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[Svetla Baykoucheva](#)

# Internet resources for scientific writing

*"In order to understand how best to improve writing, we would do well to understand better how readers go about reading."*

George D. Gopen, Judith A. Swan ([1](#))

It was a gloomy winter night, and I was sitting at the lab bench, wondering what went wrong—again—with my experiment. I had prepared all the reagents again, and I had followed the procedure exactly as described in the paper; nevertheless, the color of both the samples and the controls turned such a dark blue that it was not even worth measuring them. The values would have been beyond the range in which the spectrophotometer could detect any differences among the samples. What would have spared me many repetitions of the experiment was knowing that I should have placed the tubes with the samples on ice immediately after stopping the reaction—a small but important detail in the procedure that was not mentioned in the “materials and methods” section of the paper.

This incident, which happened many years ago when I was still in graduate school, illustrates how important it is to write a paper with sufficient detail and clarity so that other scientists can repeat the experiments and successfully reproduce the results.

The repeatability requirement makes the often-neglected materials and methods section critically important to the quality of a research paper. Good reviewers carefully read this section of the manuscript and can reject it if they are not sure that they would be able to repeat the experiment.

The requirements of journals vary widely, and it is impossible to offer recommendations that are universally acceptable. There are so many resources now, both in print and on the Internet, for how to write scientific papers that it is difficult to decide which is best. For this review, I have divided the Internet resources related to scientific writing into three main categories:

- Portals
- Direct links
- Specific tools

## Portals

Portals provide hot links to numerous resources in print and online. Many Web pages posted by educational institutions, professional organizations, publishers, and consulting firms belong in this category.

Koen Van Aken, a postdoctoral chemist at Georgia State University, Atlanta, has posted a list of useful links to resources on [how to write scientific papers](#) ([2](#)). His Web page gives some guidelines for engineering and science students and provides useful links to Chemical Abstracts Service (CAS) standard abbreviations, abbreviations of chemical compounds, submission guidelines for organic chemistry journals, general guidelines for correct scientific English, chemistry writing tools such as spell checkers, and publishing tools.

Harcourt Publishers and the Internet Business Forum have sponsored a compendium of [biomedical writing resources](#) (3) that is one of the best portals to links on general and scientific writing. Users at many different levels—undergraduates, graduates, research scientists, physicians, nurses, publishers, and librarians—will find this site helpful. Links are provided to sites for publishers, journals, articles, abstracts, Web sites, dictionaries, and other writing resources. The site is oriented mainly to the biosciences, but it also gives useful tips on research, grammar, and writing in general. There are also citation guidelines for electronic documents and for writing papers and theses.

[Writing and Editing Links for Biology and Medicine](#) was put up by Jennifer Macke, a freelance biomedical writer and editor, as a repository of relevant Web links (4). The site offers general information, including extensive lists of resources for biology and writing, and links to the Welch Library at Johns Hopkins, MedWeb at Emory, the Council of Biology Editors, the Board of Editors in the Life Sciences, the American Medical Writers Association, the European Association of Science Editors, and the National Association of Science Writers. It also provides links for finding appropriate terminology: CancerWeb's *Online Medical Dictionary*, Biotech Online's *Life Science Dictionary*, the Human Gene Nomenclature Database, and the List of Bacterial Names with Standing in Nomenclature. The site also serves as a bulletin board for freelance writers in the biomedical field.

Carey Booth of the biology department at Reed College, Portland, OR, has compiled a [list of resources](#) on how to prepare a lab report, scientific writing styles, how to acknowledge sources, grammar and punctuation, and interactive writing exercises (5).

Many professional organizations provide useful guidelines for writing specific types of articles. For example, the Web page of the [International Federation of Library Associations and Institutions](#) (IFLA) offers guides on citing electronic documents (6).

### Direct links

Direct links provide access to articles and manuals on writing in general and scientific writing in particular. One-click access to articles, manuals, and handbooks is sometimes much easier than going through portals, which list numerous URLs. Clicking links one by one can be tedious.

[A Handbook for Technical Writers and Editors](#), published by NASA, is a useful guide to scientific writing and editing. The entire document is 108 pages long (464 kB) and can be downloaded as a PDF file (7). Michael Alley of Virginia Tech has a book and a Web site, both called [The Craft of Scientific Writing](#) (8, 9). He has also posted [The Craft of Editing: A Guide for Managers, Scientists, and Engineers](#) (10). These well-structured guides are excellent for beginning authors and science writers.

[Academic Writing](#) is a handbook posted by the Writing Center of the University of Wisconsin, Madison. It has chapters on writing scientific and lab reports, grant proposals, and dissertations, and it lists resources for writing dissertations (11). Scientific writing tips, sentence structure, and common mistakes are discussed on the Web site for the [College of Forest Resources at Mississippi State University, Starkville](#) (12). A recently revised Web site supported by the [University of Guelph, Ontario](#) (13), helps you answer basic scientific writing questions:

- Why did you study this problem?
- What did you do?
- How did you do it?
- What did you find?
- What does it mean?
- How does it relate to previous work in the field?

In addition to many links to resources on scientific writing, the Web site sponsored by the [Capital Community College](#), Hartford, CT, includes recommendations on how to carry out research (14). Specific help for writing scientific papers is available from [Iowa State](#)

[University's College of Agriculture](#) Web site ([15](#)). It discusses word usage in scientific writing and includes some of the troublesome words, terms, and expressions most frequently found in the journal paper and bulletin manuscripts submitted to the Iowa Agriculture and Home Economics Experiment Station.

If English is not your first language, links to many useful English writing resources can be found at the Web sites for the [Writing Center at Union College](#), Schenectady, NY ([16](#)), and the University of Canberra (Australia) [Applied Ecology Research Group](#) ([17](#)).

Some Web sites advertise specialized programs that teach scientific and technical writing. One such program is the [Certificate Program in Technical and Scientific Writing](#) at San Diego State University ([18](#)). According to this Web site, "As a career, technical and scientific communication is one of the top 10 fastest growing fields of expertise in the United States." For those pursuing a biomedical writing career, an excellent [resource](#) has been put together by Joanne Bicknese, Patricia Connelly, Keith Lantz, Patricia MacKay, and Anne Snyder, a team of biomedical writers who wanted to share their experience with those just entering the field ([19](#)).

[How to Publish in Top Journals](#) is a manual from the College of Agriculture at Iowa State University, Ames, on how to increase the chances of your paper being accepted ([20](#)). If you prefer the checklist approach to writing scientific papers, Tom Huber of the physics department at Gustavus Adolphus College, St. Peter, MN, can help ([21](#)). His list includes what to do

- before starting to write,
- while writing and making global revisions to the paper, and
- while proofreading the paper.

Women in Academic Medicine, an organization affiliated with Harvard Medical School, has posted [Communicating Our Work](#), an excellent guide to different aspects of the process of scientific communication ([22](#)). The architecture of this Web site makes it easy for the user to move around and understand where to find information. The text is organized by chapters and subchapters. The first chapter deals with written communication: the "prewriting" stage (the process of writing the paper), the "postwriting" stage (which gives tips on submitting the paper and dealing with the editors), and authorship issues (e.g., deciding the order in which the authors' names will appear). The second chapter is devoted to oral communications at scientific meetings, including how to plan the content of a presentation, speaking style, anxiety, and the question-and-answer period. There is a third chapter on making effective posters, and the appendices offer specifics on presenting 10-minute papers, making slide presentations, and practicing oral presentations.

The Canadian Medical Association presents the uniform [requirements for manuscripts](#) submitted to biomedical journals, most of which apply to any scientific paper. Included are issues to consider before submitting a manuscript (e.g., redundancy, acceptable secondary publication, and protection of patients' rights to privacy) and requirements for submission of manuscripts ([23](#)).

["The Science of Scientific Writing"](#) ([24](#)), an article by George D. Gopen, associate professor of English and director of Writing Programs at Duke University, and Judith A. Swan, who teaches scientific writing at Princeton University, has appeared in *American Scientist* ([1](#)). The article discusses some new trends in scientific writing, placing particular emphasis on the expectations of the reader of the scientific paper: "It does not matter how pleased an author might be to have converted all the right data into sentences and paragraphs; it matters only whether a large majority of the reading audience accurately perceives what the author had in mind."

### Specific tools

Searchable databases, word lists, and other tools provide a means of finding particular pieces of information. Searchable databases allow chemists to look up abbreviations and symbols, CAS standard abbreviations, and abbreviations of chemical compounds. Some Web sites offer

chemistry spell checkers, useful publishing tools, recommendations for correct scientific English, and submission guidelines for chemistry publications. As an example of the last item, see *Chemical Innovation's* [Author's Guide](#) (25).

Other items for the science writer's toolkit include the following:

- CAS standard [abbreviations and acronyms](#) (26),
- a dictionary of [units of measurement](#) (27),
- instructions on [how to calculate concentrations of solutions](#) (28), and
- [journal title abbreviations](#) (29).

In addition to these Web sites, there are several books that make excellent, and often humorous, resources for facilitating the task of scientific writing (30–33). Reading books and articles on scientific writing is necessary and very useful, but the best way to learn how to write is by trying to do it.

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Note: All of the URLs were last accessed on Feb 6, 2001.

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Svetla Baykoucheva is the manager of the ACS Library and Information Center in Washington, DC ([s\\_baykouchev@acs.org](mailto:s_baykouchev@acs.org)).

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