Step-by-step instructions for reading a primary research article

http://violentmetaphors.com/2013/08/25/how-to-read-and-understand-a-scientific-paper-2/

Advice from Tascha: As you go through the article, make sure you are keeping track of words that you don't know – write them down and look them up if you are still unsure by the end of the article. Also, write down questions you have as you're reading. You will be able to ask the professor about it in your interview.

1. Begin by reading the introduction, not the abstract.

The abstract is that dense first paragraph at the very beginning of a paper. In fact, that's often the <u>only</u> part of a paper that many non-scientists read when they're trying to build a scientific argument. (This is a terrible practice—don't do it.). When I'm choosing papers to read, I decide what's relevant to my interests based on a combination of the title and abstract. But when I've got a collection of papers assembled for deep reading, I always read the abstract <u>last</u>. I do this because abstracts contain a succinct summary of the entire paper, and I'm concerned about inadvertently becoming biased by the authors' interpretation of the results.

2. Identify the BIG QUESTION.

Not "What is this paper about", but "What problem is this entire field trying to solve?"

This helps you focus on why this research is being done. Look closely for evidence of agenda-motivated research.

3. Summarize the background in five sentences or less.

Here are some questions to guide you:

What work has been done before in this field to answer the BIG QUESTION? What are the limitations of that work? What, according to the authors, needs to be done next?

The five sentences part is a little arbitrary, but it forces you to be concise and really think about the context of this research. You need to be able to explain why this research has been done in order to understand it.

4. Identify the SPECIFIC QUESTION(S)

What **exactly** are the authors trying to answer with their research? There may be multiple questions, or just one. Write them down. If it's the kind of research that tests one or more null hypotheses, identify it/them.

Not sure what a null hypothesis is? Go read <u>this</u>, then go back to my last post and read one of the papers that I linked to (like <u>this one</u>) and try to identify the null hypotheses in it. Keep in mind that not every paper will test a null hypothesis.

5. Identify the approach

What are the authors going to do to answer the SPECIFIC QUESTION(S)?

6. Now read the methods section. Draw a diagram for each experiment, showing exactly what the authors did.

I mean *literally* draw it. Include as much detail as you need to fully understand the work. As an example, here is what I drew to sort out the methods for a paper I read today ([Battaglia et al. 2013: "The first peopling of South America: New evidence from Y-chromosome haplogroup Q"](#)). This is much less detail than you'd probably need, because it's a paper in my specialty and I use these methods all the time. But if you were reading this, and didn't happen to know what "process data with reduced-median method using Network" means, you'd need to look that up.
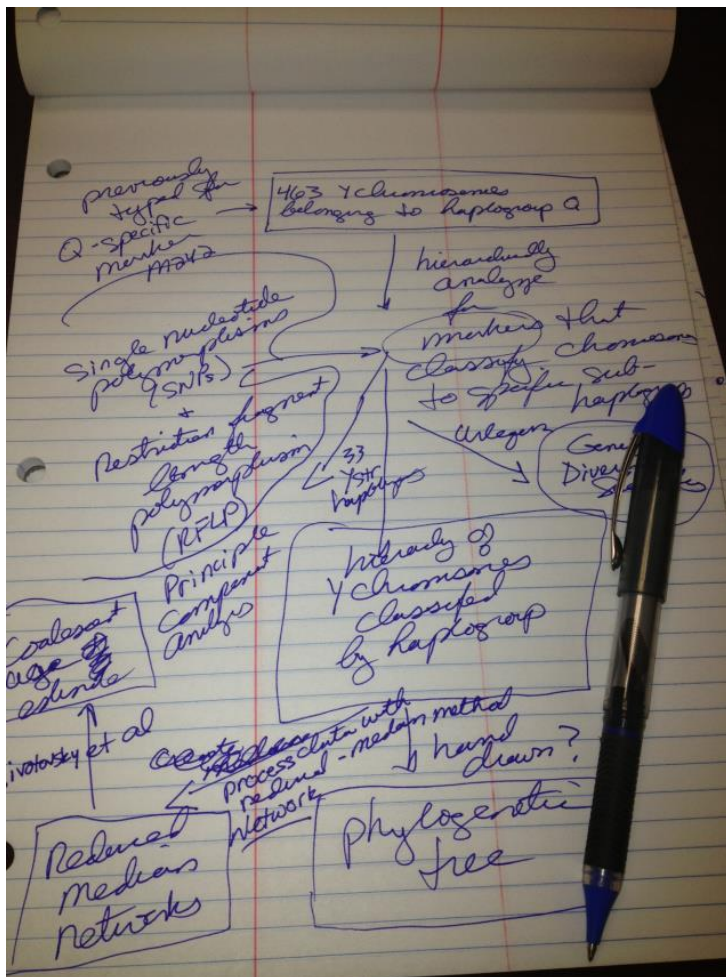
You don't need to understand the methods in enough detail to replicate the experiment—that's something reviewers have to do—but you're not ready to move on to the results until you can explain the basics of the methods to someone else.

7. Read the results section. Write one or more paragraphs to summarize the results for each experiment, each figure, and each table. Don't yet try to decide what the results *mean*, just write down what they *are*.

You'll find that, particularly in good papers, the majority of the results are summarized in the figures and tables. Pay careful attention to them! You may also need to go to the Supplementary Online Information file to find some of the results.

 It is at this point where difficulties can arise if statistical tests are employed in the paper and you don't have enough of a background to understand them. I can't teach you stats in this post, but here, here, and here are some basic resources to help you. I STRONGLY advise you to become familiar with them.

 THINGS TO PAY ATTENTION TO IN THE RESULTS SECTION:

-Any time the words "significant" or "non-significant" are used. These have precise statistical meanings. Read more about this here.

-If there are graphs, do they have error bars on them? For certain types of studies, a lack of confidence intervals is a major red flag.

-The sample size. Has the study been conducted on 10, or 10,000 people? (For some research purposes, a sample size of 10 is sufficient, but for most studies larger is better).

8. Do the results answer the SPECIFIC QUESTION(S)? What do you think they mean?

Don't move on until you have thought about this. It's okay to change your mind in light of the authors' interpretation—in fact you probably will if you're still a beginner at this kind of analysis—but it's a really good habit to start forming your own interpretations before you read those of others.

9. Read the conclusion/discussion/Interpretation section.

What do the authors think the results mean? Do you agree with them? Can you come up with any alternative way of interpreting them? Do the authors identify any weaknesses in their own study? Do you see any that the authors missed? (Don't assume they're infallible!) What do they propose to do as a next step? Do you agree with that?

10. Now, go back to the beginning and read the abstract.

Does it match what the authors said in the paper? Does it fit with your interpretation of the paper?

11. FINAL STEP: *(Don't neglect doing this)* **What do other researchers say about this paper?**

Who are the (acknowledged or self-proclaimed) experts in this particular field? Do they have criticisms of the study that you haven't thought of, or do they generally support it?

Here's a place where I do recommend you use google! But do it last, so you are better prepared to think critically about what other people say.

(12. This step may be optional for you, depending on why you're reading a particular paper. But for me, it's critical! I go through the "Literature cited" section to see what other papers the authors cited. This allows me to better identify the important papers in a particular field and find sources of useful ideas or techniques.)

UPDATE: If you would like to see an example, you can find one [here](#)