Improve your scientific writing:
To be read & remembered, convincing & influential.

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Learning objectives

- Differentiate styles of communication
- Compare a writer’s versus a reader’s perspective of a paper
- Apply a ‘layers of editing’ approach
- Identify additional advice you need
Scope of this presentation

Scientific writing

- Providing scientific context (references)
- Text > graphics
- Authorship exclusive
- Focus on results & interpretation

Science communication

- Providing societal context (examples)
- Text ≈ graphics
- Authorship inclusive
- Focus on conclusions & recommendations

http://ian.umces.edu/learn/science_communication/
Authors write for an unmet reader

Alley (1996) asks:

Who will read the document?

What do they know about the subject?

Why – and how – will they read the document?

“Readers do not simply read; they interpret”

(Gopen and Swan, 1990)
Elements of Scientific Writing

- Scavenge your proposal
- Establish structure with an outline
- How writers write
- How readers read
Don’t forget your proposal

To what extent have you already started?
What is known?
What is the limit of (or wrong with) what is known?
How does this new paper go beyond what is known?
Time saver tip: outline then write

Introduction
   > 3 paragraphs?

Materials and Methods
   Include “Study Area” section?
   Skip details and cite other papers?

Results
   1. Begin with ‘introductory’ experiment results
   2. Report results as you plan to discuss them
   3. Save most interesting for last
   4. Or, list the most speculative or least solid result last

   .
   .
   .
How writers (should) write

Write your methods while they are as fresh as possible.
How writers (should) write

Assemble your illustrations (tables, figures, photos, video) to help you write the results.

<table>
<thead>
<tr>
<th>x</th>
<th>y₁</th>
<th>y₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>75</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>375</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
<td>1875</td>
</tr>
</tbody>
</table>
Graphic display ‘revolutionized’ data science

Exports and Imports to and from Denmark & Norway from 1700 to 1780.

The bottom line is divided into years, the right hand line into £10,000 each.

Published on the Act duty 14th May 1786 by Wm. Playfair.

How writers (should) write

Introduction
Begin broadly, define terms, end with a focused thesis statement.

Discussion
Begin with the most significant finding. Put in perspective. End broadly.

Finish the first draft by writing these two sections as bookends.
How readers (likely) read

Title

Summary
  - Abstract
  - Conclusion

Text
  - Introduction/Discussion
  - Methods/Results

Illustrations
  - Tables
  - Figures
How readers (likely) read

Title

Summary

Abstract

Conclusion

Text

Introduction/Discussion

Methods/Results

Illustrations

Tables

Figures
How readers (likely) read

Title

Summary

Abstract

Conclusion

Text

Introduction/Discussion

Methods/Results

Illustrations

Tables

Figures
How readers (likely) read

- Title
  - Summary
    - Abstract
    - Conclusion
  - Text
    - Introduction/Discussion
  - Illustrations
    - Tables
    - Figures
  - Methods/Results
Readers likely read selectively rather than sequentially.
Jarita Davis’ 7 layers of Editing

<table>
<thead>
<tr>
<th>Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dump draft – just get started</td>
</tr>
<tr>
<td>Organizing draft – assemble</td>
</tr>
<tr>
<td>Spackle draft – fill in gaps</td>
</tr>
<tr>
<td>Smoothing draft – paragraph level</td>
</tr>
<tr>
<td>Wordsmithing – sentence level</td>
</tr>
<tr>
<td>Copy edits – word level</td>
</tr>
<tr>
<td>Formatting – author instructions</td>
</tr>
</tbody>
</table>

You can’t edit a blank page. - Jodi Picoult
The big picture

Anchor everything to a strong claim or hypothesis
- Is testable, shows discovery, leads to prediction

Each section should be coherent
- Results in ‘Results,’ etc.

Some sections should be coordinated
- Title, keywords, & abstract
- Text & Illustrations
- Introduction & Discussion
Build strong topic sentences: use this web tool

http://colelearning.net/who/module1/page35.html
There is a science to scientific writing.

The seven principles of scientific writing

(1) Place the "new information" you want the reader to emphasize in the stress position at the end of the sentence. Save the best for last.

(3) Place "old information" (material already stated) in the topic position, to link reader backwards.

(4) Follow a subject as soon as possible with its verb.

(7) In general, ensure that the emphasis of the substance coincides with the expectations for emphasis raised by the structure.

We have directly measured the enthalpy of hydrogen bond formation between the nucleoside bases 2'deoxyguanosine (dG) and 2'deoxyctydine (dC). dG and dC were derivatized at the 5' and 3' hydroxyls with triisopropylsilyl groups; these groups serve both to solubilize the nucleosides in non-aqueous solvents and to prevent the ribose hydroxyls from forming hydrogen bonds. Consequently, when the derivatized nucleosides are dissolved in non-aqueous solvents, hydrogen bonds form almost exclusively between the bases. Since the interbase hydrogen bonds are the only bonds to form upon mixing, their enthalpy of formation can be determined directly by measuring the enthalpy of mixing. From our isoperibolic titration measurements, the enthalpy of dG:dC base pair formation is -6.65±0.32 kcal/mol.

(2) Place the person or thing whose "story" a sentence is telling at the beginning of the sentence, in the topic position.

(5) Provide context for your reader before asking that reader to consider anything new.

(6) Articulate the action of every clause or sentence in its verb.

From "The Science of Scientific Writing" by George Gopen and Judith Swan.
Master the language

Define – or avoid – jargon, slang, or idioms

Define (or avoid) abbreviations & acronyms

Choose terms and stick with them

Use words that work.
### Style and Format

1. Abbreviations and Acronyms
2. Capitalization
3. Italics
4. Mathematics and Statistics
5. Numbers and Measurements
6. Punctuation
7. Quotations
8. References
9. Species Names
10. Spelling and Compound Words
11. Symbols
12. Tables and Figures

#### Appendices

- A. Spelling List
- B. Symbols, Abbreviations, and Acronyms
- C. Plurals of Fish Names
- D. Geographic and Geological Terms

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American Fisheries Society 2013

http://fisheries.org/docs/pub_stylefl.pdf
“Vision plays an important role in notifying animals of imminent danger, such as an impending collision with a predator or an environmental surface.”
Appeared in Science (1995), written by 3 Caltech PhDs

Flesch Reading Ease: college graduate level
Fog Scale Level: very difficult

“Without eyes, you'd soon crash into a tiger or a cliff.”
Suggested revision by Nicholas Wade, New York Times

Flesch Reading Ease: plain English
Fog Scale Level: readable

Science is complex enough, don’t make it more so.
Fred Serchuk’s ABCs

- Clarity
- Brevity
- Accuracy
Day & Gastel’s “cookbook”

Part II. Preparing the Text
7. How to prepare the title
8. How to list the authors and addresses
9. How to prepare the abstract
10. How to write the introduction
11. How to write the materials and methods section
12. How to write the results
13. How to write the discussion
14. How to state the acknowledgements
15. How to cite the references

Part III. Preparing the Tables and Figures
16. How to design effective tables
17. How to prepare effective graphs
18. How to prepare effective photographs
Alley’s “craft” approach

Structure
- Not about the I-M-R-D structure per se
- Begin-Middle-End; transitions

Language
- Precision, clarity, forthrightness, familiarity, conciseness, fluidity

Illustrations
- How you should build your text from your tables & figures

Readers
- How they decode a page, a paragraph, a sentence, a word
Booth et al.'s craft

Claim: It was Mr. Plum in the Library with the lead pipe.

Reason: The cause of death was blunt trauma, etc.

Warrant: Plum had means, motive, and opportunity.

Evidence: Alibi, forensics, nature of relationships, etc.
Don’t just take their or my advice

There are lots of resources out there. Use them.
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http://www.nefsc.noaa.gov/nefsc/woodshole/seminar-public.html
A presentation is completely different

Approach:
- Speak from points
- Memorize
- Read
- Speak off the cuff

Occasion:
- Formal symposium
- Workshop
- Informal meeting
- After-dinner speech
- Press conference
You are, without a doubt, the worst publicist I’ve ever had.
A picture is worth 1,000 words, but to be so, it may have to include 100 words. - John Tukey

Nightingale, F. 1858. "Rose Diagram".