How to Construct an Outline
Structure of Scientific Papers
The Astronomical Literature
Astronomical Databases
Assignments

• Due noon today: 1. Format  2. Topic  3. Mentor
• Received from: AR, MF, BC1, BC2, JM, AR, MW, AZ, LF, AH, EC, CD
• Responses sent by email

• Due next Friday (by email): Outline for your piece

• Signup for one-on-one meetings in week 4 — signup to be distributed by email
Working with Mentors

• Ask them for references to review or introductory articles on your topic. Read these papers and take notes to prepare for your outline.

• Work with them (or ask them) for 3 example pieces in the same format. The examples should be on different topics from the one that you are writing.
An Outline — Assignment

• Purpose of an outline: to provide structure to help you move to a first draft. Most efficient way to write papers.

• Work with your mentor to find 3 examples of similar pieces. (You will probably find most of them.) Read/skim the examples and study the structure. Note for yourself (don’t turn in): what are the common elements and structure?

• Choose a target journal or telescope. Look up the ‘Instructions for Authors’, ‘Call for Proposals’, etc. Read it thoroughly. Your outline should reflect the requirements for your piece. Include a link to the instructions in with your outline.

• Outline should contain:
  1. Provisional, descriptive title
  2. Description (few sentences) of primary audience and possible secondary audience.
  3. Structure of the piece — list the major sections and ideas for their contents, in skeletal form (details on next slide).
  4. Some details and sentences interspersed.

• See, e.g. Alley pp. 239-241 and ‘Writing a Paper’ (course website, by G. Whitesides).
Structure of an Outline (for a research paper)

• **Introduction**
  - Write first few sentences and possibly first paragraph. Should clearly state objectives and indicate importance.
  - Elements
    * **Objectives of work**
    * **Justification for objectives.** Why is the work important?
    * **Background.** Who else has done what?
    * **Guidance to the reader.** What should the reader watch for in the paper? What are the high points?
    * **Summary/conclusion.** What should the reader expect as a conclusion?

• **Analysis, Results, and Discussion**
  - Results and discussion are sometimes combined; look for examples
  - Organize subsections according to major topics (depends on research)
  - Make subsection headings as descriptive and specific as possible
  - Emphasize structure here (little text), but include subsection headings figures, tables, equations, diagrams.

• **Conclusions**
  - Summarize the conclusions with short phrases or sentences
  - Conclusion ≠ summary
  - Add new, higher level of analysis, and state significance of work.
Constraints

• Audience
  - who will read the document?
  - what do they know about the subject?
  - why will they read the document?
  - how will they read the document?

• Format
  - includes how type is arranged on page, pages are numbered, sources are referenced, length of document.
  - formats vary widely based on journal, proposal call, etc.

• Mechanics
  - rules of grammar and punctuation
  - important to get right to not distract from your piece
  - consult reference books and style guides

• Politics
  - stay honest, but know sensitivities of your audience
  - be astute in what you include and exclude, and how arguments are formed

Break: with partners discuss Audience for your piece
Style: The way you cast your thoughts into words and images.

Elements of Style

1. **Structure**
   - strategy of a scientific document
   - defines sections and flow of ideas
   - most important element of style
   - templates are helpful, but don’t be bound by them
     - Questions if you want to break a style convention:
       - Is your style effective and communication / persuasion?
       - Is it distracting?

From Alley (Ch. 1)
Elements of Style

2. Language

- the way words are used
- includes arrangement of words into phrases and sentences, the use of numbers, equations, abbreviations, examples/analogies
- **Precision**: Say what you mean. Be clear. Be forthright.
- **Concise**: Every word counts. Fluid writing is smooth writing — transitions from sentence to sentence, section to section, etc.
Six Goals of Language in Scientific Writing

- Precise
- Clear
- Forthright
- Concise
- Familiar
- Fluid

Figure 1-1 (Alley)
Elements of Style

3. Illustration
   - Effective figures and tables in document
   - meshing of figures/tables with language
   - makes reading and writing more efficient
The Astronomical Literature

- **Prestigious Journals covering science broadly:**
  - *Science*
  - *Nature*
  - *Proceedings of the National Academy of Science*

- **Astronomy Journals:**
  - *Astronomy & Astrophysics (A&A)*
  - *Proceedings of the Astronomical Society of the Pacific (PASP)*
  - *SPIE* (instrumentation primarily)
  - ...

- **New Astronomy Journals:**
  - *Nature Astronomy*
  - *Journal of Astronomical Telescopes, Instruments, and System (JATIS)*
  - ...

The Astronomical Literature

How to find papers:
• Use NASA / ADS = Astronomical Data Service !!
  https://ui.adsabs.harvard.edu/
• Google Scholar — https://scholar.google.com/

How to use ADS:
• Find specific papers: search by author, first author, year, keywords, etc.
• Find papers on topic: search by keyword
• Sort by citations, read counts, date, etc.
• Cite articles using bibtex
• Use SIMBAD (next topic) to find articles about specific object
Astronomical Databases

Common Features:
- Properties or astronomical objects or observations
- Organized by object or observation
- Searchable

Purposes:
- Provide detailed information about specific objects or observations.
- Maintain a “complete” repository of objects of a particular type, for object discovery and statistical analysis.
Astronomical Databases

General:
- Stars: SIMBAD (http://simbad.u-strasbg.fr/simbad/) (*)
- Galaxies: NED (http://ned.ipac.caltech.edu/) (*)
- Exoplanets: exoplanets.org & Exoplanet Archive
- NASA Missions: MAST (https://archive.stsci.edu/) (*)

Specialized:
- Keck Observatory Archive: KOA
  (https://www2.keck.hawaii.edu/koa/public/koa.php)
- Gaia Mission: (https://gea.esac.esa.int/archive/)
Break into small groups, skim Howard et al. (2011) and answer these questions:

• Identify (by highlighting or circling) the major parts of the paper: Title, abstract, introduction, results/discussion, conclusion

• Title: Does it convey meaning and importance?

• Abstract: Does it convey the motivation, main results, and importance?

• First paragraph: Does it draw your attention and motivate?

• Sections/sub-sections: Is the paper structure clear from the subsection headings?

• Figures/tables: Is the motivation and importance of these clear (based on 5 minutes of skimming)? Are they well designed?

• Conclusion: Does it elevate or merely summarize?