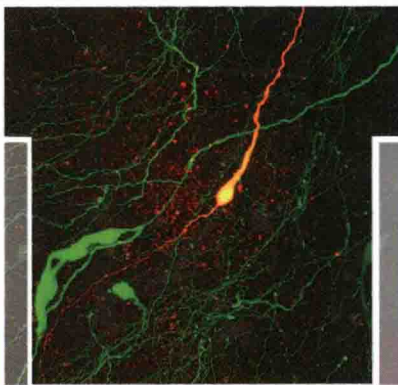




Masterclass in
Neuroendocrinology
Series

The GnRH Neuron and its Control

Editors: Allan E. Herbison & Tony M. Plant



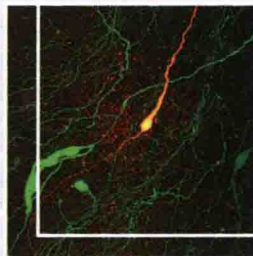
WILEY Blackwell

The GnRH Neuron and its Control

Editors:

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The GnRH Neuron and its Control examines the developmental biology of GnRH neurons including their birth in the nasal placode of the early embryo, perinatal programming, and sexual differentiation, in addition to the hypothalamic mechanisms that control GnRH neurons in adulthood to generate pulsatile and surge modes of GnRH secretion throughout the major life stages including aging. The morphology, electrophysiology, signal transduction pathways, transcriptional regulators, and genomics underlying function of the adult GnRH neuron is discussed in detail, as is the neuroendocrinology and cell biology governing the generation of both modes of GnRH release.

The book also reviews the neurobiological mechanisms and circuitry responsible for the modulation of the activity of GnRH neurons by season, stress, nutrition, and metabolism, and covers the current and potential therapeutic approaches to regulating GnRH secretion and action. Filled with newly identified research and classical fundamental knowledge to GnRH biology, it will provide students, researchers, and practitioners with an in-depth understanding of reproductive neuroendocrinology.

This is the sixth volume in the Masterclass in Neuroendocrinology Series, a co-publication between Wiley and the INF (International Neuroendocrine Federation) that aims to illustrate highest standards and encourage the use of the latest technologies in basic and clinical research and hopes to provide inspiration for further exploration into the exciting field of neuroendocrinology.

Series Editors: **John A. Russell**, *The University of Edinburgh, UK*
and **William E. Armstrong**, *The University of Tennessee, USA*




This book is accompanied by a companion website at:
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Series Preface

This Series is being published as a joint venture between the International Neuroendocrine Federation and Wiley-Blackwell. The broad aim of the Series is to provide established researchers, trainees and students with authoritative up-to-date accounts of the present state of knowledge, and prospects for the future across a range of topics in the burgeoning field of neuroendocrinology. The Series is aimed at a wide audience as neuroendocrinology integrates neuroscience and endocrinology. We define neuroendocrinology as the study of the control of endocrine function by the brain and the actions of hormones on the brain. It encompasses study of normal and abnormal function, and the developmental origins of disease. It includes study of the neural networks in the brain that regulate and form neuroendocrine systems. It also includes study of behaviors and mental states that are influenced or regulated by hormones. It necessarily includes understanding and study of peripheral physiological systems that are regulated by neuroendocrine mechanisms. Clearly, neuroendocrinology embraces many current issues of concern to human health and well-being, but research on these issues necessitates reductionist animal models.

Contemporary research in neuroendocrinology involves use of a wide range of techniques and technologies, from the subcellular to systems at the whole-organism level. A particular aim of the Series is to provide expert advice and discussion about experimental or study protocols in research in neuroendocrinology, and to further advance the field by giving information and advice about novel techniques, technologies and interdisciplinary approaches.

To achieve our aims each book is on a particular theme in neuroendocrinology, and for each book we have recruited a pair of editors, expert in the field, and they have engaged an international team of experts to contribute Chapters in their individual areas of expertise. Their mission was to give an up-date of knowledge and recent discoveries, to discuss new approaches, 'gold-standard' protocols, translational possibilities and future prospects. Authors were asked to write for a wide audience, to minimize references, and to consider use of video clips and explanatory text boxes; each Chapter is peer-reviewed, has a Glossary and a detailed Index. We have been guided by an Advisory Editorial Board. The Masterclass Series is open-ended; books in the Series published to date are: *Neurophysiology of Neuroendocrine Neurons* (2014, ed. WE Armstrong & JG Tasker);

Neuroendocrinology of Stress (2015, ed. JA Russell & MJ Shipston); *Molecular Neuroendocrinology: From Genome to Physiology* (2016, ed. D Murphy & H Gainer); *Computational Neuroendocrinology* (2016, ed. DJ Macgregor & G Leng); and *Neuroendocrinology of Appetite* (2016; ed. SL Dickson & JG Mercer). Books in preparation include *Model Animals in Neuroendocrinology*; *Neurosecretion: Secretory Mechanisms*; and *Developmental Neuroendocrinology*.

Feedback and suggestions are welcome.

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Preface

Books on the topic of the GnRH neuron are rare. Recent contributions extend only to a monograph by Andrea Gore titled *GnRH: The Master Molecule of Reproduction* (2002) and multi-authored books derived from conferences focused upon puberty (e.g., J.-P. Bourguignon and T.M. Plant, *The Onset of Puberty in Perspective*, 2000) and comparative aspects of GnRH neuron biology (e.g., I.S. Parhar, *Gonadotropin-Releasing Hormone: Molecules and Receptors*, 2002); all now over 15 years old. It could be argued that the authoritative reviews published in scientific journals by GnRH neurobiologists over recent years are a sufficient documentation of knowledge for the field. However, while comprehensive for their specific subtopic, these reviews cannot provide an overview of a field, and seldom do so in a temporally coordinate manner. For this reason, when approached regarding the International Neuroendocrine Federation (INF) Masterclass Series, we felt that it might well be appropriate to have a new book on the GnRH neuron. On reflection, and being able to see the final product, we are convinced that this was the right initiative at the right time. The book now brings together in one place the collective wisdom of many of the top GnRH neuron biologists in the world. It provides a 2017 state-of-the-knowledge date stamp for the GnRH field and, perhaps more importantly, a single source of knowledge across every facet of GnRH neurobiology that a reader could wish. Moreover, with a focus on providing detailed “how-to” experimental information, we believe this book will represent a unique and enduring source of often hard to find technical information of a very practical nature.

The book starts with a brief historical view of the discovery of GnRH and the investigative pathway that has led to our current concepts of how the GnRH neuron functions. In Part II, chapters from the Wray, Tsukamura/Maeda, and Terasawa laboratories provide us with the current state of understanding on how the GnRH neurons develop: how these remarkable cells migrate into the brain, become the subject of a sexually dimorphic neuronal network, and then undergo their postnatal start–stop–start behaviour to ultimately initiate puberty. Part III is devoted to the basic biology of the adult GnRH neuron itself. The regulation of GnRH gene expression is covered by the Mellon group, while both the morphology and the electrophysiology of the GnRH neuron are addressed in a range of vertebrate species by the Campbell, Hrabovszky, Herbison, and Oka

laboratories. Part IV is devoted to the regulation of the GnRH neuron at cellular and system-level viewpoints. This includes chapters on the glial control of GnRH neurons from the Prevot laboratory and the perspectives of the Boehm, Goodman, and Lehman groups (and their collaborators) on the regulation of GnRH neurons by the all-important kisspeptin inputs. Chapters from the Clarke, O'Byrne, Anderson, and Simonneaux laboratories then review the regulation of the GnRH neuron by estrogen, stress, nutrition, and season. Part V finishes with chapters from the Topaloglu and Millar groups, reviewing clinical perspectives on the human genetics of hypogonadal hypogonadism and the development of GnRH-related compounds for therapeutic use.

With an emphasis on contemporary techniques, the book covers virtually all current neuroscience and cell biology approaches being used to investigate the GnRH neuron. These include detailed protocols and tips for undertaking gene expression, immunohistochemistry, tract-tracing, electrophysiological, and genetic manipulation studies, through to whole-animal methodologies incorporating relevant behavioral paradigms and various hormonal treatment regimens in experimental animals, and on to human genome interrogation in the clinic. The impressive range of techniques presented reflects the truly multidisciplinary and integrative approach currently being undertaken by GnRH neurobiologists.

We hope that this book on the GnRH neuron will soon prove its worth in GnRH neurobiology laboratories worldwide, both for its crystallization of current knowledge and as a practical manual. While documenting the considerable progress that has been made, the book also indicates where further progress is required and how this may be achieved. As we come ever closer to the 50th anniversary of the 1971 discovery of GnRH, it will be fascinating to consider what a similar GnRH neuron book might contain 10 years from now.

About the Companion Website

This book is accompanied by a companion website:

www.wiley.com/go/herbison/the-gnrh-neuron

The website includes:

- Videos

Scan this QR code to visit the companion website



