

Scientific Report Writing

General Ecology (PCB 4043 & 4043L)

Review papers and lab reports give students practice with written communication in science. In General Ecology, a review paper on some ecological topic relevant to Florida (interpreted broadly) is required for the lecture. This is a “review” paper, not a “research” paper that reports original research. Actually, lab reports are similar to research papers. If you are taking General Ecology Laboratory, lab reports are required for reporting results of lab exercises.

The function of a review paper and a lab report differ, and so do their formats. However, both require similar skills in reporting and summarizing information in a clear, concise manner. Be sure to use your spelling and grammar checker in your word processor, but also know that most checkers do not know how to spell many scientific terms, especially taxonomic names, and do not catch all grammatical errors. So there is no substitute for ***careful proofreading*** by yourself *and* a colleague. Use your supplemental text, MacMillan (2006, 2012), for detailed guidance on researching and writing both your review paper and lab reports.

Plagiarism Issues

There are detailed guides concerning [plagiarism](#) and several relevant [tutorials](#) at the IRSC Libraries web site (go to [Tutorial and Research Guides](#)) and in your supplemental text, MacMillan (2012). An additional site describing plagiarism is at [Indiana University](#).

Plagiarism is essentially using someone else’s words or ideas without proper acknowledgement (citing the work). As stated in the course syllabus, plagiarism is a form of cheating and is not tolerated in this course or in the profession, in general. Certainly, intentionally stealing someone else’s work is grounds for severe consequences. This has become more common with inappropriate use of the Internet, and is becoming common in our public schools. Most students have problems with “unintentional” plagiarism. As a student, you will be held responsible for plagiarism, in any form, intentional or not.

While plagiarism may be easy to define, the problem is often that students do not recognize it and may plagiarize “unintentionally” due to poor research and writing habits. Of course, it is ***never*** acceptable to directly copy (using copy/paste or by typing) someone else’s text from any source, even with a citation except in very specific situations (see McMillan 2006, 2012). One way students attempt to avoid plagiarism is to put direct statements from others in quotes, and cite the source. This may be acceptable in other fields, but direct quotations are *rarely used* in scientific writing (and the same goes for your papers and reports). Instead, you should restate or paraphrase someone else’s findings or ideas ***in your own words***, *and* then properly cite the source(s). This is more difficult, takes more time, and requires more thorough understanding of the material, which is the part of point of the assignment. Again, it is ***never*** acceptable to frequently use direct quotes in place of your own writing in scientific papers.

There is an excellent section about taking notes for your review paper in MacMillan (2012) that you should read carefully (p. 29-30). It boils down to paraphrasing and summarizing while taking notes from the actual source. Then, you rewrite your notes as you put them into the larger context of your paper. This avoids looking directly at the source while writing your paper, at least for a lot of the writing, and helps to avoid “unintentional” plagiarism.

One of the wonderful things about the internet and using search engines is that it makes detecting plagiarism almost as easy as the actual act of plagiarism. All an instructor must do is to copy and paste a questionable phrase into Google, and if that phrase shows up, it can be considered plagiarism. There are also a number of plagiarism checkers available that allow instructors and students to check their work. It has become recognized that the chances of writing a series of words exactly the same as someone else, completely by chance, becomes infinitesimally small as you approach *five or six words*. Therefore, we will use this general rule in evaluating your writing for the possibility of plagiarism.

Review paper for the lecture course

A significant proportion of the review paper grade will be based on carefully following the guidelines in this document and in the sister document, “Dr. T’s Pet Peeves” available in the Blackboard course website. Read both carefully and follow the directions.

Quick reference guide

- Submit files through the Blackboard course Assignments in an appropriate word processor format (Microsoft Word *.doc or *.docx; all others in *.rtf) to allow review and editing.
- Name your submitted files appropriately (lastname-component.doc; for instance Smith-topic.doc)
- Follow CSE guidelines (Chapter 6) and Checklist for Review Papers (pp 85-87) as summarized in McMillan (2006, 2012)
- Word limit is 1000-1200 words (about 4 pages), not including title page or literature cited, tables or figures
- Double space text with 1” margins
- Use 12-point, Times New Roman or Calibri font
- Required sections of review paper (see Ch. 5, McMillan 2012)
 - **Title page** – includes title of paper, your name, date, course title
 - **Abstract** – a concise summary of your paper, including your aim and scope. It should be ½ to ¾ of a page (included in the page limits). Write this after the rest of your paper.
 - **Introduction** – presents your topic, why it is important, and your central question(s) addressed
 - **Body** – a well-organized, *synthesis* (not just a summary) of the literature on your topic. You should break up the body into sections with *appropriate subheadings*. Do not use “Body” as a subheading.
 - **Conclusions** – brings together main points, including any controversies, and makes recommendations for future research and applications of your synthesis
 - **Acknowledgements** – give appropriate credit to anyone that assisted you with research, writing (including proof reading). ***This is a hint, you should have someone else proof your first draft, other than the instructor.*** Do not acknowledge the instructor.
 - **Literature Cited** – This section lists in alphabetical order (by first author’s last name) all literature that you cite in the paper and *must* closely adhere to proper CSE *name-year* style. This section is not included in the page limits and is *not* called “References”. References are sources that you used to learn about the topic, but may include sources that you do not cite (so uncited sources are not included in this section).
- A **minimum of five primary literature articles** are required, and this information should make up the majority of your paper. Please feel free to use more than the minimum required.
- Use only the **CSE name-year style** for all citations throughout your paper and in the literature cited section. Do NOT use the number, citation-sequence or citation-name systems for your citations. Use the name-year type of citation in your Literature Cited section as well. Most of your citations will be “electronic versions of journal articles also available in print”, so use this format as appropriate (see McMillan 2006, 2012, chapter 6).
- If used, tables must have an appropriate title above the table; figures must have an appropriate title below the figure.
- Tables and figures may appear at the end of the paper or within the text as preferred, but all must be referred to appropriately within the text where relevant.
- Direct quotes should rarely (and preferably never) be used.
- Do NOT use footnotes; these are rarely used in scientific writing.

A Primer on Scientific Literature

A scientific review paper is a summary of a body of knowledge obtained from the scientific literature. Published scientific literature is often referred to as “technical publications” and is often divided into different levels. **Primary literature** are research articles or “papers” reporting on data collected, analyzed and interpreted to address a particular question. This level is typically heavy on data analysis and hypothesis testing, and presents original data. **Secondary literature** is a summary, compilation or review of the primary literature, and may include some secondary sources as well. **Tertiary literature** often refers to books, including textbooks and many popular online web sites. Web sites are typically tertiary or higher sources, and are usually produced as non-technical sources for the layperson. For this assignment, you may want to use websites to familiarize yourself with your topic but do not rely on websites as your main source of information; this should come from your primary sources. The purpose of this written assignment for PCB 4043 is to produce a short review paper (a form of secondary literature) of the primary sources available to you through the library’s databases and journals. You are required to use a minimum of five primary sources, but you may use additional primary sources, secondary sources and even web sites (though you should use these sparingly).

Sources of primary literature. A good source of articles is the IRSC databases available through the Miley Library. To access the databases, go to the IRSC Home Page, click on the Libraries link at the bottom left. From the [College Libraries page](#), you have several options at the left. For information and advice about using the databases, citation guides, plagiarism, etc., the [Tutorials and Research Guides](#) is a great resource. To go straight to the databases, go to [Find Articles](#). [Login to Databases and EBooks](#) gives instructions on how to login to the databases using your IRSC login and password. Click on [Databases by Subject](#) to actually log in to the databases. Choose Sciences. There are 17 databases. You may use any of them, but I highly recommend starting with **JSTOR** or **Springer eJournal Collection** for primary literature relevant to Ecology. *If you need assistance, please ask the librarians or your instructor.*

Using keyword searches in the databases will often give many citations, but some may only be available to you as an abstract rather than an entire paper (full text). You need to use **entire articles** to count toward your total number of articles for your review. A good way to tell primary literature from others is that it must report new data; look for materials and methods, and results, sections. **Feel free to ask the instructor** if an article is primary, secondary or other. In some cases, you may need to request an interlibrary loan of a journal article. This takes time, so do this early.

To find an interesting article from the many you may obtain from a search, look over the titles and the abstracts (these are brief overviews of the key points of the articles, usually at the beginning of the article). Once you’ve found an article or two that interests you, read through them. You don’t need to read them in detail at this point, but read the introduction and the discussion first to see if it is relevant. Skim over the results; usually the methods are not that important in a review article. If this is an article that you want to include, it may also lead you to other relevant articles by looking at the literature cited section at the back of the article. If you find a particularly interesting one, search for it online to see if it is in one of our databases (you may need to check more than one database). If not available from our databases, and you really think you need the article, go to an IRSC librarian to determine the possibility for an interlibrary loan (*but don’t wait until the last minute*). Loans are usually free for you, so don’t hesitate to ask.

When citing a primary source obtained from an electronic database, you should include a link to the source within the database (see McMillan 2006, 2012; Chapter 6). This allows others, including your instructor, to easily locate your source.

Appropriate use of internet sources. You may also use Internet sources or websites in very limited quantity and appropriately cited, especially to obtain a quick background for a particular topic. There may also be primary literature references suggested at certain, better websites. But do not use internet sources as your main source of information. Most websites provide information that is too general for the purposes of your review but they may be a good place to start to familiarize yourself with your topic.

Make sure the websites are legitimate and authoritative sources (from academic institutions; federal or state government sites; relevant non-governmental organizations or NGOs). Do not use blogs, or other questionable sources without confirmation with other sources. Just because information is online, does not mean it is reliable or true. *Internet sources are **not** to be counted toward your five primary source minimum.*

Assignment requirements and source requirements

The review paper will be broken up into stages; this is valuable so progress is made throughout the semester and helps to avoid a last minute effort typically resulting in poorer quality. Writing a paper takes time. The four components of this assignment are 1) choosing and submitting a topic, 2) creating an outline, 3) submitting a draft of the paper, and 4) submitting the final paper.

Choosing a topic. Many topics are appropriate, but remember that there must be a sufficient number of primary papers available to review. Thus, before settling on a topic, research it on the library databases to determine if enough primary literature is available to you for a review. But you should be careful not to select a topic that is so broad that it is impossible to cover it within the word limits. For instance, the ecology of coral reefs is much too broad; focusing on some aspect of coral reef ecology would be more appropriate (effect of herbivores on coral survival, or the costs and benefits of zooxanthellae to coral hosts). For the purposes of this assignment, ***at least five primary articles are required*** on your topic by the draft version; two primary articles are required when you submit your topic initially. You are strongly encouraged to use more than five, if available. Secondary literature may also be appropriate to cite, but you need to analyze and summarize the information within your primary sources yourself rather than relying on someone else's summary.

Appropriate topics for your review article:

- Natural history of a particular species of microbe, fungus, plant, or animal found in Florida (including estimates of distribution and abundance, current and historic range, reproductive biology, behavior, diet, predators/parasites/symbionts, conservation status, etc.). Any species may be appropriate, including, but not limited to, endangered/threatened species, and exotic/invasive species. Focus on only one or two aspects of the natural history of a species (diet, habitat requirements, reproduction, genetic variation, etc.), otherwise you risk choosing a topic that is too broad.
- An ecological concept or process pertinent to Florida (e.g. fire ecology and pineland communities; enhancement of species diversity using artificial reefs; use of island biogeography theory in conservation biology).

- Your sources do not have to be all from Florida, as long as they address a topic that is relevant to Florida. For instance, studies on fire ecology may be conducted anywhere in the world but may be relevant to issues of fire ecology in Florida. As long as you can broadly relate it to our fine state.
- Environmental issues are appropriate as long as you focus more on the ecological components (conservation, habitat loss and protection, genetic isolation, etc.) rather than the social or economic issues (these may be relevant and included in a minor way, but the focus should be ecological).

Organizing your thoughts – the outline. After choosing a topic and reading your literature, you are required to produce and submit an outline before you begin writing the body of the paper. An outline is a listing of subtopics that you want to address. It makes it easier to arrange these in a meaningful flow of subtopics and information. In movie-making or drama, this is often called “story-boarding”. You do not need to use complete sentences. Use the subtopics as section headings within the body of your paper. One way to organize your paper is around the primary literature sources, perhaps in chronological order or by topic. I recommend using a hierarchical format with bullets or letters/numbers. *The more detailed the outline, the better the organization and flow, and the easier the writing will be later.* You are required to submit at least three primary sources with your outline.

Writing the draft. To begin writing the actual paper, fill in your outline with sufficient detail; eventually fill it in with complete sentences. This is the time to look for holes in your text and/or literature sources, and perhaps look for more information.

For most purposes, *reporting detailed descriptions of methods are not appropriate in your review article*, and detract from the general flow of your discussion. Many students describe the methods in more detail than needed. This is not desirable unless the methods are of particular interest as a topic of discussion. Generally, only a brief mention of methodology, if any, is all that is needed. Focus on the results and implications of the results.

End your paper with a **conclusion section** that attempts to tie all the aspects of your paper together. This is not just a summary of your paper (that is for the abstract), but a synthesis. This section should also include recommendations for future research, and why they are needed.

Writing the draft is the hardest part of this assignment. Write a good solid first draft (after light editing), put the paper aside for a day or two, and **heavily edit again**. Fill in any holes of logic or flow. *Ask a peer to help edit...better yet switch papers with a fellow student in the course.* You learn about writing by reading and editing other’s work.

The term draft does not mean that it is done quickly; this “first” draft should be as polished as any paper you have ever submitted for a grade before. Before turning in your first draft, you should have completed the vast majority of the writing of the paper, and proofed it *at least two* times, carefully checking for logical flow, organization, and grammatical and spelling errors. Make sure that all your cited literature is listed in the Literature Cited section, and that all of the sources listed are cited within the text of the paper. Follow CSE style for all in-text citations and for all citations in the Literature Cited section (see McMillan 2006, 2012 or the CSE guide under Biology Libguides at the IRSC Library website for examples).

Much of the grade for your draft will be for following the instructions in this document and following the handout *Good Writing Habits (Dr. T's Pet Peeves)*, in addition to the scientific content and writing style. Points will be deducted for not following any of the "pet peeves". Attention to details of formatting and style are important throughout the paper, including following appropriate CSE style. McMillan (2006, 2012) has an excellent chapter about writing a review paper (both drafts and final versions); you should read it carefully.

Writing the final version. The final version should completely address all the issues the instructor has brought to your attention from reviewing the earlier draft. This is the last time to very carefully go over your citations within the text and in the Literature Cited section again. Make sure to closely check for spelling and grammatical errors. Again, attention to details is very important. If you did a really good job on your first draft, the final draft should be relatively easy; if the draft is not your best effort, there will likely be a lot of work on the final version.

Additional sources for writing your review paper

- McMillan, VE. 2006. *Writing Papers in the Biological Sciences*. 4th ed. Boston: Bedford/St. Martin's.
- McMillan, VE. 2012. *Writing Papers in the Biological Sciences*. 5th ed. Boston: Bedford/St. Martin's.
- An excellent summary of CSE style with examples at the IRSC Library LibGuides (under Biology) - <http://www.irsc.libguides.com/cse>
- Excellent advice for writing a review paper - <http://www.dushkin.com/online/study/dgen2.mhtml>
- Tongue-in-cheek, but very good article about science writing in general - <http://www.indiana.edu/~halllab/GradRes/BoringWriting.pdf>

Lab reports

Lab reports must follow standard formats for scientific articles of the primary literature, as if you were going to submit your paper to a scientific journal. Refer to Chapter 4 in McMillan (2006, 2012). The sections ***required*** (in order) for Ecology Lab reports are:

- **Title page** – includes title of study, your name, course and date.
- **Abstract** – a brief summary of the paper on a separate page; *write this last*. This includes the main focus of the research, a brief summary of your most important results (2-3 sentences), and a closing sentence or two about the significance of the results (1/2 - 1 page). You don't need to include literature citations in the abstract nor statistical results (these are for later in the report).
- **Introduction** – a brief summary of the current knowledge of the particular topic addressed in the lab report, and a brief summary of what your question (hypotheses) you plan to address. (1-2 pages)
- **Methods** – for our purposes, write a brief *sentence* that refers to following the methods outlined in the lab exercise. You do not need to rewrite the methods.
- **Results** – a concise but fairly detailed description of the results and data analyses *without interpreting the results*. The number of pages will vary depending on the amount of data included.

Helpful hints:

- Do not present results of statistical analyses in a long written-out form in the text, but in a concise, abbreviated form with relevant statistics within parentheses. Examples: The mean leaf length was 34.5 ± 3.2 mm (SE, $n = 30$). The three treatments differed significantly from the control group (Figure 3; $F = 4.56$, $p = .0045$, $n = 48$). For more examples, *note how results are reported in your primary literature papers* and refer to McMillan (2006, 2012).
 - Tables should have a title above the table; figures should have the title below the figure.
 - Tables should be numbered consecutively. Figures should be numbered consecutively and separately from tables.
 - Tables and figures should appear embedded within the text in appropriate locations or may appear at the end of the paper in numerical order, and referenced appropriately within the text where relevant.
- **Discussion** – an in-depth *interpretation* of the implications of the results, and how they relate to other studies and larger ecological processes. The number of pages will vary depending on the amount of data included.

Helpful hints:

- Do not simply restate the results in this section; this section is for *interpreting* your results.
- If you report data in the Results section, then these results should be discussed within the Discussion section (so don't leave out any of your reported results).
- Include mention of the results of other researches (see outside readings of papers associated with each lab exercise). How do their results compare with yours?

- End your discussion with concluding remarks, tying your results with the main questions you are addressing. Also include what additional work may be needed.
- **Acknowledgements** – thank your lab partners (by first initial and last name) for their contributions (short and sweet...but this lets people know that you didn't do all of this alone). Do not acknowledge your instructor.
- **Literature Cited** – properly alphabetized and formatted citations (follow CSE name-year style) of the literature you cited within the paper.

McMillan (2006, 2012) reviews writing lab reports extensively (Chapter 4) and there is an **excellent checklist** (please use it). There are also many excellent websites that have detailed instructions on how to write proper lab reports (two are listed below). Particular attention should be paid to the formatting of tables and figures. Summaries of these formats are included in lab handouts and in the websites below. Figures and tables should appear on separate sheets of paper, properly labeled and titled, and referenced appropriately in the text.

Literature Cited

- McMillan, VE. 2006. Writing Papers in the Biological Sciences. 4th ed. Boston: Bedford/St. Martin's.
- McMillan, VE. 2012. Writing Papers in the Biological Sciences. 5th ed. Boston: Bedford/St. Martin's.
- Excellent: <http://www.bms.bc.ca/library/Guidelines%20for%20writing%20Scientific%20papers.pdf>
- Short/sweet: <http://ww2.coastal.edu/jjhutche/BIO370L/Tips%20for%20writing%20successful%20Ecology%20Lab%20reports.pdf>
- Good example except poor figure formatting: <http://www.ncsu.edu/labwrite/res/labreport/res-sample-labrep1.html>
- An excellent summary of CSE style with examples at the IRSC Library LibGuides (under Biology) - <http://www.irsc.libguides.com/cse>