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April 10, 2008

Writing in the Sciences

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

I. Writing

Writing is an intensely creative endeavor. Whether or not a writer chooses the topic for a writing assignment, he or she most surely chooses what to say, how to say it, what sources to use, how to begin and how to conclude, and how to structure the discussion or argument. Because writing is intertwined with thinking, revising a writing assignment is an extremely important step in the writing process. Revision lets one rethink, re-evaluate, and restate one's ideas. Furthermore, learning to write about science is an important part of learning science.

II. Audience

The purpose of writing is to communicate one's ideas to someone else, 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?

III. 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. The kinds of writing may be (from an unknown source): descriptive, investigative, analytical, or reflective.

Experimental reports. (investigative, analytical) 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 each standardized section. For example, a reader might start with the last paragraph of the introduction to find the hypotheses of the study and then jump to the beginning of the discussion to find an overview of the results. 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):

Title	
Abstract	
Introduction	What is the context, and why did I do what I did?
Methods	How did I study it?
Results	What did I find out?
Discussion	What does it all mean?
Acknowledgements	
Literature Cited	

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

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

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

Theses. (descriptive, investigative, analytical) Theses are larger, more complex documents that may incorporate several of different kinds of writing.

Lab notes. (descriptive) Notes in a lab book may be informal but must be detailed.

Abstracts and summaries. (descriptive, analytical) Condensing a larger work into an abstract or summary may be done for both general and professional readers.

Posters. (investigative, analytical) Poster presentations require short, concise, and clear narratives.

Essays and response papers. (reflective) Sometimes one writes an opinion piece about an idea or a study.

Popular writing and journalism. (descriptive) Scientists communicate with the general public in numerous ways.

IV. Voice

Generally, active voice is better than passive 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, who did something is usually less important than what was done, however, so passive voice may be encountered more often for writing in science than in other disciplines, e.g., "the solution was heated for 20 minutes."

Advice: Use active voice whenever possible, though some use of passive voice provides diversity in style while de-emphasizing the performer of the actions.

V. 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 of the reader. On the other hand, the first person should not be overused because science 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 in the context of what others have done.

VI. Tense

There's a big difference in tense usage between writing in science and 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's a strong sense of timing in science: anything that took place in the past is generally described in past tense, whereas anything currently true is described in the present tense, as it is in all disciplines, e.g., "Watson & 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., "Tilman wrote that…" rather than "Tilman writes 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 "Wilson argues [present tense] that the loss of biodiversity…"

Lab Reports. One should be careful about tense usage in writing lab reports. A lab handout might give directions as, "Make a solution of A and B," or "We will test the hypothesis that…" In all cases, a lab report about an experiment shouldn't repeat the directions; it should report the action already taken, which means that the lab report should be written in the past tense, e.g., "We hypothesized that…" or "We found that…" By the time the report is being written, all the work has been done!

VII. Quotations, Citations, & 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.

Quotations. Quotations are infrequent in science writing because the exact words used to describe an idea are rarely important. Instead, most sources are paraphrased, not quoted. This is not the case in the humanities, in which the exact wording is often important; thus, quotations are much more frequent in those disciplines. It is hard to put someone's 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.

Citations. Most writing in science uses the 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 …

The page number is added to a science citation in the infrequent circumstance when a quotation is used, e.g.,

> Gould's argument for punctuated equilibrium is that "stasis is data" (1993:223).

There are two reasons why page numbers aren't used routinely in the science citation system: (1) The standard piece of science literature is a relatively short, technical article, not a book, so it's straight-forward to cite the whole thing; and (2) science writers paraphrase ideas rather than quote specific wording, so it's not important (or sometimes even possible) to refer to a single statement.

Space is at such a premium in the top journals *Science* and *Nature* that citations are by the citation-sequence (numbered) system. In these journals, too, the usual format for experimental reports is dropped in favor of a condensed presentation.

Literature Cited. Science writing uses a Literature Cited section, not a bibliography. Every item listed must be cited specifically within the document or not included at all. Different science disciplines and different journals require variants of the forms shown here, which are in a standard form used by many biological journals.

Hinde, R.A., & L.A. Barden. 1985. The evolution of the teddy bear. Animal Behavior 33:1371-1373.

Wilson, E.O. 1992. *The Diversity of Life.* W.W. Norton Co., New York.

Prysby, M.D. 2004. Natural enemies and survival of monarch eggs and larvae. *In:* K.S. Oberhauser and M.J. Solensky (eds.), *The Monarch Butterfly: Biology and Conservation.* Cornell Univ. Press, Ithaca. pp. 27-38.

Walsh, B. 2004. Multiple comparisons: Bonferroni corrections and false discovery rates. <nitro.biosci.arizona.edu/workshops/Aarhus2006/pdfs/Multiple.pdf> Last accessed 27 Nov 2007.

VIII. Conciseness

Brevity is important in all disciplines and is stressed in science. Get to the point. There is no room in any paper for sentences that don't contribute something significant to the paper.

First sentences. The initial sentence of a paper is a clue to the quality of the thinking that went into the writing of the paper. Contrast these examples, which are the first sentences of papers submitted by Hamilton students:

> The study entitled "Biochemical variation in roe deer *(Capreolus capreolus* L.): are r-strategists among deer genetically less variable than k-strategists?" was conducted by Gunther B. Hartl and Friedrich Reimoser in 1998.

> Carson and Wisotzkey (1989) reported evidence contrary to the conventional understanding of genetic drift in their study, "Increase in genetic variance following a population bottleneck."

Notice that the first example has no significant idea in it; the sentence provides background information only. The second example, in contrast, has an idea that hooks the reader (something contrary or unexpected!). The entire paper then developed that idea.

As another example, look at the first sentence of one of the most influential publications in the sciences in the 20th century, Watson & Crick (1953). No dillydallying here. Note also use of the first person and active voice:

> We wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.).

IX. Basic Advice

Keep in mind the centrality of communication in science. Writers should aim to:

Write with clarity, precision, and economy.

Acknowledgements. I thank Eugene Domack, Tom Jones, Ann Silversmith, Barb Tewksbury, Jon Vaughan, Sharon Williams, and Penny Yee for commenting on a draft of this document and Emily Starr for contributing ideas. *EHW 4/10/08*