

Preface

Our compendium is written for university undergraduates, graduate students, faculty, and investigators at research institutes. There are 26 articles and a length of over 800 pages, and as such it is the largest in-depth, up-to-date treatment of RNA Regulation presently available.

This *RNA Regulation* compendium differs in content and quality from all others available in five ways: (i) the overall coverage was approved by our Board, which includes 11 Nobel Prize laureates; (ii) the selection of each article and author was validated by reviewers from major university research centers; (iii) each article was then reviewed by peers from other universities; (iv) a glossary of terms with definitions is provided at the beginning of each article; and (v) the articles average 30 printed pages – which provides several times the depth of other such compendia.

RNA has long been regarded as a molecule that can function either as a messenger (mRNA) and/or as part of the translational machinery (tRNA, rRNA), and in fact RNA dominates the functions that define the state of a given cell at any moment. Subsequently, it became clear that RNAs are versatile molecules that not only play key roles in many important biological processes such as splicing, editing, protein export and the degradation of proteins and other RNAs, but also – like enzymes – can act catalytically. RNAi serves as an umbrella term, encompassing several phenomena discovered in a diversity of eukaryotes and prokaryotes, all of which are mediated by short noncoding RNA species. RNAi has been shown to be important in regulating gene expression by several mechanisms, from transcriptional silencing to mRNA degradation and translational repression. It has been determined that the genomes of all eukaryotes are almost entirely transcribed, generating an enormous number of nonprotein-coding RNAs (ncRNAs). It is increasingly evident that many of these RNAs have regulatory functions exhibiting cell type-specific expression, localization to subcellular compartments, and association with human diseases. Advances in understanding the basic molecular cell biology of RNA regulation is leading towards medical applications in cancer, aging, neurological disease, cardiac disease and infectious diseases. In addition, we cover the utilization of RNA interference for sensing endogenous molecular signals, processing and actuation in mammalian cells, and medical applications aimed towards the creation of smart molecular devices for therapeutic purposes, as well as elucidating genetic regulation and cellular functions.

Our coverage includes RNA interference and the delivery of therapeutic RNA to cells, as well as the basis for some of the most recent RNA breakthroughs such as the bacterial origin for harnessing the CRISPR system to target the destruction of specific genes in human cells and thereby provide a method for RNA-guided next-generation genome editing. We also provide an introduction to the recently emphasized investigation into extracellular RNA (exRNA), and whether it can be harnessed for the diagnosis and treatment of human diseases.

The 26 chapters are arranged in three sections: **Molecular Cell Biology**, which includes RNA regulation chapters on bacteria, plants, fungi, and humans and RNA stability and modification as well as transport and regulation in development; **Methods for Analysis and Manipulation of RNA-Mediated Regulation**, which includes vectors for delivery to cells, pharmacokinetics of RNA and methods for the purification of chemically stable and biologically functional RNA; and **Medical Applications**, for example, in cancer, infectious diseases, neurodegenerative disorders and cardiac disease. In fact, noncoding RNAs – functional RNA molecules that do not encode proteins such as microRNAs (miRNAs) – are discussed in relation to regulation of the cancer stem cell properties of self-renewal and differentiation, and thus also provide a potentially new therapeutic approach.

Our team hopes that you, the reader, will benefit from our hard work, finding the content useful in your research and educational. We wish to thank our Managing Editor, Sarah Mellor, as well as our Executive Editor, Gregor Cicchetti, for both their advice and hard work during the course of this project.

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