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## Preface

Hearing is a sensory modality critical to both language and cognitive development. In its absence, and without sensory input through another modality, such as the manual/visual modality of sign language, cognitive and language development can be severely impaired in the earliest formative years of a child. In its endeavor to discover the mechanisms underlying audition, the field of auditory science has provided rich comparative physiological studies, allowing insights into both the micromechanical and electrochemical world of this system. For many years, the auditory/vestibular sciences have been influenced by the discoveries of electrical engineers and sensory physiologists, who have provided insights into the functions of this dynamic system. The early discoveries in these fields, as well as advancements in microprocessing and materials technologies, provided a means whereby hearing could be regained partly through the use of a bionic device, known as a cochlear implant. Presently, this device and the auditory brainstem implant are the only ones to prosthetically replace brain function.

With the advent of molecular biology tools, such as RT-PCR, the auditory and vestibular fields have made great strides in understanding the genetic basis for various hearing and balance disorders over the past fifteen to twenty years. These technologies permitted the discovery of genes that control inner ear structure and function by overcoming the hurdle of working with small amounts of tissue, as found in the inner ear. The amplification of genes with RT-PCR provided a means to discover gene expression in the small, inner ear endorgans during development, as well as in damaged and normal sensory epithelia in the adult. The use of gene knockout animal models provided the means to verify the effects of genes critical to the development of this system, whereas *in situ* hybridization localized newly discovered gene transcripts. As these technologies continue to broaden the discovery of genes and their regulatory behavior, auditory and vestibular studies have begun to focus on proteins in terms of their interactions, structure, and how these factors relate to function.

In light of the dramatic changes in the auditory and vestibular sciences over these past fifteen plus years, this book describes RNA, protein, and imaging protocols that currently are in use and that have provided insights into genetic regulation, as well as insights into genes and pathogens involved in diseases of the ear. This overview provides a perspective of basic research with both mammalian and non-mammalian animal models, as well as protocols applicable to clinical studies. The chapters in Part 1 include basic protocols of RNA isolation and expression, followed by methods to study cell lineage, gene delivery, and the identification and use of stem cells. This section ends with techniques that are applicable to clinical studies of genes, pathogens, and cancers that lead to hearing loss in humans. Part 2 focuses on the study of inner ear proteins and more specifically on their interactions, including techniques such as the yeast-two hybrid assay, coimmunoprecipitation, plasmon resonance, and protein tagging for mass spectrometry. The final section, Part 3, describes imaging techniques

useful for the study of ions, protein-protein interactions, and imaging of proteins at the atomic level.

While the chapters are written by specialists in the auditory and vestibular fields, the techniques described herein will be useful to those exploring genes and proteins in other systems as well, especially where tissues are scarce and where a comparative approach lends itself to discovering the underlying causes of human disorders.

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