

PRINCIPLES OF NEURAL SCIENCE

Sixth Edition

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Steven A. Siegelbaum

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PRINCIPLES OF NEURAL SCIENCE

Sixth Edition

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Sarah H. Mack
1962–2020

WE DEDICATE THIS SIXTH EDITION OF *Principles of Neural Science* to our dear friends and colleagues, Thomas M. Jessell and Sarah H. Mack.

Sarah Mack, who contributed to and directed the art program of *Principles of Neural Science* during her more than 30-year tenure, passed away on October 2, 2020. She worked courageously and tirelessly to ensure that all the artwork for this edition met her high standards and could be completed while she still had the strength to continue.

After graduating from Williams College with honors in English literature in 1984, Sarah worked for five years in the field of social work, while taking courses at Columbia in studio art and computer graphics. She first contributed to the art program for the third edition of the book when she joined the Kandel lab as a graphic artist in 1989. Five years later, as the fourth edition went into the planning stage, Sarah, together with Jane Dodd as art editor, completely redesigned the art program, developing and converting hundreds of figures and introducing color. This monumental task required countless aesthetic decisions to develop a stylistic consistency for the various figure elements throughout the book. The result was a set of remarkably clear, didactic, and artistically pleasing diagrams and images. Sarah maintained and extended this high level of excellence as art editor of the fifth and sixth editions of the book. She has thus left an enduring mark on the thousands of students who over the years, as well as in years to come, have been introduced to neuroscience through her work.

Sarah was a most remarkable and gifted artist, who developed a deep understanding and appreciation of neuroscience during the many years she contributed to the book. In addition to her artistic contributions to the figures, she also edited the associated text and legends for maximum clarity. Because her contributions extended far beyond the preparation of the figures, Sarah was made co-editor of the current edition of the book. Sarah also had an amazing ability to juggle huge numbers of negotiations with dozens of authors simultaneously, all the while gently, but firmly, steering them to a final set of elegantly instructive images. She did this with such a spirit of generosity that her interactions with the authors, even those she never met in person, developed into warm friendships.

Over the past three editions, Sarah was the driving force that formed the basis for the aesthetic unifying vision running throughout the chapters of *Principles*. She will be greatly missed by us all.



Thomas M. Jessell
1951–2019

Tom Jessell was an extraordinary neuroscientist who made a series of pioneering contributions to our understanding of spinal cord development, the sensory-motor circuit, and the control of movement. Tom had a deep encyclopedic knowledge and understanding of all that came within his sphere of interest. Equally at home discussing a long-forgotten scientific discovery, quoting Shakespeare by heart, or enthusing about 20th-century British or Italian Renaissance art, Tom was a brilliant polymath.

Tom's interest in neuroscience began with his undergraduate studies of synaptic pharmacology at the University of London, from which he graduated in 1973. He then joined Leslie Iversen's laboratory at the Medical Research Council in Cambridge to pursue his PhD, where he investigated the mechanism by which the newly discovered neuropeptide substance P controls pain sensation. Tom made the pivotal observation that opioids inhibit transmission of pain sensation in the spinal cord by reducing substance P release. After receiving his doctoral degree in 1977, he continued to explore the role of substance P in pain processing as a postdoctoral fellow with Masanori Otsuka in Tokyo, solidifying his lifelong interest in spinal sensory mechanisms while managing to learn rudimentary Japanese. Tom then realized that deeper insights into spinal cord function might best be obtained through an understanding of neural development, prompting him to pursue research on the formation of a classic synapse, the neuromuscular junction, in Gerry Fischbach's laboratory at Harvard.

Tom then joined the faculty of Harvard's Department of Neurobiology as an Assistant Professor in 1981, where he explored the mechanisms of sensory synaptic transmission and the development of the somatosensory input to the spinal cord. In 1985 Tom was recruited to the position of Associate Professor and investigator of the Howard Hughes Medical Institute in the Center for Neurobiology and Behavior (now the Department of Neuroscience) and Department of Biochemistry and Molecular Biophysics at Columbia University's College of Physicians and Surgeons. Over the next 33 years, Tom, together with a remarkable group of students and collaborators, applied a multidisciplinary cellular, biochemical, genetic, and electrophysiological approach to identify and define spinal cord microcircuits that control sensory and motor behavior. His studies revealed the molecular and cellular mechanisms by which spinal neurons acquire their identity and by which spinal circuits are assembled and operate. He defined key concepts and principles of neural development and motor control, and his discoveries generated unprecedented insight into the neural

principles that coordinate movement, paving the way for therapies for motor neuron disease.

Eric Kandel and Jimmy Schwartz, the initial editors of *Principles of Neural Science*, recruited Tom as co-editor as they began to plan the third edition of the book. Tom's role was to expand the treatment of developmental and molecular neural science. This proved to be a prescient choice as Tom's breadth of knowledge, clarity of thought, and precise, elegant style of writing helped shape and define the text for the next three editions. As co-authors of chapters in *Principles* during Tom's tenure, we can attest to the rigor of language and prose that he encouraged his authors to adopt.

In the last years of his life, Tom bravely faced a devastating neurodegenerative disease that prevented him from actively participating in the editing of the current edition. Nonetheless Tom's vision remains in the overall design of *Principles* and its philosophical approach to providing a molecular understanding of the neural bases of behavior and neurological disease. Tom's towering influence on this and future editions of *Principles*, and on the field of neuroscience in general, will no doubt endure for decades to come.

Notice

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required. The authors and the publisher of this work have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication. However, in view of the possibility of human error or changes in medical sciences, neither the authors nor the publisher nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they disclaim all responsibility for any errors or omissions or for the results obtained from use of the information contained in this work. Readers are encouraged to confirm the information contained herein with other sources. For example and in particular, readers are advised to check the product information sheet included in the package of each drug they plan to administer to be certain that the information contained in this work is accurate and that changes have not been made in the recommended dose or in the contraindications for administration. This recommendation is of particular importance in connection with new or infrequently used drugs.

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