

Preface

Careful thinking cannot be separated from effective writing. Being a biologist is not just about memorizing facts and terminology or about mastering an increasing array of computer software and molecular techniques. Biology is a way of thinking about the world; it is about making careful observations, asking specific questions, designing ways to address those questions, manipulating data thoughtfully and thoroughly, interpreting those data and related observations, reevaluating past work, asking new questions, and redefining older ones. It is also about communicating information—accurately, logically, clearly, and concisely. The hard work of thinking about biology is at least as important as the work of doing it. Writing provides a way to examine, to evaluate, to refine, and to share that thinking. Writing is both a product and a process.

Biology instructors are increasingly concerned about their students' writing for two reasons. First, bad writing often reflects fuzzy thinking, so questioning the writing generally guides students toward a clearer understanding of the biology being written about. Second, effective communication is such a key part of the biologist's trade that our students really must learn to do it well. The difficulty, of course, is finding the time to teach both biology and presentation skills when there is barely enough time in the semester to cover the biology. This book allows instructors to guide their students' writing without taking up valuable class time. And as their writing improves, so, too, will the students' understanding of what they are writing about.

Although this book covers every sort of writing assignment that biologists face—both as students and as professionals—it is brief enough to be read along with other, more standard assignments and straightforward enough to be understood without additional instruction. The book is intended especially for undergraduate use in typical lecture and laboratory courses at all levels, but it is also widely used in undergraduate and graduate seminars. Many colleagues tell me they have also found much in the book that was new and helpful in their own writing, and in their teaching.

I have included examples from all fields of biology. However, because the book is intended for use even at introductory levels, I have avoided examples that assume substantial specialized knowledge or terminology. Instructors in advanced courses may wish to amplify basic principles with examples chosen from papers published in their own fields; students will benefit in particular from guided study of good models.

CHANGES MADE FOR THE NINTH EDITION

For this edition of the *Short Guide*, I have made the following major changes:

- I have added new content about avoiding plagiarism and have highlighted that issue further in Chapter 2.
- I have updated information about citing references and listing them in the Literature Cited section of reports, including information about adding digital object identifiers (DOIs) to references and citing online journals.
- In Chapter 8, I have added new material about in writing an effective Materials and Methods section, writing strong figure captions, and preparing manuscripts for online submission. I have also added new examples about building logical introductions that lead inexorably to the specific research question to be addressed.
- In Chapter 3, I have updated my advice about using indexes for online searches and have added Google Scholar screen shots.
- In Chapter 10, I have added new advice about organizing talks, and I introduce the idea of having students give short talks based on a single graph or table from a research paper.
- I now suggest using cloud storage for backing up drafts, and emphasize the importance of doing so.

For this ninth edition, I have retained the narrative style that has made previous editions so successful with students. We can't expect students to become better writers if we reduce everything to bullets and summaries for them. Students can learn a great deal by writing their own summaries but little of lasting value by reading or memorizing mine. I have, however, added more boldfacing to this edition, making it easier for students to locate advice of particular importance. Users of the previous edition will notice many smaller improvements in every chapter.

ORGANIZATION

The first 6 chapters cover general issues that apply to all types of writing (and reading) in biology. In Chapter 1, I emphasize the benefits of learning to write well in biology, describe the sorts of writing that professional biologists do, and review some key principles that characterize all sound scientific writing. Chapter 2 emphasizes the struggle for understanding that must precede any concern with how something is said. In it, I explain how to read the formal scientific literature, including graphs and tables; how to take useful notes; and how to take notes in ways that prevent unintentional plagiarism. In Chapter 3, I describe how to locate useful sources using computerized indexing services, online journals, and the Internet. Chapter 4 explains how to cite references and

prepare a Literature Cited section. Chapter 5 talks about the use and interpretation of statistical analyses. Chapter 6 focuses on the process of revision—for content, organization, clarity, conciseness, grammar, word use, and spelling. It emphasizes the benefits of peer review, and it explains both how to be an effective reviewer of other people's writing and how to interpret criticism. Many readers have found Chapter 6 to be one of the most important chapters in the book. Most students learn little in preparing the first draft of anything. However, they can learn much—both about biology and about communicating their thoughts—through properly guided revision.

The rest of the book covers all of the specific writing tasks encountered in biology coursework and in professional life: writing summaries, critiques, essays, and review papers (Chapter 7); writing laboratory and other research reports (Chapter 8); writing research proposals (Chapter 9); preparing oral and poster presentations (Chapter 10); answering essay questions on exams (Chapter 11); and writing letters of application for jobs or for graduate school (Chapter 12). I encourage instructors to incorporate short oral presentations into their course design. Writing typically improves when students are first asked to give a short oral presentation on some aspect of what they are planning to write about: Writing, thinking, and speaking are all interconnected. Requiring brief oral presentations (based, for example, on a single figure from a published research paper) is a particularly good way to get students started on larger projects early in the semester.

My discussion of writing summaries and critiques is an especially important part of the book because most students seem not to have had much practice summarizing information accurately and concisely and in their own words. An inability to summarize effectively is a serious obstacle to both synthesis and evaluation. Writing summaries is also a particularly effective way for students to self-test their understanding and to prepare for examinations.

The chapter on writing research reports (Chapter 8) emphasizes that the results obtained in a study are often less important than the ability to discuss and interpret those results convincingly in the context of basic biological knowledge and to demonstrate a clear understanding of the purpose of the study. It emphasizes the variability inherent in biological systems and how that variability is dealt with in presenting, interpreting, and discussing data. This chapter will also be useful to anyone preparing papers for publication.

The checklists found at the ends of most chapters allow students to evaluate their own work and that of their peers. Most of the checklists include page numbers, helping students locate the text on which each item is based. Instructors can easily turn these checklists into grading rubrics, which should be shared with students well before the assignments are due. Sample rubrics, along with related materials, are available on my Website: <http://ase.tufts.edu/biology/labs/pechenik/publications/books.htm>

"Technology Tips" are scattered throughout the book, helping students take better advantage of the computer technology available to them for finding sources, writing, graphing, and giving oral presentations.

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I am grateful to all of these people for their comments and suggestions and am much cheered by their dedication to the cause. And who could ask for a more attentive reader than Victoria McMillan? "Oh, shame! Where is thy blush?"

It is also a pleasure to thank Regina Raboin, Science Research and Instruction Librarian at Tufts University, who was a great help in updating the material on conducting Internet and database searches.

Finally, I have learned much about writing and teaching from correspondence and conversation with enthusiastic readers of previous editions, from conversations with faculty in the many workshops that I've led over the past 20-plus years, and from working with colleagues from all disciplines in what was once the Writing Across the Curriculum program at Tufts University. I welcome additional comments from readers of the present edition, both instructors and students (jan.pechenik@tufts.edu).