

Researching Information in the Scientific Literature

Preparing an effective lab report or research paper requires first identifying an appropriate topic and then searching for relevant literature. The scientific literature currently includes thousands of journals and hundreds of thousands of books. Searching this enormous scientific literature requires skills that can only be learned through experience. However, most of the scientific literature is well indexed, and can be accessed relatively easily when the proper "channels" are known. This guide is designed to introduce you to some of the skills and strategies that you can use to efficiently search the scientific literature. Don't let the challenge of researching scientific topics overwhelm you, only a few basic skills and experience are needed. **Save this guide—you will need it in future biology courses.**

Objectives:

1. You should learn to distinguish between the major sources of scientific information in terms of focus, quality, and bias.
2. You should learn to effectively use bound and computer-based information resources to buttress arguments in your lab reports and other papers.

Primary, Secondary and Tertiary Literature

Scientific literature is generally classified as primary, secondary, or tertiary sources of information. You should learn to distinguish these types of sources. Some journals carry literature in 2 or more of these categories, although, depending upon the intended audience, many journals and magazines may present only a single type of source literature.

Primary literature. The primary (1°) literature comprises all scientific literature that presents new scientific data or ideas. In general, this encompasses all papers that present novel scientific research, but also may include literature reviews, perspectives and analyses that advance new concepts and viewpoints about data generated by others. The 1° literature is written by scientists who have done the research themselves. In general, this literature is published in scholarly journals. The most widely respected journals are "peer-reviewed," which means that the scientific articles are reviewed by other scientists before being accepted for publication.

Examples of journals that publish 1° literature:

- * *Journal of Experimental Zoology*
- * *Journal of the History of Biology*
- * *Cell*
- * *Ecology*
- * *Science* (in "research Articles and "Reports" section)

Secondary literature. Secondary (2°) literature comprises summaries of results and ideas from the primary literature written for an audience of scientists with some understanding of the topic. Since sources of information in 2° literature are always cited, these articles are excellent places to begin researching a topic. Some examples of 2° sources are given below:

1. Journals that only publish review articles. Review articles present updates on current research on a particular topic. "Annual Reviews" publishes volumes each year dedicated to specific subject areas, such as *Annual Review of Ecology* and *Annual Review of Immunology*. Other relevant subject areas include plant physiology, cell biology, genetics, microbiology, and many other disciplines. "*Trends in ...*", and "*Advances in ...*" are other review series publishing volumes focusing on different subject areas.

2. Review Articles and Perspectives in other journals. Many journals publish papers that review topics of current interest. This would include, for example, papers in *Science* published as "Articles" and "Perspectives."

3. Symposia. Scientists within a discipline often meet to present scientific information focused upon a particular topic. These presentations are often published together as a book.

4. Books. Obviously there are many books written about specific scientific topics. Some of these are written by an individual, others include articles by many different authors compiled by one or more editors. Some books may be considered 1° sources, such as "monographs" discoursing new ideas on a very specific topic, for example, Darwin's *On the Origin of Species*.

Tertiary literature. The tertiary (3°) literature is generally written for a nonscientific audience or for scientists in other disciplines. Generally sources of information in these articles are not cited, or only a bibliography of related readings is included. Some examples of 3° literature sources are described below.

1. Science magazines. Generally, these magazines publish articles readable by scientists in other disciplines. This also includes "News and Comment" and "Research News" articles in *Science*. Examples of magazines that carry literature of a 3° nature include:

- * *Scientific American*
- * *Current Science*
- * *Science Today*

2. Lay magazines. Written for a non-scientist audience. Information found in these articles is generally unreferenced. As sources of information about the impacts or effects of new science on society, these might be acceptable, but they are **not acceptable** sources for information about the science itself. These sources include:

- * *Discover Magazine*
- * *Newspapers*
- * *Newsweek, etc.*

3. Textbooks. Textbooks are a good place to begin learning about a topic, but textbooks often contain inaccuracies and simplifications. Generally your textbook *is not an acceptable* source of information for a lab report research paper (we want you to get familiar with other sources).

4. Encyclopedias. Can be consulted to familiarize yourself with a topic, but generally these are *not acceptable* sources of information for a lab report or a research paper.

* *The Harper Encyclopedia of Science*

* *Scientific Encyclopedia*

“Gray” literature. There is a lot of material that is not easily classified; some of this falls into what scientists call “gray” literature. This includes many **government publications**. Material in these publications may range from interpretive brochures for an agency or park (which would correspond to tertiary literature), to detailed scientific studies done by competent government scientists (or university researchers under government contract). These detailed studies may have all the attributes of a primary paper except peer review (some government publications even pass this test). Ask your instructor on how to handle such papers in your class.

Which types of sources are appropriate for your research paper?

This is a question that will be answered by your instructor for specific classes, however, bear in mind a few general guidelines.

Introductory level science classes. You should expect to delve somewhat into the 2° literature, however, multidisciplinary *science* journals are acceptable 3° sources. You will probably be required to include some 1° sources. Lay magazines should only be used as sources of social commentary and relevance and not "hard" scientific information. You will be expected to use one or more indexes to the scientific literature described below. **Unless otherwise indicated, your textbook and encyclopedias are not acceptable sources.**

Upper level courses. Your literature sources should be *exclusively* from 2° and 1° literature. Limited use of 3° sources may be allowed in some cases. You should plan to make extensive use of the scientific indexes described below.

Researching Topics in the Scientific Literature

The ability to effectively research a topic among thousands of different journals and hundreds of thousands of books is a skill as important to science as those used in the laboratory itself. The rest of these guidelines will introduce you to some of the major "portals of entry" to this immense scientific literature. Don't forget that the library staff is there to help also.

Some Basic Steps to Searching the Scientific Literature

The first step in researching a paper is not necessarily a trip to the library! Before you can make a successful search, you must know what you are looking for. Typically, this will involve doing some reading about the subject in a handy source, such as your textbook. If the textbook isn't helpful, a quick online search of the world-wide web, or an article or two in an encyclopedia may help you develop an initial understanding of the topic. The steps outlined below take you through this initial study and the subsequent steps of a literature search:

1. Use an encyclopedia, textbook, or other easily accessible 3° source to gain background information and possibly develop a beginning bibliography.
2. Develop an initial list of "key words" that can be used to research your topic.
3. Search the computerized catalog (M.C. Cat.) under those key words.
4. Use the various computerized and bound indexes to search key words. Identifying recent books and review articles will enormously expedite the search process. Revise your key words as needed to broaden or narrow the search.
5. As you begin to access the 2° and 1° sources, use the literature cited in these papers to identify other relevant articles.

Resources Available on Computer

On-line services. Use the page called [Information Resources](#) linked to the [Biology Department Home Page](#). This page provides links to many Internet resources categorized by subject matter and course. The Internet can be a powerful tool for gaining information. While a wealth of information is present, however, you must recognize three key limitations of it:

1. There is so much information, that comprehensive searches are nearly impossible.
2. There is no guarantee of the accuracy or the quality of much of the material.
3. The material may be moved or removed at any time.

Because of these last two limitations, as a general rule, we do **not** allow you to use information taken directly from web pages as sources for your papers, although they may be used for other class assignments¹. This conforms to the general practice in science, which is struggling to deal with this same issue. Presently web pages are too ephemeral and 'fluid' in content--a reference to information on a page today may be meaningless tomorrow.

¹ The prohibition against using information taken from the web does not apply to full-length scientific articles delivered via the Internet from a source such as the Electronic Journal Center. Such articles are usually available in print as well, and you should reference them as if you were looking at the printed product.

The Internet should be used for bibliographic research, i.e., to search for references to relevant scientific articles, because it offers great time savings. Exhaustive databases of scientific literature can be accessed through the Internet and searched through a variety of channels, including key words, authors, and titles. Unfortunately, literature covered by computer databases may only extend back 10 to 20 years, so earlier literature may need to be searched in bound volumes (the "old-fashioned way"). The power of online databases is increasing as abstracts and entire articles become available through the web. Many databases currently provide abstracts, but relatively few journals publish full articles online that can be accessed without a subscription (but see JSTOR, below). Please note the difference between an abstract and the full text of a journal article. You must locate and read the full text; you may not rely on an abstract.

Some of the databases available online include [BIOSIS Previews](#) (On-line version of *BioAbstracts*), Zoological Record On-line, Enviroline, MEDLINE, Pollution Abstracts, OCEAN ABSTRACTS, New England Journal of Medicine Online, AIDSLINE, and CANCERLIT.

[BIOSIS Previews](#) is perhaps the most powerful tool for searching, but it requires a little bit of experience to get the most out of it. In most classes, we will give a hands-on demonstration of how to use this powerful tool.

[Periodical Abstracts](#) is an index available online. Titles, subjects, and authors of articles are classified under a broad range of key words. *Periodical Abstracts* covers a very broad range of academic subject areas--it is not limited to the science literature--and its coverage of biological sources is **quite limited**. A search restricted to *Periodical Abstracts* is not sufficient in an upper level course.

[OHIOLINK](#) is a computerized database of holdings in libraries in Ohio. It includes all of the major state universities. The interface is the same as M.C. CAT. The beauty of OHIOLINK is that once you locate a journal or a book, you can use the HOLDINGS search to identify which libraries hold the material. You might be able to travel to the library and examine the source directly in less time than it would take to get an interlibrary loan. In particular, you could develop a bibliography to take home with you on a weekend or over spring break, particularly if you live near one of the universities. OHIOLINK also has access to electronic copies of many research journals eliminating the need for interlibrary loans completely! OHIOLINK is our gateway to many of the other databases shown on this page.

Indexes on CD-ROM: Dawes Memorial Library subscribes to a number of indexes available on CD-ROM, such as *PsychLit* and the *Physical Fitness/Sports Medicine Indexes*. CD-ROMs can be searched independently by students with minimal training. There is no expense to students for use of these indexes. While a CD-ROM index often covers a rather narrow field, they can also be of great value when searching subjects that overlap with these fields.

Bound Indexes to the Scientific Literature

Biological Abstracts. *Bioabstracts* is the most comprehensive index to the biological literature, providing access to titles and abstracts to articles in thousands of journals. Bioabstracts covering years from 1926 through 1992 are available in bound form in the biology reading room (second floor of Bartlett). Searching the bound volumes of *Bioabstracts* can be time consuming; however, it is a skill that should be practiced when researching topics for upper level courses. The more recent literature can be searched online via *Biosis Previews*, as discussed below.

General Science Index (GSI). This index is available in bound form. Although its coverage of the biological literature is relatively limited and does not include abstracts, it is relatively easy to use and can serve as a good starting place. To use the GSI, appropriate key words are searched. The key words are listed in alphabetical order, and sometimes categorized with secondary headings.

Other Bound Indexes. There are many other indexes available in Dawes Library, these include the *Abridged Index Medicus*, *Applied Science and Technology Index*, *Physical Fitness/Sports Medicine Index*.

Careful Selection of Key Words is Important

As for searches of all indexes, careful selection of key words is crucial to an effective search. Suppose you wished to research a term paper on 'Environmental Impacts of Pesticides.' Careful choice of key words will be necessary to identify papers that are most relevant to this topic. Figure 1 shows the results of 3 searches, each using sequentially more refined key wording; notice how the number of citations is brought down to a manageable level. Take time to learn Boolean, or set, searching. This techniques allows you to link search terms with connectors such as AND, OR, or NOT. This technique can be used with all electronic databases, and *Periodical Abstracts* is a friendly place to learn. Remember, you can learn how to use electronic databases by using the on-line "help" menus, written documentation, and the library staff.

Num	Search	Hits
#1	ENVIRONMENT	4127
#2	PESTICIDES	376
#3	ENVIRONMENT AND PESTICIDES	20

Figure 1. Outcomes for three searches through *Periodical Abstracts* on the topic "Environmental Impacts of Pesticides." The results illustrate the importance of narrowing a topic through careful selection of key words.

Other Research Tools

Annual Index of Individual Journals. Most journals compile each year's literature in subject and author indexes. These indexes are usually found in the final volume of each year. If you have identified key journals for your subject area, browsing through the annual indexes is a quick, effective means of locating literature germane to a research topic.

Science Citation Index (SCI). The SCI is available in bound form at the Ohio University main library, or here through Dialog with the assistance of a Librarian. The SCI identifies articles that have cited other papers in the primary literature. Thus, after you have found a paper in the primary literature, you can use the SCI to identify other papers that have subsequently cited that paper (and, presumably, deal with a related topic). When used together, *Bioabstracts* and the SCI allow essentially an exhaustive search of the scientific literature.

Electronic Journal Center (EJC) (<http://journals.ohiolink.edu/cgi-bin/sciserv.pl?collection=journals>) and JSTOR (<http://www.jstor.org/search>). These are two online resources that Marietta College subscribes to. From these sources, you can access full text versions of many journals. Most of these journals are not held by the library. The Electronic Journal Center is accessed through OHIOLINK; both resources can be accessed through the Dawes Library Home page as well.

Information Research Assignment

Due Date: _____ Name: _____

This may be a **pre-lab** *or* **post-lab** assignment; consult with your instructor for the due date.

Learning to recognize the various types of scientific literature is one of the first steps in evaluating the value of a particular source. In this exercise, you will examine 10 papers that are on reserve in the Dawes Library. For each, you will determine if it is a primary, secondary, or tertiary source and describe the characteristics of the paper that led you to your conclusion. Warning! A couple of these are really tough - even your instructors classify them differently.

1	Title:	Primary	Secondary	Tertiary
Characteristics:				

2	Title:	Primary	Secondary	Tertiary
Characteristics:				

3	Title:	Primary	Secondary	Tertiary
Characteristics:				

4	Title:	Primary	Secondary	Tertiary
Characteristics:				

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5	Title:	Primary	Secondary	Tertiary
Characteristics:				

6	Title:	Primary	Secondary	Tertiary
Characteristics:				

7	Title:	Primary	Secondary	Tertiary
Characteristics:				

8	Title:	Primary	Secondary	Tertiary
Characteristics:				

9	Title:	Primary	Secondary	Tertiary
Characteristics:				

10	Title:	Primary	Secondary	Tertiary
Characteristics:				