How to Read a Scientific Research Paper--
a four-step guide for students

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Reading research papers ("primary articles") is partly a matter of experience and skill, and partly learning the specific vocabulary of a field. First of all, DON'T PANIC! If you approach it step by step, even an impossible-looking paper can be understood.

1. **Skimming.** Skim the paper quickly, noting basics like headings, figures and the like. This takesjust a few minutes. You're not trying to understand it yet, but just to get an overview of what's ahead.

2. **Vocabulary.** Go through the paper word by word and line by line, underlining or highlighting **every word and phrase** you don't understand. Don't worry if there are a lot of underlinings; you're still not trying to make sense of the article.

Now you have several things you might do with these vocabulary and concept questions, depending upon the kind of question each is. You can

a) **Look up simple words and phrases.** Often the question is simply vocabulary--what's a *lateral malleolus, or a christa*, or the *semilunar valve*? The first and best source is often a **textbook**, either your course text or another one you find. Textbook glossaries tend to give definitions that are the most useful in that they are in the context of the subject. Better yet, look up the term in the index of the text, and you may find an illustration showing just what that thing is and what is does in the body. A **medical** or **biological dictionary** is also a good place to look for definitions. Your ordinary shelf dictionary is not a good source, because the definitions may not be precise enough or may not reflect the way in which scientists use a word (for example "efficiency" has a common definition, but the physical definition is much more restricted.
b) **Get an understanding from the context in which it is used.** Often words that are used to describe the procedures used in an experiment can be understood from the context, and may be very specific to the paper you are reading. Examples are the "lithium-free control group" in a rat experiment or the "carotene extraction procedure" in a biochemical experiment. Of course, you should be careful when deciding that you understand a word from its context, because it might not mean what you think.

Flag this phrase as belonging to one of the major concepts of the paper--it's bigger than a vocabulary question. For example, a paper about biomechanics kept referring to the "inherent elasticity" of muscles. This meant the muscles' resistance to stretch when they were not contracting, but it also was one of the central concepts around which the paper revolved--the question whether "inherent elasticity" was sufficient to keep people standing upright or muscles needed to actively contract.

3. **Comprehension, section by section.** Try to deal with all the words and phrases, although a few technical terms in the Methods section might remain. Now go back and read the whole paper, section by section, for comprehension.

In the **Introduction**, note the overall context--

- what larger question is this a part of?
- the author's summary and comments on previous research,
- the hypothesis of the paper and the ways this will be tested.

In the **Methods**, try to get a clear picture of what was done at each step. What was actually measured? It is a good idea to make an outline and/or sketch of the procedures and instruments. Keep notes of your questions; some of them may be simply technical, but others may point to more fundamental considerations that you will use for reflection and criticism below.

In **Results** look carefully at the figures and tables, as they are the heart of most papers. A scientist will often read the figures and tables before deciding whether it is worthwhile to read the rest of the article! What does it mean to "understand" a figure? You understand a figure when you can redraw it and explain it in plain English words.

The **Discussion** contains the conclusions that the author would like to draw from the data. In some papers, this section has a lot of interpretation and is very important. In any case, this is usually where the author reflects on the work and its meaning in relation to other findings and to the field in general.

4. **Reflection and criticism.** After you understand the article and can summarize it, then you can return to broader questions and draw your own conclusions. It is very useful to keep track of your questions as you go along, returning to see whether they have been answered. Often, the simple questions may contain the seeds of very deep thoughts about the work--for example, "Why did the authors use a questionnaire at the end of the month to find out about premenstrual tension? Wouldn't subjects forget or have trouble recalling?"

Here are some questions that may be useful in analyzing various kinds of research papers:

Introduction:

What is the overall purpose of the research?
How does the research fit into the context of its field? Is it, for example, attempting to settle a controversy? show the validity of a new technique? open up a new field of inquiry?
Do you agree with the author's rationale for studying the question in this way?

Methods:

Were the measurements appropriate for the questions the researcher was approaching?
Often, researchers need to use "indicators" because they cannot measure something directly--for example, using babies' birthweight to indicate nutritional status. Were the measures in this research clearly related to the variables in which the researchers (or you) were interested?
If human subjects were studied, do they fairly represent the populations under study?

Results

What is the one major finding?
Were enough of the data presented so that you feel you can judge for yourself how the experiment turned out?
Did you see patterns or trends in the data that the author did not mention? Were there problems that were not addressed?

Discussion

Do you agree with the conclusions drawn from the data?
Are these conclusions over-generalized or appropriately careful?
Are there other factors that could have influenced, or accounted for, the results?
What further experiments would you think of, to continue the research or to answer remaining questions?