
Preface

Techniques for controlled genetic manipulations have become universal and are used in numerous biomedical fields. Meanwhile, studies of the nervous system prompted development of perhaps the most sophisticated variants of this methodology. The demand for such development is driven by the anatomical and physiological complexity of the brain and by the need for experimental models that can address this complexity through selective manipulation of defined components of the system: specific neuronal populations or selected synapses. The ideal model, which would allow very precise temporal and spatial control of such manipulations, had been considered an unattainable dream just few years ago, but has almost become a reality following recent technical advances, which include the development of genetic tools for inducing or suppressing neuronal activity not only by the chemicals but also by the optical signals.

The general use of “conditional knockouts” or “regulated expression” became a routine, following broad implementation of the Cre-loxP and similar systems. Meanwhile it is getting increasingly important to learn how these already well-established techniques can be combined with continuously generated tools, like new lines of mice with cell-type specific promoters, advanced methods for delivering genetic material into the brain, and new molecules that allow control of neuronal firing or intracellular signaling pathways. As combinations of these techniques should be uniquely crafted to address specific biological questions, the objective of this book is twofold: to supply basic technical information about controlled genetic manipulations and to provide examples of creative implementation of this methodology when addressing a unique biological problem. Subsequently, some chapters of the book describe the most recent developments in the basic methodology, which includes use of Cre-recombinase, and methods for delivery of genetic material into the brain, whereas other chapters focus on applying these techniques to addressing particular biological questions like structural and functional mapping of neuronal circuits, analysis of specific synaptic connections, and modeling or gene therapy of neurological disorders.

Based on this book objective, the contributing authors represent a broad range of expertise in molecular biology, neurophysiology, and behavioral models and pioneered many approaches described in the book.

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