BOOK REVIEW
Principles of Neurobiology

By Liqun Luo
2016 Garland Science Paperback, 645 pages

Reviewed by Ronald R. Hoy
Department of Neurobiology and Behavior, Cornell University, Ithaca, NY 14853.

Today's instructor(s) of entry level neuroscience courses have several choices of excellent textbooks, the most prominent that I'm aware of are "Principles of Neuroscience," from Kandel et al. (2012), McGraw-Hill, "Neuroscience," from Purves, et al. (2012), Sinauer Associates, "Neuroscience, Exploring the Brain," from Bear et al. (2016), Wolters Kluwer, and "Fundamental Neuroscience," from Squire et al. (2013), Academic Press. These four textbooks are time-tested over at least 20 years in multiple updated editions. They are used in both undergraduate and graduate/medical school neuroscience courses. Stanford's Liqun Luo's text is a new entry to our field and stands apart from the "Core Four," in being single-authored and in its spanking-new first edition and therefore completely "birthed" in the 21st Century. So there is no need to address legacy-chapters by previous or new authors, a potential issue with multiply-authored textbooks. Obviously, there are advantages and disadvantages a single-authored text as far as covering the demanding range of neuroscience in size and scale of neural analysis, molecular to systems, and context from basic molecular biology of neurons to brain generated behavioral acts. Basic neuroscience is so thoroughly interdisciplinary in its techniques, that draw from physics and engineering for powerful new optical analysis to synthetic and physical chemistry for X-ray crystallography and designer fluorescent neurochemicals, to genetics for the optogenetic techniques applied to genetically-tractable model systems: worms, zebrafish, drosophila, and mice, to name just a few of the interfaces that characterize contemporary neuroscience. In the face of this challenge, I admire Professor Luo for tackling it in writing a new introductory textbook for our field.

The advantage of a single-authored book is a consistent voice and narrative style, which is not always the case in books with multiple authors, unless the senior editor exerts a strong hand throughout the book. But the obvious advantage of a tag-team, multiple authors approach should be a guarantee that every chapter and topic in text would be covered by accomplished, well-known experts writing about her-his specialty. How well did Professor Luo do in covering the depth and breadth of neuroscience from molecules and molecular machines in neurons, from ion channels to synapses, and from neural systems in the brain to cognition, including learning and memory, and the brain's disorders such as neuropsychiatric disease? Quite well, and Luo lists his own large and impressive list of "critical and developmental advisors and consultants" who helped him. But undeniably, the textbook by committee format retains the advantage of breadth of coverage by specialist authors in each sub-area of neuroscience. The trade-off is that here you have a single author speaking with one voice and a consistent narrative rhythm.

I think the strength of this book is his coverage of the chapters on molecular and cellular substrates of neurobiology and synaptic signaling. Textual descriptions and explanations are depicted in clear diagrams that deploy color in ways that are informative and not distracting. The colors are well-saturated and vivid, not pastel which is frustrating. This makes for key components in figures "popping out" in strong contrast. Either the author or the publishers deserves credit for a text-book wide set of figures that are didactically strong and supportive of the text, i.e., memorable (clearly a goal in any introductory textbook).

The chapters on sensory systems reflect the same emphasis on the visual system that occurs in all other textbooks, which is not surprising as it reflects the proportion of research allotted to vision by comparison with other sensory systems. Over 80 pages are devoted to light transduction in rods and cones, retinal neuro-circuitry in generating opponent receptive fields, and the more complex receptive fields of the primary visual cortex. The developmental liability of cortical wiring due to experience will be familiar to readers of other textbooks. The Hebbian processes and their molecular substrates in enacting and embodying experiential influences are clearly presented. Overall, the treatment of visual systems is pretty similar to just about all other textbooks and is virtually canonical, arising from the foundations established by Hubel and Wiesel. The addition of studies from drosophila vision is welcome and I wish had been expanded. However, I find the book falling a little short in discussions of structure and function in the auditory system (a dozen pages) and somatosensation (a baker's dozen of pages). However, the well-chosen and depicted figure set alleviate my complaint (full disclosure—my interest is in mechanoreception—hearing and touch). The chemical senses get greater coverage reflecting advances in this field as well as the strong molecular-cellular neurobiology emphasis of this text, in general.

Another strength of the text is its up-to-date treatment of learning and memory, particularly the underlying molecular and cellular synaptic basis. However, for the behavioral and cognitive aspects of L & M, such as conditioning paradigms and involvement of brain systems outside the hippocampus, teachers and students will have to look elsewhere (ample and excellent web resources are just

one click away). This chapter is a good place to start for the cellular basics, however—it's excellent. The book provides well-selected introductions to topics that build from the basic cellular substrates of neurobiology to cognitive systems including circadian rhythms, sexual behavior, and sleep. Some instructors might find the lack of a chapter dedicated to neuroanatomy problematic. Luo spreads morphological information throughout the book in a "just-in-time," as needed strategy. Instructors and students who want a concentrated dose of neuroanatomy will find all they need and more from web resources.

What I really liked about the textbook are the last two chapters: one on evolution of the nervous system, in which the role of genetics and development interact to produce the form that enables neural function. The concluding chapter on "Ways of Exploring," will be welcome to instructor and student, alike. It thoughtfully discusses the use and selection of animal models in neurobiology research, and most importantly, the new techniques, such as optogenetics and connectomics technology are made accessible for the aspiring neurobiologist, fresh from introductory biology. In particular, discussion of genetic techniques including the likely revolutionary genome engineering made possible by the CRISPR-Cas9 technology makes this text up-to-date.

Since this review is written for undergraduate students and their faculty in neuroscience, I would be remiss if I did not point out the many online resources made available by the publisher. This will be welcome no matter how the course is taught—whether in traditional lecture format or by the rising tide of "flipped classroom" pedagogy. The resources include online homework, ways to track student performance, useful tutorials on concepts known to be well-worn "potholes" on the royal road to learning, as well as videos and animations for the enterprising teacher. Students have online access to a "journal club," flashcards, and their own access to animations and videos. I welcome the availability of these online enhancements and linking them to a good textbook definitely adds value to the text. This text should also be worth a look from neurobiology instructors in psychology departments, because it is so strong in the basics.

In conclusion, Liqun Luo's "Principles" is a welcome addition to an already excellent portfolio of introductory textbooks in neuroscience. But teachers window-shopping for a text ought to go beyond the hard-copy book in their hands and look into the wealth of online resources and enhancements which make this book especially attractive. This book is a very nice one-stop shop for new and returning teachers of undergraduate neuroscience.

REFERENCES

Bear MF, Connors BW, Paradiso MA (2016) Neuroscience exploring the brain, 4th edition. Philadelphia, PA: Wolters Kluwer.

Kandel ER, Schwartz JH, Jessell TM, Siegelbaum SA, Hudspeth AJ (2012) Principles of neural science, 5th edition. Columbus, Ohio: McGraw-Hill Education.

Purves D, Augustine GJ, Fitzpatrick D, Hall WC, LaMantia A-S, White LE (2012) Neuroscience, 5th Edition. Sunderland, MA: Sinauer Associates, Inc.

Squire LR, Berg D, Bloom FE, du Lac S, Ghosh A, Spitzer NC (2013) Fundamentals of neuroscience, 4th Edition. Waltham, MA: Elsevier Inc.

Received September 19, 2016; revised September 20, 2016; accepted September 20, 2016.

Address correspondence to: Dr. Ronald R. Hoy, Department of Neurobiology and Behavior, Cornell University, S.G. Mudd Hall, 215 Tower Rd., Ithaca, NY 14853. Email: rrh3@cornell.edu