

IMPROVING YOUR SCIENTIFIC WRITING

STEM-PLEDGE

(Science, Technology, Engineering and Mathematics -
Providing Leadership and Enhancing Diversity in Graduate Education)

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WHY ARE YOU HERE ?

- The goal of scientific research is to produce novel scientific results.
- As a scientist, you will need to communicate research plans/results to
 - specialized collaborators, colleagues, competitors;
 - scientists at large;
 - prospective job selection committees;
 - funding agencies.
- Improving your scientific writing should
 - help organize and clarify your own thinking;
 - make your communication more effective;
 - increase the influence of your scientific work.
- Almost all great scientists are great writers, including, for example, Newton, Einstein, and Weinberg.

WHY AM I HERE ?

- I wish I could have attended such a class in graduate school.
- I teach the Scientific Writing Course in the Physics Department
 - for “Graduate Assistants in Areas of National Need” (or GAANN)
- Class notes are on my home page
 - <http://personnel.physics.ucla.edu/directory/faculty/>
- Elementary guidelines to help improve your writing.

ORGANIZING INFORMATION

- Good scientific writing is all about ORGANIZATION.
- Organizing information related to your work starts during research:
 - use systematic notes in notebooks and/or folders;
 - keep a record of questions, arguments, and intermediate results;
 - notes should be understandable to YOU;
even 10 years from now,
when a colleague may ask you for details on your research.

SELECTING YOUR AUDIENCE

- Assuming that your research is **essentially** done; you are ready to write.
- The purpose of writing a paper is to **communicate** with your **readers**.
- Who will your readers be ?
- Before you start writing the first line of your paper,
 - **select who your audience will be;**
 - **determine the general level of expertise of this audience;**
 - **find out how familiar your readers are with your specific topic;**
 - **familiarize yourself with the journal to which you plan to submit.**

DEFINING YOUR AIMS

- You have organized the information and you have selected your audience.
- Now, it is time to explain why anyone should read your paper,
 - Justify your subject; why is it interesting, important and timely ?
 - Justify your specific problem; why is it interesting and important ?
 - What was known in the subject prior to your work ?
 - What was known on your specific problem prior to your work ?
 - What are your results; to what extent are they new ?
 - What are your methods and arguments; are they new ?
- Generally, all these questions need to be answered in your paper.

MAKE AN OUTLINE !

- MY SINGLE MOST IMPORTANT PIECE OF ADVICE.
- An outline consists of a LIST of topics/arguments you plan to address.
- Its purpose is to divide the task of writing the entire paper
 - into a number of smaller tasks,
 - each one of writing only a few pages.
 - Often a helpful remedy against writer's block.
- A good outline provides a preliminary ORDERING of topics/arguments.
 - Helps identifying gaps in your information and/or argumentation.
 - If you find gaps, you may need to return to research.
- If you cannot get an outline, despite trying, you are not ready with your research, selecting your audience, defining your aims, or all of the above.

CLARITY

- Confusing, obscure papers do not get read – **and, they should not !**
- The author must do the work of making the paper understandable.
- A few tips are as follows.
 - **New terms, concepts and symbols should be defined when first used.**
 - **Keep the writing concise and crisp without giving up clarity.**
 - **Examples help the reader understanding new concepts.**
- For example, the paper in Particle Physics with the largest number of citations (currently 5956) is a mere 3 pages !
“A model of Leptons”, by Steven Weinberg,
Physical Review Letters, Vol 19 (1967) 1264.

HONESTY and TRUST

- The dream of every scientist is to have a brilliant idea which,
 - with the use of flawless logic,
 - demonstrates the existence of an important new phenomenon,
 - or solves a famous long-standing problem.
- In reality, life is only rarely so generous to a scientist.
 - Instead, to work out, your new idea requires extra assumptions.
 - You may believe the extra assumptions, but have no proof.
 - Should you still write a paper ?
- Probably yes, but your paper should clearly distinguish between
 - hard results of which you have flawless proof;
 - conjectures of which you are sure, but have no proof;
 - wild speculations.

- If you fail to properly make the distinction between these categories, the reader will be free to look upon your wild speculations as outlandish claims and yet to doubt your truly hard results.
- By contrast, an author whose statements are accurate and verifiable throughout, should gradually gain the trust of the reader.

DRAFTS, REWRITING AND FINALIZING

- To improve upon a first draft, ask yourself some of the following questions,
 - Is the development of your arguments logical and sequential ?
 - Are all concepts and symbols uniquely defined when first used ?
 - Can your arguments and proofs be made more precise and concise ?
 - Are all immediate questions addressed in the paper ?
 - Are examples needed to clarify definitions or to illustrate results ?
- Do not be afraid to work through several rewritings.
- To finalize your manuscript, pay attention to the little things,
 - Make sure the bibliography is complete;
 - Include acknowledgments to funding sources and institutions;
 - Acknowledge helpful correspondence or conversations;
 - Carefully proofread text, formulas, check titles and section headings.

CONCLUDING REMARKS

- Science aims to find **patterns** and **structure** in the observed world.
- Good scientific writing aims to bring forward in the text
 - **structure, and**
 - **organization of scientific knowledge.**
- Communicating and learning about scientific discovery via good scientific writing can be a source of
 - **pleasure and beauty.**
- Nothing can replace practice
 - **READ** : look at the structure and organization of famous papers
 - **WRITE** and have someone read your work critically.