The Scientific Literature
Using Library Resources and Reading Scientific Papers

Objectives
By the end of this exercise you should be able to:
1. Differentiate among peer reviewed, primary and secondary articles.
2. Locate primary and peer-reviewed articles in two biology databases.
3. Understand how Boolean operators can narrow or expand research results.
4. Use a basic and advanced search screens in a science database.
5. Write a bibliography in an appropriate style.
6. Learn how to read a scientific paper for the purpose of obtaining the information you need.

In order for science to make progress, scientists must be cognizant of the research that came before. This allows scientists to build upon previous knowledge and identify gaps in our understanding that need to be addressed. Without knowledge of previous research, scientists would simply be repeating the same basic studies over and over again. The primary mechanism by which the results of scientific research are made available to other scientists is through the publication of research reports in scientific journals.

Most scientific journals are peer reviewed. This means that any article submitted for publication is sent to other scientists in that specific field that evaluate the quality of the research and validity of its conclusions. This provides critical quality control of what is published, a feature that is lacking from most other types of publication.

Although many of you may not have encountered any peer-reviewed scientific papers, most of you have encountered other forms of scientific information, such as books (including your textbook), magazines, government reports, newspapers, television programs, and the internet. All of these are secondary sources that are reporting on research represented elsewhere and are usually written by people other than the scientists that actually did the research. In contrast, a primary article is one reporting on new, original research by the persons that carried out that research.

Most of the articles in peer-reviewed scientific journals are primary articles, but some journals publish, or even specialize in, review articles that summarize and synthesize a particular topic. Such review articles are secondary sources, but have the advantage of being written by experts in that field and are still often peer-reviewed.

Scientists rely primarily on primary scientific articles rather than secondary sources.

Question 1
a. Why is it important for scientists to rely on primary articles rather than secondary sources?
Procedure S.1
Prelab Assignment
Go to the “Empirical/Primary Research Articles” Tutorial on the Fletcher Library web page. You can find it by going to:
http://www.asu.edu/lib/tutorials/empirical/empirical1.html
or from the Fletcher Library homepage click on “Tutorials” under the Get Help menu, and then click on “Empirical/Primary Research Articles” link under Advanced Library Skills. Perform this tutorial and the quiz at the end of the tutorial.

Searching for Scientific Literature
Whenever using an electronic (or physical) database or index, one needs to have an idea of what words or phrases will retrieve useful results. We will begin by identifying search terms that will be relevant to the experiment you performed in the previous lab.

One suitable starting point is the name of the organism you are studying. Scientific names will generally produce better results than common or colloquial names, since the latter may not be used in scientific publications and may apply to multiple species.

You should also search for terms relevant to the hypothesis that you are testing, since similar research may have been done on species other than yours. In general, the more specific you can get the better. General terms like “ecology” or “behavior” will often produce too many results that are not especially relevant.

Question 2

a. What is the name of the organism you studied.

b. Working with your lab partners from last week’s experiments, come up with a list of four or five terms relevant to your hypothesis and experiment.

Procedure S.2
Performing a Basic Search Using BIOSIS
1. From the ASU Libraries home page, click on the “Find Articles” link (fig. S.1) on the left side of the page, and then click on the Research Databases link which appears in the drop-down menu. This will take you to the main access page for all of the research databases to which the library subscribes.

2. There you will find alphabet links and a drop-down menu to locate specific databases. From the drop-down menu, select “Biology” to obtain a list of databases that cover biological topics.

3. You will be presented with a list of databases with brief descriptions of what they include. Scroll down the list until you find “BIOSIS Previews.” This database is one of the most useful because of its broad coverage of journals plus records that go back to 1969.

4. Clicking on the BIOSIS Previews link will take you to a search page similar to the one shown in fig. S.2. (If you are off campus, you will be prompted to enter your ID and password.)

Figure S.1
Left menu from ASU library homepage.
5. Enter the scientific name of your species in the first box, and leave the right hand menu set to “Topic” (this searches titles, keywords, and abstracts). Click on the search button to obtain your results.

6. The results page will hopefully list a number of records (if you retrieved no records, the first step is to double check your spelling of the search terms). The total number of records is listed above and to the left of the retrieved records (fig. S.3A).

Figure S.2
BIOSIS Previews main search window.

Figure S.3
BIOSIS Previews search results. (A) total number of records retrieved. (B) Narrow your search here by selecting relevant records. (C) perform another search. (D) Retrieved results.
7. If you have a lot of results, or many of the results don’t seem relevant, you can use the check boxes on the left (fig. S.3B) to refine your results by restricting subject areas or type of document. Alternatively, you can click on the search tab (fig. S.3C) to perform a new search.

8. Examine the list of retrieved articles (fig. S.3D), looking for any that might be relevant to your research project. If you find one that might be useful, you can click on the article’s title to get the abstract (a short summary) that may help you decide if it is useful to you.

9. If the article is relevant to your project, you can click on the icon to retrieve it. This will pop up a page with one or more options, depending on the availability of the article (fig. S.4). You may be presented with one or more journal or database sites that carry the article. Clicking on the icon next to the one of these choices will bring up a page with the article available for reading or download. You may need to locate the link to the PDF version of the article. PDF versions are preferred over html (web) versions as these have the layout, figures, and pagination of the actual print article and can be downloaded as a single file.

10. If an article is not online, there may still be an link to a paper or microform version. This will link to the library catalog information for the journal. If there is neither an online or print form available at ASU, you will be presented with a link to request a copy via interlibrary loan.

Procedure S.3

Advanced Searching Strategies

1. Return to the BIOSIS search page. If necessary, re-enter the scientific name of your species, but now follow this with AND and one of the additional search terms you derived in Procedure S.2. For maximum efficiency, each of your lab partners should work with a different search term.

2. The AND term is an example of a **Boolean operator** that combines terms into sets. AND will retrieve only those records that contain both the scientific name and the second term. In contrast, OR will retrieve any record that contains any one of the terms.

3. Boolean operators can also be used to exclude terms that are not relevant. The term NOT will exclude any articles that contain the title and key words or phrases listed after the NOT.

**Question 3**

**a.** Will the use of AND or the use of OR retrieve the larger number of records?

**b.** If you want to search for a concept that can be described by two nearly synonymous terms, such as foraging and feeding, which Boolean operator would be most appropriate?

**4.** Another useful trick is to use a wildcard symbol, usually an asterisk (*), to truncate terms. For example, MIGRAT* would retrieve articles that contain the terms migrate, migration and migratory.
5. If you want to search for an exact phrase, enclose the phrase in quotation marks. For example, “SOUTH AMERICAN” would not retrieve articles with the phrase American south.

6. Return to the search menu and note the additional search boxes. The second box is set by default to search for author names. While this may not be useful starting out, if you find an article that seems especially relevant, you may want to search to see if that author published other similar research.

7. You can also use these boxes to retrieve a known article, such as an article that was cited by an article you already read.

8. Continue to experiment with advanced search techniques until you and your lab partners have located at least four articles that are relevant to your hypothesis and experiment.

9. Download the articles to a USB drive or the computer’s hard drive. If using a lab computer and you don’t have a USB drive or CD-R you will need to email the articles to yourself and your lab partners.

**Procedure S.4**

**Using Other Databases**

1. Return to the list of databases from which you originally selected BIOSIS Reviews.

2. Scroll through the list and identify at least two other databases that would likely contain articles useful to your project.

3. Some databases have additional useful features such as the ability to restrict your search to only peer-reviewed articles.

**Question 4**

a. Name at least two additional databases that are relevant.

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**Preparing a Bibliography**

As you read through the articles that you retrieved, you will notice that they all contain a “References” or “Literature Cited” section that contains the bibliographic information for all of the articles that they referred to in their article. In order to ease the retrieval of information, such bibliographies are written in a very specific format. Although some minor details (such as in punctuation) vary from journal to journal, most scientific journals follow the same basic format.

The most common type of citation is for a journal article similar to what you retrieved, so we will begin with that (fig S.5). The authors names (last name followed by initials; include all authors) come first, followed by the year of publication. Next, write the exact title (do not capitalize except for the first letter and any proper nouns). Finally, the title of the journal (often abbreviated), volume number and page numbers. It is usually not necessary to include issue numbers since most journals are paginated continuously across an entire volume.

Smith, A.B. & Jones, C.D. 2008. Students that attend class and study get higher grades than those that do not study, *Journal of Irreproducible Results* 42: 123-156.

**Figure S.5**

Annotated bibliographic format for a journal article.

You may also have occasion to cite books. For books include the publisher and city of publi-
There are additional formats for works such as government reports, individually authored chapters in an edited book and web pages. Consult your instructor or suitable reference for such formats.

Bibliographic citations are always listed alphabetically by author. If two articles are written by the same author(s), they are listed chronologically by year. In the event that a single author has published two or more articles in a single year, they are distinguished by a lower-case letter following the year (e.g., 2008a, 2008b).

The process of creating bibliographies can be automated with software such as RefWorks or EndNote. It is possible to import citations obtained from a search at the ASU library page directly into such software by using the provided buttons. See the library web pages for more information and tutorials.

Procedure S.5
Prepare a Bibliography
1. Working with your lab partners, write up a bibliography containing any relevant articles retrieved during your searches.
2. Be sure to carefully follow the format indicated above and to alphabetize your entries.
3. Type up your bibliography in word-processing software and submit it as instructed by your lab instructor.

Reading Scientific Papers
In order to read and understand a scientific paper, it is first necessary to understand its general organization. Developing a logical approach to reading a paper will help with reading efficiency and comprehension. It is also necessary to develop the ability to understand and interpret the data presented by other scientists. Reading a scientific paper is not a passive process like reading a novel—it requires that you be intellectually active as you process the information, hunt for answers to specific questions and ask critical questions.

Scientific papers are organized into a number of more or less standard sections identified by headings. These allow readers to quickly jump to the parts of the article that are of interest to them. Begin by reviewing the section on How to Write a Scientific Paper at the beginning of this lab manual, especially the different parts of a scientific paper.

Once you are familiar with the basic layout of a scientific paper you can begin reading them. Start by reading the title and then the abstract. This will tell you if the paper is even relevant or of interest. If not, go on to another article.

Begin reading through the whole paper, starting with the introduction. Since the introduction functions to set the stage for the research, this section will help you educate yourself about this topic as well. You may also find references to other articles that could be of interest. The end of the introduction usually will address the specific questions and hypotheses that are being asked, so you should pay particular attention here.

As you read through the article you will likely encounter unfamiliar words. Do not just gloss over them but try to determine their meaning. The glossary and index of your textbook is a good start, but you may also have to check online resources such as technical dictionaries. In Google, you can type: define: yourword to bring up definitions.

Read through the methods section to get a feel for what kind of research was done. Don’t worry too much about the details at this point. Move on to the results. Read the text explanations as well as the tables and graphs. It is often helpful to return to the methods to clarify what was done to obtain a particular data set. It is very common for scientists to move back and forth between these sections to clarify various points. It is common for many scientific papers to present the results of several experiments and with multiple analysis. Reading scientific articles requires effort; they cannot simply read straight through passively.

Finally, read the discussion or conclusion. Critically evaluate whether the author’s conclusions are justified by the data. Did they answer the question that they set out to do? You may need to return to the results to reconsider their data.
Procedure S.6
Evaluating a Scientific Paper
1. Read a scientific paper, either one that you retrieved from your search or a paper assigned by your instructor.
2. Be prepared to discuss the paper and answer the following questions about it.

Question 5
a. List the full bibliographic citation for this paper:

b. What is the goal of this paper? What is the question being asked?

c. What general approach did the authors take to answer the question and what assumptions did they make?

d. What evidence supports the conclusions presented in the paper? Which graph or table is most critical to the conclusions of this paper?

e. Are the data supporting the conclusions convincing? Do the methods and analysis used seem to be appropriate? These questions can be difficult to answer for inexperienced scientists. It helps to try to understand the methods used as much as possible.

f. What are the overall implications of the findings represented here? How do they relate to other research? What is the greater significance of the results?