

Reading the Primary Literature Plant Reproductive Ecology - Fall 2005

Introduction to the primary literature

The primary literature is the foundation for information exchange in science. The papers we will be reading weekly in this class are reports that are based on experiments conducted by scientists and their students. Each paper typically represents many months, or in some cases, many years of effort. These papers are the currency of a researcher's reputation and represent a record of their contributions to the field. An individual researcher in biology in a strong department such as the one here at PSU will typically publish from one to three papers per year, and large labs with several graduate students and post-doctoral research scientists (these are like interns - they have their Ph.D. and are looking for a faculty position) may publish up to five or more papers per year.

Who writes these papers? Once a research project is completed the lead researcher in the lab (often referred to as the PI = Principle Investigator) at a university or federally-funded research lab and her/his students write a manuscript reporting the results of one or more experiment or set of observations. In a university setting the PI is typically a faculty member and is an Assistant (pre-tenure), Associate, or Full Professor. Students working in the lab are either undergraduates doing independent research or honors theses, or are graduate students working on their Masters or their Doctor of Philosophy (Ph.D.). Students will typically write most of a paper that reports their research and the order of authorship usually reflects the relative "creative" contribution of each individual to a project (i.e., people who contributed to the design of the experiment, interpretation of the data, or the writing of the paper). The acknowledgments will list individuals who acted in an advisory role (minor suggestions) or helped collect data.

How long does it take for a paper to go to print? Typically papers are written within a year after the data are collected and then it may take six months to a year to go through the review and revision process. Once a paper is written it is submitted to a journal. If the editor determines that the content and format of the paper are appropriate for that particular journal it will be sent out to other researchers for anonymous review. The editor will then make a decision on whether to accept the paper and what revisions need to be made based on the comments and opinions of the anonymous reviewers. Once accepted for publication, it may take an additional three to six months for the paper to appear in print.

What kind of primary literature papers are there? Most papers are original reports of research. The information in these papers is copywritten by the publisher and it is forbidden to publish the same results in more than one paper. Researchers may publish similar papers from a series of experiments that explore a particular topic or set of related hypotheses. You will also find reviews of the literature and some journals specialize in the review format. These are useful because they will give an overview of a field and will often point out new avenues of research that need to be explored. Review papers also appear in books that are collections of papers from a particular field.

How do I know if a paper is from the primary literature? The primary thing that sets these journals apart is the peer review process. The best way to find these papers is to use one of the electronic literature data bases. These include Agricola, Biosis, Current Contents, and the ISI Web of Science. The only problem with these electronic data bases is that they do not extend back very far- sometimes only to the 1970's or 1990's. Once you find a recent paper you can look at the papers they cite to find older papers. You can also go to the Science Citation Index to search topics back farther. A list of peer-reviewed journals can be found at the ISI web site.

What is the most effective way to do library research?

The most effective way to research a topic is to follow this procedure:

1. Do some initial searches with key words in Web of Science.
2. Once you find a paper that is “right on,” or seems to be the closest to the main theme of the topic you are researching, then you can use the “find related sources” button to get a more comprehensive list. Not all of the papers that come up will be what you are looking for, but you should find some more relevant papers by sifting through this list.
3. Repeat the process in 1 and 2 until you think you start seeing papers you have already found.
4. Now start reading some of the papers you think are most relevant to your topic. Pay particular attention to the introduction, and when you see a statement that you think is important for your research topic, look to see what papers the authors cite to support that statement. Add these to your list of papers to find.

Hints and suggestions:

1. With electronic data bases it is very easy to get lured into just focusing on the recent literature. Every idea in science has an origin, and it should be your goal to find the first paper(s) that proposed the hypothesis or observation that you are researching. These older papers can sometimes be real gems, so read them carefully! Make sure you cite older papers as well as the most recent work when you write your paper.
2. As you search on electronic databases you may be able to download lists of the papers you want to a file or to literature database software on you PC (such as Endnote). Having this list will help tremendously when it comes time to create your Literature Cited or Bibliography section of your paper.
3. If you find a statement made in the paper you are reading and there are no citations listed to support the idea, observation, or conclusion, then it means that this is a novel hypothesis or observation. In that case you should cite the paper when you refer to the same idea in your own paper. These statements are most often found in the discussion section of the paper, but may be found in introduction if it is a new hypothesis, or in the methods section if it is a new technique.

Reading the primary literature

The first thing you will notice is that you will encounter a lot of terms that you are unfamiliar with. Worst than that many of these terms are not found in regular dictionaries. A lot of students find this frustrating at first, but you will find that this will become easier as you read more papers. The best thing to do is to jot down things you don't understand and try to read through the paper to get the gist of it. If you run into a part you don't understand then mark it for later and skim over it.

Papers are usually formatted in the same way:

- The *abstract* is a summary of the whole paper.
- The *introduction* gives background information and presents one or more questions that the research will try to answer.
- The *methods* provide information on how the experiments or observations were conducted.
- The *results* report the outcome of experiments and statistical analyses.
- The *discussion* provides an interpretation of the results and helps the reader understand how these results are similar or dissimilar to other papers on related topics.

The best thing to do is to start by reading the introduction and methods. When you read about data analysis in the methods and results **don't get bogged down in the statistical jargon**. Try to extract what the tests are saying. For example, if it says “the treatment mean was significantly greater than the mean of the controls ($F = 4.89$, $P < 0.01$, $2/89$ df) ...” this means that the average measurements from the treatment was greater than the average from the controls. The “ $P < 0.01$ ” part tells you that there is less than a 1% chance that these averages (means) are actually the same (if it said 0.05 that = 5%, 0.001 = 0.1%, etc.). So, that's a pretty strong result and could be believed. Researchers typically take probabilities less than 5% as “significant” and greater than that as not significant or maybe indicating a trend if it's close to 5% (say $P < 0.06$).

Once you understand the reason they are doing this (these) experiments and you get the basic idea of what they did, you can skim the results section to find out what the outcomes were. Then read the discussion to get a fuller view of what the results were about and what they mean. All this time you should be jotting down

questions on things you don't understand, things that just are confusing, things you like, and things you disagree with. As you read more papers you will get better at doing the latter two things, so don't worry if you are just confused on your first few papers.

Things to remember when reading a paper:

- The authors, editors, and reviewers have worked very hard to present things clearly and to provide correct interpretations. But, there still may be mistakes.
- Results from good experiments are always reliable. Problems arise when we try to make interpretations of results- that's when our biases may interfere with what we see.
- Don't be afraid to question methods or interpretations. Again, these papers are not perfect and there may be flaws in the methodology or biases in the discussion of the results.
- Once you become better at this you will become tempted to tear apart every paper you read. Even if a paper has flaws it may also have some very good points. Look for the good stuff as well as the problems.

What do I need to turn in?

One or a few sentences on each of the following questions (try to make each very brief):

1. Why did they do this (these) experiment(s)?
2. What methods did they use?
3. What were the results?
4. What interpretations did they give?

Plus, do the following:

5. Jot down or highlight all of the terms or phrases you did not understand.
6. Write one or two questions you have on any aspect of this paper.

Bring your written report to class on Friday for the discussion and turn it in at the end of class.