

## Writing Made Easier—The Outline

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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.

Many of the ideas presented in this talk 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.

For more of Professor Wilkins' excellent advice on technical writing, see his "Brief Guide to Writing and Speaking":

[http://www.physics.ohio-state.edu/~wilkins/writing/Handouts/brief\\_writ\\_speak.html](http://www.physics.ohio-state.edu/~wilkins/writing/Handouts/brief_writ_speak.html).

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## Two fundamental rules for every writing project

**Rule #1—think first, then write**

**Rule #2—Never start writing until you have made an outline**



“Stream of conscious” may have worked for James Joyce and Virginia Woolf (although the jury is still out on that one, in my opinion), but it doesn’t work for science writing—*cme*

“The only demand I make of my reader is that he should devote his whole life to my works.”  
—James Joyce

In science, ***nobody*** is going to devote his or her whole life to your work.

You heard it here first.

**Novice writers use the  
“core dump” method  
—inefficient and  
produces poor results**



**Always start from an outline—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)**

Trying to write without an outline is like trying to build a skyscraper without a blueprint, foundation, tape, or level. If you think you can go back and “fix” it later, you probably can, but it's going to be painful, expensive, and time-consuming. It's always faster, cheaper, and ultimately easier to plan first.

Learning to write from an outline 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 images, or further analysis.

## **An outline helps you to focus on the main ideas and avoid novice writers' mistakes**



**Using chronological instead of analytic order**

**Devoting too much ink to the parts that took the longest to do**

**Including superfluous or discursive information**

**Leaving holes in your argument**

**Failing to provide logical transitions**

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 comprehensive 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.

## **Writers use two kinds of outlines— “topic” and “sentence”**

### **Topic outlines use short phrases**

- **CO<sub>2</sub> underground storage—motivation**
- **Advantages of deep saline formations**
- **Convection could provide “stirring”**
- **Boycott effect**

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

Topic outlines are fast and easy to write.

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 physics papers.

## **Writers use two kinds of outlines— “topic” and “sentence”**

### **Topic outlines use short phrases**

- **CO<sub>2</sub> underground storage—motivation**
- **Advantages of deep saline formations**
- **Convection could provide “stirring”**
- **Boycott effect**

### **Sentence outlines use full sentences (duh!)**

- **Deep saline aquifers (DSAs) are underground salt-water reservoirs capped by impermeable rocks.**
- **DSAs offer large storage capacity for carbon capture and sequestration.**
- **Sequestered CO<sub>2</sub> would rise and form a separate layer that restricts dissolution.**

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, such as *physics* papers.

## 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**

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 to reach? It's much easier to move sentences around as you are planning a paper than it is whole paragraphs.
- 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 or repetitive 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...).

## **Tips for writing a sentence outline**

**Make your sentences as specific and quantitative as possible**

**If you have two closely related sentences, combine, differentiate, or eliminate one**

**Make a logic map of your sentences; can you show a linear progression of your ideas?**

**Devise a method that makes it easier to move sentences around and “see” the overall structure of the paper**

**This slide is an example of a “sentence” outline—use it for writing projects (papers, proposals, talks) where it’s important to show a logical progression of your ideas**

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 generalized, 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.



## Start by writing down the main points you want to make

- The NASA Solar Dynamics Observatory (SDO) was launched in 2010 to study the solar corona.
- One component of SDO is the Atmospheric Imaging Assembly (AIA), a suite of four telescopes.
- Mirrors image Sun at all seven EUV wavelengths.
- The Sun is the source of all space weather, but its physical processes are poorly understood.
- The AIA is composed of highly reflective multi-layer mirrors.

**TIP: Write a complete sentence for each point**

Today, we're going to look at how we might organize a paper on the multi-layer mirrors built for NASA's Solar Dynamics Observatory.

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?

Write down those important points as you think of them, in no particular order at this time. We'll arrange them in a logical order later.

As you are deciding about these points, consider three main 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 article?
3. What are my space/time/page constraints?

## **Next, arrange the points so they provide a logical narrative**

- **The NASA Solar Dynamics Observatory (SDO) was launched in 2010 to study the solar corona.**
- **One component of SDO is the Atmospheric Imaging Assembly (AIA), a suite of four telescopes.**
- **Mirrors image Sun at all seven EUV wavelengths.**
- **The Sun is the source of all space weather, but its physical processes are poorly understood.**
- **The AIA is composed of highly reflective multi-layer mirrors.**

Next, arrange the points in a logical order so they provide a coherent storyline.

Think of this step as creating a map to guide your reader through your paper.

Each one of these points is going to be a signpost along the journey.

## **Check to see if you've left anything out...**

- ✓ **The Sun is the source of all space weather, but its physical processes are poorly understood.**
- ✓ **The NASA Solar Dynamics Observatory (SDO) was launched in 2010 to study the solar corona.**
- ✓ **One component of SDO is the Atmospheric Imaging Assembly (AIA), a suite of four telescopes.**
- ✓ **The AIA is composed of highly reflective multi-layer mirrors.**
- ✓ **Mirrors image Sun at all seven EUV wavelengths.**

**... or if you've included superfluous material that will derail the logical flow of your story**

Check to see if you've left anything out, or if you have superfluous statements that lead the reader off the trail that you'd laid out for him or her to follow.

Make adjustments (additions or deletions) now. It's much easier to write from a structure than to try to go back after you've already written something and try to impose a logical structure on it.

One of the key advantages of this method is its scalability—you can use it for short papers, sections of longer papers, theses, talks, posters, proposals—for any audience.

## **Number your sentences...**

- 1. The Sun is the source of all space weather, but its physical processes are poorly understood.**
- 2. The NASA Solar Dynamics Observatory (SDO) was launched in 2010 to study the solar corona.**
- 3. One component of SDO is the Atmospheric Imaging Assembly (AIA), a suite of four telescopes.**
- 4. The AIA is composed of highly reflective multi-layer mirrors.**
- 5. Mirrors image Sun at all seven EUV wavelengths.**

**...and start writing**

It seems silly, but numbering actually helps to keep you on track. Writing is an evolutionary process, and if you have a numbered list of points and check them off as you write, you'll stick to your plan.

Having a numbered list is also helpful if you decide that you'd rather write about the telescopes first, instead of general solar processes. As long as you have a (numbered) structure in place, you can start writing wherever you want.

## Your outline must accommodate the standard model of physics papers

- I. Background and Introduction
- II. Methods/Procedure
- III. Results
- IV. Discussion
- V. Conclusions
- VI. Acknowledgments
- VII. References

**Make outlines for §I. through §V.**


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

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

Most scientists usually write papers in the following order:

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


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



**To recap:**

- Think before you write**
- Commit to making an outline before you write *anything***
- Follow the “formula” for science papers**
- Use full-sentence outlining for best results**

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Notes and Questions: