Reading Primary Literature:
an introduction to scientific communication

Steve Lee
CLIMB Program Asst Director

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- **My goals for this talk are:**
  - to help you think more deeply about scientific communication, so that you will be able to read papers more efficiently and thoroughly
  - to lay the groundwork for future talks on scientific communications so that you will learn how to more effectively communicate your science

- **Introductory Discussion**
  - From your experiences of reading papers, what do you think are some good features of well-written papers? What are some of your pet peeves?

Levels of Scientific Communication

- **reading**
- **posters and oral presentations**
- **written communication**

- **Remember that communication is critical, because science is a contact sport.**
- **But this is difficult because:**
  - most of us were not taught explicitly how to communicate
  - we are encouraged to be independent
  - many of us are introverts

How do we communicate science?

- **In science, we try to be objective and neutral**
  - Early on, you probably have had lots of practice in the passive tense and in descriptive communication styles.
- **But in reality, a lot of communication needs to be persuasive and prescriptive.**
- **You need to convince:**
  - thesis committee members to accept your research proposal,
  - editors and reviewers to accept your manuscript,
  - agencies and reviewers to fund your proposal, etc
- **The science needs to be communicated to engage the readers or viewers, and to persuade them to accept your conclusions and thereby accept your proposal or manuscript.**

How do we communicate an engaging and persuasive scientific story?

- **What does an engaging story look like?**
- **The classic form of a story involves a:**
  - thesis – a story's main ideas and characters are proposed
  - antithesis – a reaction and conflict is raised against the main idea or characters
  - synthesis – resolution of the conflict

Another structure for stories that's more relevant for science:

- **Context – the main ideas and characters are introduced; this sets up the premise of the story, where the audience easily accepts and understands the main ideas and characters**
  - The author also needs to quickly establish the significance of the story, so it's clear why the story is important.
  - Don't belabor the background or without presenting the complication. Otherwise the audience will get bored.
- **Complication – a problem or twist raises a complication with a state of uncertainty or of the unresolved; sometimes a set of alternative answers or characters is presented**
  - Ex: a love triangle with a main character and two suitors
  - Ex: a murder mystery with a whodunit

Structure for scientific stories (cont'd)

- **Question – the complication raises a compelling question that, if answered, will provide a resolution**
- **Hypothesis – a proposed answer**
  - in scientific terms, the hypothesis needs to be testable, so that after experimentation and analysis, the research will advance our understanding
- **Design and Methods – how will the hypothesis be tested?**
- **Data and Results – raw results**
- **Conclusions – the results are interpreted and summarized; discussion if the hypothesis was confirmed or proven invalid; future directions**

Mapping the story of the paper helps you to see the big picture.

C Context

C Complication

Q Question

H Hypothesis

Design and Methods

Data and Results

Conclusions

Note that most research projects are complex and involve multiple layers of questions and hypotheses.

What are the CCQH elements in these stories?

- Spiderman
  - Context
  - Complication
  - Question
  - Hypothesis
- Wood, et al, *J Am Chem Soc*, 2005, *127*, 12513
  - Context
  - Complication
  - Question
  - Hypothesis

Types of Publications

- **Reviews**
  - Reviews a field, technique, or research problem
  - Summary of the present and past literature in a particular field or discipline
- **Communications or Letters**
  - Brief articles
  - Description of particularly novel and timely findings for a significant study currently in progress
  - No well-defined format due to length constraints
  - Focus on presenting results with a brief discussion of their significance
- **Full Papers**
  - Description of the results from a complete study of a system or process.
  - Generally longer (~ 4-10 pages) than communications
  - Distinctive well-defined format

How to read papers critically

- **Skim the paper and illustrations for the main elements**
  - look up definitions and acronyms
- **Identify the CCQH structure**
- **Identify the authors underlying assumptions**
- **Read with a pen! Taking notes helps to understand concepts and remember**
  - write down questions and record your ideas
  - draw connections between various parts and to other papers
- **Question the author's assumptions and approaches to solve the problem**
  - Are there better methods to answer the questions?
  - Are there better hypotheses for the questions?
- **Identify the raw results and separate them from interpretation**
  - Are other conclusions possible that are consistent with the results?

How to read papers critically (cont'd)

- **Discuss the paper with others**
- **Summarize and synthesize the main points in your own words**
  - Write down and record your summary for future reference.
- **Capture the big picture, and don't get lost in the details.**
  - What are the main relevant points for your research?
  - Does this paper relate to other papers for your research?
- **Explore future possible options**
  - What are the next series of questions that need to be addressed?
  - Can these conclusions be connected to other research areas?
- ***Do any of you have any suggestions or tips?***

- **Just because it's published, it doesn't mean that it's all "true."**
- **Reading papers should be an active exercise, not a passive.**

Remember that authors have their own objectives

- **Get the paper published**
- **Convince the reader of their interpretations and conclusions, often based upon**
  - validity of the methods and data
  - support for a single interpretation vs. other options
- **Move the field forward**
- **Move their standing in the scientific community forward**
- **Support future proposals for funding**

- **Take home messages:**
  - Read papers critically and actively, not passively.
  - Science is a contact sport, so get out there and communicate!
- **Future CLIMB workshops**
  - Working with people who are different than you: Knowing the Myers-Briggs Types can effective communication
  - An Introduction to Oral Presentations and Posters
- **Resources**
  - Randy Olson, *Tell Me a Story of Science*, The Scientist, Vol 23 (10), p 27.
  - Roberta Ness, *Writing Science: The Story's the Thing*, online article from Science Careers, posted 4/6/2007.