



THESIS APPROVED BY

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TITLE:  
SUBTITLE

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by

AUTHOR NAME

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A THESIS

Submitted to the faculty of the Graduate School of Creighton  
University in Partial Fulfillment of the Requirements for the degree of  
Master of Science in [Physics/Medical Physics] (choose one) in the  
Department of Physics

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Omaha, NE  
Month Day, Year



# Abstract

The abstract is a maximum 350 word, double-spaced summary of your work. The word count limit is important for upload to the Creighton Digital Repository.

This project can be found as a template on the Overleaf.com Latex-writing website.

# Acknowledgments

Thank your research team, advisor, committee, family and friends, etc. See previous theses for examples.

I would like to thank Kian for introducing me to Latex, Kyle and Bong for troubleshooting help, and Dr. Nichols for his help with thesis creation.

*For Dr. Nichols*

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# Chapter 1

## Introduction

The thesis usually consists of about 5 chapters:

1. Introduction /Background
2. Materials and Methods
3. Results
4. Discussion
5. Conclusions.

However, you can adjust your chapters to best suit your work and how you want to present it. You can expect to have to include a lot of background information, since the thesis is written to a general audience, with basic explanations, literature review, etc. This can usually be drawn from your seminar papers. Please see [Appendix A](#) for important style and organizational resources from Dr. Soto.

Other sections of the thesis are the front matter, including title page, abstract, (acknowledgments, dedication, preface are optional), table of contents, list of tables, and list of figures. You may also want to include a list of equations in the front matter. The front matter has Roman numerals for page numbers. The material after

the main body of the work includes appendices, glossary (optional but helpful), and references. This material continues the arabic numeral page numbers from the main body of the work.

Thesis submission instructions from the graduate school can be found here:

<https://gradschool.creighton.edu/current-students/academic-policies-and-forms/thesis-dissertation-guidelines-submission>. Formatting guidelines are linked on that page and can be found here:

<https://gradschool.creighton.edu/sites/gradschool.creighton.edu/files/media/Thesis-Guidelines.pdf>.

# Chapter 2

## Materials and Methods

This chapter discuss the tools used to write and format a thesis in Latex, including general document construction and formatting (Section 2.1), how to write a references section (Section 2.2), and how to connect important ideas that are contained in different chapters of the document (Section 2.3). I will primarily be discussing how to use Overleaf.com, which is an online Latex program (like Google docs). Please note that there is a basic version of Overleaf which is free, but if you want more than 60 files per project you'll end up paying \$6/month student price for the Pro version. There are many other programs for Latex: Share Latex is another free online-based program, and TexStudio is a free download. All the programs mentioned are capable of generating a pdf preview as you type, which is helpful to check to make sure you know what you're doing!

### 2.1 Latex

If you are working in Overleaf, please ensure that you have clicked the “Project” tab in the upper left to show the project files, and expand the green arrows in the main view so that you can see both the source document and the pdf preview at once.

### 2.1.1 Document structure

Look through the project files (on the left side of the window in Overleaf and TextStudio). You'll see a "main.tex," which is the file which contains the document setup packages and `\input{}` commands for the document components. Take a look at the "main.tex" file now to see there are `\input{}` commands for the title page, the acknowledgments, dedication, chapters 1-5, the appendices, and the references. The table of contents, list of tables, list of figures, and glossaries are automatically generated and have their own commands.

In Overleaf, create new .tex files by clicking "Files" in the upper left, and clicking "Add...> Blank File." Type the name of your file as "example.tex," and add the file in your document by typing `\input{example}`. Next to the input line, type `\label{sec:example}`, which gives that section an automatic numerical label based on where it is in the document. This allows you to easily rearrange your sections without messing up references that you may have made to them elsewhere. You'll do the same for figures, equations, and tables. To reference your label, type Section `\ref{sec:example}` in your source. This will print the section number in the pdf, and when you generate the final pdf, the number will automatically hyperlink to that section.

You can also input files within the chapter files. If you click on "chapter2.tex" in the project files, you will see the chapter heading as `\chapter{Materials and Methods}` followed by a short text introduction. After this, you'll see section headers, labels, and input files for each section. To title a section, use `\section{Section Title}`. Also available are `\subsection{}` and `\subsubsection{}`. For most of my sections, unless they are very short, I usually choose to `\input{}` the text so that I can rearrange the document easily if needed. If you click on the "latex.tex" project file, you'll see this text, divided into subsections. You can nest input files inside input files as

far as you want. In Overleaf, and possibly other programs, if you click on a place in the pdf preview, it will take you right to that source file.

### 2.1.2 Figures

First, add the figure to your project files either by copying the figure into the project folder (TexStudio or other downloaded program) or by uploading to the project (Overleaf or Share Latex). In Overleaf, click “Files” in the upper left under the project tab, then “Upload from... > Computer.” I have also found the website “plot.ly” very useful for generating graphs, since they will connect automatically to Overleaf (Files > Add...> Plot from Plot.ly (beta)). Then, when you click “Files > Refresh linked files,” any changes made on the plot.ly website will automatically show in your Overleaf document, which is useful for quick aesthetic changes. Another way to do it is to generate the graph in Excel and right-click and choose “Save as Picture,” to upload to Overleaf or save to your project files folder.

Second, to use the figure in your document, look at the source code for Figure 2.1. Essential features include a way to resize the picture (adjust the number in `width=0.4\textwidth`), the caption, and the label (e.g. `\label{fig:retreat}`). Put the code for the figure into the .tex document following the paragraph in which you reference it. Usually, the program will place the figure where it logically fits. However, if you find that the figure drifts too far away from the text you are illustrating, write `[!h]` immediately after and on the same line as `\begin{figure}`. This may induce some blank space before or after.

To use subfigures, see the source for Figure 2.2. You can resize each picture independently of the other, and have independent labels and captions/titles.



Figure 2.1: **2018 Physics retreat.** Please note that this is the longer caption which is placed inside squiggle brackets after the caption command, and goes under the figure. You can generate a shorter caption for the “List of figures” by using square brackets [Short caption] after the caption command. It is good practice to include the short caption in bold in your long caption as a figure title.



(a) Title for Subfigure 1



(b) Title for Subfigure 2

Figure 2.2: **Short title for subfigures example.** Long caption for subfigures example.

Chapter Number	Chapter Title
1	Introduction
2	Materials and Methods
3	Results
4	Discussion
5	Conclusion

Table 2.1: **Short table title.** Long table caption.

### 2.1.3 Tables

You can make very nice tables in Latex either typing them out by hand or using this useful website to automatically generate tables from data pasted from a spreadsheet: <https://www.tablesgenerator.com/>. See source code for Table 2.1 for an example. To add a horizontal line use the command `\hrline`. The command `\begin{tabular}{cc}` controls the columns and their justification (left=l, right=r, or centered=c). To add another column, add another letter inside the squiggle brackets. To add a vertical line, surround the letter of that column with “pipes” (the vertical line character usually typed by doing Shift+backslash) like this `\begin{tabular}{|c|c|}`

### 2.1.4 Equations

Typing equations in where using Latex has a real advantage over using Word. To use a normal, centered equation, see the source for the following equation

$$E = mc^2, \tag{2.1}$$

where  $E$  is energy,  $m$  is mass, and  $c$  is the speed of light. Notice that equations have labels too. You can also do inline equations like this `\(E=mc^2\)` to get:  $E = mc^2$ . To get normal text in an equation i.e. for units, use the `\textnormal{}` command. For example,

$$1 \text{ in} = 2.54 \text{ cm.} \tag{2.2}$$

For more help on Latex equations, please see

[https://www.sharelatex.com/learn/Mathematical expressions](https://www.sharelatex.com/learn/Mathematical%20expressions).

### 2.1.5 Glossary

The glossary is set up in this document such that the acronym in the text can be automatically linked to the glossary page. To do this, set up the acronym in the “glossary.tex” as `\newacronym{cdr}{CDR}{Creighton Digital Repository}` where the info letters in the first squiggle brackets are the “call” letters, the letters in the second brackets are how the acronym will appear the second and all following times you “call” it , and the words in the last bracket are how the acronym will appear the first time you “call” it. Use the acronym by typing `\gls{cdr}`. The first time you type that, you’ll get: [Creighton Digital Repository \(CDR\)](#), and the second time, you’ll get: [CDR](#). This way, if you rearrange your sections, the program will always write out the acronym for you on first use.

To input the glossary page, type `\printnoidxglossaries` between the appendices and the references in the main.tex file. Before this line, add

`\addcontentsline{toc}{chapter}{Glossary}` to have the Glossary listed in the table of contents.

### 2.1.6 Other formatting

Most character/formatting issues can be solved with a Google search. Make sure to keep an eye on your pdf preview as you type your thesis so that you know you are getting what you want. Here I’ll just include a few formatting things that I had trouble with that may trouble you too.

- For the ampersand sign &, use `\&`, not just `&`
- For a quotation, use ‘ ‘quote’ ’, not "quote", to get “quote.” In other words, to begin the quotation, use the backward apostrophe under the escape button on the keyboard, and to close the quote, use double apostrophes. Otherwise, you’ll get ”quote.”
- To use a period for an abbreviation, use `.\` instead of just a period. If you just use a period, it will put a large space after the period, as if it were the end of the sentence. For instance, compare Dr. Nichols versus Dr. Nichols.

## 2.2 References

There are at least two different ways to do a references section effectively in latex. The first is to create a .tex file and type the bibliography entries by hand, formatted in the style you want them in. The second is to create a .bib file which contains entries containing the necessary information to format the entry in any style you tell it to. Examples of both methods are included in this thesis template.

If you click on the biblio.tex file, you will see the following:

```
\begin{thebibliography}{99}
\bibitem{schueler}\href{https://pubs.rsna.org/doi/full/10.1148/radiographics.20.4.g00jl301115}{Schueler B. A. The AAPM/RSNA physics
tutorial for residents general overview of fluoroscopic imaging.
\textit{RadioGraphics 2000;20,} 1115-1126.}
\end{thebibliography}
```

For each `\bibitem`, first you’ll write a word to call the citation (usually the author’s name). Then you have the option of linking to the article using the `\href{}` command. Finally, in squiggle brackets, put the citation in the style you would like to use. To use the citation, type `\cite{schueler}` in the body of the document.

Make sure the citation is prior to the period at the end of the sentence like this [1]. To use this form of bibliography, just input the biblio.tex file in the main file at the end, after the appendices and glossary, and add it to the Table of Contents as you did the glossary. The first reference page in this pdf shows a reference page generated this way.

To use a .bib file, which is the preferred method of creating a bibliography for longer documents, create a file with the extension .bib, such as the biblio.bib in this document. Then, cut and paste bibtex entries from Google Scholar article citations, download from the article itself, or type up yourself. Alternatively, a service such as Mendeley.com (free) will generate your .bib file for you. The first line of the entry is the nickname you give to call the citation, for instance: `\cite{schueler2000aapm}`. Then, add the bibliography to the main.tex file in the place you want the references by typing `\bibliography{biblio}` and choose the style, commonly `\bibliographystyle{plain}` or `\bibliographystyle{IEEEtran}`. Please note that with a .bib bibliography it is more difficult to hyperlink to the article in your pdf, but the internet has some suggestions. See the second page of references in this pdf for an example of a reference page generated with .bib file. See [2] for an example of an article citation, and [1] for an example of a webpage citation.

For more resources, see:

- <http://kb.mit.edu/confluence/pages/viewpage.action?pageId=3907111>
- <https://blog.mendeley.com/2011/10/25/howto-use-mendeley-to-create-citations-using-latex-and-bibtex/>
- <https://www.youtube.com/watch?v=SEzC7C69Dk4>

## 2.3 Document flow

Since the thesis document is very long, you have to assume that your readers will skip around or not read the whole thing in the same day. For this reason, you will want to provide your reader tools to orient themselves. One method of doing this is to include a short introduction at the beginning of each chapter or section mentioning what you have discussed so far, why, and where (link to important sections and figures using `\ref{}` command). Also, conclude each chapter with a short summary of the major points of the chapter and give an overview of where you are going in the rest of the work. Be creative in helping your reader find what they are looking for in your writing. The Introduction and the Conclusion in particular are great places to provide road maps through the work; try to include enough information in these chapters that if a person only read the Abstract, Introduction, and Conclusion, they would still be able to understand the purpose and major results of your project.

# Chapter 3

## Results

Every Latex program should have a way to generate a pdf of your work. You'll want to save it as `Lastname_FirstInitial_YEAR_MS.pdf`. Your thesis advisor will want to see your draft versions along the way and provide suggestions. Ask your thesis advisor if he or she wants the pdf via an electronic copy or print. It is probable that your pdf will be too big to send over email. If that is the case, you can compress your pdf (loss of image quality) through one of many free online services such as [smallpdf.com](http://smallpdf.com), or you can send the thesis through Creighton's [Jaydrop](#) service or a similar program.

You'll want to give a copy of the finished, revised thesis to the members of your thesis committee about 1-2 weeks before the thesis defense date (please ask them). The thesis defense is usually scheduled several weeks in advance (coordinate with your advisor and committee members, and you are required to publicize the event to the physics department. Simply send an email with details to the physics major list email address and/or print flyers and post in the department. The defense is open to the public; family and friends are welcome to attend as well.

# Chapter 4

## Discussion

You should prepare for the thesis defense by preparing a 45 minute talk oriented to the general public. You will need more background information in your slides than you would for a seminar presentation. After that, there will be around 15 minutes of questions before a short break. The public departs and your thesis committee remains to ask you questions. Some questions may be simple, background questions, some may be questions on material already contained and explained in your thesis, some may be on material omitted from your thesis. After the committee panel (about an hour), you will depart and the committee will deliberate and let you know your results usually within a half hour. It is common that they ask you to make revisions to your written work. After required revisions, have your thesis committee members sign your signature page, one copy for every print bound copy of your thesis. Submit all copies of the signature page to the graduate office, where the Dean will sign each, and you will be sent a pdf copy of one of them for insertion into the digital version of your thesis (use `\includepdf{}` command in Latex).

# Chapter 5

## Conclusions

Once your thesis is in its final form, you will:

1. Upload it to the [CDR](#), and
2. Print out copies for binding.

For upload instructions, see the videos at

<https://dspace2.creighton.edu/xmlui/handle/10504/111793>. Once you have uploaded your thesis to the CDR, you will be eligible to graduate.

You'll print at least three copies for binding: one for the department, one for you, one for the library. The department will pay for these three copies. If you want additional copies bound (for parents, friends, your barista) they will cost \$35 each. Print the copies that you'll need and drop them off at the graduate office (they will probably still have your signature pages; if not, insert them). Binding takes about a month.

Throughout the process, don't be afraid to ask your advisor, committee members, and fellow students for their advice and assistance!

# Appendix A

## Style guide

Dr. Soto's advice on thesis style:

In the attached paper, you may have a look at sections 2.4 (overall strategy to plan a paper but in my opinion the strategy also applies to a thesis) and 3 (the first 2/3 of the bullets give general overview of language style). There is an interesting course (you may google Stanford + scientific writing) with lots of resources on how to structure the language. Other suggestions are avoid nominalizations, adverbs, and nouns as adjectives. Scientists experienced in technical writing suggest to avoid long and wordy sentences. Also avoid the gender (use either "they" or the corresponding noun).

# Whitesides' Group: Writing a Paper\*\*

By George M. Whitesides\*

## 1. What is a Scientific Paper?

A paper is an organized description of hypotheses, data and conclusions, intended to instruct the reader. Papers are a central part of research. If your research does not generate papers, it might just as well not have been done. "Interesting and unpublished" is equivalent to "non-existent".

Realize that your objective in research is to formulate and test hypotheses, to draw conclusions from these tests, and to teach these conclusions to others. Your objective is not to "collect data".

A paper is not just an archival device for storing a completed research program; it is also a structure for *planning* your research in progress. If you clearly understand the purpose and form of a paper, it can be immensely useful to you in *organizing* and conducting your research. A good outline for the paper is also a good plan for the research program. You should write and rewrite these plans/outlines throughout the course of the research. At the beginning, you will have mostly plan; at the end, mostly outline. The continuous effort to understand, analyze, summarize, and reformulate hypotheses on paper will be immensely more efficient for you than a process in which you collect data and only start to organize them when their collection is "complete".

## 2. Outlines

### 2.1. The Reason for Outlines

I emphasize the central place of an outline in writing papers, preparing seminars, and planning research. I especially believe that for you, and for me, it is most *efficient* to write papers from outlines. An *outline* is a written plan of the organization of a paper, *including* the data on which it rests. You should, in fact, think of an outline as a carefully organized and presented set of data, with attendant objectives, hypotheses, and conclusions, rather than an outline of text.

An outline itself contains little text. If you and I can agree on the details of the outline (that is, on the data and organization), the supporting text can be assembled fairly easily. If we

do *not* agree on the outline, any text is useless. Much of the *time* in writing a paper goes into the text; most of the *thought* goes into the organization of the data and into the analysis. It can be relatively efficient in time to go through several (even many) cycles of an outline before beginning to write text; writing many versions of the full text of a paper is slow.

All writing that I do—papers, reports, proposals (and, of course, slides for seminars)—I do from outlines. I urge you to learn how to use them as well.

### 2.2. How Should You Construct an Outline?

The classical approach is to start with a blank piece of paper, and write down, in any order, all important ideas that occur to you concerning the paper. Ask yourself the obvious questions: "Why did I do this work?"; "What does it mean?"; "What hypotheses did I mean to test?"; "What ones did I actually test?"; "What were the results? Did the work yield a new method of compound? What?"; "What measurements did I make?"; "What compounds? How were they characterized?". Sketch possible equations, figures, and schemes. It is essential to try to get the major ideas. If you start the research to test one hypothesis, and decide, when you see what you have, that the data really seem to test some other hypothesis better, don't worry. Write them both down, and pick the best combinations of hypotheses, objectives, and data. Often the objectives of a paper when it is finished are different from those used to justify starting the work. Much of good science is opportunistic and revisionist.

When you have written down what you can, start with another piece of paper and try to organize the jumble of the first one. Sort all of your ideas into three major heaps (1–3).

#### 1. Introduction

Why did I do the work? What were the central motivations and hypotheses?

#### 2. Results and Discussion

What were the results? How were compounds made and characterized? What was measured?

#### 3. Conclusions

What does it all mean? What hypotheses were proved or disproved? What did I learn? Why does it make a difference?

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[\*\*] The text is based on a handout created on October 4, 1989.

Next, take each of these sections, and organize it on yet finer scale. Concentrate on organizing the *data*. Construct figures, tables, and schemes to present the data as clearly and compactly as possible. This process can be slow—I may sketch a figure five to ten times in different ways trying to decide how it is most clear (and looks best aesthetically).

Finally, put everything—outline of sections, tables, sketches of figures, equations—in good order.

When you are satisfied that you have included *all* the data (or that you know what additional data you intend to collect), and have a plausible organization, give the outline to me. Simply indicate where missing data will go, how you think (hypothesize) they will look, and how you will interpret them if your hypothesis is correct. I will take this outline, add my opinions, suggest changes, and return it to you. It usually takes four to five iterations (often with additional experiments) to agree on an outline. When we *have* agreed, the data are usually in (or close to) final form (that is, the tables, figures, etc., in the outline will be the tables, figures,... in the paper).

You can then start writing, with some assurance that much of your prose will be used.

The key to efficient use of your and my time is that we start exchanging outlines and proposals as early in a project as possible. *Do not, under any circumstances, wait until the collection of data is “complete” before starting to write an outline.* No project is ever complete, and it saves enormous effort and much time to propose a plausible paper and outline as soon as you see the basic structure of a project. Even if we decide to do significant additional work before seriously organizing a paper, the effort of writing an outline will have helped to guide the research.

### 2.3. The Outline

What an outline should contain:

#### 1. Title

#### 2. Authors

#### 3. Abstract

Do *not* write an abstract. That can be done when the paper is complete.

#### 4. Introduction

The first paragraph or two should be written out completely. Pay particular attention to the opening sentence. Ideally, it should state concisely the objective of the work, and indicate why this objective is important.

In general, the Introduction should have these elements:

- The *objectives* of the work.

- The *justification* for these objectives: Why is the work important?
- *Background*: Who else has done what? How? What have we done previously?
- *Guidance to the reader*: What should the reader watch for in the paper? What are the interesting high points? What strategy did we use?
- *Summary/conclusion*: What should the reader expect as conclusion? In advanced versions of the outline, you should also include all the sections that will go in the Experimental section (at the level of paragraph subheadings) and indicate what information will go in the Microfilm section.

### 5. Results and Discussion

The results and discussion are usually combined. This section should be organized according to major topics. The separate parts should have subheadings in boldface to make this organization clear, and to help the reader scan through the final text to find the parts of interest. The following list includes examples of phrases that might plausibly serve as section headings:

- Synthesis of Alkane Thiols
- Characterization of Monolayers
- Absolute Configuration of the Vicinal Diol Unit
- Hysteresis Correlates with Roughness of the Surface
- Dependence of the Rate Constant on Temperature
- The Rate of Self-Exchange Decreases with the Polarity of the Solvent

Try to make these section headings as specific and information-rich as possible. For example, the phrase “The Rate of Self-Exchange Decreases with The Polarity of The Solvent” is obviously longer than “Measurement of Rates”, but much more useful to the reader. In general, try to cover the major common points:

- Synthesis of starting materials
- Characterization of products
- Methods of characterization
- Methods of measurement
- Results (rate constants, contact angles, whatever)

In the outline, do not write any significant amount of text, but get all the data in their proper place: Any text should simply indicate what will go in that section.

- Section Headings
- Figures (*with* captions)
- Schemes (with captions and footnotes)
- Equations
- Tables (correctly formatted)

Remember to think of a paper as a collection of experimental results, summarized as clearly and economically as possible in figures, tables, equations, and schemes. The text in the paper serves just to explain the data, and is secondary. The more information can be compressed into tables, equations, etc., the shorter and more readable the paper will be.

## 6. Conclusions

In the outline, summarize the conclusions of the paper as a list of short phrases or sentences. Do not repeat what is in the Results section, unless special emphasis is needed. The Conclusions section should be just that, and not a summary. It should add a new, higher level of analysis, and should indicate explicitly the significance of the work.

## 7. Experimental

Include, in the correct order to correspond to the order in the Results section, all of the paragraph subheadings of the Experimental section.

### 2.4. In Summary

- Start writing possible outlines for papers *early* in a project. Do not wait until the “end”. The end may never come.
- Organize the outline and the paper around easily assimilated data—tables, equations, figures, schemes—rather than around text.
- Organize in order of importance, not in chronological order. An important detail in writing papers concerns the weight to be given to topics. Neophytes often organize a paper in terms of chronology: that is, they give a recitation of their experimental program, starting with their cherished initial failures and leading up to a climactic successful finale. *This approach is completely wrong. Start with the most important results*, and put the secondary results later, if at all. The reader usually does not care how you arrived at your big results, only what they are. Shorter papers are easier to read than longer ones.

## 3. Some Points of Style

- Do not use nouns as adjectives:

*Not:*

ATP formation; reaction product

*But:*

formation of ATP; product of the reaction

- The word “this” must always be followed by a noun, so that its reference is explicit.

*Not:*

This is a fast reaction; This leads us to conclude

*But:*

This reaction is fast; This observation leads us to conclude

- Describe experimental results uniformly in the past tense.

*Not:*

Addition of water *gives* product.

*But:*

Addition of water *gave* product.

- Use the active voice whenever possible.

*Not:*

It was observed that the solution turned red.

*But:*

The solution turned red. *or*

We observed that the solution turned red.

- Complete all comparisons.

*Not:*

The yield was higher using bromine.

*But:*

The yield was higher using bromine than chlorine.

- Type all papers double-spaced (not single- or one-and-a-half-spaced), and leave two spaces after colons, and after periods at the end of sentences. Leave generous margins.

Assume that we will write all papers using the style of the American Chemical Society. You can get a good idea of this style from three sources:

- *The journals*. Simply look at articles in the journals and copy the organization you see there.
- *Previous papers from the group*. By looking at previous papers, you can see exactly how a paper should “look”. If what you wrote looks different, it probably is not what we want.
- *The ACS Handbook for Authors*. Useful, detailed, especially the section on references, pp. 173–229.

I also suggest you read Strunk and White, *The Elements of Style* (Macmillan: New York, 1979, 3rd ed.) to get a sense for usage. A number of other books on scientific writing are in the group library; these books all contain useful advice, but are not lively reading. There are also several excellent books on the design of graphs and figures.

# Appendix B

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# Glossary

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# References

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