

How to Write a Research Paper

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Why you *should* care about writing research papers

- Unwritten Rule #1: If you don't publish it, you haven't done it.
- Unwritten Rule #2: The credit goes to the guy who publishes first.
- Unwritten Rule #3: People who don't submit their work for peer review do crappy work.
- Unwritten Rule #4: Writing things down in a form for others to read makes you understand them better.
- Unwritten Rule #5: Writing a paper is the only way you will know what you did six months from now.

Why you should care *less* about writing a thesis or dissertation than a paper

- It is a lot more work.
- You get less credit.
- No-one will ever read it.
- You won't be particularly proud of it.

“The skill of writing is to create a context in which other people can think.”
- **Edwin Schlossberg**

The structure of a research paper

Experimental process	Section of Paper	Order of Writing	
		Ideal	Actual
What did I do in a nutshell?	Abstract	Fifth	Fifth
What is the problem?	Introduction	First	Third
How did I solve the problem?	Methods & Experiment	Second	First
What did I find out?	Results	Third	Second
What does it mean?	Discussion	Fourth	Fourth
Who helped me out?	Acknowledgments (optional)	Last	Last
Whose work did I refer to?	Literature Cited	Always	Always

“If you don't have the time to read, you don't have the time or the tools to write.”
- **Stephen King**

Step #0 of Actually Writing: Read

You have to read enough papers to pick up the style and tone of the journal you are submitting to and also to be able to reference the work of others.

“Of writing well the source and fountainhead is wise thinking. “
- Horace

Step #1 of Actually Writing: What Story are you Telling?

- In science and engineering the creative part is in the work, not the writing.
- Scientific papers use a very formal, stilted writing style that is very different than fiction, historical novels, biographies, or “fun” literature.
- Just because they don’t sound the same doesn’t mean they don’t both tell stories.
- ***Write out a one page story of what you are trying to communicate.***

“Reading maketh a full man, conference a ready man, and writing an exact man.”
- Sir Francis Bacon

Step #2 of Actually Writing: Make an Outline!

- ***Before writing any words or making any figures of your paper make an outline!***
- There should be a minimum of one outline entry per paragraph.
- Put your figures in your outline in text form. Describe what the figure should communicate.
- Your outline should tell you what you want to say and why it needs to be said. What exactly are you trying to communicate?
- Put references (when you know them) in your outline.
- NEVER, BUT NEVER start writing a section until you are satisfied with your outline and you have let your advisor look over and approve your outline.
- Don't underestimate how hard it is to write a good outline! The work is worth it.

“It is not a bad idea to get in the habit of writing down one's thoughts. It saves one having to bother anyone else with them.”

- **Isabel Colegate**

Step #3 of Actually Writing: Make the Figures!

- Figures make or break a paper. Many people will *only* look at your figures.
- Figures should speak for themselves- they don't need to be completely explained in the text.
- If you can't make a figure, your data or understanding is not yet complete enough.
- You should be able to follow your story just by looking at the figures.
- Don't make a figure if you can borrow it from someone (with permission).

Novice Mistakes

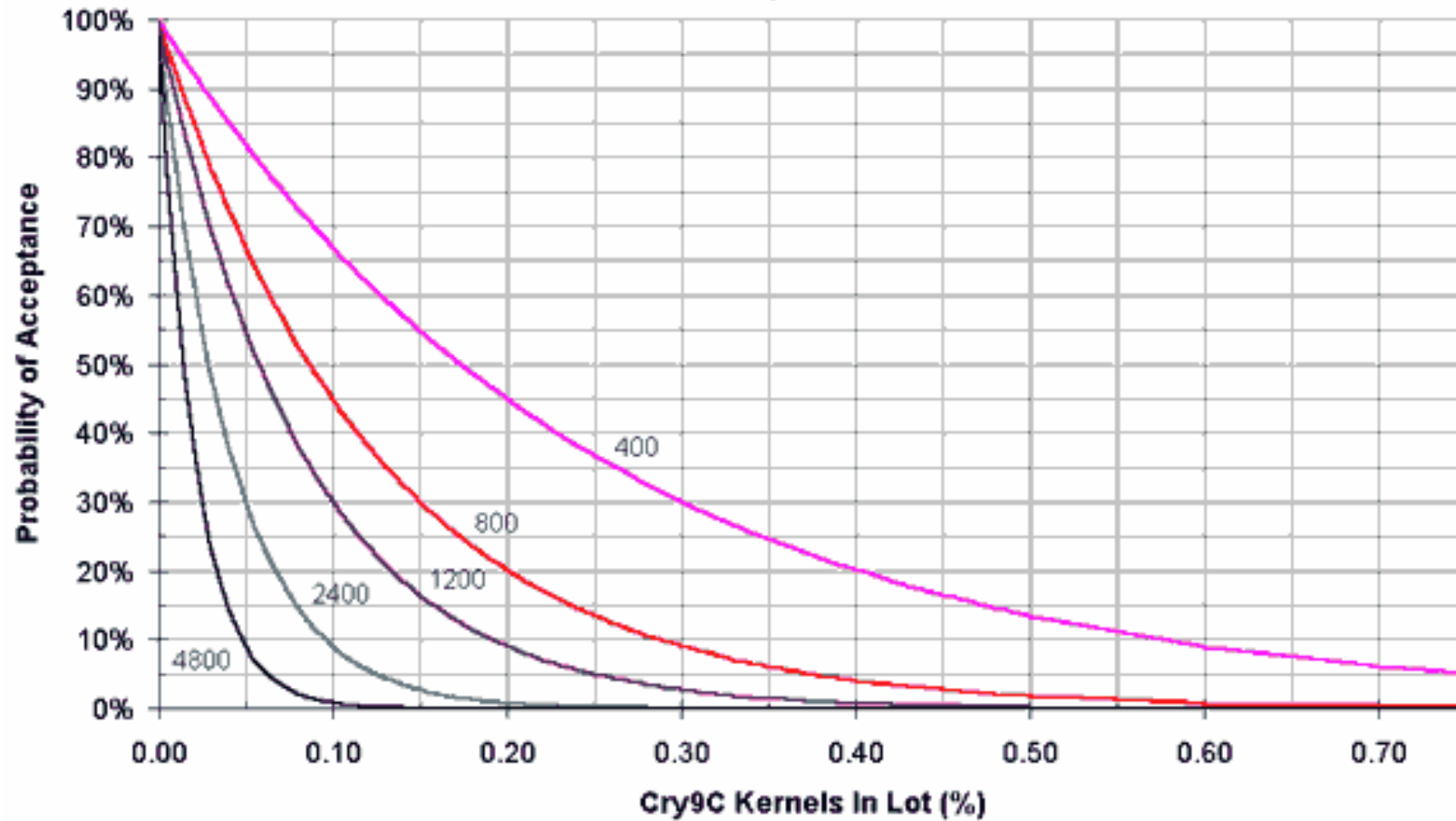
- Trying to cram too much into one figure.
- Forgetting your figures will get shrunk down in the paper.
- Making text or data points too small- 14 pt. font is minimum.
- Nobody really cares about a photograph of your experiment except for you.
- Not distinguishing data from theory in a figure.

Hints

- You will redo your figures many times, so keep the raw data used to make the figure in the same folder as the figure.
- In Word a table with invisible or white lines is a great way to put figures into the text.

Example Figures- good and bad

OC Curves Showing the Effect of Number of Kernels Tested on Acceptance Rate



0 grams N Treatment 5 grams N

“The Zen way of doing things is to do them.”
The way to write a paper is to write.

Step #4 of Actually Writing: Write what you Know About

- For most students in this is the experimental section; this may be the only section you write, especially if you have co-authors.
- Don't worry about having perfect spelling and grammar, or getting all your references in the first time.
 - If you don't know some number put in a place holder: i.e. XXX
 - If you don't know a reference put in a place holder: [ref]
 - If you don't like how the writing sounds, don't worry about it, just make a comment: [rewrite this section]
- It is very easy to get distracted. Write when you are fresh and alert. Edit your writing when you are tired or brain dead.
- Block out several hours a day away from distractions to write. I suggest the library.
- If you get stuck refer back to your outline. If it doesn't help then stop writing and work on your outline instead.
- This is not a paper you turn in for a grade- expect to have many revisions done by your advisor.
- Don't get upset or angry or take revisions personally even if they seem harsh.
- Tell your advisor if their revisions start to contradict themselves.
- *Something* is going to be changed; put in a few spelling and grammar mistakes on purpose!
- Rename or renumber your document EVERY time you make a change.

“True glory consists in doing what deserves to be written; in writing what deserves to be read; and in so living as to make the world happier for our living in it.

- **Pliny The Elder**

Step #5 of Actually Writing: The References

- Anything you do not derive yourself needs to have a reference (citation).
- Learn how to do literature searches- this is a class in itself.
- Any time the reader could learn more by reading what you did, put in a reference.
- Help your readers! If you reference a book tell them what part of the book you are referring to.
- Help your readers! Make sure you cite important and relevant work.
- Every professional organization uses a different format for references- make sure you read the style guide from their web sites.
- Learn how to use bibliographic software like EndNote and put papers in as you read them. EndNote is free from the OSU Library
- Don't put in references manually or using Word- you will regret it later

“Typos are very important to all written form. It gives the reader something to look for so they aren't distracted by the total lack of content in your writing.”

- Randy K. Milholland

Step #6 of Actually Writing: Finalizing and Submitting your Paper

- Have someone read over your work besides your advisor. This is especially important if English is not your native language.
- Format the paper using the same margins and columns as the journal uses if there are page limitations to make sure it fits. Don't submit this version.
- Add a few typographic errors or minor mistakes for the reviewer to find.
- Write the abstract- make sure you are not over the word limit.
- Think up a descriptive title.
- Put in the authors. You should be first author if you did most of the writing. Your advisor should be the final author.
- Make sure you acknowledge any funding agencies using the wording or format they need. Acknowledge anyone who helped you that isn't an author.
- Look up and put in the reference/taxonomic/classification codes.
- Write a nice letter to the editor explaining why you are submitting the paper, why it is an important contribution, and suggesting possible reviewers.
- Go over the author's submission checklist for the journal you are submitting to! Send in all the copyright forms
- Make sure you can pay the page charges.

“After all, one knows one's weak points so well, that it's rather bewildering to have the critics overlook them and invent others.”

- **Edith Wharton**

Step #7 of Actually Writing: Surviving Peer Review

- Wait.
- Eventually you will get a letter back saying there are a lot of things wrong with your paper. This is perfectly normal and part of the process. Don't get upset.
- Read the letter then take a few days off and calm down.
- There are usually four levels of reviews:
 - Accept- congratulations, you wrote an outstanding paper. Pay the page charges and pat yourself on the back.
 - Accept pending minor (optional) revisions- congratulations, you wrote an excellent paper. Make the changes and write a nice letter to the editor praising the reviewers.
 - Accept pending major revisions- congratulations, you wrote a good paper. Make the changes highlighting each change in your manuscript, then write a letter to the reviewers explaining how you addressed each of their concerns in detail. Be nice.
 - Reject- you either overlooked something important or the reviewer is a jerk. Decide if you want to fight the review or withdraw the paper. Submitting to a less prestigious journal may be an option.

Cheville's Rule of Paper Acceptance: 50% well known scientists, 20% slipped through, 20% really good papers, 10% 'affirmative action' papers.

If you would not be forgotten, as soon as you are rotten,
either write things worth reading or do things worth the writing.

- **Benjamin Franklin**

Things to do Before, During, and After you Write: Be Organized!

- Write parts of the paper as you do your research. As you build your experiment or run a simulation write a few paragraphs and a figure describing the work. You will publish it anyway and it is a lot harder to do it months later.
- Keep figure files and original data in the same folder. It sucks if it takes nine months for your paper to be reviewed then you have to redo your figures.
- It isn't plagiarism to build off your own work! Keep a folder of boilerplate you can use for different papers. Be aware of possible copyright violations though!
- Enter references into EndNote as you read them.
- Make a file of papers you have read in PDF format. Figure out some way to find them again.
 - I use *First Author's Last Name_Journal_v####_p####_year.pdf*
- Remember that reading and writing papers gets easier the more you do it- you need to continuously practice your writing.
- Even though you know what you are writing about really well at the time, you will forget most of it six months later. Figure out a way to organize your work so it is easy to make associations between your notes, the paper, the data, any code you developed, and your collaborators.
- What you write is the only record you will leave. Quality counts more than quantity.

“This is the challenge of writing. You have to be very emotionally engaged in what you’re doing, or it comes out flat. You can’t fake your way through this.”

Resources

How to write a scientific paper

- <http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWtoc.html>
- <http://classweb.gmu.edu/biologyresources/writingguide/ScientificPaper.htm>
- <http://www.scidev.net/ms/howdoi/index.cfm?pageid=60>
- <http://www.medicine.uiowa.edu/esr/education/Buettner-Writingsem.pdf>
- <http://www.improbable.com/airchives/paperair/volume2/v2i5/howto.htm>
- <http://www.cs.wisc.edu/~kovar/hall.html>

Style Guide

- <http://standards.ieee.org/guides/style/>

Figures

- http://www.visionlearning.com/library/module_viewer.php?mid=109&l=&c3=
- <http://www.eviltutor.com/>