

## WRITING IN THE SCIENCES

*Caveat:* Note that accepted practices about writing vary among science disciplines, and expectations about written work vary among science faculty.

### Audience

The purpose of writing is to communicate ideas to others, so a writer must always focus on the readers for each piece of writing and ensure that the document is readily understood by those readers. Keep in mind: Who is the audience? What is the purpose of the writing? What does the audience already know, and how do I connect what they know to what is new? For some science writing the audience is the other students in the course, and other times the intended audience is broader.

### Style

Science writing is known for being concise and there is no room in any paper for words, phrases, and sentences that do not contribute anything significant. However, “conciseness” does not necessarily mean “brevity”; this is a common misunderstanding and a better word to have in mind than “brief” is “efficient”. Phrasing should be efficient – every word counts – but explanations and arguments must be detailed, coherent and complete.

### Kinds of Writing

Although experimental reports are the most obvious form of science writing, writing in science serves a number of different purposes, so different forms of written work are needed. This handout focuses on writing that reports results of scientific studies, but mentions other kinds of assignments that students may encounter.

*Experimental reports.* The format for an experimental report differs somewhat among science disciplines and different journals, but a standardized format allows one to read science differently from reading a novel. We read for information, not from the first word to the last, and we expect to find specific information in specific sections. For example, a reader might start with the Abstract to learn the main results of the study and then jump to the Results section to look at an important graph. The standard sections for an experimental report in science are the following (documents describing these sections more fully may be found on the Writing Center website)

<b>Experimental Reports</b>	
Title	
Abstract	
Introduction	Motivates the paper and sets a context for the work
Methods	How the experiments were done.
Results	Observations and data
Discussion	Interpretation of results
Conclusions	Main lessons and suggestions for future investigation.
Acknowledgments	
References	

Sometimes the Results and Discussion are merged. In Physics reports, a separate “Theory” section is often inserted between Introduction and Methods, and in some Chemistry reports, the methodology may be presented as an “Experimental” section after the Acknowledgements. Other variations exist, too, within different science disciplines.

*Theses* are larger, more complex documents with the same general organization as an experimental report. *Abstracts and summaries* are short documents where authors condense a larger work into a paragraph of single page for either general or professional readers.

### **Other kinds of scientific writing are:**

*Research proposals.* Proposals give background about an idea, describe a plan for research, and argue persuasively for the value of the study.

*Literature reviews.* As in other disciplines, one may investigate an idea in the literature and then write to describe the state of understanding of that topic.

*Essays and response papers.* Sometimes one writes an opinion piece about an idea or a study, usually for a general audience.

### **Voice**

Generally, active voice is better than passive voice because it describes more clearly who did what and thus is easier to follow. Passive voice shifts emphasis away from the actor. In experimental work, however, who did something is usually less important than what was done, so one may encounter passive voice more often in writing in science than in other disciplines, especially in Method sections (e.g., “the solution was heated for 20 minutes”).

*Advice:* Use active voice when it is natural, though some use of passive voice provides diversity in style while de-emphasizing the performer of the actions.

### **Person**

In the past, the first person was used infrequently in science writing, but the use of “I” or “we” is more common now because of increasing emphasis on clarity of expression. One may use the first person in writing whenever doing so improves comprehension by the reader. On the other hand, the first person should not be overused because science writing generally emphasizes the work, not the one who did it. Most experimental writing remains in the third person. In some science disciplines, the first person is referred to as “we” because a scientist is always working as part of a larger community.

### **Tense**

There is a big difference in tense usage between writing in science and writing in many other disciplines. One reads texts in the humanities as if the author is speaking to the reader in present time, so one discusses the text in the present tense (what is known as the literary present) even though the text was actually written in the past, e.g., “Milton writes...” But there is a strong sense of timing in science: anything that took place in the past is generally described in past tense (e.g., when referring to a specific study), whereas anything currently true is described in the present tense, as it is in all disciplines. For example: “Watson and Crick (1953) proposed [past tense] a structure for DNA,” but “Our genetic heritage is encoded [present tense] in our DNA.” Most science writers don’t use the present tense when writing about work someone else has done because any work that one reads was completed in the past, e.g., “Feynman proposed that...” rather than “Feynman proposes that...” An exception is when a living person’s views are well known, have been expressed over time, or have been written in multiple articles; then one might write “Domack argues [present tense] that climate change...”

*Lab Reports.* A lab report should never read like an instruction manual; a lab handout might give directions as, “Make a solution of A and B,” or “We will test the hypothesis that...”. However, a report that a student writes should report the action already taken, which means that the report should be written in the past tense, e.g., “The data was consistent with...” or “We found that...” By the time the report is being written, all the work has been done! When suggesting ideas for additional research in the final section of an experimental report, future tense is appropriate. (This sounds complicated, but following your instincts usually works. Most often, an individual part of a paper, e.g. the Methods section, will be in a single tense. Tense should not vary from sentence to sentence.)

## Figures, Tables, and Equations

Figures (worth  $10^3$  words!) and tables are important parts of any report, and are efficient ways of describing data, graphs, and experimental methods. Figures do not *replace* text - every figure or table is discussed in the text. Each figure and table must have a caption that provides technical information about the data incorporated, and/or a few notes about important features. The information in the captions is typically reiterated in the text.

Every equation gets its own line, with an equation number at the far right so you can refer to it later in the paper. All symbols must be defined. For example:

“Assuming laminar flow, the drag force on a falling sphere is given by Stoke’s equation:

$$|\vec{F}| = 6\pi\eta r v \quad (1)$$

where  $\eta_{\text{air}}$  is the viscosity of air,  $r$  the radius of the sphere, and  $v$  the speed.”

## References/Literature Cited

The proper use and acknowledgement of sources is important in every discipline, and science writers ensure that readers know the sources of ideas and information not their own.

Direct quotations are infrequent in science writing because the exact words used to describe an idea are rarely important. Instead, most sources are paraphrased rather than quoted, and then cited in a footnote. It is hard to put someone else’s ideas in one’s own words, but that is what a science writer generally must do. Paraphrasing forces a writer to extract and distill whatever he or she deems important from the outside source.

*Literature Cited.* Science writing uses a Literature Cited or References section, not a bibliography, at the end of a paper. Every item listed must be cited specifically within the document at the appropriate place. Some publishers ask for a name-year system of citation. If the author is referred to in the sentence, then only the date is in parentheses.

...mosaic structure of habitats across a landscape (Connell, 1978).

Wilson (1992) and Kerr et al. (1998) have argued for the importance of ...

Other publishers use a numbering system. Different science disciplines and different journals require variants of the forms shown below. Refer to handouts from faculty for specific guidelines.

[1] A.J. Silversmith et al., Phys. Rev. B 25 (2002) 3456. [authors, journal, vol. Number (year) page number.]

[2] Wilson, E.O. (1992). *The Diversity of Life*. NY: W.W. Norton Co.

[3] G. Jones and B. Collett, in: *Nuclear Physics: Polarized  $^3\text{He}$* , ed. P. Millet (Springer, New York, 1999) pp 245-310.

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<b>Several writing bloopers to look out for</b>		
<i>Issue</i>	<i>bad example</i>	<i>improvement</i>
1) avoid needless complexity	utilization	use
2) avoid arrogant phrases	it is well known that...	(omit)
3) use strong verbs	made a measurement of	measured
4) eliminate writing zeroes	as a matter of fact	(omit)
	it should be pointed out that	(omit)
5) eliminate fat	at this point in time	now
	at that point in time	then

*The Craft of Scientific Writing* by Michael Alley is a good resource for these. There are many websites that focus on scientific writing that contain similar examples.

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