THE MOLECULAR LIFE OF PLANTS

Russell Jones | Helen Ougham | Howard Thomas | Susan Waaland

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American Society of Plant Biologists

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The Molecular Life of Plants

Companion website

This book is accompanied by a companion website:

www.wiley.com/go/jones/molecularlifeofplants

The website includes:

- Powerpoints of all figures
- PDFs of all tables from the book for downloading
- PDFs of the table of contents and index

Preface

The Molecular Life of Plants, a textbook designed to introduce undergraduate students to contemporary experimental plant biology, was inspired by *Biochemistry and Molecular Biology of Plants* published in 2000 by the American Society of Plant Biologists. *Biochemistry and Molecular Biology of Plants* was written with a graduate student readership in mind, its 24 chapters covering key topics at the forefront of plant biochemistry and molecular biology. In addition to presenting advances in plant science research, an outstanding feature of *Biochemistry and Molecular Biology of Plants* is the quality and richness of the artwork, many aspects of which have been emulated by other textbooks. *Biochemistry and Molecular Biology of Plants* has been translated into Chinese, Japanese and Italian and an English language version of the book has been produced for the Indian market.

The success of *Biochemistry and Molecular Biology of Plants* led the American Society of Plant Biologists to collaborate with Wiley-Blackwell to produce other publications in plant biology. The editors of *Biochemistry and Molecular Biology of Plants*, Bob Buchanan, Willi Gruissem and Russell Jones, developed the outline of *The Molecular Life of Plants*, an undergraduate textbook incorporating the strengths of *Biochemistry and Molecular Biology of Plants*, especially the outstanding illustrative material. The goal of this new text is to include broader aspects of contemporary experimental plant biology in a typical undergraduate plant physiology curriculum. Thus *The Molecular Life of Plants* is designed to show how the unifying influence of molecular advances in the fields of biochemistry, physiology, development, adaptation and evolution is revolutionizing the teaching of experimental plant biology.

The Molecular Life of Plants uses the life cycle of a seed plant as a framework to discuss the key aspects of plant function from seed to seed. Helen Ougham and Sid Thomas, both at Aberystwyth University, and Susan Waaland at the University of Washington, joined Russell Jones at the University of California at Berkeley to write this book. Russell Jones, Helen Ougham and Sid Thomas wrote the elements of the 18 chapters and Susan Waaland was the scientific editor ensuring that the whole book read uniformly and was factually accurate.

The teaching of functional plant biology has a long and illustrious history in Europe and North America. Many outstanding textbooks have been devoted to this topic. In the middle to late 19th century this field was dominated by books written in German by authors such as Haberlandt, Sachs and Pfeffer, whose texts were translated into English and were used in English-speaking countries worldwide. It was only in the 1930s that textbooks dealing with the mechanisms of plant growth and development written by North American authors began to be published, the first by Edwin Miller in 1931. Miller's Preface to *Plant Physiology* stated: 'The various texts by European investigators and teachers, while summarizing the work that has been done on the continent, have failed to cover adequately the contributions of American and English plant physiologists.' From the mid-20th century, authorship of textbooks covering the field has had a decidedly North American bias, largely due to the impact that Land Grant Universities in the USA have had on the teaching of this subject so essential to agriculture. Publication of Miller's book was followed by the now famous text *Plant Physiology* by Bernard Meyer and Donald Anderson, first published in 1938 and surviving in various editions until the 1970s. Two other textbooks have since dominated the field, one by Frank Salisbury and Cleon Ross first published in 1969 and the most recent by Lincoln Taiz and Eduardo Zeiger, first published in 1991 and now in its fifth edition.

The Molecular Life of Plants differs from its predecessors in that it reflects the dramatic changes made possible in biology by the revolution in molecular genetics. The complete genome sequences of a large number of plant species have been published and the ability to generate mutants with unique phenotypes in *Arabidopsis*, in *Zea mays* and in many other species has allowed the dissection of biochemical pathways and cell processes and an enhanced understanding of the fundaments of plant growth and development. Following the lead of *Biochemistry and Molecular Biology of Plants*, we have incorporated many of these topics into *The Molecular Life of Plants*. We have also introduced 'Key points' as a tool to summarize material and facilitate student learning. Salient aspects within each section of a chapter are summarized in a 'Key points' text box that condenses the topic to its essence in 100–150 words.

This book is organized into six parts beginning with *Origins* which has four chapters, the first providing a primer on plant structure and reproduction, then Chapter 2 presenting the basics of cellular chemistry,

followed by Chapter 3 on plant genomes, their organization and expression, and Chapter 4 on cell structure. Part II (*Germination*) has three chapters. Chapter 5 describes the cellular events crucial for germination including membrane transport and intracellular protein trafficking. The other two chapters in this part discuss germination and the mobilization of stored food reserves (Chapter 6), and how these reserves are metabolized to provide energy and carbon skeletons for the developing plant (Chapter 7).

Part III (*Emergence*) deals with the roles of light in seedling growth and development. Chapter 8 discusses light perception and the developmental consequences of this, while Chapter 9 addresses photosynthesis and photorespiration. Part IV (*Growth*) covers hormone synthesis and action (Chapter 10); the cell cycle and meristems (Chapter 11); and cell elongation, embryogenesis and vegetative development (Chapter 12).

Maturation (Part V) and *Renewal* (Part VI) complete the functional aspects of the plant life cycle. In Part V, Chapter 13 discusses nutrient acquisition, Chapter 14 covers the topics of long-distance transport with a focus on the mature plant, and Chapter 15 deals with interactions of the plant with its environment. In the final part, Chapter 16 describes the development of flowers, seeds and fruits, while Chapter 17 discusses the development of resting structures and dormancy mechanisms. Events in the plant life cycle are completed in Chapter 18 with a detailed treatment of senescence, ripening and death in the final stages in the life of a plant.

A comprehensive list of credits and permissions for the use of the many figures and tables is provided at the end of the book. Special thanks are due to several members of the editorial team at Wiley-Blackwell. Celia Carden our Development Editor deserves particular recognition for moving the project forward and for her good humor under all conditions. In addition to her deep inside knowledge of the publication business, Celia demonstrated her broad knowledge of plant biology, helpful in selecting the anonymous reviewers of the manuscript in its various stages of development. We are indebted to these reviewers. Celia was instrumental in hiring Debbie Maizels as the illustrator for the book. Debbie is an extraordinarily talented artist with the bonus of having a sound background in the biological sciences. We owe Debbie special gratitude for her work on this book. Fiona Seymour, Senior Project Editor at Wiley-Blackwell provided excellent support during the production process. Fiona's knowledge of the intricacies of textbook production was invaluable in ensuring the overall very high quality of *The Molecular Life of Plants*. Jane Andrew, Project Manager, has helped immensely with the details of production including copy-editing, liaising with the typesetters, proofreading and indexing. Last, but not least thanks are due to Andy Slade at Wiley-Blackwell and Nancy Winchester at ASPB headquarters in Rockville, Maryland. Andy and Nancy were instrumental in the launching of the joint ASPB–Wiley publication venture and they were both very supportive of *The Molecular Life of Plants*, cheering from the sidelines when needed and making sure that the project did indeed come to fruition.

Russell Jones
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Brief contents

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Contents