



## Using Scientific Literature in Biology Courses

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## Introduction

In science, knowledge accumulates as individuals study phenomena in the natural world. These **researchers base their studies on the information contributed in the past by others**, and the results of the new studies provide new information or different interpretations of the subjects under investigation. **Scientists share their work through the publication** of the results of their original research projects. In this way, the new knowledge is available to all who have an interest in those subjects.

At Earlham, we believe it is important that you learn how to **access and use** this scientific literature. Our reasons for this include:

- Reading scientific literature is one of the necessary components of scientific research.
- Using scientific literature shows something about the social structure of the activity of scientists -- it illustrates the formal means by which scientists communicate with each other and with wider communities.
- By reading scientific literature, you will see examples of the writing style by which scientists communicate.
- The acquisition of library research skills will enable you to find scientific literature on subjects that interest you now and in the future.

## Scientific Literature

### Primary Literature

Scientific knowledge is furthered through the publication of the results of original research projects. These publications, the scientists' own reporting of their original research, are known as primary literature. Since a **primary article** is the report of a given study, it will include an introduction to the research, the methods used, the data and results obtained, a discussion of the results and a list of references to the literature used in the design and analysis of the research.

These publications are found in **journals, government** and other institutions' **research reports**, and occasionally in **books**. Before a research paper is accepted for publication in the scientific literature, it is subjected to the "**peer review**" process. This means that the publisher sends a copy of the submitted paper to one or more scientists working in the same field. These peer scientists read the paper and assess the quality of the research and the paper describing it. They look at such factors as whether or not the design of the experiment was appropriate for the hypothesis being tested, whether sufficient data were collected, and whether the conclusions follow logically from the results of the experiment. They also consider whether the overall topic was of sufficient importance and interest to warrant publication.

It is important to read primary literature because it provides details of how the research was conducted, includes the data that were collected, and outlines the researcher's own interpretation of the work. Because the methodology of the study is described, a primary literature paper gives readers the opportunity to repeat the study or a

variation of it. It also enables one to **argue with the conclusions** of the study since the data is there for all to consider.

## Secondary Literature

Another important type of scientific literature is created when other **scientists integrate information** from the primary literature into review articles or books. These reviews are called secondary literature, and they are useful in providing a broad overview of a field or by providing a **synthesis** of the ideas of many people. These **articles** and **books** may present tables and figures showing data from experiments, but these have always been taken from the primary literature which originally published the results. There may be a literature cited section in which the author refers to other people's publications, but **a secondary article may describe or explain things without giving specific references.** Sometimes one of these articles or books provides a synthesis of a field that is sufficiently unique that it can be considered a primary source because **it contributes a new understanding** and shapes the future of research in that area.

Scientific literature may take a variety of physical forms: print publications such as books or journal articles, electronic documents, web sites, personal communications, etc.

You will consult a variety of types of literature when you do scientific research. In general, **a good research strategy is to begin looking at secondary sources to gain an overview of the subject in question and to locate references to other secondary and primary literature that are included in the bibliographies of the secondary sources.** Then you can proceed to the primary literature, using the bibliographies of these papers as well.

## Comparison of Primary and Secondary Literature

The chart below summarizes some features that will help you as you learn to distinguish primary from secondary articles:

WHAT TO LOOK FOR IN JUDGING AN ARTICLE	PRIMARY LITERATURE	SECONDARY LITERATURE
<b>Peer Review</b>	primary literature is always peer reviewed	may or may not be peer reviewed
<b>Title</b>	a brief statement of a research project, usually very technical	may sound technical, but may sound broad or "cute"
<b>Focus</b>	very narrow and specific	a broader overview
<b>Abstract</b>	usually	not usually
<b>Introduction to Topic</b>	yes	yes
<b>Methods Section</b>	yes	not usually
<b>Results Section</b>	yes	not usually
<b>Data in Figures and Tables</b>	usually	not usually
<b>Discussion Section</b>	yes	the whole paper may be considered a discussion
<b>Literature Cited</b>	always	may or may not have
<b>The Form of Publication</b>	usually an article in a print or online journal, but may be in a book, conference report, or a report from the government or another institution	may take any form -- an article in a journal, an article in an "annual review" series, a report, a book, a part of a book, a website
<b>Examples of Publications Which Specialize in Either Primary or Secondary Articles</b>	Ecology, Journal of Ecology, Oecologia, Ecological Monographs	Science News, Scientific American, Annual Review of Ecology and Systematics
<b>Journals with Both Primary and Secondary Articles</b>	Science, Nature  Primary articles may be labeled "research" or "report" and secondary articles are often labeled "review" or "news"	

## Guidelines for deciding when to use primary literature and when to use secondary literature:

<b>Use primary literature for:</b>	<p>For most biology course assignments, you are expected to base your work on the primary scientific literature. Whenever possible, read these original sources of information.</p>
	<p>You may be tempted to refer to a study that you are reading ABOUT in a primary source, but that you have not read yourself personally. This is <b>NOT</b> acceptable procedure. You should make all efforts to read the additional study itself, either in our library or by getting the additional study through interlibrary loan.</p>
<b>Use secondary literature for:</b>	<p>Secondary literature is useful for gaining a broad perspective on a topic or a synthesis of ideas about a topic and to find a bibliography of relevant sources.</p>
	<p>Secondary literature can be used in addition to primary literature, but not in place of it. For instance, if you are reading a review article which refers to information in a primary research article, you should find that primary article and read it yourself.</p>

## Citing Sources of Information

You, like other scholars, must cite the sources of information you use. Citing others' work fulfills a number of purposes:

- it can be a way of recognizing the contributions of pioneers in a field
- it identifies the original publications in which an idea or concept was first presented
- it provides access to other readings on the topic of the work at hand
- it can be used to identify a methodology
- it is a way to refer to work of one's own or others that is being critiqued or corrected

### Guidelines for deciding when to cite:

<b>You don't need to cite if:</b>	you use information that seems to be common, background knowledge (Example: <i>The vast majority of birds have functional wings.</i> )
<b>You DO need to cite if:</b>	you refer to or describe specific information that you have taken from a source ( <i>The Galapagos flightless cormorant has rudimentary, non-functional wings.</i> )
	you refer to a theory or idea from a source
	you want to incorporate a figure, table, or photograph from another source

### Avoid plagiarism in scholarly writing:

<b>Never</b>	do NOT cut and paste text from an electronic source with the intention of paraphrasing the text after copying it -- this practice makes it easy to accidentally plagiarize by following the original text too closely
<b>Never</b>	do NOT use direct quotations; in scientific writing, you express the information and ideas you have taken from other sources <b>IN YOUR OWN WORDS</b> , rather than how the author says it
<b>Always</b>	<b>THINK</b> about the information that you're using from another source and when you understand it sufficiently, you'll be able to say it <b>IN YOUR OWN WORDS</b>

## II. How to Cite Sources (Council of Biological Editor's Style)

### The Name-Year System

In the text of your paper, refer to a source of information by the name of the author and the publication year.

- Put name and year in parentheses at the end of the sentence (before the period)
- Or use the author's name as part of the sentence and the year in parentheses just after the name.
- For example: *Bird nests located in vegetation are protected from adverse weather conditions (Montevcchi 1979). Dunn and Davis (1976) note that chick survival is increased when there is shrub coverage around the nest. The coverage can result from dense leaf cover (Wininger 1987a) or from a thick pattern of branching (Hagberg and Perrera 1989).*

### Variations

IF...	Do this...	For example...
An author has written more than one article in the same year	Distinguish the articles from each other by adding a letter to the year (a, b, c, etc.)	(McCarthy 1996a) or (McCarthy 1996b)
There are two authors	Use both names in the citation	(Denton and Lee 1997)
There are three or more authors	Use the first author's name followed by "et al."	(Strauss et al. 1997)
There are several sources to cite on a given topic	List them in chronological order from oldest to the newest. If some of the articles have been published in the same year, then list those alphabetically by the author	(Aldington and Fry 1993, Jackson 1993, Kiesecker and Blaustein 1997)
If you didn't read a source yourself, but read about it in another source (always try to avoid this by reading that additional source)	Refer to both sources in a form similar to the example to the right	Birds were once thought to be reptiles (Jones 1924 in Anderson 1987)
If the information isn't published in print or electronic form (interview, letter, conversation, etc.) and can't be accessed by another person	In the text of your paper, refer to the source of information, the type of communication.  Because this source is only available to you, omit from the Literature Cited list.	(Smith R., personal communication)

## Creating a *Literature Cited List*

Create a list of references to all the documents that you have cited in your work.

- Only include the sources that you directly cited in the text of your paper; do not include background reading you didn't specifically cite.
- List references by the last name of the author, in alphabetical order.

### Variations

<b>If there are several works by the same author</b>	<p>List in order of the oldest to the most recent.</p> <p>Iverson, J. B. 2001. Reproduction of the river cooter, <i>Pseudemys concinna</i>, in Arkansas and across its range. <i>Southwestern Naturalist</i> 46: 364-370.</p> <p>Iverson, J. B. 2002. Reproduction in female razorback musk turtles (<i>Sternotherus carinatus</i> : Kinosternidae). <i>Southwestern Naturalist</i> 47: 215-224.</p>
<b>If an author has written more than one work in the same year</b>	<p>Distinguish the works from each other by using letters. For example,</p> <p>Iverson, J. B. 1995a. Natural history notes: <i>Heterodon nasicus</i> (Western Hognose Snake): reproduction. <i>Herpetological Review</i> 26: 206.</p> <p>Iverson, J. B. 1995b. <i>Podocnemis lewyana</i>. <i>Catalogue of American Amphibians and Reptiles</i> 605: 1-3.</p>
<b>Author writes alone and also with other authors</b>	<p>List all works written by an author alone before listing articles that the author has co-written with others. List the additional works alphabetically by the name of the second author. For example:</p> <p>Iverson, J. B. 2002. Reproduction in female razorback musk turtles (<i>Sternotherus carinatus</i>: Kinosternidae). <i>Southwestern Naturalist</i> 47(2):215-224.</p> <p>Iverson, J. B., and Moll., E. O. 2002. Turtles. In: Halliday, T. R. and K. Adler (Eds.). <i>The New Encyclopedia of Reptiles and Amphibians</i>. Oxford University Press, Oxford, England.</p> <p>Iverson, J. B., and Vogt, R. C.. 2002. <i>Peltocephalus tracaxa</i>. <i>Catalogue of American Amphibians and Reptiles</i> 744:1-4.</p>

## Formatting References

### CITATION GOALS:

- 1) Give credit to the author of the source;
- 2) Enable another person to locate the source.

The following are the basic components that ALL cited work should have:

- Author(s)**, Editors or both if relevant, [Note. If not available or clear, use organization's name or website title]
- Year of publication**, [Note. If the resource has NO clear visible date, use n.d. and if it is an online resource share also the date when information was accessed]
- Title**, [Note. If it is an electronic resource you may need to write at the end of the URL link the type resource]
- Publisher** (for datasets this is often the archive where it is housed)
- Edition**, version, or issue [Note. include page numbers if it is an article or chapter of a report, book, document]
- Access information** (a URL or other persistent identifier, DOI preferred).

General Note. If some of the information is missing (no author, no date...), omit those elements from your reference or write the name of the institution.

### Electronic Resources General

Websites, datasets, can vary tremendously in terms of the "bibliographic information" that they provide or one could extract from them because:

- Authors or dates may or may not be noted, they may change due to recent contributions to the data.
- Some websites are very dynamic in nature, constantly changing, being updated, changing gatekeepers, shifting ownership, or changing their URL entirely.
- Electronic resources may have specific ways that they request for you to cite their work. This is the first piece of information that you need to look for \*.

### Variations

<b>No author</b>	Use <b>Anonymous</b> as the name for an article lacking an author
<b>More than 10 authors</b>	For an article with multiple authors, include the first 10 names. For more than 10, list the first 10 followed by <b>and others</b> .

Main	Types	Examples
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">JOURNAL ARTICLES (Print or electronic)</p>	<p>Journal Article</p> <p>Article types: [hard copy, peered-review, electronic, primary, review article, etc]</p> <p>[e.g., PLoS, Science (hard copy), full-text Annual reviews, PDF from Elsevier, etc]</p>	<p>Herring, P. J. 2007. Sex with the lights on? A review of bioluminescent sexual dimorphism in the sea. <i>Journal of the Marine Biological Association of the UK</i> 87:829. <span style="border: 1px solid black; padding: 2px;">1 Author</span></p> <p>Saunders, K. O., Freel, S. A. , Overman, R. G., Cunningham, C. K., and Tomaras, G. D. 2010. Epigenetic regulation of CD8+ T-lymphocyte mediated suppression of HIV-1 replication. <i>Virology</i> 405:234–242. <span style="border: 1px solid black; padding: 2px;">2+ Authors</span></p> <p>Horn, K. C., Eubanks, M. D., and Siemann E. 2013. The effect of diet and opponent size on aggressive interactions involving Caribbean crazy ants (<i>Nylanderia fulva</i>). <i>PLoS One</i> 8. n.pag. <span style="border: 1px solid black; padding: 2px;">Online JrnI.</span></p> <p><b>Note.</b> Only the first word of article title is capitalized. After the name of the journal comes the volume number and then a colon and the page numbers. <i>Italicize genus and species names. If an article has many authors 10+ ALL authors name need to be written down.</i></p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">BOOKS (Print, electronic, audio)</p>	<p>Book with Authors (Print)</p>	<p>Cowan, W.M., Jessell, T.M., and Zipursky, S.L. 1997. <i>Molecular and Cellular Approach to Neural Development</i> (New York: Oxford University Press).</p> <p>Quammen, D. 1996. <i>The song of the dodo: island biogeography in an age of extinction</i>. Touchstone, New York, New York, USA.</p>
	<p>Book with Editors (Print)</p>	<p>Scriver, C. R., Beaudet, A. L., Sly, W. S., and Valle, D. editors. 2000. <i>The metabolic basis of inherited disease</i>. 8th ed. McGraw-Hill, New York, New York, USA.</p>
	<p>Book Chapter or part of book (Print)</p>	<p>Newton, I. 1988. Age and reproduction in the sparrowhawk. Pages 201-219 <i>in</i> T. H. Clutton-Brock, editor. <i>Reproductive success</i>. University of Chicago Press, Chicago, Illinois, USA</p>
	<p>Electronic Book</p>	<p>Darwin, C. 1859. <i>The origin of species by means of natural selection</i>. <a href="http://www.gutenberg.org/files/2009/2009-h/2009-h.htm">http://www.gutenberg.org/files/2009/2009-h/2009-h.htm</a> [EBook #2009]. (Accessed May 1, 2013).</p>
	<p>Kindle Book</p>	<p>Quammen, D. 1996. <i>The song of the dodo: island biogeography in an age of extinction</i>. <a href="http://www.amazon.com">http://www.amazon.com</a> [Kindle Edition 2011]. (Accessed Apr 20, 2014).</p>
	<p>Audio Book</p>	<p>Darwin, C. 1859. <i>The origin of species by means of natural selection</i>. <a href="http://www.amazon.com">http://www.amazon.com</a> [Audiobook 2008]. (Accessed Apr 20, 2014).</p>
	<p>Chapter/Section of a Web Document or eBook</p>	<p>Gaston, K. G. 2010. Biodiversity. Pages 27-42 <i>in</i> S. S. Navjot and P. R. Ehrlich, editors. <i>Conservation biology for all</i>. <a href="http://www.conbio.org/publications/free-textbook">http://www.conbio.org/publications/free-textbook</a> [EBook]. (Accessed Apr 14, 2014).</p>

OTHER PERIODICALS (Print, electronic)	Magazine or newspapers or journals that do not number pages continuously between issues	<p>Packer, C., and Pusey, A. E. 1997. Divided we fall: cooperation among lions. <i>Scientific American</i> 276(5):52-59.</p> <p>Kolata, G. 1997, July 27. Some scientists ask: how do we know Dolly is a clone? <i>New York Times</i>; Section C:3. <span style="border: 1px solid black; padding: 2px;">NYT Print</span></p> <p>Parker-Pope, T. 2008, May 6. Psychiatry handbook linked to drug industry. <i>The New York Times</i>. <a href="http://well.blogs.nytimes.com">http://well.blogs.nytimes.com</a> [Blog]. (Accessed May 20, 2013). <span style="border: 1px solid black; padding: 2px;">NYT Electr.</span></p> <p><b>Note</b> In some publications, each issue starts with page number one. Thus for a given volume or year, several articles may start on the same page number. To avoid confusion, supply an issue number as well as a volume number and/or include the year, month, and day of publication.</p>
WEBSITES Professional (.gov, .org, .edu, etc), personal websites, online encyclopedias, wikis	Professional Website or Lab website	Curtis, R. 1998, February 25. Princeton environmental reform committee (PERC) home page. <a href="http://www.princeton.edu/~perc/">http://www.princeton.edu/~perc/</a> [Webpage]. (Accessed Oct 20, 2013)
Non periodical web document, web page, or report	<p>National Cancer Institute. n.d. [Reviewed: 06/24/2013]. Cell phones and cancer risk. <a href="http://www.cancer.gov/cancertopics/factsheet/Risk/cellphones">http://www.cancer.gov/cancertopics/factsheet/Risk/cellphones</a> [Webpage]. (Accessed Feb 20, 2014)</p> <p>American Cancer Society. n.d. [Reviewed: 02/23/2012]. Cellular phones. <a href="http://www.cancer.org/cancer/cancercauses/othercarcinogens/athome/cellular-phones">http://www.cancer.org/cancer/cancercauses/othercarcinogens/athome/cellular-phones</a> [web-page]. (Accessed Feb 1, 2014).</p>	
Personal Website	Smith, C. 2011, September 23. Chris Smith's home page. <a href="https://sites.google.com/site/ecantlab/">https://sites.google.com/site/ecantlab/</a> [Website]. (Accessed May 20, 2013)	
Program website	<p>HGCI Programs Green Campus Loan Fund. 2002. In Harvard Green website campus Initiative. <a href="http://www.greencampus.harvard.edu/programs/GCLF.shtml">http://www.greencampus.harvard.edu/programs/GCLF.shtml</a> [Website]. (Accessed May 27, 2003)</p> <p><b>Note</b> When there is no author, use page title in place of author</p>	
Online Encyclopedias (e.g., Britannica)	Feminism. n.d. [Reviewed: 02/02/2010]. In Encyclopædia Britannica online. <a href="http://www.britannica.com/EBchecked/topic/724633/feminism">http://www.britannica.com/EBchecked/topic/724633/feminism</a> [Website]. (Accessed Jan 1, 2012).	
Online Forums	Frook, B. D. 1999, July 23. New inventions in the cyberworld of toylandia. <a href="http://groups.earthlink.com/forum/messages/00025.html">http://groups.earthlink.com/forum/messages/00025.html</a> [Msg 25, Web log comment, Video file]. (Accessed April 13, 2013).	
Wikipedia or Wikis	<p>Cystathionine beta synthase. n.d. [Revised Feb 8, 2014]. In Wikipedia the free encyclopedia. <a href="http://en.wikipedia.org/wiki/Cystathionine-beta-synthase">http://en.wikipedia.org/wiki/Cystathionine-beta-synthase</a> [Wiki]. (Accessed Feb 3, 2014).</p> <p><b>Note:</b> Wikis (like Wikipedia, for example) are collaborative projects that cannot guarantee the verifiability or expertise of their entries.</p>	

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">SCIENTIFIC DATABASES or DATA SETS (Genomics data, GIS data, proteomics data, etc)</p>	<p><b>Databases or Data sets</b></p> <p>Example: NCBI databases maintained and or connected to NCBI (e.g., OMIM, Gene, GenBank, BLAST) KEGG, Neotropical Birds, RCSB Protein Data Bank, Human Protein Reference Database HPRD, etc</p>	<p>Weizmann Institute of Science. n.d. The GeneCards human gene database; Gene=ABCB4. <a href="http://www.genecards.org/cgi-bin/carddisp.pl?gene=XXXX">http://www.genecards.org/cgi-bin/carddisp.pl?gene=XXXX</a> (Accessed Apr 1, 2014).</p> <p>National Center for Biotechnology Information. n.d. PubChem Database; CID=2519, <a href="http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=2519">http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=2519</a> [Database]. (Accessed Jun 15, 2011).</p> <p>Sensenig, A., Blackledge, T., and Agnarsson. I., n.d. Silk tensile and web architecture measurements for 280 individuals and 22 species of Araneidae. Dryad Digital Repository. <a href="http://dx.doi.org/10.5061/dryad.1827">http://dx.doi.org/10.5061/dryad.1827</a> [Internet]. (Accessed Jun 16, 2011).</p> <p>Royal Society of Chemistry. n.d. ChemSpider; Caffeine, CID=2424. <a href="http://www.chemspider.com/Chemical-Structure.2424.html">http://www.chemspider.com/Chemical-Structure.2424.html</a> [Database]. (Accessed Jun 15, 2011).</p> <p>Flannagan, K., Schmidt, K., and Tori, W. P. 2012. Lance-tailed Manakin (<i>Chiroxiphia lanceolata</i>). Neotropical Birds Online (T. S. Schulenberg, Editor). Ithaca: Cornell Lab of Ornithology. <a href="http://neotropical.birds.cornell.edu/portal/species/overview?p_p_spp=502956">http://neotropical.birds.cornell.edu/portal/species/overview?p_p_spp=502956</a> [Webpage]. (Accessed Apr 1, 2014)</p> <p><b>Note.</b> For some databases/datasets source might specify best ways to cite their information. When available use their suggested citation but accommodate to this style (e.g., HPRD has a special style)</p>
<p>OTHER Sources not existing print/online</p>	<p>Interview, email, or other personal communication</p>	<p>Because this source is unavailable to anyone else but you, omit from the Literature Cited list. In the text of your paper, however, refer who, the way in which the information was obtained. For example:</p> <p>(Blair, P., personal communication)</p>

For additional Information or sources not available as examples go to:  
<http://owl.english.purdue.edu/owl/resource/560/01/> (This are on APA style)