

Guidelines for Writing a Scientific Paper

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General comments:

All scientific writing begins with a question about the natural world. The purposes of a scientific paper are to introduce the reader to the question you have chosen, explain how you went about testing the question, provide a summary of the data (this is your “answer” to the question), and discuss the implications of your discoveries. For these reasons, scientific papers follow a specific format of organization: Introduction, Methods, Results, Discussion, and Literature Cited. Specific guidelines for each section are outlined below.

Topic sentences are perhaps the most important component of lucid scientific writing. Begin each paragraph with a summary sentence that embraces all of the main ideas included in the paragraph. Ideally, putting the topic sentences from each paragraph together should give you a crisp, concise summary of the paper.

Scientific writing aims for clarity and logical flow. In contrast to writing assignments in the humanities, poetic language and creative composition rarely enhance scientific papers. Wordy sentences should be avoided, and removing the passive voice often reduces wordiness. In addition, in modern scientific writing, use of the first person (rather than the third person) is encouraged and often makes sentences more succinct. Avoid repetition of facts and thoughts; decide in which section of the paper the statements are most appropriate and do not restate them elsewhere. Finally, keep in mind the mantra “*What is the question?*”—commentary that significantly deviates from the main question(s) should be eliminated.

Common mistakes and additional advice.

- Most people find it easiest to begin with writing the methods and results, saving the introduction and discussion for last.
- The word “data” is plural. Thus, use “These data were...” not “This data was...”
- Avoid using long clusters of nouns such as “The Wild Horse Canyon herbivore exclusion experiment...” Instead, opt for including more prepositions such as, “At Wild Horse Canyon, excluding herbivores resulted in...”
- Scientific names are italicized and consist of two words, the first indicates the genus (and is capitalized) and the second indicates the species (and is always given in lower case), e.g., *Homo sapiens*.
- Write positively, employing phrases such as “these data show...” rather than using non-committal statements such as “these data could possibly suggest...”
- Do not ignore or discard results because they differ from textbook generalizations or because of variability and biases in the data. Use the discussion section to put forth your own ideas about why your results may be biased or differ from expectations.

Title. The title should convey information on the organism or system studied, the aspect of ecology or evolution examined, and what factors were experimentally manipulated. Use the fewest words possible. The best titles express the question or main result of the study. Avoid titles beginning with “The effects of...” or “The role of...”

Introduction. The introduction should consist of several paragraphs that relate why the research was conducted and provide background material on the question addressed. Typically, the introduction also references previous studies to support arguments for why the question is significant and interesting. The introduction should build up to the question(s), which should be stated at the end of the last paragraph. (Think of a funnel with the narrow end being the question at the end of the introduction.) Start generally and finish with the specifics of the system. *Always* rewrite the ideas of other authors in your own words and cite them (e.g., (Janzen 1966)).

What to avoid: Do not *begin* the introduction with a *lengthy* description of the system or organism; save this detailed part for the Methods section. It is o.k. to describe relevant aspects of the study system toward the end of the introduction, *after* you have introduced the broader conceptual framework. Also, avoid using footnotes or direct quotations. Finally, the introduction is not a place for a lengthy literature review; therefore, keep it simple and short, providing only information essential to establish the motivation for asking the question.

Methods. The methods section should communicate sufficient detail to allow others to repeat the study. In ecology papers, the methods generally begin with a brief paragraph on the natural history of the species or ecosystems and a description of the site where the work was conducted, but you should include only the natural history that is relevant to the question. In shorter papers, and some papers in evolution, the relevant information about the system can be included in the latter part of the introduction.

The methods should provide information on what factors were manipulated (or of interest, but not manipulated, such as the site where the work took place) and how the manipulations or observations were executed; these factors are considered independent variables. The methods should also include a description of the data (including the sample size(s)) and how the data were collected; these are the dependent (or response) variables. Finally, data analysis methods should be described briefly in the methods; common statistical techniques can be referred to (e.g., t-test, ANOVA) without explaining how to perform them.

Please use the past tense and first person (*active voice*), where appropriate, although specific journals may have differing guidelines on this issue. When measurements are described, include the units (e.g., “We measured the height of elephants (m).”) Avoid making this section unnecessarily long—explain only the essential steps in the research protocol.

Results. This section should state the results of the observations or experiments *without interpretation by the author*. The order of presentation should be the same as in the methods section (i.e., if observations on mice eating seeds were presented before an experiment to manipulate the diets of mice in the methods, the findings of the observations should also come before the experiment in the results section.) Keeping the methods and results sections parallel in this way makes it easier on the reader to match up what you found with what you did. Often, if several different observations or experiments were conducted, subheadings in both the methods and the results sections can help to organize the information. However, do not use subheadings if they are not allowable in your chosen journal format.

If figures or tables are included, these must also be summarized in the text of the results section. For example, do not just state “The growth curve is shown in Fig. 1.” Instead, report “The number of individuals in the population increases exponentially under the condition of unlimited resources (Fig. 1).” Figures and tables should also have brief headings to explain what they contain, and remember to label axes with the variable name and the units of measurement. To support your statements, always report statistical test values and significance values, where appropriate.

Discussion. The discussion contains the author’s interpretation of the results. Start by answering this question: Do the results resolve the question(s) you posed in the introduction? Then, address whether and how the results might be generalized to other systems or questions. Relate your results to accepted principles and ecological/evolutionary concepts. References to other studies will enhance the discussion.

You may also propose new questions or future experiments that arise from your results. However, avoid commentary that is not directly related to your overarching question(s).

Finally, end the discussion with a summary that states the take-home-message of the study and why it is important. For example:

We found that plots with a higher diversity of plant species had greater water availability than low diversity plots. Furthermore, plots of high diversity were less invaded by introduced honeysuckle. Therefore, conservation practices that preserve species diversity may sustain important ecosystem functions and reduce the invasion of communities by non-native species.

Literature Cited. References should conform to the format specified by the journal. References to websites are not typically included in scientific papers (except under rare circumstances). Your references should come primarily from reading papers in the primary scientific literature (not from websites, newspaper articles, textbooks, etc.)