

The conventional approach is to do a project and then write the paper, but that method is non-optimal:

- 1) You forget or overlook important insights and details after the fact.
- 2) If you've worked on a project for an extended period, you get bored, and that's reflected in the paper.
- 3) You can't find the time to write up the paper because you've moved on to a new project or a different phase of the work.

Instead, write in increments:

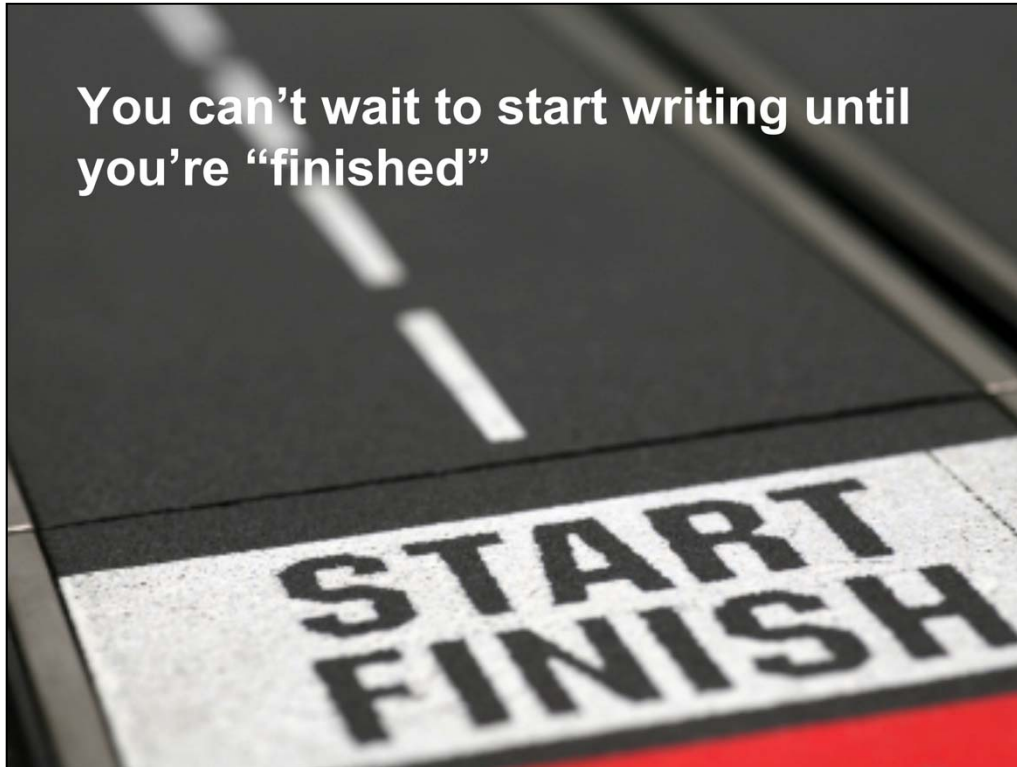
- 1) Construct a preliminary outline, based on the your initial goals for the project.
- 2) Write portions of the "results" and "discussion" sections while you're taking and analyzing your data.
- 3) Continually add to and refine your outline and your preliminary section drafts as the project proceeds.

Advantages of the incremental method:

You may discover additional data that are needed while the equipment is still set up and the project ongoing.

You get a finished paper faster, with more time to revise and edit.

H.B. Michaelson, *How to Write and Publish Engineering Reports and Papers* (Oryx Press, Phoenix, 1990).

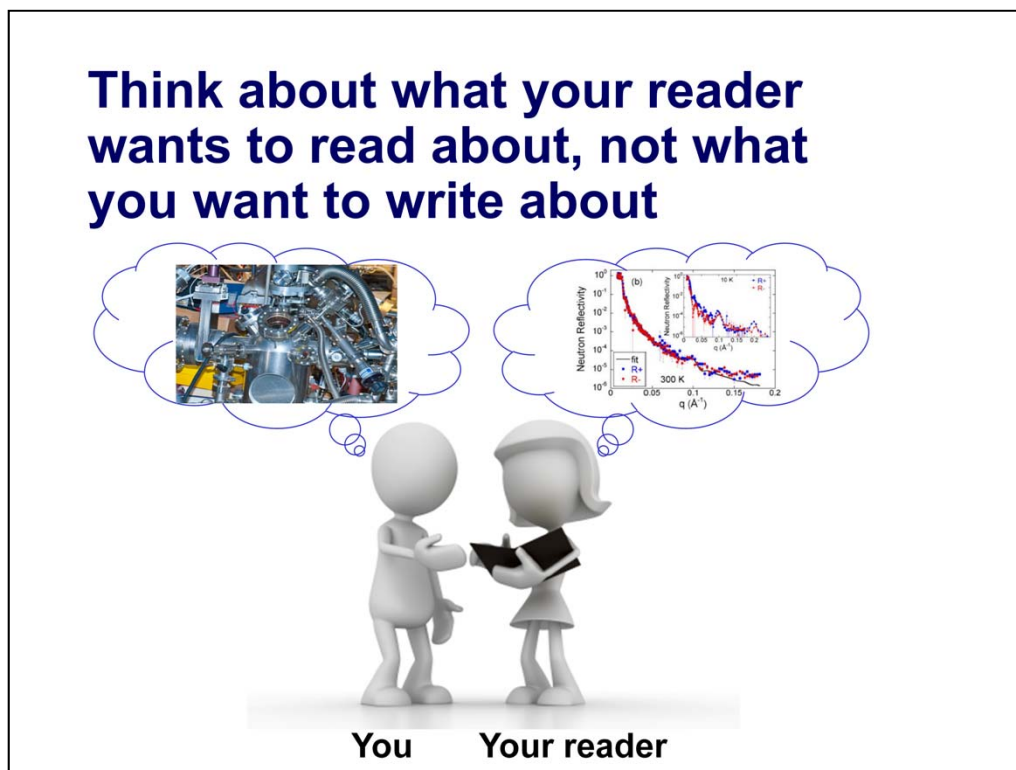


**You can't wait to start writing until  
you're "finished"**

Because you think in words, the act of expressing observation in language—of distilling amorphous thoughts into words—is a powerful tool for clarifying your thinking.

You don't really understand something—deeply understand it—until you can explain it to somebody else who doesn't know anything about it.

"The act of composition disciplines the mind; writing is one way to go about thinking, and the practice and habit of writing not only drain the mind, but supply it too." Strunk and White, *The Elements of Style*, 3rd ed., p. 70.



Good advice from Elmore Leonard: “Try to leave out the part that readers tend to skip.”  
(Elmore Leonard’s Rules for Writers, 24 Feb 2010,  
<http://www.guardian.co.uk/books/2010/feb/24/elmore-leonard-rules-for-writers>)

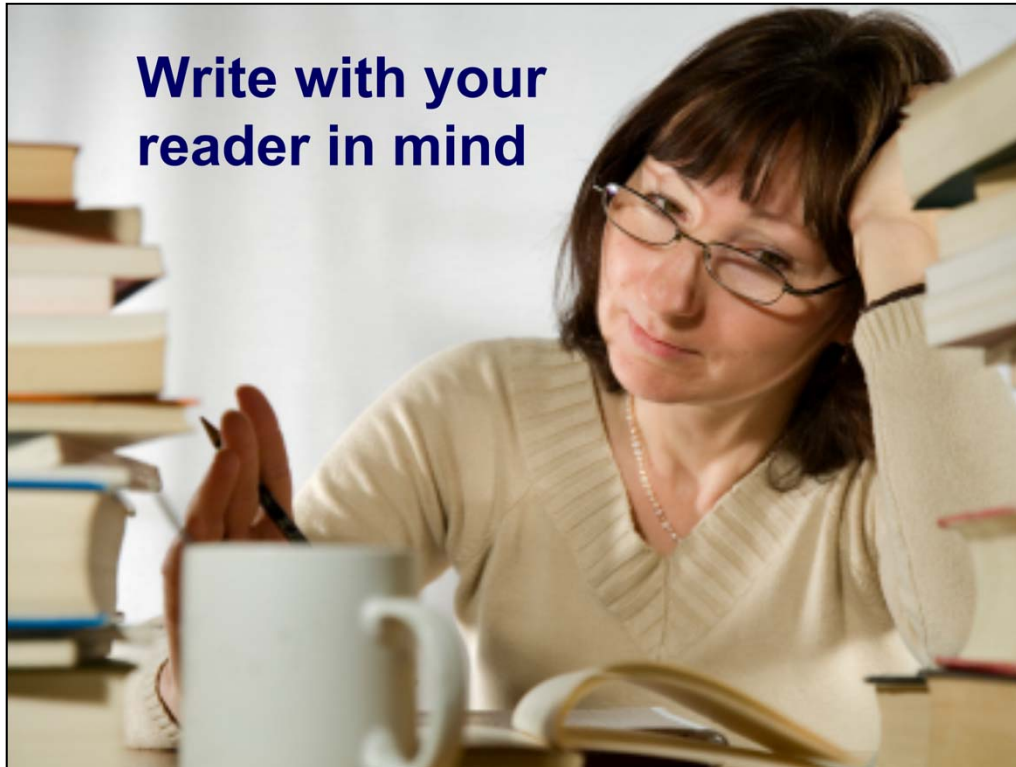
A common error that beginning researchers make is that they emphasize what they found most interesting, or what they spent the most time doing, and not what the reader wants to **know**.  
Know thy audience! It’s absolutely critical to producing a successful paper or talk.

- Why is the person reading your paper?
- What is his motivation? (What does she want to know?)
- What do you want him to learn? to believe?
- What do you need to tell him so that she can understand?
- What is likely to confuse him?
- What will he likely object to? What counterarguments will he raise?

While **everything** must be recorded in your laboratory notebook, in real time, not everything goes in the paper.

Readers don’t want to know all the things that went wrong, all the components that failed, all the adjustments that had to be made to get the data. They want to know what worked, how it worked, what the results were, and what you think they mean.

Remember, the purpose of a journal article is to archive enough information for another scientist “trained in the art” to reproduce your experiment and evaluate the validity of both your data and your conclusions. It is not a chronological history of the experiment or a cemetery where you inter all your mistakes.



Be aware of the realities of the scientific readership.

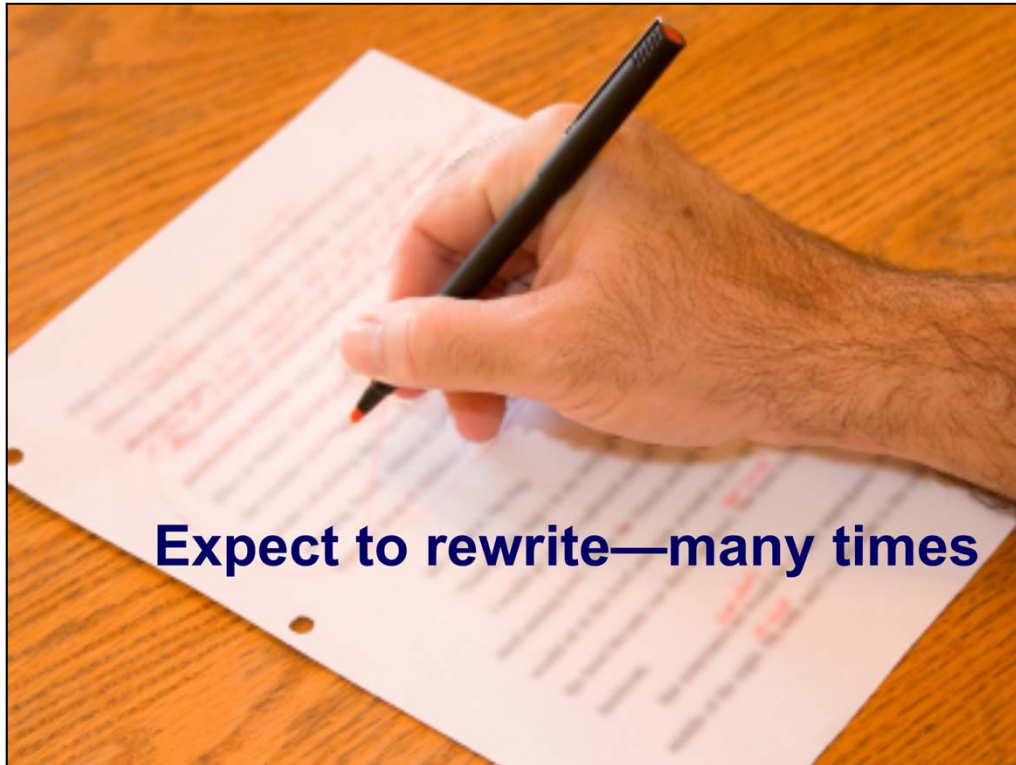
Readers will read your papers early in the morning and very late at night. They'll read them on airplanes and in poorly lighted hotel rooms. They'll read them when they're feeling frustrated and overwhelmed, or when they're trying to remember when they ate last, or when they're slogging through a stack of 27 other papers on the same topic.

**Be kind to your prospective reader:**

Make it easy to pick out important points and to follow the logic of your argument.  
Use words he'll understand.

Entice him into thinking about the hard parts with engaging figures and clear, concise captions.

Guide him through the paper with subheadings and transitional statements.



The probability that a first draft will not require revision asymptotically approaches 0.

“Perfection is achieved, not when there is nothing left to add, but when there is nothing left to take away.”—Antoine-Marie-Roger de Saint-Exupery

Brevity is a key goal. Use your revisions to clarify and simplify.

Give yourself adequate time to reflect and rewrite.

Revising should incorporate four distinct elements:

- 1) clarifying the selection and presentation of ideas.
- 2) organizing the narrative logically and incrementally.
- 3) using language precisely and concisely.
- 4) correcting “mechanical” errors that detract from a professional argument.

Ideally, editing should be done in three passes:

- 1) reading for content (the science).
- 2) editing for style (organization and language).
- 3) proofreading for mechanics (spelling, punctuation, grammar, usage).

Writing well is a learned skill—train yourself to recognize good writing; emulate good examples, and practice, practice, practice.

## Remember: Good writing is an evolutionary process:



**Commit to writing incrementally.**  
**Analyze your audience and purpose.**  
**Make an outline and follow it.**  
**Get words on paper/screen.**  
**Revise, revise, revise, revise, revise, revise, revise, revise,...**  
**FINISH!!!\***

**Tip: Don't use too many exclamation points in scientific writing!!  
People will think you're a crackpot!!!!**

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### Sources of good advice and further reading:

W. Strunk and E.B. White, *The Elements of Style*, 3rd ed. (Allyn & Bacon, Boston, 1979).

V. Booth, *Communicating in Science*, 2nd ed. (CUP, Cambridge, 1993).

H.B. Michaelson, *How to Write and Publish Engineering Papers and Reports*, 3rd ed. (Oryx Press, Phoenix, 1990).

S.L. Montgomery, *The Chicago Guide to Communicating Science* (University of Chicago Press, Chicago, 2003).

W. Cleveland, *Visualizing Data* (Hobart Press, Summit, NJ, 1993).

Celia's materials on technical writing and editing:

<http://physics.illinois.edu/people/profile.asp?cmelliot> (and scroll to the bottom of the page).

<http://online.physics.uiuc.edu/courses/phys496/Spring11/MsParticular.htm>

