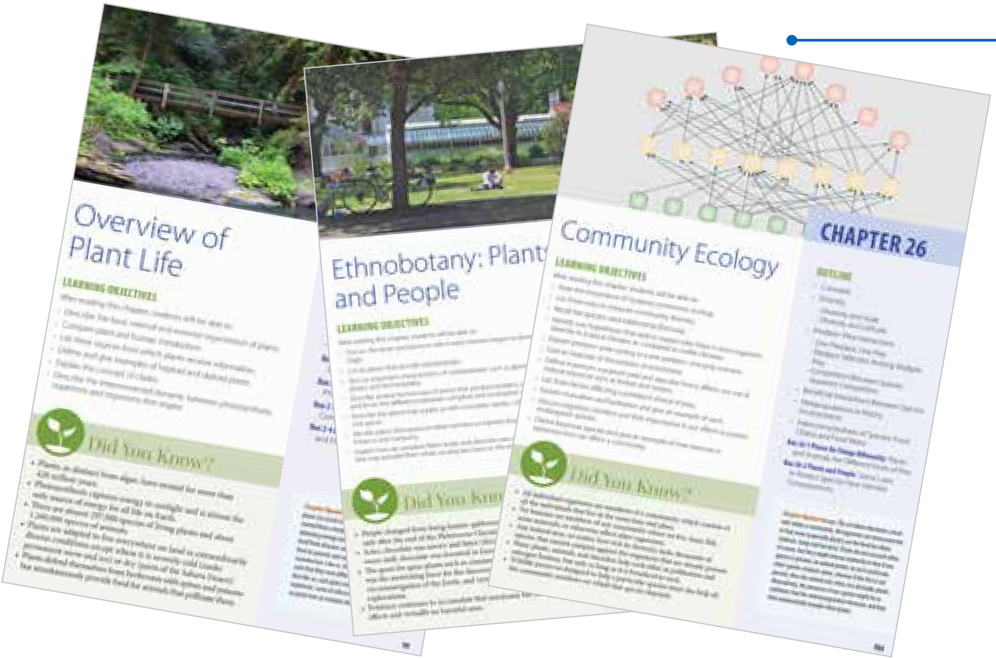
New to This Edition

Learning Objectives New to this edition, every chapter opens with a list of *Learning Objectives* that allow students to review the important concepts they will encounter in the chapter. Students should review this list prior to digging into the chapter to help guide their focus. As they progress through the material, they should periodically flip back to the *Learning Objectives* to ensure they are fully grasping that chapter's key botanical concepts.

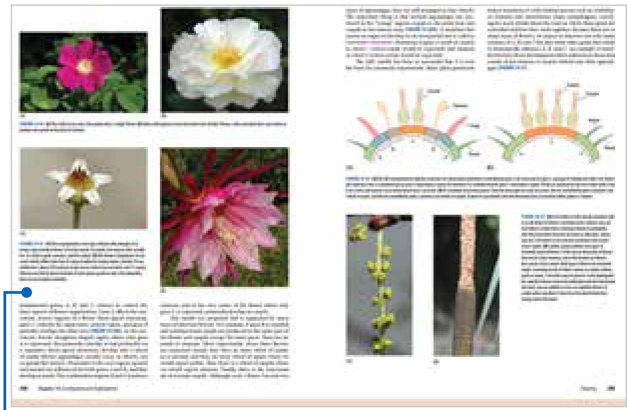


Did You Know? New *Did You Know?* feature opens every chapter and illuminates the direct application of plants to students' lives. This list of interesting facts stimulates curiosity about the fascinating botanical world around us, making plant biology more accessible and relevant to students.

At the Next Level New *At the Next Level* feature closes every chapter and provides opportunities for students to expand their understanding of the key botanical concepts they just learned. This feature is especially helpful for higher-level botany courses and biology majors.

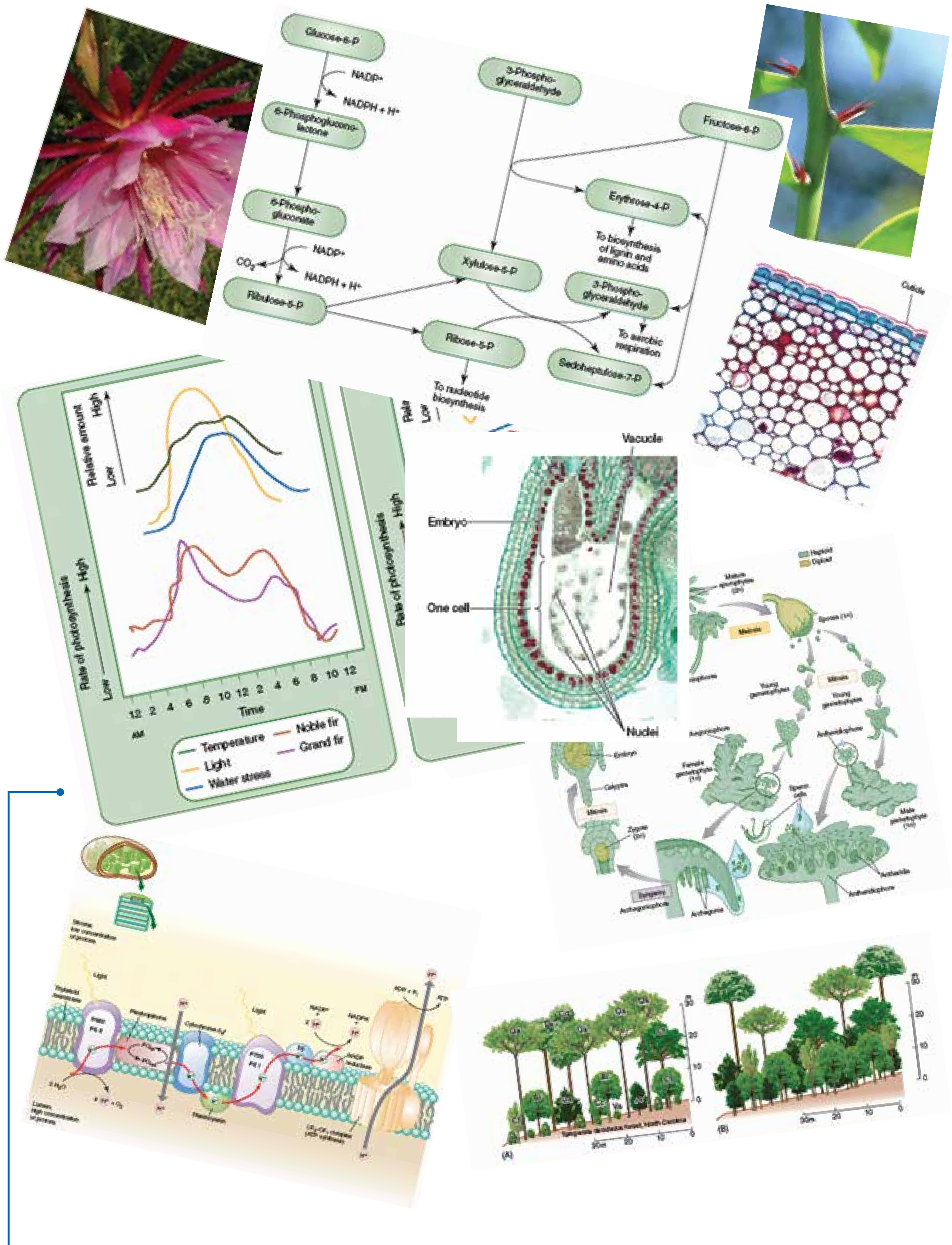


Three New Chapters on Overview of Plant Life, Ethnobotany, and Community Ecology Three new chapters have been added to this edition; *Chapter 2: Overview of Plant Life* provides a broad introduction to plant biology and covers topics such as plant structure, metabolism, genetics, diversity, evolution, and ecology; *Chapter 24: Ethnobotany: Plants and People* emphasizes plant–human relationships and interactions, including information on food plants, plants that provide drugs, and plants that provide fibers, wood, and chemicals; *Chapter 26: Community Ecology* further emphasizes the major theme of this text—the interactions of plants with the biosphere and all other organisms, not just humans.



Interactive eBook Including Web Links Every new print copy of this *Sixth Edition* includes access to a complete and interactive eBook with embedded enhancements such as Web Links and ungraded Knowledge Checks to reinforce key concepts.

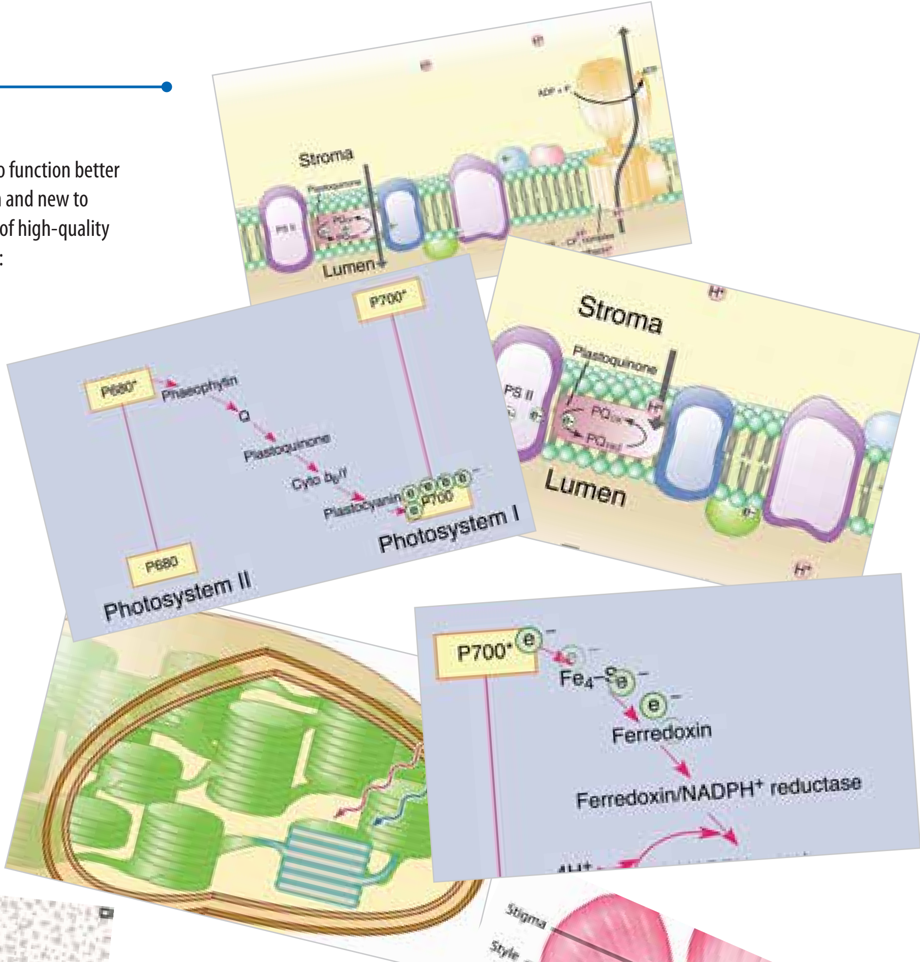
Pronunciation Guide The addition of a *Pronunciation Guide* further improves the accessibility of this edition. Students can feel confident that they are correctly pronouncing certain botanical words such as xylem, allele, and Rosaceae.

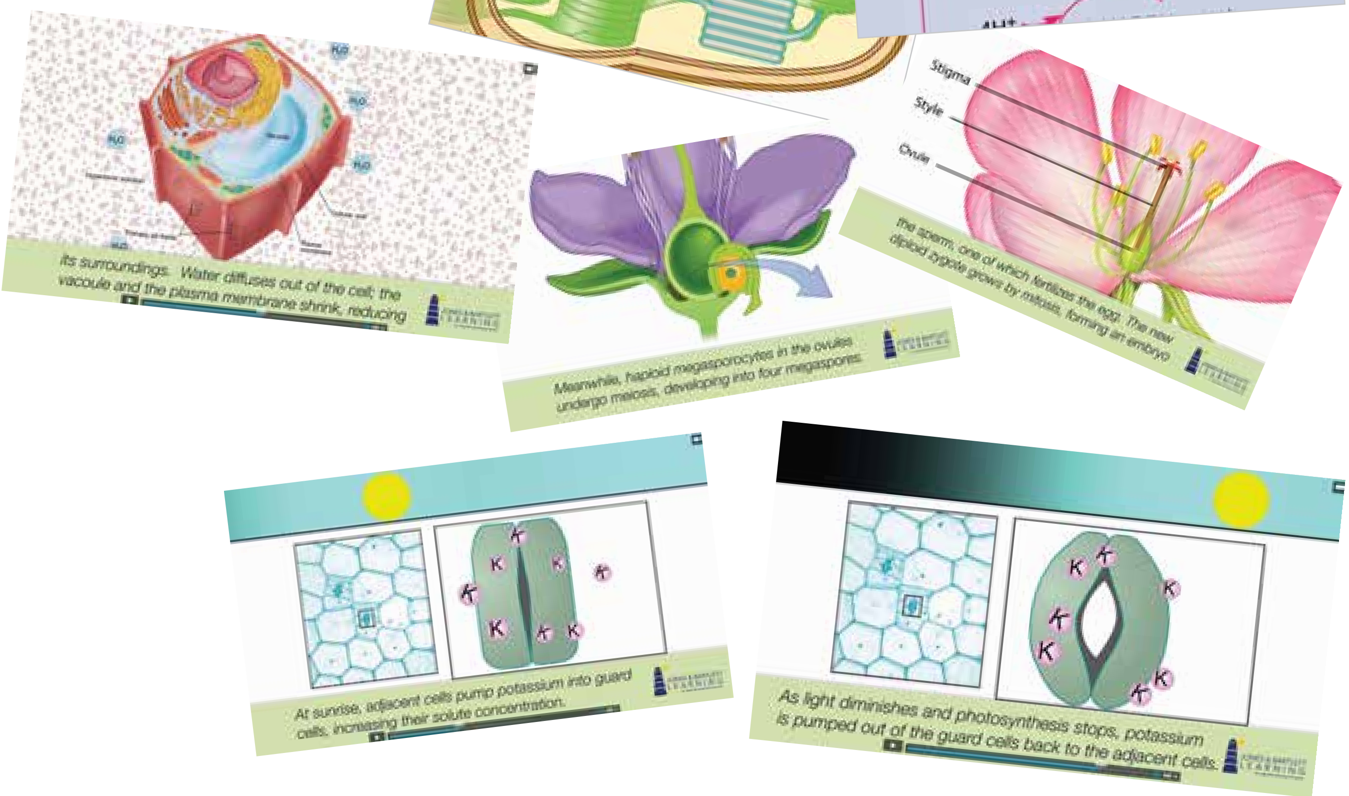


Market-Leading Art and Photos This edition has received a complete overhaul to its art package. It features a visually stunning design with over 550 new and revised figures, including new photographs (most of which were taken by James Mauseth) and thoroughly revised, detailed illustrations that unlock complex topics and biological processes.

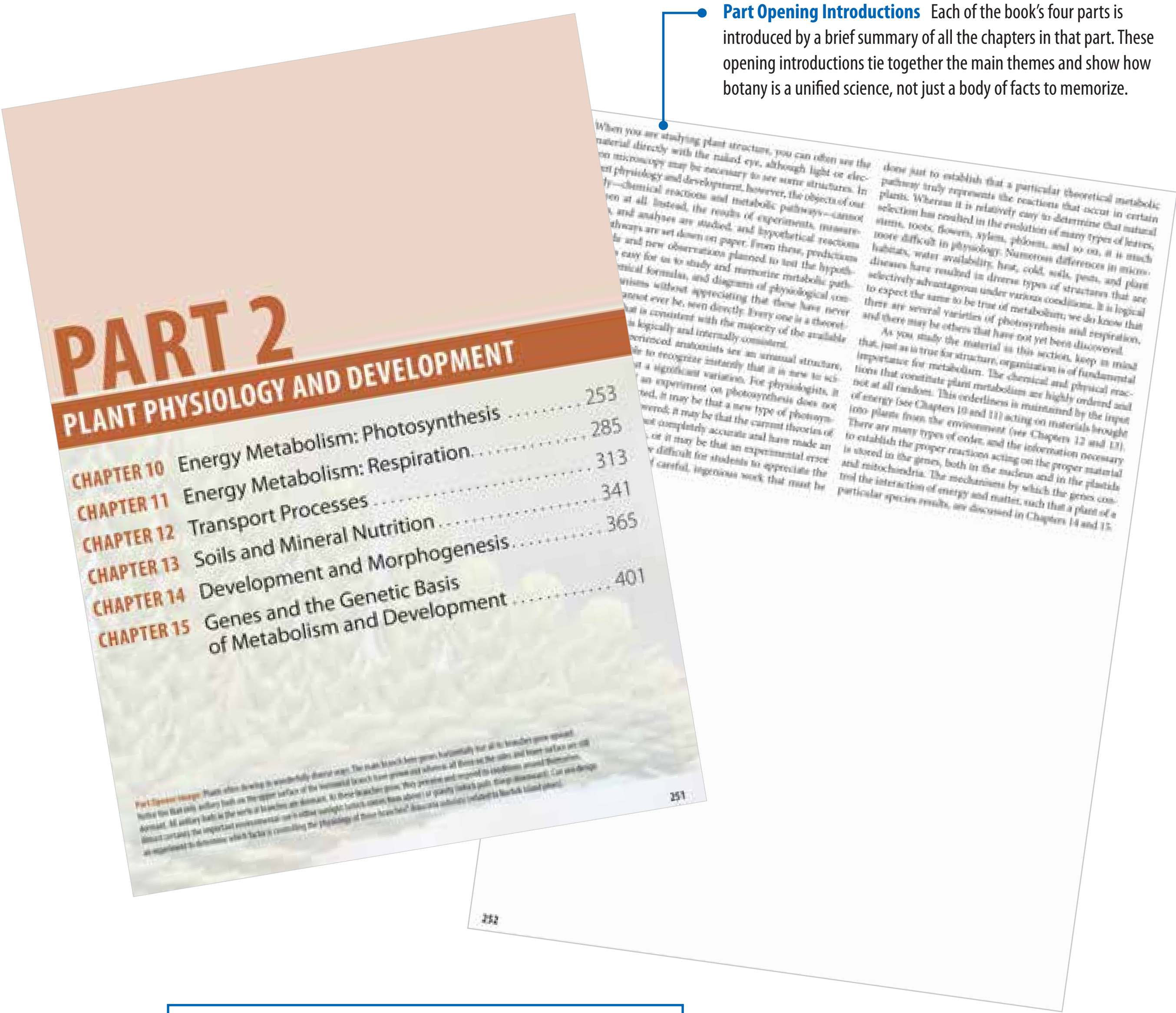
Botany in Action No text connects structure to function better than Mauseth's *Botany*. Building on this strength and new to the *Sixth Edition* is Botany in Action, a collection of high-quality animations on market-selected topics, including:

- Photosynthesis
- Water Movement
- Calvin Cycle
- Respiration
- Flowers and Reproduction
- Growth of Wood
- Primary and Secondary Growth
- Pressure Laws Sequence





Classic Features

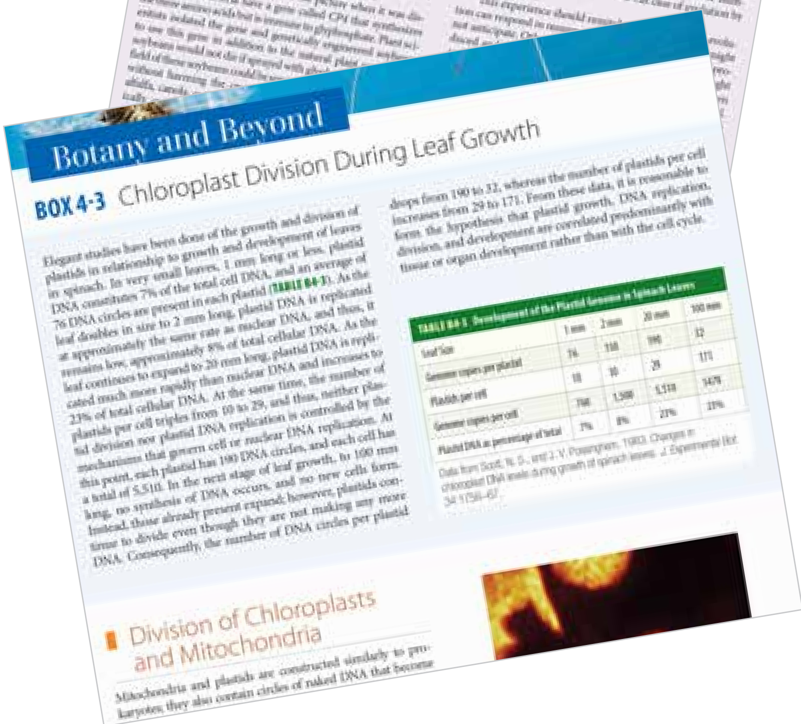


Part Opening Introductions Each of the book's four parts is introduced by a brief summary of all the chapters in that part. These opening introductions tie together the main themes and show how botany is a unified science, not just a body of facts to memorize.

Alternatives Boxes The Alternatives boxes show students they should think expansively. While the text describes the most common, typical aspects of plant biology, there are alternative types that are more advantageous in certain conditions.

Plants Do Things Differently Boxes Retained by popular demand, these boxes help students understand and compare plant biology with human biology. Plants really are doing things very differently from the way we do them.

Plants and People Boxes These boxes discuss ways in which plants and people influence each other. Some plants influence people by producing poisonous or irritating compounds; others produce food, medicine, and beauty. In the other direction, human activities influence plants either directly by habitat destruction and the farming of "wastelands" or by producing acid rain and global climate change.



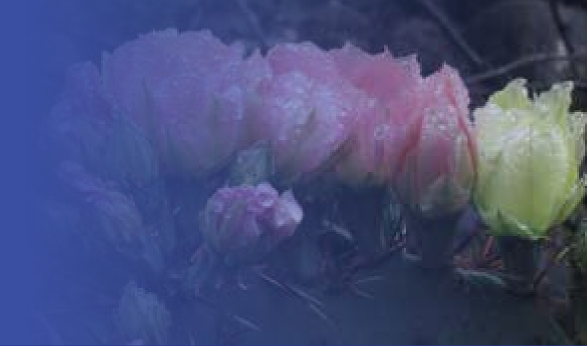
Botany and Beyond Boxes Modernized to suit a new generation of learners, the popular Botany and Beyond boxes elaborate on subjects that, while not essential to the study of botany, help make the material more relevant and accessible.

Chapter Summaries To ensure students thoroughly grasp the important concepts, each chapter concludes with a comprehensive Chapter Summary. Students can review the summary before digging into the chapter to direct their study and can also use it as a study tool to prepare for course lectures and exams.

Important Terms A list of Important Terms is included at the end of every chapter. Furthermore, the terms in the chapter appear in bold to draw the reader's attention. Students should refer to the Important Terms as part of their study to assess their understanding of chapter material.

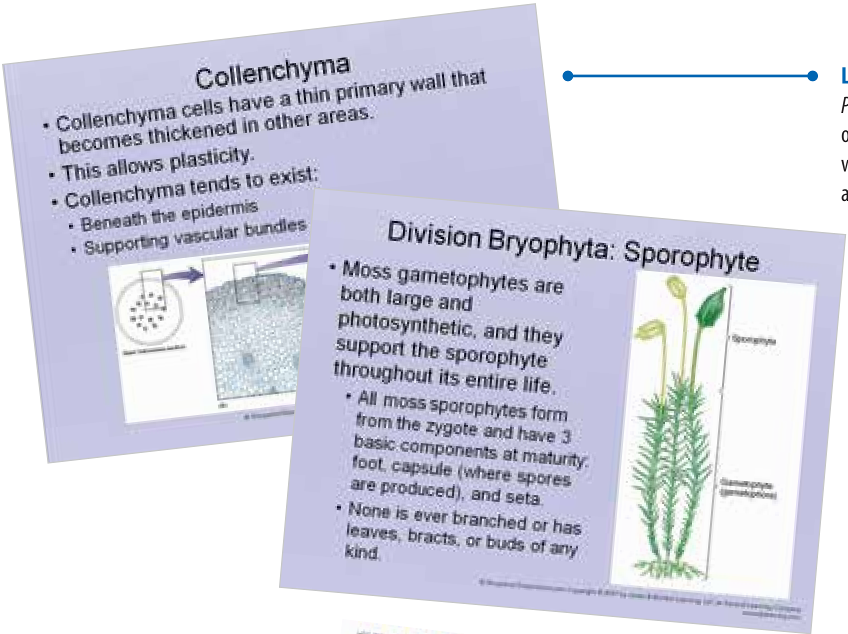
Review Questions These questions have been designed to act as a study guide, to lead students to the most important points, and to focus students' efforts on mastering the most significant concepts. Every chapter includes 30 to 50 thought-provoking questions.

Glossary A comprehensive Glossary defines major botanical and general biological terms. Each definition is keyed to the chapter where the principal discussion occurred.



TEACHING TOOLS

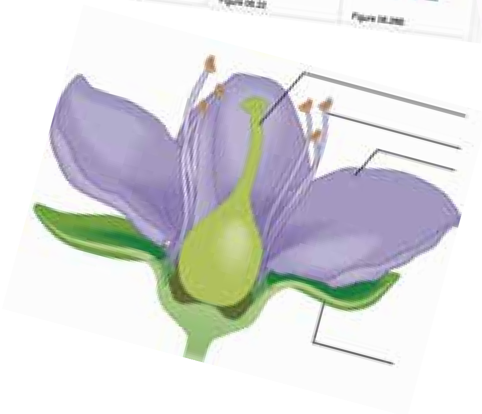
A variety of Teaching Tools assist instructors with preparing for and teaching their courses. These resources are available via digital download and multiple other formats.

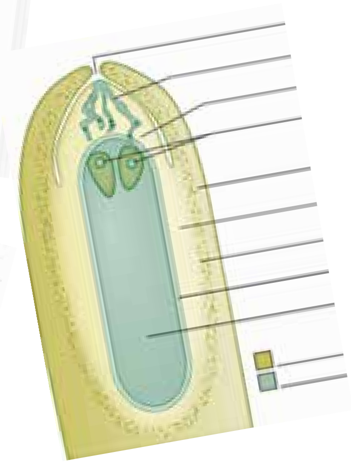


Lecture Outlines in PowerPoint format The *Lecture Outlines in PowerPoint* format provide lecture notes and images for each chapter of *Botany: An Introduction to Plant Biology, Sixth Edition*. Instructors with Microsoft PowerPoint software can customize the outlines, art, and order of presentation.

Instructor's Manual The Instructor's Manual, provided as a text file, includes lecture outlines and teaching tips.

Solutions to Review Questions These files contain answers to all of the end-of-chapter review questions found in the text.

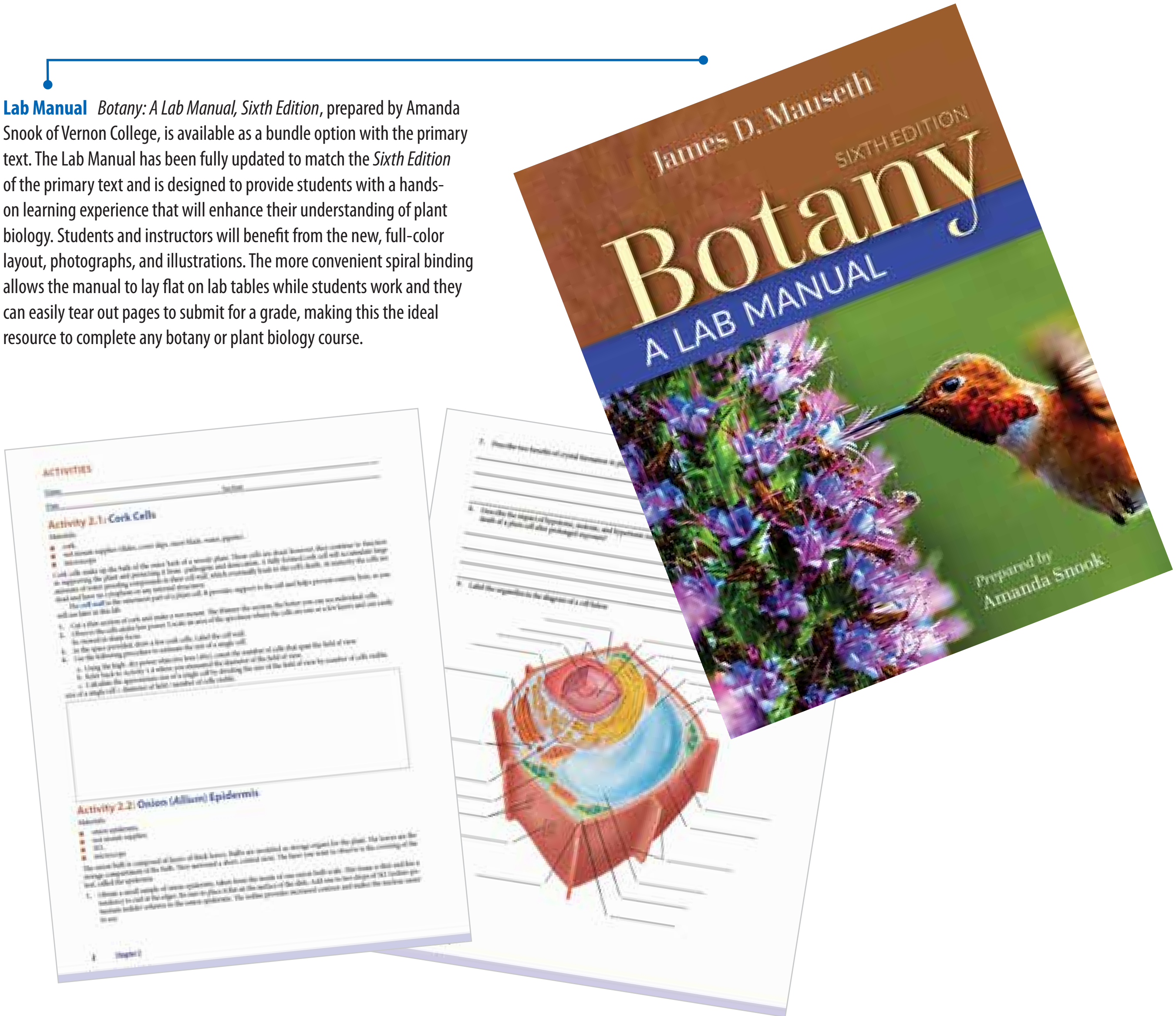




Key Image Review and Unlabeled Art The *Key Image Review* provides the illustrations, photographs, and tables to which Jones & Bartlett Learning holds the copyright or has permission to reprint digitally. These images are not for sale or distribution but may be used to enhance your existing slides, tests, and quizzes, or other classroom material. The *Unlabeled Art,* consisting of 45 illustrations available on PowerPoint slides, can be used as part of a labeling exercise in an exam or can be photocopied and handed to students for taking notes. Instructors can add their own labels to customize them to their course.

LAB MANUAL

Lab Manual *Botany: A Lab Manual, Sixth Edition*, prepared by Amanda Snook of Vernon College, is available as a bundle option with the primary text. The Lab Manual has been fully updated to match the *Sixth Edition* of the primary text and is designed to provide students with a hands-on learning experience that will enhance their understanding of plant biology. Students and instructors will benefit from the new, full-color layout, photographs, and illustrations. The more convenient spiral binding allows the manual to lay flat on lab tables while students work and they can easily tear out pages to submit for a grade, making this the ideal resource to complete any botany or plant biology course.



Lab Manual ISBN-13: 978-1-284-11184-2
Main Text + Lab Manual Bundle ISBN-13: 978-1-284-11819-3

Lab Manual Table of Contents

ACKNOWLEDGEMENTS

This and previous editions have benefited from the generous, conscientious thoughts of many reviewers. They provided numerous suggestions for improving clarity of presentation, or identified illustrative examples that would improve the student's understanding and interest. It has been a pleasure to work with them. I thank them all:

Reviewers of the *Sixth Edition*

Fernando Agudelo-Silva, PhD, College of Marin
Robert G. Ewy, PhD, SUNY Potsdam
Joyce Phillips Hardy, PhD, Chadron State College
Stephanie G. Harvey, PhD, Georgia Southwestern State University
Kevin B. Jones, Charleston Southern University
Rebecca S. Lamb, PhD, Ohio State University
Jeffrey J. Law, MS, PhD, Daemen College
Elizabeth A. Machunis-Masuoka, MA, PhD, Midwestern State University
Kamal A. Malik, MSc, PhD, University of Mount Olive
Brian R. Maricle, PhD, Fort Hays State University
Ross A. McCauley, PhD, Fort Lewis College
Eric C. Morgan, PhD, Farmingdale State College
Jennifer Ann Oberle, PhD, Rutgers University, Camden
T. Page Owen, Jr., PhD, Connecticut College
Susan Rolfsmeier, PhD, Chadron State College
Christina Russin, PhD, Northwestern University
Marshall D. Sundberg, PhD, Emporia State University
Philip Villani, PhD, Butler University
Mark B. Watson, PhD, University of Charleston

Reviewers of Previous Editions

Vernon Ahmadjian, Clark University
Bonnie Amos, Angelo State University
John Beebe, Calvin College
Curtis Clark, California State Polytechnic University, Pomona
Billy G. Cumbie, University of Missouri, Columbia
Jerry Davis, University of Wisconsin, La Crosse
Cynthia J. Denbow, Virginia Polytechnic Institute and State University
Nicole Donofrio, University of Delaware
John Dubois, Middle Tennessee State University
Donald S. Emmeluth, Fulton-Montgomery Community College
Nisse Goldberg, Jacksonville University
Howard Grimes, Washington State University
Stephanie G. Harvey, Georgia Southwestern State University
James Haynes, State University College at Buffalo
James C. Hull, Towson University
Shelley Jansky, University of Wisconsin, Stevens Point
Roger M. Knutson, Luther College
John C. Krenetsky, Metropolitan State College of Denver
Rebecca McBride-DiLiddo, Suffolk University
Lillian Miller, Florida Community College at Jacksonville, South Campus
Louis V. Mingrone, Bloomsburg University
Rory O'Neil, University of Houston, Downtown
John Olsen, Rhodes College
Jerry Pickering, Indiana University of Pennsylvania
Mary Ann Polasek, Cardinal Stritch College
Barbara Rafaill, Georgetown College
Michael Renfroe, James Madison University
Michael D. Rourke, Bakersfield College
Sangha Saha, Harold Washington College
James L. Seago, Jr., State University of New York at Oswego
Bruce B. Smith, York College of Pennsylvania
Garland Upchurch, Southwest Texas State University
Jack Waber, West Chester University
James W. Wallace, Western Carolina University
Katherine Warpeha, University of Illinois at Chicago
Peter Webster, University of Massachusetts, Amherst
Paula S. Williamson, Southwest Texas State University
Ernest Wilson, Virginia State University
Mark Wilson, Oregon State University
Stephen Wuerz, Highland Community College

We also wish to thank Dr. Erika Latty of Unity College for her work to prepare the Test Bank and other Assessments that accompany this book, Professor Alexandria Gilmore of Vernon College for her contributions as a subject matter expert and consultant for developing the animations, and Dr. Thomas Smith of Ave Maria University for his assistance with preparation and revision of the Instructor's Manual.

Just like the initial production of a textbook, the preparation of a new edition is not by any means the sole effort of the author. I am fortunate to have benefited from the many contributions of numerous talented individuals through the various editions. The current editorial staff at Jones & Bartlett Learning is one of the best and most skillful. I especially thank Matt Kane, Audrey Schwinn, Alex Schab, Troy Liston, Kristin Parker, and Jamey O'Quinn for their intelligent, creative solutions to many problems that had to be solved in preparing the *Sixth Edition*. This edition benefits particularly from Matt's vision to expand the treatment of environmental issues and ethnobotany, Audrey's artistic skills in designing the overall book and chapter elements, and Alex's ability to manage the thousands of details that arise in the actual production of each and every page. I also thank my husband Tommy Navarre for his never-ending (33 years so far) support, encouragement, and confidence.

James D. Mauseth, PhD
Austin, Texas

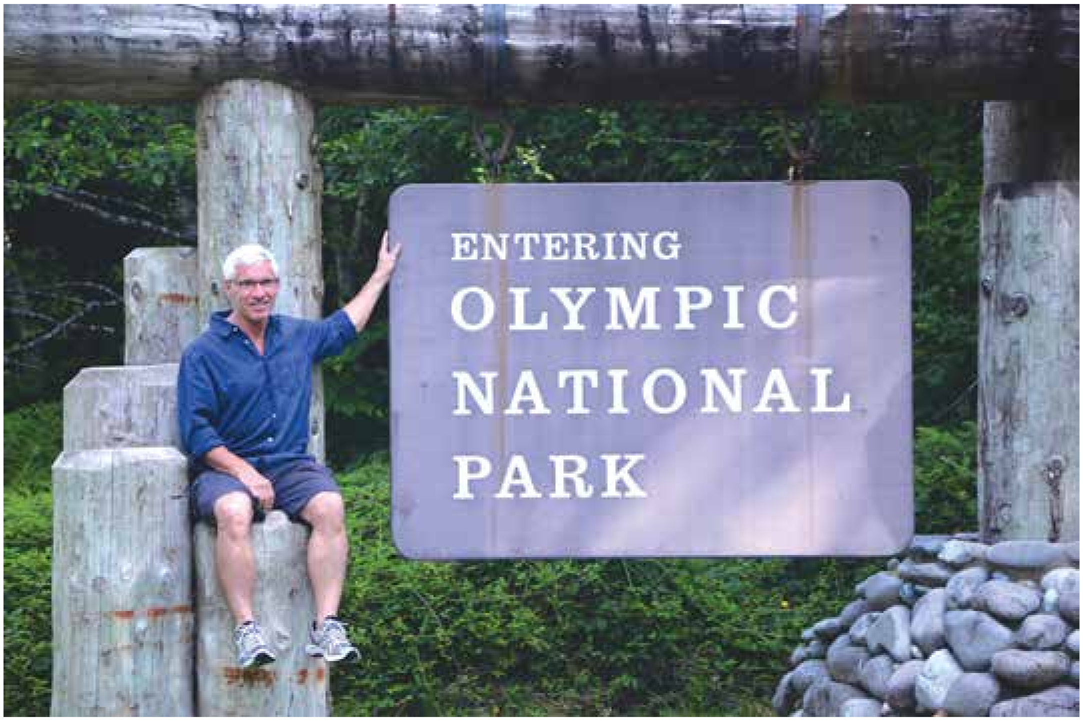
ABOUT THE AUTHOR

Jim Mauseth was born in eastern Washington state and spent his childhood on his family's irrigated farm, tending wheat, potatoes, corn, and other crops. Adjacent to the farm was an undisturbed sagebrush desert with a sparse but rich variety of wildflowers. He studied botany at the University of Washington in Seattle, and hiked in the cool, rainy Cascade Mountains, the Olympic Rainforest, and on Mount Rainier. The rocky coast of Puget Sound, with its abundant algae and invertebrates, was also a favorite place.

In 1975, he obtained his PhD and became a professor at the University of Texas and has lived in Austin ever since. The vegetation around Austin includes pine woodland, oak-juniper forest, mesquite scrubland, and open grassland. Representatives of all major groups of plants are present within an hour or two, and the streams contain Chara, an alga closely related to true plants. The swamps of Louisiana and the desert of Big Bend National Park are nearby.

Jim's research at UT centers on the anatomy and evolution of plants that have highly unusual bodies, such as cacti and parasitic plants. Many of these occur in Latin America, and Jim has travelled extensively in South America to study plants. He believes that one of the best ways to observe plants is from the seat of a bicycle, and he has cycled through many parts of the United States (coast-to-coast once), across Alaska, and through much of Europe.

As a professor, he has taught both Introductory Botany as well as Plant Anatomy every year since 1975. Many students, both graduates and undergrads, have assisted in his research. He knows from this long experience that students today are just as talented, capable, and interested as students half a century ago.



PRONUNCIATION GUIDE

abiotic	AY bye otic	
abscisic (acid)	ab SIZE ick	or ab SIZ ick (SIZ as in sizzle)
actinomorphic	ack tin oh MORE fick	
adenosine	a DEN oh seen	(a as in adverse)
adventitious	ad ven TI shush	
allele	al EEL	(the final e is silent; not al EEL ee)
allelochemic	al eel oh KEM ick	
allelopathy	al EEL oh pathy	or al eel oh PATH ee
androecia	an droh EE see uh	
androecium	an droh EE see um	
angiosperm	AN gee oh sperm	
angiospermous	an gee oh SPERM us	
anion	AN eye on	(not AN yun)
anisogamy	AN eye so gam ee	or an eye SAW gam ee
antheridia	anther ID ee uh	
antheridiophore	anther ID ee oh for	
antheridium	anther ID ee um	
antipodal	an TI poad uhl	(poad like road)
apomorphy	AP oh more fee	(ap as in apple)
apoplast	A po plast	(a as in adverse)
archaebacterium	ar key bact IR ee um	
archegonia	arch eh GON ee uh	
archegoniophore	arch eh GON ee oh four	
archegonium	arch eh GON ee um	
aril	AIR ill	
atactostele	ay TACT oh steel	
axoneme	AX oh neam	(neam as team)
biome	BUY ohm	
biotic	buy AW tick	
biotroph	BUY oh troph	(troph as in loaf)
bryophyte	BRY oh fight	(bry as in dry)
calyces	KAY li sees or KAL i sees	
calyx	KAY licks	
cation	CAT eye on	
charophyte	KAR oh fight	
chiasma	key AHS muh	
chitin	KAI tin	
chlamydospore	klam IH doh spoar	
cilia	SILLY uh	
cilium	SILL ee um	
circadian	sur KAY di un	
coenocyte	SEEN oh sight	
coenzyme	KOH en zyme	
coevolution	koh ev ol OU shun	
coleoptile	coal ee OP tile	
collenchyma	kol EN kim uh	
crista	KRIS tah	
cristae	CHRIS tee	
cuticle	KIU tih kl	
cutin	KIU tin	
cytokinesis	sight oh kai NEE sis	
cytokinin	sight oh KAI nin	
dibiontic	dye bye ON tik	
dichotomous	dye KOT oh mus	
dicot	DYE kot	
dioecy	dye EE cy	
endophyte	END oh fight	
epiphyte	EPI fight	
eudicot	you DIE kot	
eukaryote	you KAR ee oat	
euphyllophyte	you FILL oh fight	
eustele	YOU steel	
flagellum	fla- GEL um	
gamete	GAM eat	
gametophore	gam EAT oh four	
gametophyte	gam EAT oh fight	
gene	jean	
genera	GEN er uh	
genome	JEAN ohm	
genotype	JEAN oh type	
genus	JEAN us or GEE nus	
gibberellin	jib er ILL in	
gymnosperm	JIM no sperm	
gynoecium	jah een EE see um	
hila	HIGH lah	

hilum	HIGH lum	
homeotic	home ee AH tik	
hypha	HIGH fuh	
hyphae	HIGH fee	
isogamy	eye SAW gam ee	
leucoplast	LOU koh plast	
lignophyte	LIG noh fight	
lysis	LIE sis	
lysosome	LIE soh soam	
manoxylic	man oh ZY lik	
meiosis	my OH sis	
mitosis	my TOE sis	
monoecy	mon EE see	
mycorrhiza	my koh RYE zuh	
mycorrhizae	my koh RYE zee	
niche	NI ch (as in rich) or KNEE ch	
oogamy	OH oh gam ee	or oh AH gam ee (each "o" is pronounced)
oogonia	oh oh GON ee uh	
oogonium	oh oh GON ee um	
pangaea	pan GEE uh	
paramylon	pair AM ill on	
parenchyma	par EN kim uh	
perigynous	pair IH jen us	
phage	FAY jj	
phellem	FELL em	
phelloderm	FELL oh derm	
phellogen	FELL oh jen	
phenotype	FEE noh type	
phloem	FLOW em	("o" and "e" are distinct)
phyletic	fi LET ik	("fi" as in high)
phyllode	FILL oad	(oad as in toad)
phyllotaxy	FILL oh tax ee	
phylogenetic	fi low jen ET ik	
phytoalexins	fight oh al EX inz	
phytochrome	FIGHT oh chrome	or fight oh CHROME
phytoferritin	FIGHT oh fer it in	
pleiotropic	ply oh TROH pic	
pneumatocyst	new MAT oh sist	
poikilohydry	poy kil oh HIGH dree	
prokaryote	pro CARRY oat	
protonema	pro tow NEEM uh	
protostele	PRO tow steel	
protoxylem	pro tow ZY lem	
pycnoxylic	pik noh ZY lik	
rachis	RAY kis	
rachises	RAY kis ease	
raphe	RAY f	
raphide	ray FIE d	(fie as in pie)
rhizoid	RYE zoid	(zoid as in Boyd)
rhizome	RYE zoam	(zoam as in foam)
ribose	RYE bose	(bose as in gross)
saprotroph	SAP row troph	(troph as in loaf)
sclereids	SKLER ee id	or SKLER eed
sclerenchyma	skler EN kim uh	
scutellum	skee u TEL um	
seta	SEAT uh	
setae	SEAT ee	
statocyte	STAT oh sight	
statolith	STAT oh lith	
stele	STEAL	
stigma	STIG muh	
stipe	STY p	
stipule	STIP you'll	
stolon	STOW lon	
stoma	STOW muh	
stomata	stow MA ta	or STOW ma ta
strobilus	STROW bil us	(strow as in grow)
stroma	STROW muh	(strow as in grow)
stromatolite	strow MAT oh light	
taxis	TAX sis	
taxon	TAX on	
telome	TEAL ohm	
thylakoid	THIGH la koid	
ti plasmid	TEA EYE plasmid	
tracheary	TRAKE ee ary	(trake as in rake)
tracheid	TRAKE ee id	(trake as in rake)
trichogyne	TRICK oh jyn	(jyn as in mine)
trichome	TRI comb	
tropic response	TROPE ick	(trope as in rope; not as in Tropic of Cancer)
tyloses	tie LOW sees	
tylosis	tie LOW sis	
vacuole	VAK you ol	(ol as in hole)
valance	VAY lance	(vay as in way; not as in valley)
violaxanthin	vi ol uh ZAN thin	
xerophyte	ZERO fight	
xylem	ZY lem	
zoospore	ZOH oh spore	(zoh as in mow, tow, go)
zygote	ZIGH goat	(zigh as in sigh)