

How to Read Scientific Primary Literature

One goal of this class is to help you get comfortable reading primary scientific literature. This is literature that scientists write for other scientists in order to report new results and relate these results to previous knowledge in the field. This is one of the most important ways that scientists communicate.

Reading a research article is not easy. The fact that it has been published means at least the editor and two other scientists believed that it contained important information to their field.

This paper will walk you through the different sections of a standard journal article and suggest what to look for in each section. Then I will provide advice on how to actually go through and read a journal article, which usually involves reading the paper at least 2-3 times.

The Title:

Read this carefully, it was designed to describe the article. From the title alone, you should know

- 1) What are the major ideas discussed in the article?
- 2) Who were the authors and what was their affiliation?

The Abstract:

The purpose of the abstract is to summarize the article. Because of its brevity, the abstract may also be more or less incomprehensible. Never cite a paper in which you have ONLY read the abstract. The abstract will help guide you determine

- 1) What variables were examined?
- 2) What were the main / exciting results?
- 3) Where the work was conducted (laboratory or field). If field, what location?
- 4) Why this study is important?

The Introduction:

The introduction tells the reader the rationale for the study and provides a description of the study and why it was performed. Also, the authors usually include a review of previous research on the topic to providing context for the current study. When reading keep these general questions in mind

- 1) What is the purpose of this study (is it empirical, theoretical, or a review)?
- 2) What is the topic?
- 3) Where is the article going? (look at the whole article and look at the structure of subheadings to see how the introduction individually covers each one, if you know where the author is going you will have an easier time placing each piece of the study in context rather than being overwhelmed)
- 4) Why is this project interesting or worthwhile in its field of study?
- 5) What else is known about the topic?
- 6) What are the specific predictions or hypotheses that are being tested?
- 7) What are the independent variables (what the author manipulated) and dependent variables (what the author measured)?

The Materials and Methods:

This is the section where the authors describe their study organisms, equipment and methods in detail. Theoretically, at least, this description should be detailed enough to allow other researchers to replicate

the work. This section usually ends with an explanation of the statistics used to analyze their data and why they used that approach. Some of the top journals (Science & Nature) have an abbreviated materials and methods with most of it appearing in an appendix or paragraph at the end of the article. As you read this, you should ask yourself

- 1) What research techniques are used?
- 2) Is the method used a valid test of the predictions or hypotheses?
- 3) Is there anything the authors overlooked or some variable that could complicate their results?
- 4) How do these methods used compare to those used in similar studies?

The Results:

This section is perhaps the most important because it describes the outcome of the project in detail, providing numerical evidence. This section includes any data tables, statistical analyses and graphs generated by the project. It does not, however, explain the greater meaning of the results or interpret the results, it simply reports the findings.

- 1) Pay particular attention to the figures (write down your interpretation of each figure before reading the authors).
- 2) Do you think the results support or reject the project predictions / hypotheses.

The Discussion:

In this section, the data/observations outlined in the results are summarized (in relatively plain English), interpreted, and related to other studies in the field. While reading this section, you should try to answer

- 1) Do you agree with the authors' interpretation of the results?
- 2) Are the authors justified in making any theoretical claims based on this study?
- 3) Did they actually address their hypotheses?
- 4) What are the implications of the findings from this study?
- 5) What suggestions are there for future research?

So, How Do I Read This Stuff?

Most undergraduates, when first faced with scientific journal articles, try to begin at the beginning and read them straight through, as one might a novel or a textbook chapter. This can be a tedious and sleep-inducing process. Most scientists, who read a lot of journal articles, have a different strategy.

- 1) Go from the general to the particular:
Do not waste time struggling with minute details if you do not first understand the big picture. Before you dive into the article, you should already know roughly what it is going to say! Get that information by reading the title, abstract, and headings and by skimming the introduction and discussion, and any tables or figures.
- 2) Look for definitions:
Jargon is usually defined somewhere in the article, at least by subtle context if not explicitly. If you do not understand a concept that is being discussed at length, look around for the definition. It may be helpful to consult a textbook or even a dictionary. Do not just ignore terms you do not understand.
- 3) Examine the tables and figures:

Briefly review the tables and figures to obtain a sense of the data presented in the article. Read the title legends to provide a context for the data presented. Note the important patterns that emerge from your review of the data presentation represented in the tables and figures. This review should provide a useful context when reading the methods, results, and discussion sections of the article.

4) Selectively read the method and results:

Read these sections with certain questions in mind. How were the variables measured? Do those measures really capture the conceptual variable, or might they be measuring something else? What were the actual numerical results? Where are the findings that the authors discuss? Are there anomalies that they don't address? What was the main hypothesis? What were the findings regarding those variables?

5) Re-read whole paper:

You usually need to read an article two or three times to understand its message. Often there is so much information presented that it cannot all be absorbed in one pass. Even experienced scientists need to read articles slowly, carefully, and repeatedly, **SO DO NOT EXPECT YOURSELF TO BREEZE THROUGH THEM!** After you have a good feel for the article's results, go back and re-read the introduction, and finally, go back and read the general discussion to see how the author interprets his or her data.

Please note that this handout was modified from similar handouts written by Jeremy Quayle and others.