Introduction to Scientific Communication

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Primary objectives

- To provide a systematic review of the principles and practice of the various modes of **scientific communication** including scientific papers, technical reports, presentations, posters and proposal writing

- Together we will identify the different objectives of these communication modes, and understand key steps and ingredients for effective scientific communication

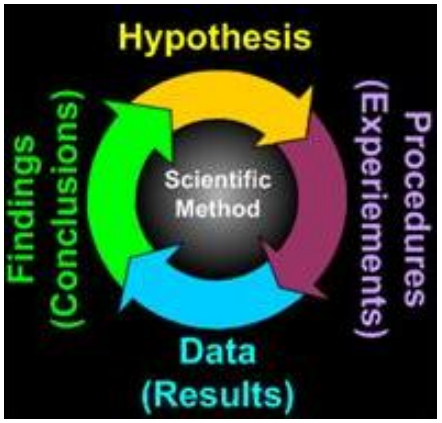
- The “short course” emphasizes basic skills for critical evaluation of scientific communications and provide opportunities for practicing these principles

Science and scientific communication

- **What is Science?** *"Science is the systematic enterprise of gathering and organizing knowledge about the world and distilling knowledge into testable laws and theories."*

- The objective of **scientific communication** is to accurately and clearly communicate (new) scientific knowledge, hence it is intimately linked with **the scientific method**

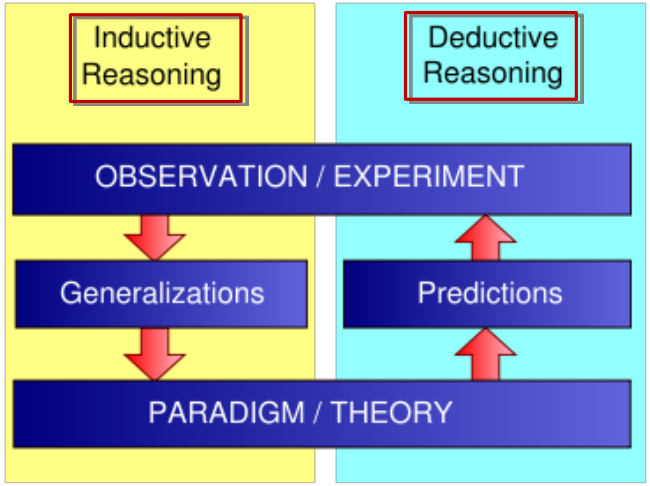
- **The Scientific Method**
  - Make careful *observations* of the world
  - Ask a question based on what has been seen
  - Propose some tentative answers/*hypotheses*
  - Use the hypotheses to make *predictions* about new as yet unobserved data/phenomena
  - Test predictions by making observations of new data
  - *Reject hypotheses* that fail to predict new observations



The scientific method and communication paths

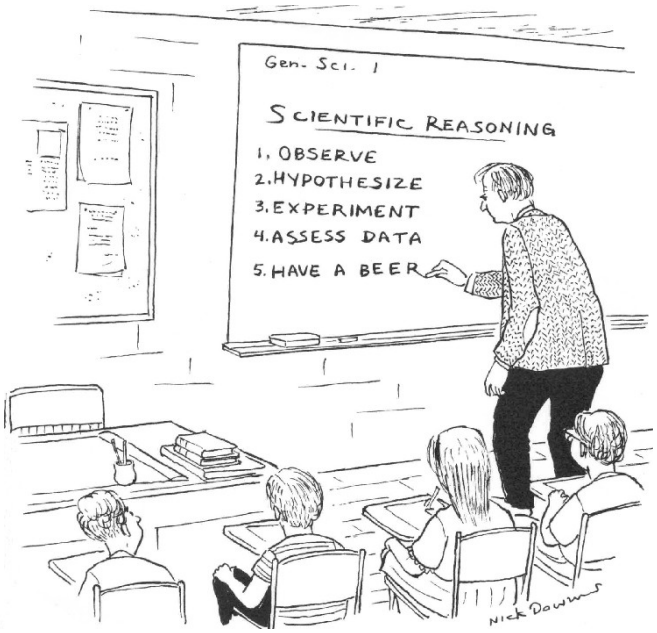
The Scientific Method

- Observe and question
- Propose tentative hypotheses
- make predictions about unobserved phenomena
- Test by making observations
- Reject hypotheses that fail to predict new observations



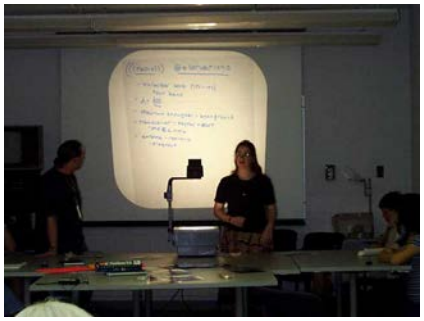
The Scientific communication path

1. Define the question
2. Gather information and resources
3. Formulate hypothesis
4. Perform experiment & collect data
5. Analyze data
6. Interpret and draw conclusions for new hypotheses
7. Publish/communicate results



Scientific communication is now part of your life..

- It may be hard to accept – but in your professional life you will be EXPECTED to communicate effectively to a group, it is an integral part of your job…



What are common modes of scientific communication?

- Writing scientific papers
- Making a scientific or technical presentation
- Writing research or project proposal
- Extracting, searching & creating Web pages

Why would you need scientific communication?

1. The quality of your PhD, MSc and post-graduate career depend on it

2. Your professional success in any future workplace relies on your technical communication skills (*making effective presentations, writing proposals, compiling technical reports, etc.*)

3. Mastering scientific communication and acquiring these skills would probably payoff more than any other single topic you have studied

Scientific communication is key to professional success

Modes of scientific communication

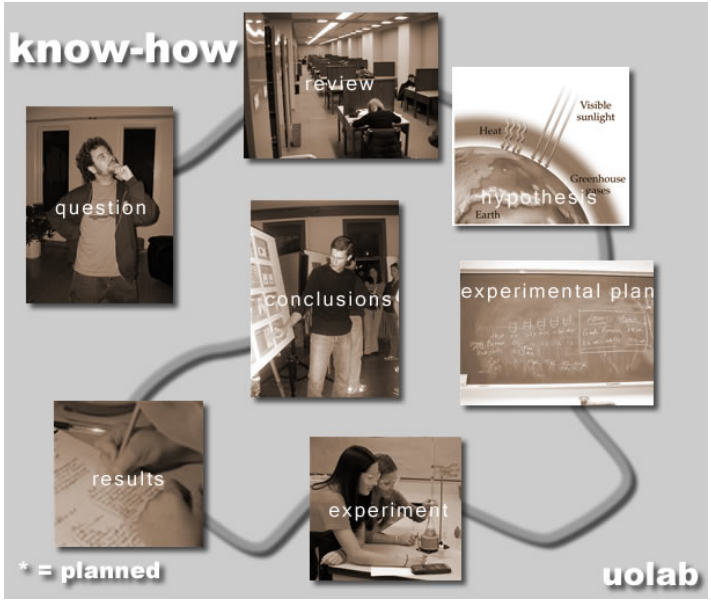
1. **Making a scientific or technical presentation (or poster)**
2. **Writing scientific papers**
3. **Writing research or project proposals**
4. *Writing technical reports*
5. *Data and information from the Web*

These diverse communication activities require skills:

- Computer and technical proficiency
- Organized thinking and ability to abstract ideas
- Good mastery of language, and in the global context often in English
- Differentiating and understanding the objectives of each communication mode (audience, clients, goals)

A quick tour of available web resources

- **The Web offers virtually unlimited resources, information and examples for scientific communication**



1. Michael Alley, 1996, The Craft of Scientific Writing (3rd ed) Springer
2. http://www.writing.eng.vt.edu/index.html
3. http://www.io.com/~hcexres/textbook/acctoc.html#examples
4. The Elements of Style (online) http://www.bartleby.com/141/
5. http://www.cimms.ou.edu/~schultz/communication.html
6. http://www.presentation-pointers.com

Elements of an effective presentation

1. **Tell an interesting story**, know and calibrate content for the specific audience – ***it's showtime!***
2. Outline, motivate, coherence, clear message, continuity
3. **Creating slides** – simple and clear content (next section)
4. **Delivering** – practice, take control, show enthusiasm, look at the audience, even when nervous and lack confidence "fake it" and don't apologize
5. A presentation is different than a paper or a report

Scientific/technical proposal

- Proposals are often written to secure research funding, to win a consulting contract – the primary objective here is to ***persuade*** reviewers/funding agency to provide funding to solve a problem
- **Primary difficulty in proposal writing** - you imagine a solution to a problem and write about the steps towards the anticipated solution (this is not something we know…)
- **Format of a proposal** – solicited proposals require that you adhere to strict format for uniform evaluation, to ensure certain content, and to check *whether you are able to follow instructions*
- **Funding landscape and "politics"** – have you addressed the scope of the call? Is the topic and proposed work appropriate for the call? Is the collaboration appropriate?
- **The audience –** management look at costs, feasibility, timeline; technical types look at science, innovation (both groups must be persuaded for successful funding)

Proposal style

1. Title *(orient the audience)*
2. Introduction
3. Problem statement
4. Assertions set up proposed solution
5. Assertions are supported
6. Proposed solution is pitched *(does solution make sense from technical point of view? Does it make sense from management point of view? Can the proposal writers do it?)*
7. Objectives are concise, clear and logical
8. Plan of work – in connection with objectives (*how solution is developed*)
9. Management plan – timeline, budget, Q-A, collaboration
10. References
11. Appendices - facilities, qualifications (CV),

The structure of a scientific paper

1. Title *(orient the audience)*
2. Authors and affiliations
3. Abstract
4. Introduction
5. Theory/Methods
6. Results
7. Discussion
8. Summary and conclusions
9. Acknowledgements
10. References

The order of a scientific paper

Scientific process	Section of paper
Orienting readers	**Title**
What was done in a nutshell?	**Abstract**
What is the problem addressed?	**Introduction**
How did we solve the problem?	**Theory / Methods**
What did we find?	**Results**
What does it mean?	**Discussion**
What have we learned (in short)?	**Summary and conclusions**
Who helped us?	**Acknowledgements**
Whose previous work did we rely on?	**References**
Additional information	**Appendices**

What is an informative abstract (for a paper)?

An abstract summarizes, in one paragraph the major aspects of the entire paper in the following sequence:

1. The question you investigated (**Introduction**)
   - Clearly state the purpose in the first or second sentence
2. The experimental design and methods used, (**Methods**)
   - clearly express the basic design of the study
   - briefly describe the basic methodology used without detail, indicate key techniques used
3. Major findings, key quantitative results or trends (**Results**)
   - report results relevant to the questions asked
   - identify trends, relative change or differences
4. A brief summary of your conclusions (**Discussion**)
   - clearly state the implications of the results

What is an informative abstract (for technical report)?

1. Summarizes key facts, information, and conclusions of the report
2. Less 5% of the report length (sometimes less than 150 words)
3. Summarizes the key information from each section
4. Phrases information in a very dense, compact way (long sentences)
5. Omits introductory explanation, definitions and other background information - it is not an introduction!
6. Omits citations
7. Includes key statistical detail - one expects to see numerical data in an informative abstract
8. Omits descriptive and abstract-phrasing focusing on key conclusions and recommendations (specifics)