

PREFACE

A new approach to molecular biology for the twenty-first century

Molecular Biology: Principles of Genome Function offers a fresh, distinctive approach to the teaching of molecular biology. It is an approach that reflects the challenge of teaching a subject that is in many ways unrecognizable from the molecular biology of the twentieth century – a discipline in which our understanding has advanced immeasurably, but about which many intriguing questions remain to be answered. Among the students being taught today are the molecular biologists of tomorrow; these individuals will be in a position to ask fascinating questions about fields whose complexity and sophistication become more apparent with each year that passes.

We have written the book with several guiding themes in mind, all of which focus on providing a faithful depiction of molecular biology in the twenty-first century, and on communicating this reality to students in a way that will engage and motivate, rather than overwhelm and intimidate.

A focus on the underlying principles

Arguably one of the biggest challenges facing instructors and students of molecular biology today is the vast amount of information encapsulated by the field. It is impossible for an instructor to convey every last detail (and equally impossible for students to absorb everything that there is to know). Indeed, we believe that, in order to understand the main concepts of molecular biology and to appreciate their exquisite complexity, it is not necessary to delve into every fine detail. Therefore, our approach focuses on communicating the *principles* of the subject.

We believe it is better for students to truly understand the foundational principles rather than simply learn a series of facts. To this end, we do not try to be exhaustive in our coverage. In the digital age in which we live, it is easier than ever before for students to gather a vast amount of information on a particular topic of interest. This information is of little value, however, if the student lacks a conceptual framework within which to make sense of all the information to which they are exposed.

By focusing on key principles, we seek to equip students with a conceptual framework, which we believe will be invaluable to them during their later careers.

An emphasis on commonalities

Until relatively recently, much more was known about the molecular components and processes of bacterial systems than of their archaeal and eukaryotic counterparts. In recent years, however, our understanding of archaeal and eukaryotic systems has increased enormously. With this increased understanding has come the realization that bacterial, archaeal, and eukaryotic systems exhibit many commonalities – commonalities that point to the common ancestry of the three kingdoms of life.

Throughout this book, therefore, our emphasis is on the *common features* of bacterial, archaeal, and eukaryotic systems. Differences do exist, of course – an inevitable outcome of evolutionary processes generating biological diversity. However, we have strived where possible to present a single view of key topics based on conserved processes and components. We have then discussed key differences between bacterial processes and their archaeal and eukaryotic counterparts where they exist, and where they have helped to further our understanding.

We recognize that some may feel that the processes occurring in bacteria, and in eukaryotes and archaea, are best taught separately. However, our focus on principles – and on constructing an overarching conceptual framework – leads us strongly to believe that an emphasis on commonalities is a valuable educational approach.

Integration of key themes and concepts

One of the most startling realizations of recent years has been the widespread importance of certain molecular phenomena, such as chromatin modification, or RNA silencing, which have impacts on genome function in ways far more diverse than had previously been recognized. Rather than examining each of these phenomena in isolation, our approach reflects their diverse impacts by presenting them in the various contexts in which they function. Therefore, you will not see a separate chapter on such topics; instead, the impact of these basic processes on genome function is woven throughout the book.

Similarly, while many books deliberately separate the regulatory control of basic processes from the processes themselves, we have chosen to put them together. As more is learned about how regulation takes place, it becomes increasingly apparent that regulation is typically nothing more than the alteration of the core process, so that an alternative, but related, pathway is chosen. Regulation simply acts on the core mechanistic features of the process, and so it makes sense to present them side by side.

We believe this overall approach reflects the reality of molecular biology, and helps students to appreciate molecular biology as a unified discipline, with many components and phenomena acting in concert, rather than as a series of isolated topics.

A demonstration of how we know what we know

At heart, molecular biology is an experimental science. Our understanding of the field is increased through the accumulation of experimental evidence, which leads to the gradual emergence of key ideas and paradigms. Therefore, a central element to the understanding of molecular biology is an appreciation of the approaches taken to yield the information from which concepts and principles are deduced.

However, as instructors, we face a potential conflict: a mass of experimental evidence can often be overwhelming for students, and can make it more challenging for them to grasp the central ideas and paradigms that the experimental evidence has allowed us to elucidate. On the other hand, ignoring the experimental evidence deprives students from fully understanding the fundamental aspects of

Look at the *Map of key themes* in the Online Resource Center at www.oxfordtextbooks.co.uk/orc/craig/ for an illustration of how topics such as regulation are blended throughout the book.