How to Read a Scientific Paper

Key Topics

- Types of scientific papers
- Organization of a paper
- Actions to take – to properly read a paper
- Difficulties in reading scientific papers

Types of Scientific Papers

- Original article – information based on original research
- Case reports – usually of a single case
- Technical notes - describe a specific technique or procedure
- Pictorial essay – teaching article with images
- Review – detailed analysis of recent research on a specific topic
- Commentary – short article with author's personal opinions
- Editorial – often short review or critique of original articles
- Letter to the Editor – short & on subject of interest to readers

Effective Medical Writing. Peh WCG &, NG K H *Singapore Medical Journal* 2008 49(7) 522 smj.sma.org.sg/4907/4907emw1.pdf (accessed 05 November 2013)

Organization of a Paper

- Title
- Abstract
- Introduction
- Methods
- Results
- Discussion/Conclusions
- Acknowledgements
- References

Note: most scientific journals follow the format of the Structured Abstract. Occasionally, the Results and Discussion are combined – when the data need extensive discussion to allow the reader to follow the train of logic of the research.

Or the **IMRAD** Format

- **I**ntroduction: What was the question?
- **M**ethods: How did the research(s) try to answer it?
- **R**esults: What did the researchers find?
- **A**nd
- **D**iscussion: What do the results mean?

- **Title** – describes paper's content clearly using keywords (for databases and search engines)
- **Abstract** - a summary (~ 150-200 words) of the problem, the method, the results and the conclusions; the reader can decide whether or not to read the whole article
- **Introduction** - clearly states the problem being investigated & reasons for the research; summarizes relevant research to provide context; identifies the questions being answered; briefly describes the experiment, hypothesis(es), research question(s) & general experimental design or method

- **Methods** - provides the reader enough details so they can understand and replicate the research; explains how the problem was studied; identifies the procedures followed; explains new methodology in detail; includes the frequency of observations, what types of data were recorded, etc.
- **Results** - presents the findings, and explains what was found; shows how the new results are contributing to the body of scientific knowledge; follows a logical sequence based on the tables and figures presenting the findings to answer the question or hypothesis(es)

- **Discussion/Conclusions** - describes what the results mean regarding what was already known about the subject; indicates how the results relate to expectations and to the literature previously cited; explains how the research has moved the body of scientific knowledge forward; outlines the next steps for further study
- **Acknowledgements** – recognize various contributions of other workers
- **References** - the sources of previously published work; includes information not from the experiment and not ‘common knowledge’

Actions to Take

- Skim the article without taking notes:
  - Read the abstract; it will tell you the major findings of the article and why they matter
  - Read first for the ‘big picture’
  - Note any terms or techniques you need to define
  - Jot down any questions or parts you don’t understand
  - If you are unfamiliar with any of the key concepts in the article, look them up in a textbook

- Re-read the article more carefully especially the ‘methods’ and ‘results/conclusions’ sections:
  - Carefully examine the graphs, tables, and diagrams
  - Try to interpret the data first before reading the captions and details
  - Make sure you understand the article fully
- Ask yourself questions about the study, such as:
  - What problems does the study address? Why is it important? Is the method good? Are the findings supported by evidence? Are they unique and supported by other work in the field?

  - Is the study repeatable? What was the sample size? Is this representative of the larger population? What variables were held constant? Was there a control? What factors might affect the outcome?
- Write a ‘summary’ of the article
  - Describe the article in your own words - to distill the article down to its ‘scientific essence’
  - Note the ‘key points’ - purpose of the study/questions asked, assumptions, major findings & conclusions, questions unanswered & any surprises

How to Read and Review a Scientific Journal Article *Duke University Writing Studio* twp.duke.edu/uploads/media_items/scientificarticlereview.original.pdf (accessed 05 November 2013)

Other Useful Hints

- Draw inferences (a conclusion reached on the basis of evidence and reasoning):
  - not everything in an article is stated explicitly; rely on your prior knowledge/experience and the background in the article, to draw inferences from the material
- Distinguish main points:
  - Document level: in title, abstract and keywords
  - Paragraph level: look for words/phrases like *unexpected, in contrast to previous work, hypothesize that, propose, introduce, data suggests*

- Take notes as you read:
  - this improves recall and comprehension; you may think you'll remember everything but details will slip away
  - develop a template for recording notes on articles
  - can use the structured abstract format (abstract, introduction, methods, results, discussion & conclusions, references)

How to read a scientific article: Mary Purugganan & Jan Hewitt, Rice University www.owlnet.rice.edu/~cainproj/courses/HowToReadSciArticle.pdf (accessed 05 November 2013)

Difficulties in Reading Papers

- Papers can be poorly written:
  - some scientists are poor writers & others do not enjoy writing; author can be so familiar with the material that he/she cannot see it from the point of view of a reader not familiar with the topic
- Bad writing has consequences for the reader:
  - logical connections are often left out - instead of saying why an experiment was done, or what ideas were being tested, the experiment is simply ‘described’; papers often are cluttered with ‘jargon’; authors often do not provide a clear road-map through the paper

- The reader cannot easily understand what the experiment was:
  - the descriptions are not well-written and it is ambiguous what was done
  - authors refer back to previous papers; these refer in turn to previous papers in a long chain; it is unclear which methods were used in this experiment
- Authors are uncritical about their experiments:
  - if they firmly believe in a particular model, they may not be open-minded about other possibilities; these may not be tested experimentally, and may go unmentioned in the discussion
  - authors do not clearly distinguish between fact and speculation especially in the Discussion/Conclusions

- The sociology of science:
  - many authors are ambitious and wish to publish in trendy journals; they overstate the importance of their findings, or put a speculation into the title in a way that makes it sound like a well-established finding

How to read a scientific paper. John W. Little & Roy Parker--University of Arizona www.biochem.arizona.edu/classes/bioc568/papers.htm (accessed 05 November 2013)

Annotated Journal Article Appendix
(Part A How to Read a Scientific Paper Appendix)

- *Annotated Journal Article by Michele Yeoman…* analyzes the content of a scientific journal article
- The author notes why this is a well-written article
- Using text boxes and arrows, Yeoman analyzes each section of this article - title, abstract, introduction, methods, results, discussion, acknowledgements, charts and references

Additional Resources

- Effective Medical Writing. Peh WCG &, NG K H *Singapore Medical Journal* 2008 49(7) 522 smj.sma.org.sg/4907/4907emw1.pdf
- How to read a scientific article. Mary Purugganan & Jan Hewitt, Rice University www.owlnet.rice.edu/~cainproj/courses/HowToReadSciArticle.pdf
- How to read a scientific paper. John W. Little & Roy Parker--University of Arizona www.biochem.arizona.edu/classes/bioc568/papers.htm
- How to read and review a scientific journal article. *Duke University Writing Studio* twp.duke.edu/uploads/media_items/scientificarticlereview.original.pdf