TEXTBOOK REVIEW
Guide to Research Techniques in Neuroscience
By Matt Carter and Jennifer Shieh

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"Neuroscience is the field of study that endeavors to make sense of such diverse questions…The exchange of information among a half-dozen branches of science and the clinical practice of mental health have shaped a new scientific approach to the study of the brain."

-Sandra Ackerman *Discovering the Brain* (1992)

As an undergraduate enrolled in my first neuroscience course, I quickly discovered the daunting array of experimental techniques subsumed under the broader neuroscience umbrella. For the experienced scientist these many methodologies allow for complex analyses of the human mind from the level of the molecule to whole organism, situating neuroscience in a unique position among disciplines. However, as an introductory student, the rapid tour we took through the varied modes of investigation used in contemporary neuroscience research in no way could prepare me for reading and fully comprehending primary research documents, much less doing so with a critical lens. Whether the seasoned researcher or first-year undergraduate, in-depth exposure and knowledge of all the techniques used within the neurosciences is seemingly impossible. To address this need, Carter and Shieh's *Guide to Research Techniques in Neuroscience* functions as a primer to the design and analysis of a variety of neuroscience research techniques. Although not meant to replace the standard neuroscience textbook or techniques manual, this guide provides an excellent introduction to nearly every technique commonly used in neuroscience. In contrast to the superficial and often incorrect information encountered on a cursory search through Wikipedia or Google, topics are presented in the *Guide* in an approachable and succinct manner appropriate for the introductory student, yet with enough detail to please the seasoned neuroscientist in a field outside of their expertise.

Written by graduate students, this methodology resource focuses on common techniques used in neuroscience research, including what questions that technique can answer, the materials needed, and the proper controls for an experiment using its methods. In the Introduction Carter and Shieh provide a concise overview of the many levels of analysis used by the neuroscientist, from genetic analysis to whole brain imaging, while simultaneously emphasizing the common themes in scientific method and experimental design. Each chapter is structured around a specific technique or field of research (e.g., microscopy, cell culture, whole brain imaging; Table 1) and provides a review-like overview of these topics. Although the chapters do not necessarily follow an obvious progression (i.e., from micro to macro levels of analysis), this is not a major concern as each chapter functions as an independent unit. Hence, a reader could go through the book from cover to cover or more likely jump to the topic they need to understand. From a student's perspective this flexibility is one of the greatest benefits of the *Guide* as a technique or topic can be quickly understood when encountered in a research paper or the laboratory. From an instructor's perspective, the stand-alone nature of the text allows for a student-friendly resource related to a technique that will be discussed in class or used in the laboratory. Indeed, I have used this resource in varied aspects of my undergraduate career; in a sophomore seminar as I navigated new techniques, in a methods class as I started to apply these procedures, and now in the research laboratory as we discuss papers and ideas in laboratory meetings.

Chapter	Topic
1	Whole brain imaging
2	Animal behavior
3	Stereotaxic surgeries and *in vivo* techniques
4	Electrophysiology
5	Microscopy
6	Visualizing nervous system structures
7	Visualizing nervous system function
8	Identifying genes and proteins of interest
9	Molecular cloning and recombinant DNA technology
10	Gene delivery strategies
11	Making and using transgenic organisms
12	Manipulating endogenous genes
13	Cell culture techniques
14	Biochemical assays and intracellular signaling

Table 1. Topics covered in each chapter.

Each chapter has clear objectives delineated in "After Reading This Chapter" and "Techniques Covered" boxes located at the start of each topic. Wonderful illustrations and images clearly depict equipment needed for and underlying theory of each topic. For example, in the chapter devoted to animal behavior (Chapter 2), representative images of each behavioral assay provide a clear depiction of how the assay is performed.

Furthermore, advantage and disadvantage charts, such as one comparing model species used in genetics, help a reader weigh the relative strengths and weaknesses of the described techniques as an aid to choose which one may best suit his or her needs. Although the images of materials and theory are beautiful and abundant, inclusion of more primary data and guidance on how to analyze these data would greatly improve the *Guide*. Often data are depicted in a cartoon or iconographical manner rather than presenting examples of data from primary literature. Despite the inclusion of "Data Analysis" subsections in some chapters, these descriptions are more often than not missing a representative graph or example image of actual data. Consequently, data analysis skills are taught in the abstract with the reader needing to imagine what these data would look like, rather than having the source readily available.

It should be noted that the *Guide* appropriately presents just the information necessary to understand the basics of each method; it is in no way a research protocol. In this way, the *Guide* functions less like a cookbook that provides the instructions for making a dish at home and more like an elegantly labeled menu that allows one to savor and critique the dish at hand. However, Carter and Shieh clearly recognized this limitation by concluding each chapter with a "Suggested Readings and References" section including books, protocols, review papers, websites, and examples from the primary research. These sources are a wonderful addition for the student interested in learning more about the topic as well as an instructor looking for additional readings to include in his or her curriculum.

Arguably the greatest benefit of *Guide to Research Techniques in Neuroscience* is how it compares to other options on the market. I believe the author's put it best when speaking to how they came about writing the book, "we tried to find a book just like it, couldn't find one anywhere, and ultimately decided the book would be so useful that we would write it ourselves." Yes, other books provide more detailed and in-depth descriptions of specific groups of methodologies to the level of detail that a user can attempt the techniques (Yuste and Konnerth, 2005; Freshney, 2010; or Green and Sambrook, 2012) and, texts such as *The Design of Experiments in Neuroscience* (Harrington, 2010) provide better descriptions of research design in neuroscience. Yet nowhere are so many techniques included in sufficient detail that the reader is able to comprehend, design, and analyze research using those methods. This simple fact, combined with the relatively inexpensive price (~$50), make *Guide to Research Techniques in Neuroscience* an invaluable tool for students and instructors alike. With the continual emergence of new and modified techniques to study the nervous system, I hope that there are many future editions of the *Guide* in years to come.

REFERENCES

Ackerman S (1992) Discovering the brain. Washington, DC: National Academies Press

Carter M, Shieh JC (2009) Guide to research techniques in neuroscience. Burlington, MA: Academic Press.

Green MR, Sambrook J (2012) Molecular cloning: a laboratory manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

Harrington ME (2011) The design of experiments in neuroscience. Thousand Oaks, CA: Sage Publications, Inc.

Freshney RI (2010) Culture of animal cells: a manual of basic technique and specialized applications, 6th edition. Hoboken, NJ: John Wiley & Sons.

Yuste R, Konnerth A (2005) Imaging in neuroscience and development: a laboratory manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

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