# Preface

Vision is crucial to allow for reliable orientation in the three-dimensional space and an immediate response to changing situations of the surrounding environment. In higher life forms, the ability of the visual system is intriguing in terms of resolution and the utilization of a wide range of ambient light conditions as well as the speed with which information is generated and transmitted to the brain where it triggers a direct reaction. To accomplish such remarkable tasks, highly complex networks of neuronal and auxiliary cells have evolved which are required to convey the physical energy of a light quantum via a molecular cascade to an electrical signal in the nervous system.

Over the past decades, our knowledge about the cellular and molecular basis underlying the visual process has remarkably increased. Hereby, a most fruitful approach included the study of the causes of visual impairment, in particular the analysis of degenerative diseases of the retina. Elucidating photoreceptor degeneration in animal model species such as *Drosophila melanogaster*, zebrafish, *Xenopus laevis*, or the mouse greatly advanced the field of eye research and has also fueled progress in delineating retinal degeneration in humans.

In accordance with the general objectives of the *Methods in Molecular Biology* series, the aim of the current volume *Retinal Degeneration: Methods and Protocols* is to provide a comprehensive step-by-step guide of relevant and state-of-the-art methods for studying retinal homeostasis and disease. Consequently, this book covers a broad range of techniques addressing cell culture systems and animal models of disease, their generation, their phenotypic and molecular characterization as well as their use in therapeutic approaches to the retina.

This volume is divided into seven parts. In an introductory chapter, Part I provides an overview of successfully applied approaches in human gene identification and characterization of retinal disease. Part II describes the mouse as a suitable animal model for monitoring and functionally analyzing retinal degeneration in vivo while Part III addresses specific technical aspects of vision research in non-rodent animal models such as frog, zebrafish, and the fruitfly *D. melanogaster*. In Part IV techniques for the analysis of retinal tissue and specific cell types in situ are described. Part V details some methods for tissue culturing and the use of cellular models to study homoeostatic processes in specific retinal cell types. Part VI addresses transcription and gene regulation in the healthy and diseased retina. Finally, Part VII is devoted to crucial aspects of therapy to treat retinal degeneration. Specifically, this part addresses the technique of subretinal injection, the adeno-associated viral vectors as vehicle to deliver gene constructs, and an innovative approach to barrier modulation to efficiently deliver drugs to the retina. These topics are most relevant as part of proof-of-concept approaches in animal models and also to advance treatment options in human patients.

The current volume *Retinal Degeneration: Methods and Protocols* should be helpful to all those researchers from academia, biotech, and industry interested in cutting-edge techniques to study retinal cell biology in health and disease. We would like to thank all authors of this volume for their excellent contributions. It is their expertise and willingness to share

bits and pieces of valuable information which is usually not readily available in the scientific literature but makes all the difference between a successful and a useless experiment. We are also deeply grateful to John Walker for inviting us to contribute this volume to the *Methods in Molecular Biology* series and for his expert editorial assistance during the preparation of this book.

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