How to Get Started if You Hate to Write

Part I—Outlining

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One thing I've learned in physics, you have to satisfy both the theorists and the experimentalists…

…so this talk has two parts:

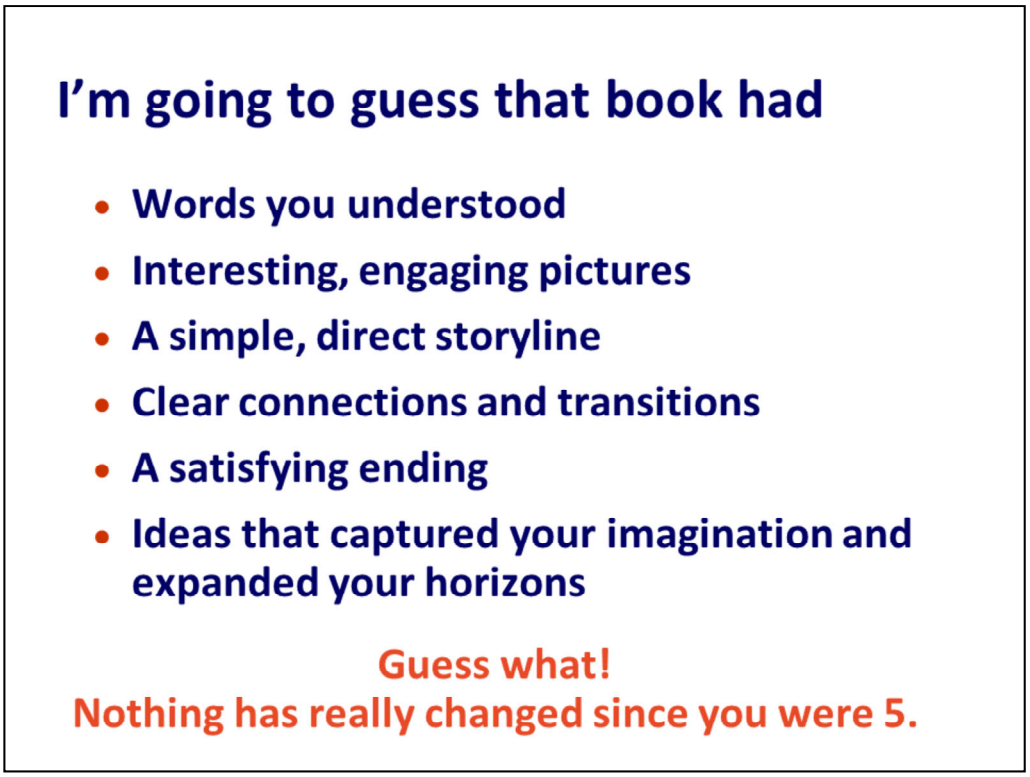
I. **a theory of technical writing**

II. **the nuts and bolts of first putting together a scientific paper**

In this lecture, I'll talk mostly about writing papers, but the advice and techniques apply to any form of communication—oral, written, or visual.

Close your eyes and picture in your mind your favorite childhood storybook

What made it so attractive to you?



Think about what made a good story when you were 5 years old. The same elements that attracted you as a child still work—interesting pictures, words you understand, simple, direct storyline, a logical structure, analogy, an enthusiastic narrator, something that stimulates your imagination and makes you think.

First step, throw out most of what you've been taught about "writing"

- Scientific writing ain't Shakespeare
- Your purpose is to inform, educate, and persuade—not to entertain
- Write with concrete, quantitative nouns and strong verbs, not adjectives and adverbs
- Use the simplest word
- Write short sentences and control your modifiers
- *No literary flourishes*

Scientific writing is fundamentally different from other kinds of writing—in tone, in style, in content, in organization.

Good scientific writing is concise, direct, concrete, and unambiguous.

The harder the concepts, the simpler and more transparent the writing should be.

Technical writing is a *craft*, not an art

Like any other craft, you have to learn the techniques

You have to get feed-back from experts

The same skills that make you a good scientist or engineer will make you a good technical writer

- logic
- precision
- the ability to recognize patterns and sort out what's important

Learning to write in the style described here will not only make you a better writer, it will also make you a better scientist. It will force you to see holes in your thinking, areas where you've made assumptions, places where you should add references, or data, or further analysis.

Successful science writing is

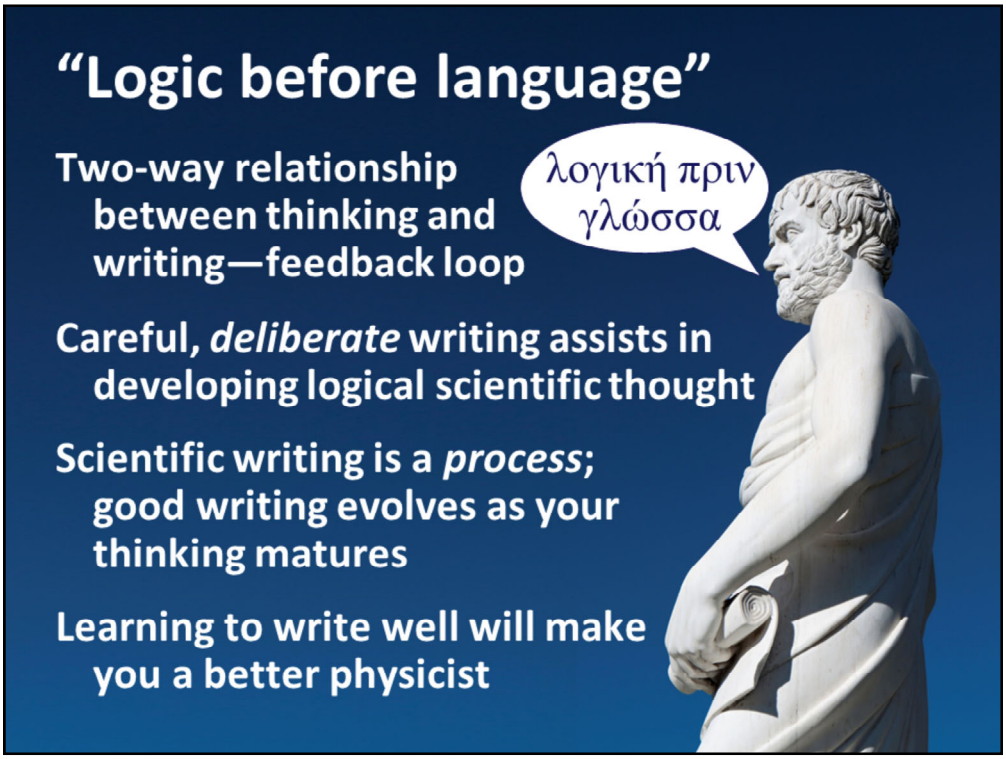
- Written with the *reader* in mind
- Logically constructed—think "linear"
- Clearly and succinctly expressed
- Precisely and simply worded
- Written to inform and persuade

The first step in *any* writing project should be an analysis of the audience for whom the document is intended.

As you are thinking about your writing task, first ask yourself four questions:

1. What is my *purpose* in writing this document? What's my ultimate goal?
2. Who is going to read it? What do they already know, and what am I going to have to explain? What do *they* want to get out of this paper?
3. What *one thing* do I want the reader to remember? What's the "take-away" message?
4. What are my space/time/page *constraints*?

At this stage of your writing project, think about what you want to convey to your audience. What are the important points that you want them to understand and remember?

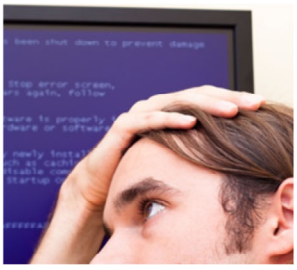


logikḯ prin gló̱ssa (loyeekee prin glōssuh)

Too often, scientists think of doing research and writing as discrete tasks that have little to do with one another. Today, I'd like you to think of them as a feedback loop, where progress in one informs and drives progress in the other.

From Peter Woodford: "Somehow the discipline of crystallizing a thought into a grammatical sentence with a beginning, a middle, and an end clarifies, sharpens, and delimits the thought."

Novice writers use the "core dump" method —inefficient and produces poor results

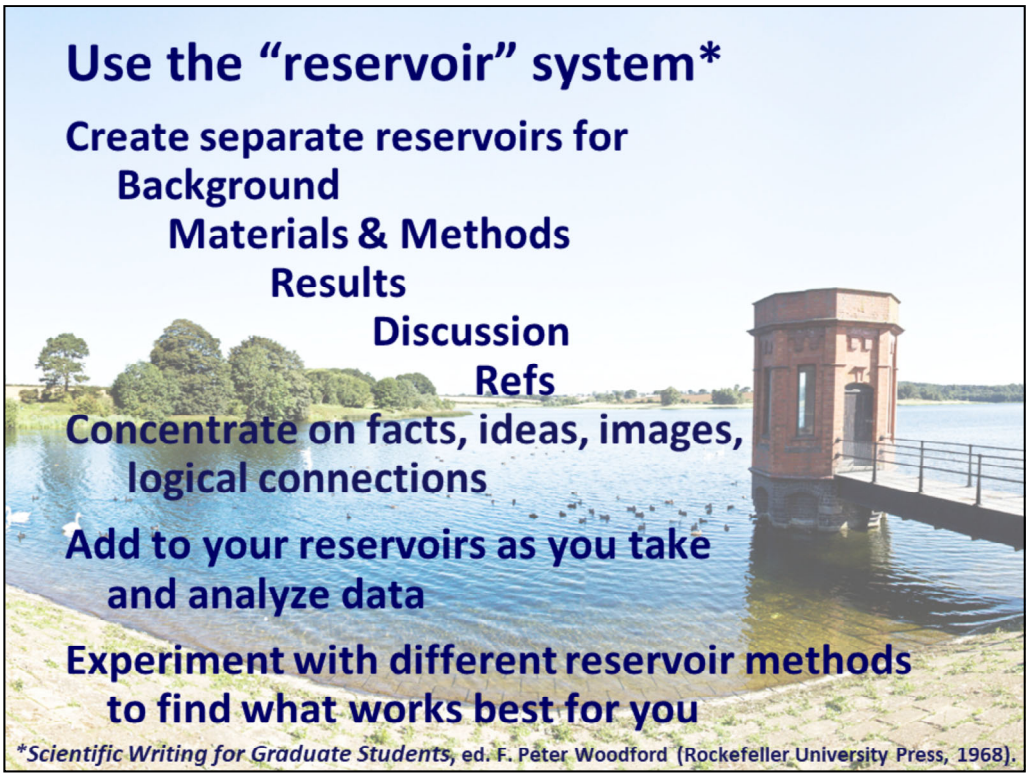


Always start from a plan—always!

1. Promotes thinking
2. Easiest way to get started if you don't like to write
3. Gives you control over length and focus
4. Increases the logical persuasiveness* and coherence of your final paper (or talk)

*"Persuasion in Technical Communications," http://people.physics.illinois.edu/Celia/Persuasion.pdf

Novice writers often just word-spew and then try to go back and "fix" what they've written. It's inefficient, time-consuming, and usually produces bad results.



The idea of creating separate holding pens for various parts of a technical document was first articulated, as far as I know, by F. Peter Woodford in *Scientific Writing for Graduate Students: A CBE Manual* (Rockefeller University Press, New York, 1968). Although targeted to graduate students in the life sciences and dated in language (not ***all*** scientists are men!), the fundamentals of Woodford's approach remain sound.

Vernon Booth, a major god in my pantheon (*Communicating in Science: Writing a scientific paper and speaking at scientific meetings*, 2nd ed. [Cambridge University Press, Cambridge, 1993]) also recommends the use of writing reservoirs.

Fill your reservoirs thoughtfully

Is the item really necessary?

To what reservoir does it logically belong?

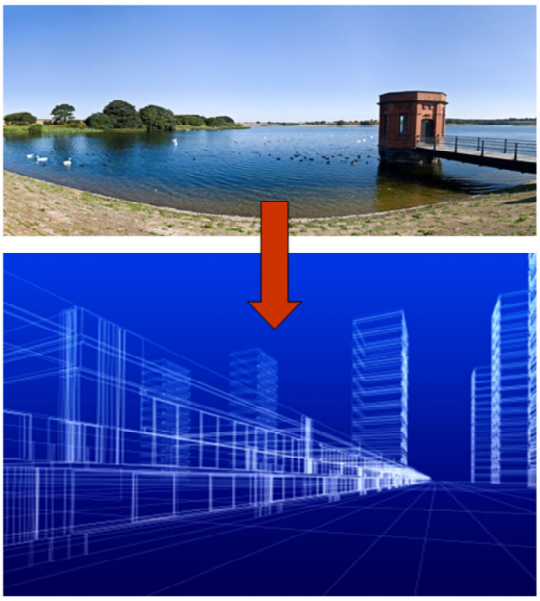
Content for reservoirs:

- Facts, observations, data
- Figures and captions
- Tables
- Analogies
- Ideas and speculations
- Unanswered questions
- Key words
- Felicitous phrases

At this stage, don't worry too much about niceties of language—concentrate on including essentials, eliminating superfluities, and getting things sorted into the right categories.

Now you're ready to start building a coherent narrative

In the next steps, we'll take the content of our reservoirs and make a plan to guide the building of our paper



RULE #1: Never write *anything* without first analyzing your audience

Who is going to read my paper?

What do they already know? (words, concepts, methods)

What *don't* they know that I will have to explain?

Where might they become confused?

Where can I send them for more information?

What is most important for them to understand?

Think carefully about who you want to read your paper, and craft your message to engage that reader.

RULE #2: Tell a good story

- Orient the reader with a solid introduction
- Emphasize what is new
- Use language that is understandable and meaningful for your reader
- Arrange the narrative so the logic is clear—use transitional statements to guide your reader
- Provide clear, visually interesting, memorable figures
- Provide a strong summary; don't just trail off at the end

If the first rule of writing a successful paper is to know your audience, the second rule is ***tell a good story***, in language that your reader will understand.

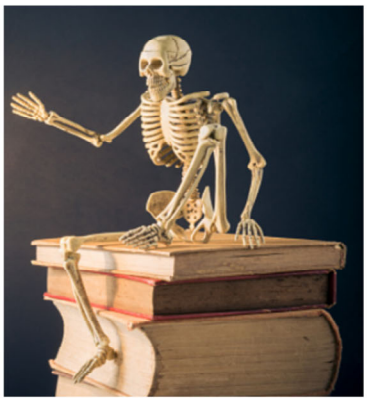
RULE #3: Never write *anything* without first writing a synopsis and an outline!

"If you don't know where you are going, you might wind up someplace else."

—Yogi Berra

Start out with a five-sentence synopsis

1. What was the goal?
2. How does it fit into the context of prior work?
3. What method(s) did you use?
4. What were your results?
5. What do they mean?



Answer each question in one coherent sentence

The synopsis is the skeleton that will hold up the rest of your story

Writing a synopsis is a good way to get started, because it defines the content and scope of your paper.

Note that the synopsis looks a lot like the recipe for an abstract that we looked at last week, but the synopsis serves a different purpose. It is a *planning document* to guide you as you develop the ideas in the paper. But writing is a process, and your content or emphasis may change as you draft and revise your paper. The abstract must represent the final *finished* paper.

Think of the synopsis as the skeleton—it gives the whole paper its shape and supports your evidence and arguments.

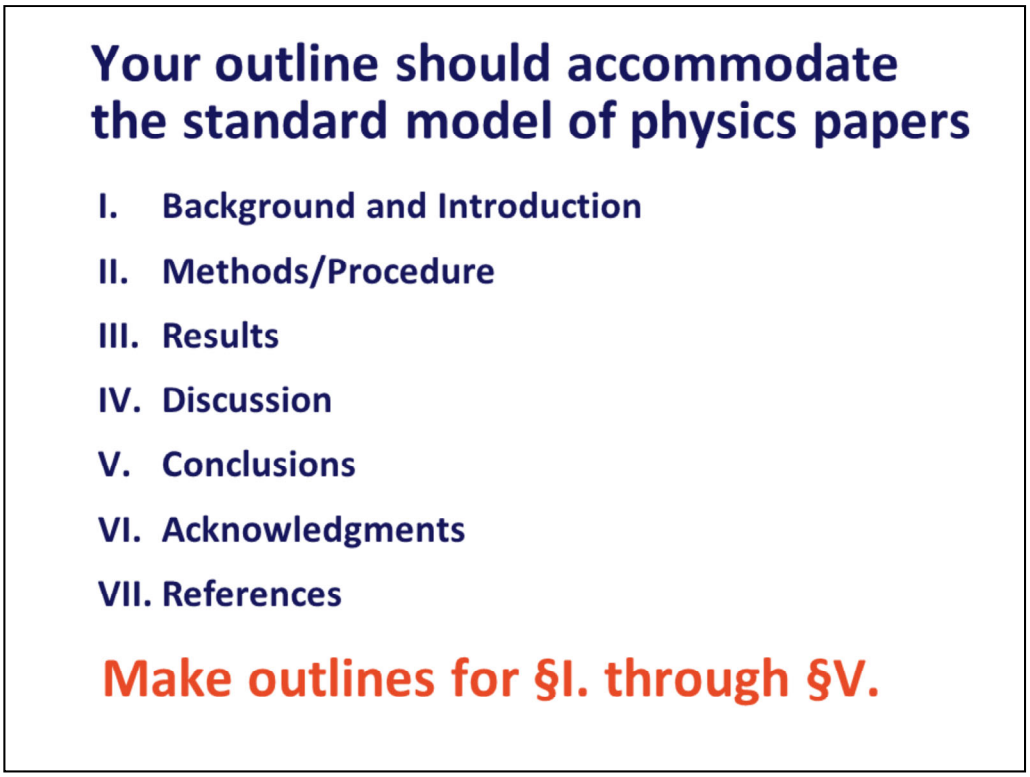
Next, make an outline to avoid an amateur's mistakes

- Using chronological instead of analytical order
- Devoting the most ink to the parts that took the longest to do
- Including superfluous or discursive information
- Omitting discussion of assumptions
- Failing to provide logical transitions
- Each sentence in your synopsis becomes a section of your outline

Some beginning authors think that if they spent 90 percent of their time on some aspect of the experiment, they should devote 90 percent of the paper to that topic, or they should present a chronological history of the experiment.

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 are, and what you think they mean.

Remember, a journal is an archive of your results and how you got them so others can reproduce them, not a cemetery where you bury all your mistakes.



Formal scientific papers are ***always*** presented in this order, but they're not written in this order.

No experienced researcher that I know starts with the title and writes a paper sequentially. Nobody.

Most scientists and engineers usually write papers in the following order:

1. Methods
2. Results
3. Discussion
4. Conclusions
5. Background and Introduction
6. References
7. Acknowledgments
8. Abstract & Final Title

You ***must*** have an outline to keep a coherent narrative flow as you write the separate sections of a paper.

Writers use two kinds of outlines—"topic" and "sentence"

Topic outlines use short phrases

- CO_2 underground storage—motivation
- Advantages of deep saline formations
- Convection could provide "stirring"
- Boycott effect

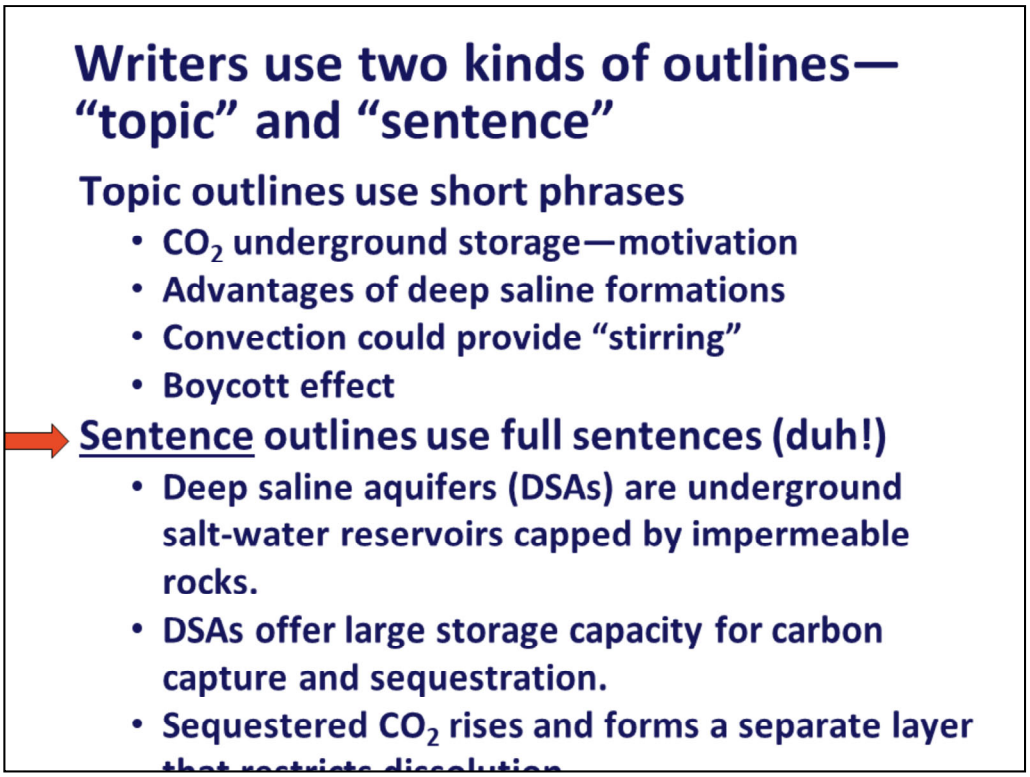
A topic outline is a good way to get started, but it may not be detailed enough for science writing

An outline is a tool that enables you to look systematically at how a paper or presentation is organized. Learning to write from an outline is one of the easiest ways to (1) get started and (2) improve the content and coherence of your scientific writing.

Today, we'll look at how to use outlines to get started on any writing project.

A topic outline consists of short phrases. Here's an example of a topic outline for a paper on carbon sequestration in deep saline geological formations.

A topic outline may be best for organizing a number of issues or ideas that could be presented in a several different ways, where the order of presentation is not important. Unfortunately, that is not typically the case for science papers.



Today we'll look at the sentence outline, which is better suited for papers (and talks) that require complex information to be presented in strict logical order.

Topic outlines are fast and easy to write. You might find it helpful to sketch out a topic outline first and then expand it into a full-sentence outline.

Many of the ideas about full-sentence outlining are taken from a course given by Ohio Eminent Scholar and Professor of Physics at The Ohio State University, John W. Wilkins (who is also a Physics Illinois alumnus). His trenchant thinking and incisive writing on communicating in physics are gratefully acknowledged.

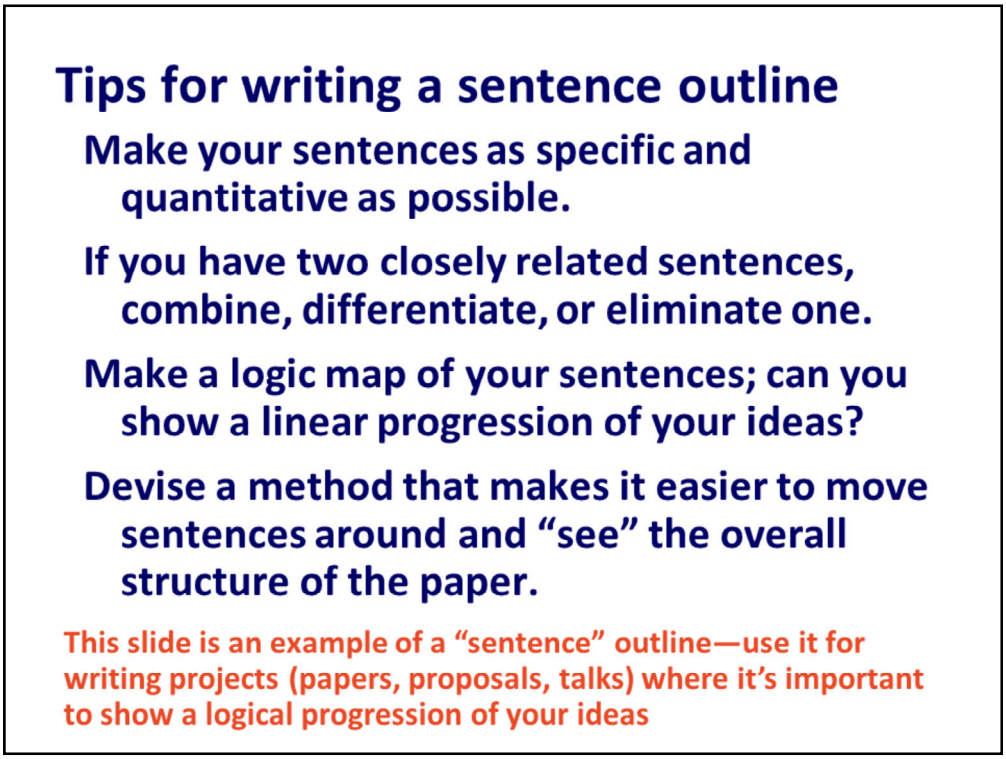
Practice full-sentence outlining

Improved clarity
Improved logical argument
Improved cohesiveness; better transitions
Improved conciseness
Improved control of length
Improved writing efficiency
Improved reader experience

This slide is an example of a "topic" outline—the order that the points are presented in doesn't really matter

Writing a sentence outline will help you as a writer in a variety of ways:

- Your writing will be clearer and more direct. It's unlikely that you'll write a cogent paragraph until you can write a sentence that plainly articulates the point of that paragraph.
- Your arguments will be stronger. A sentence outline shows you the narrative flow of the paper. Are your ideas arranged in the most logical, persuasive way to lead the reader to the conclusions you want him or her to reach? It's much easier to move sentences around as you are planning a paper than it is whole pages.
- Your paper will be more cohesive, because you'll be more aware of where transitions are needed to move the reader from one idea to the next.
- Your writing will be more concise. A sentence outline will help you spot superfluous material that stands in the way of a straightforward narrative.
- You will get a better idea of the size and scope of your final paper. The length of proposals, journal articles, and conference papers is usually strictly limited. A sentence outline makes it easier to estimate what the final length of your document will be and allows you to make any needed adjustments earlier in the writing process. It's agonizing to make major cuts after you've already gotten something written, and you'll avoid the temptation of leaving digressions in your paper because of pride of authorship.
- You will ultimately save time. The investment in planning and getting organized now will pay off in an easier-to-write, coherent, clear final document.
- Your colleagues will eagerly look forward to hearing your next talk or reading your next paper. Your reviewers will expedite your publications. Funders will shower you with $$$. (Okay, maybe not #3...).



Make your sentences as specific as possible. The purpose of the sentence outline is to help you spot missing or superfluous material. If your sentences are vague and general, you'll lose the main advantage of sentence outlining.

If you have two sentences that say about the same thing, eliminate one of them, combine them, or differentiate them.

Ideally in science writing, the narrative should flow logically and incrementally from Point A to Point B to Point C to the conclusions. If your outline does not reveal a logical progression of ideas, move things around until it does.

A word processing document that displays only part of your outline at a time may not be the best way to get an overall look at your paper. Experiment with other methods—index cards dealt out on a big table, Post-It notes stuck on a wall—use your imagination.

Commit to writing incrementally

Think "feedback loop"

Write in increments:

1. Construct a preliminary outline, based on your initial goals for the project
2. Write portions of the "results" and "discussion" sections while you're taking and analyzing data
3. Add to your references as you go
4. Make your figures and tables early

Advantages:

- More complete, persuasive paper
- Finished result faster, giving you more time to edit and polish

Commit to writing incrementally; writing should be an integral part of your research work—remember "feedback loop."

Advantages of the incremental method:

1. You may discover additional data that are needed while the equipment is still set up and the project ongoing.
2. 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).

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.

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

To recap...

Think Plan Write

Think first

Analyze your audience and know your purpose

Commit to writing incrementally—start filling your reservoirs while you're still taking data

Make an outline and *use* it

Writing well is a learned skill!

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NOTES: