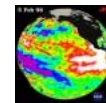# An Article-Reading Framework (ARF) for developing scientific article reading skills

Originally developed by F. Jones for use in EOSC212, September 2012.

THIS FIRST PAGE IS AN OUTLINE AND BACKGROUND FOR INSTRUCTORS ONLY.   PRINT Pgs. 2,3,4 FOR USE IN CLASS.
The exercises starts with students gathering in their usual teams.   Develop a worksheet that you can use as a guide when reading science articles or papers. It will be based on modified "scientific method", suitable for observational sciences.

1) Getting started: Issues for today are:
   a) Distinguish between primary, secondary tertiary
   b) Difference between reading a text book and primary literature. What to expect?
   c) What is the intent of articles, how are they structured, and how should you capitalize on these?

2) Robertson's multi day exercise cycle:
   a) In groups brainstorm an outline for science articles based on scientific method
   b) Share outlines.
   c) Build a collective outline – this becomes the worksheet that will guide readings.
   d) Use the worksheet to read the demonstration paper, filling in blanks on your worksheet.
      i) In primary literature, focus on figures – these are often hardest.
   e) Discuss worksheets in groups.
   f) Whole class then discusses how the paper maps onto the worksheet, with the final outcome being a collective worksheet.
   g) Read own papers using worksheets, in teams.
   h) Teams deliver 15-min journal club presentations. Strict limitations on powerpoint.
   i) Peer assessment using this worksheet as a rubric.

3) Purpose for basing a reading framework on the scientific method: To guide the reader toward systematically identifying the following …
   a) observations that led to the research,
   b) the question that was addressed (probably more general than the hypothesis being tested).
   c) hypotheses that were actually tested in this study.
   d) the experiments and/or observations that were done or made to test those hypotheses and corresponding results
   e) analysis and / or modelling
   f) discussion points and/or conclusions that were drawn from results or observations, including implications for the question being addressed.

4) How to use this framework to help you actually read the article?
   a) Find answers to questions above.
   b) Do NOT necessarily read from start to finish.
   c) Probably scan abstract, conclusion, headings and figures before ***studying*** details.
   d) ***"Studying"*** means self-check all the time …
      i) where in the framework am I?
      ii) does what I just read make sense?
      iii) What implications with respect to the purpose, question or hypothesis?
   e) Iterate, revisit sections, mentally test for consistency making notes when "stuck" or puzzled.

5) CAVEATS: What types of articles might this model be LESS successful with?
   a) Review papers or meta-studies.
   b) Methods or instrumentation studies.
   c) History – of a science or discipline or method etc.
   d) Secondary literature including summaries of ideas for general audience
      i) Difference generally being the scope – primary are generally rigorous about details while secondary often argue more overarching ideas with wide ranging sources that support an argument.
      ii) Secondary <u>may</u> also be more opinion oriented or less objective.
   e) This reading model's emphasis on figures may be harder to incorporate in secondary literature, but listing statements about experiments, data &/or observations should be possible.

Article Reading Framework worksheet. HINTS ON THIRD PAGE.

Citation: _____ *Name/date:*_____

1. What observation or idea led to research? (Look in abstract and introduction.)
2. What question(s) are being addressed? (Try rewording the title.)
3. What is (are) the hypothesis? (Often not stated but implied in abstract or intro. look for "this research shows…", etc.)
4. What experiments / measurements / observations were actually done?
5. What results are actually presented? (Consider starting with figures.)
6. Describe analysis and / or modeling if any was done.
7. What are main discussion points / conclusions / implications? (Be sure to refer to data/observations.)
8. Jot down questions YOU have about what's going on in this paper. Terminology, assumptions – anything.

Overflow notes from front of sheet …

1.

2.

3.

4.

5.

6.

7.

8.

Article Reading Framework

Framework modified from Robertson, 2012[1]   (With suggestions for where to look in brackets.)

1. What observation or idea led to research? (Look in abstract and introduction.)
    a. It may be "needs" that lead to research, rather than observations.

2. What question(s) are being addressed? (Try rewording the title.)
    a. Identify the setting / situation / context.
    b. State what is being observed or asked about.
    c. State why this is important / what did the authors hope to learn about the subject?.

3. What is (are) the hypotheses? (Often not stated but implied in abstract or introduction; e.g. "this research shows…".)
    a. Consider why these hypotheses make sense based on current knowledge (introduction).
    b. Some research involves "exploratory" observations rather than explicit solving of problems or testing of clearly defined hypotheses. Identify here if you think that is the case.

4. What experiment / measurement / observation was actually done?
    a. Relate these to the hypotheses or purposes and needs.
    b. For experiments, what was done & how? What were controls and why are they appropriate? (A flow diagram may help).
    c. For observations, what was "measured"? If innovative, how?

5. What results are presented? (Start with figures)
    a. Explain key figures clearly: what is presented? How is it relevant to the hypothesis and/or needs or purposes?
    b. Look for trends; e.g,. what is increased over what?
    c. Identify controls (if relevant) and how they validate the trends.
    d. Are statistics needed to validate data?
    e. For observations only, are there comparisons to expectations based on synthetics, theory or prior knowledge?

6. Describe analysis and / or modeling if any was done.
    a. If analysis, what methods? Were any limitations or caveats identified?
    b. If 'modelling' was done, how do "models" relate to data or observations? What assumptions etc.?

7. What are the main discussion points / conclusions /implications? (Refer, if you can, to data or observations, NOT just the article's discussion section.)
    a. What are implications for the question being addressed? Do data support the hypotheses or purposes?
    b. Are alternative explanations possible?
    c. Are data convincing? (consider statistics or precedent or theory.)
    d. Are there recommendations for improvements or subsequent work?
    e. Who do data contribute to our understanding of the field?

8. Keep track of your own questions as you read. Whether about terminology and details, or more fundamental, discussion oriented questions, jot them down as you read. It might be distracting to deal with every question immediately.

Component parts (eg for abstracts):

1. Introduction: Context and motivation
2. Introduction: Research question / thesis
3. Methods: Data / observations
4. Methods: Analysis
5. Results
6. Discussion (might include implications, future research directions, caveats, etc.)

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[1] Robertson K. *A Journal Club Workshop That Teaches Undergraduates a Systematic Method for Reading, Interpreting, and Presenting Primary Literature*. Journal Of College Science Teaching. 2012; 41(6):25-31, 2012.