Biology 171L – General Biology Lab I
Lab 3: The Scientific Research Paper and Literature Resources

Introduction

The primary objective of this laboratory activity is to learn about how to research and write a scholarly scientific paper. Along the way you will learn about the kinds of scientific papers and their formats, types of literature sources and how to find them, and how to cite these literature sources. By the end of the lab activity, you should define a research topic you’d like to pursue, retrieve the bibliographic details for at least three scientific research papers relevant to this topic, and write a short overview of the topic you intend to study.

Type of Research Papers

In general, there are two broad categories of scientific research papers: scientific review papers (library research papers) and experimental research papers. Scientific review papers involve investigating the research that has been published on a particular topic and reporting on this topic. While it does not normally involve conducting experimental work, it may involve analysis and integration of published experimental information on a topic. At the very least, it presents a scholarly summary of the work completed upon a particular topic. Scholarly scientific review papers may be published in scientific journals (periodicals) or technical books.

Experimental scientific research papers typically report on original experimental research. The author will usually have identified a research question or problem, offered a hypothesis, and conducted experimental research on the topic. Published experiment research papers, often referred to as the "primary literature", describe, interpret and analyze the research that was conducted. Scholarly experimental research papers are normally published in scientific journals.

The formats of scientific review papers and experimental research papers is presented below.

Scientific Review Paper Format

A scientific review paper (may also be called a "library research paper") generally should be divided into four titled sections:

Abstract, Introduction, Discussion, and Literature Cited. What gets presented in these sections is presented below. Note the exact format of this kind paper is more flexible than that of an experimental research paper. This format depends on the organization that makes the most sense in its presentation.

ABSTRACT The function of an abstract is to allow a reader to quickly evaluate whether or not a paper is relevant to the subject that interests this reader. Thus the abstract is a short synopsis of the paper, usually only a few sentences long present as a single paragraph. At the very minimum, the abstract should consist of a sentence that identifies the main topic or thesis, a sentence the presents the most significant information, and a sentence that draws a conclusion about this information.

INTRODUCTION The Introduction identifies the objectives of the paper and why the topic is important. In this section the author provides relevant background information (citing literature sources), identifies the problem, proposes the hypothesis (if relevant), and gives the reader a general idea of where and how the paper is going to take the reader to a conclusion.

DISCUSSION In the Discussion section, the author presents the details and analyses of the work of others (citing appropriate literature sources). Here the author attempts to integrate past work into a cohesive whole that tells a story. This section could be used to evaluate how past work may support or refute any hypotheses that have been suggested. The author suggests possible limitations and sources of error these studies. The author explains how these limitations and errors might have influenced the results and their interpretation. Finally the author suggests future studies that could be conducted in order to answer any new questions suggested by the study. The exact format of this section is flexible and depends upon the topic or thesis being discussed. This section could be divided into logical subsections.
Finish the discussion with a concluding paragraph or two.

LITERATURE CITED This section presents the bibliographic details for all literature sources cited in the paper. The format (see below) varies, depending upon the type of literature source used. The author does not include the bibliographic details for sources that were not cited in the paper.

Experimental Scientific Research Paper Format

An experimental scientific research paper should be divided into six titled sections: Abstract, Introduction, Materials and Methods, Results, Discussion, and Literature Cited. What gets presented in these sections is presented below.

ABSTRACT The function of an abstract is to allow a reader to quickly evaluate whether or not a paper is relevant to the subject that interests this reader. Thus the abstract is a short synopsis of the paper, usually only a few sentences long present as a single paragraph. At the very minimum, the abstract should consist of a sentence that identifies the research objectives, a sentence that suggests the experimental approach, a sentence the presents the most significant results, and a sentence that draws a conclusion about these results.

INTRODUCTION The Introduction identifies the objectives of the study and why the study is important. In this section the author provides relevant background information (citing literature sources), identifies the problem, proposes the hypothesis, and gives the reader a general idea of the approach taken to evaluate the hypothesis.

MATERIALS AND METHODS The Materials and Methods section provides a detailed, matter-of-fact description of the procedures used. The procedures should be detailed enough that anyone could reconstruct the experiment from the description. The author may include figures in this section. But be the body of the text clearly explains what the author did. The author also provides the scientific name of the organisms used and describes how they were treated prior to the actual experiment.

RESULTS In this section, the author reports the results collected without evaluating their significance. The author may (and should) include tables and figures (see rules for table and figure formats below). But the text in this section should identify and describe the major trends observed in the data (i.e., does just present a table of figure without including text in the body of this section).

DISCUSSION In the Discussion section, the author presents his/her interpretations and evaluations of the results collected. In other words, the author explains the trends presented in the Results section. One important point to address would be how the observed results support or refute hypotheses being tested by the study. The results should also be compared to relevant work completed by earlier researchers (citing appropriate literature sources). Suggest possible limitations and sources of error in the study. The author explains how these limitations and errors might have influenced the results and their interpretation. The author suggest future studies that could be conducted in order to answer any new questions suggested by the study. The discussion usually ends with a concluding paragraph.

LITERATURE CITED This section presents the bibliographic details for all literature sources cited in the paper. The format (see below) varies, depending upon the type of literature source used. The author does not include the bibliographic details for sources that were not cited in the paper.

Style and Format of Writing

Since the experiment or study reported on was conducted in the past, it should be written in past tense. It should also use third person voice in describing what took place. The style should be concise, objective, impersonal, and impassionate. It should also be organized and logical in presentation. Sentences should be simple, direct, and grammatically correct. Proper letter case and punctuation should be used. Authors should use a standard font and font size in double-spaced lines. Finally, the author should provide a clear descriptive title for the paper.
Presenting Tables and Figures

A table is a list of values arranged in columns and rows for presentation. Be aware that a useful table is one that does not require further explanation. In other words, a table should be able to stand alone for anyone to interpret without having to refer to more descriptive text elsewhere. Thus every table should have an identifying number, descriptive title, column headings, and row headings. The units for a particular variable should also be indicated (usually in the column or row headings). Any other information pertinent to the table may be placed in a legend below the table. An example of a table (Table I) is provided below.

<table>
<thead>
<tr>
<th>TABLE I</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Effects of High Fat Versus Low Fat Diets on Rat Weights and Lengths</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIET TYPE</th>
<th>AVERAGE WEIGHT (g)</th>
<th>AVERAGE LENGTH (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>high fat</td>
<td>545.5</td>
<td>55.3</td>
</tr>
<tr>
<td>low fat</td>
<td>346.7</td>
<td>53.2</td>
</tr>
</tbody>
</table>

The high fat diet consisted of 50% fat, while the low fat diet consisted of 5% fat. Each rat was fed ad libidum. Length was measured from the tip of the snout to the base of the tail. The values presented averages for samples of 100 rats.

Figures may be graphs, photographs, or drawings. As with tables, figures should be able to stand alone without having to refer to text elsewhere. Figures require assigned figure numbers, descriptive titles, and legends if necessary. The axes of graphs should be adequately labeled with units indicated. Examples of graphs (Figs. 1 & 2) are presented below.

The following rules regarding the presentation of data in tables or figures should be followed:

1. Each figure or table must be identified by a figure or table reference number.

2. Each figure or table must have a clear descriptive title. If the figure or table refers to biological specimens, then the scientific names of these specimens are generally referred to in the title.

3. In tables, column/row headings should clearly identify the variable and its units of measure.

4. In figures such as graphs, the axes should be clearly labeled and the units of measure indicated.

5. In figures, such as diagrams or maps, the pertinent features should be clearly labeled.

6. Do not cram figures and graphs into a small space on a sheet of paper; try to fill up a whole sheet of paper.

7. A general rule of thumb is that each figure/table should be able to stand alone without forcing the reader to read additional text to understand it.

Figure 1. Frequency histogram of number of seeds per pod for koa haole, *Leucaena leucocephala*, seed pods.

Figure 2. Weight-length relationships of koa haole, *Leucaena leucocephala*, seed pods.
Descriptive Title

After completing the research paper, decide upon an appropriate descriptive title and insert at the beginning of your paper. Implied in the title is the nature of the topic investigated. A good title tells the reader what the paper is all about.

Literature Sources

Citing Literature Sources

Whenever writing a scholarly paper, you must document your sources of facts and information. For a typical science paper this is done by identifying the author(s) and year of publication of the article or book from where you for your information. Several examples of citations are presented in the text below.

Brown tree snakes have caused the extinction of many forest bird species on Guam (Savidge, 1987). They are also responsible for hundreds of power outages (Fritts et al., 1987), losses of domestic and pet animals (Fritts and McCoid, 1993), envenomation of human babies (Fritts et al., 1990) and the extirpation of native bats and lizard populations (Wiles, 1987; Fritts, 1988). According to Rodda et al. (1992), there is an immediate need to control brown tree snake populations.

Note in the first sentence of the example above "(Savidge, 1987)" indicates that the source of information for the fact presented about the extinction of forest birds in Guam was a paper or book written by an author whose last name was Savidge and that this paper or book was published in 1987. When a cited paper or book is authored by two co-authors, then both names are listed along with the year of publication (e.g., “Fritts and McCoid, 1993”). If three or more co-authors are involved, then the standard practice is to list the first author’s last name, followed by the Latin abbreviation “et al.” (= “and others”), then the year of publication. Note the sentence including the text “According to Rodda et al. (1992), …” indicates Rodda and his co-authors published their conclusion in an paper or book in 1992.

When describing the methods in the “Materials and Methods” section of an experimental research paper, you may describe methods reported on in the literature by other authors. If this situation occurs, then it is valid to simply refer to those authors’ publications as citations and avoid writing out all of the details - unless your methodology includes significant departures from these other methods. For example, you may write, “The protein concentrations were measured using the methods of Lowry et al. (1951).”

You may have an occasion to cite an expert who presented you some facts or opinions through email or through a personal conversation, rather than through a formal publication. In this situation, your citation should present the sources name, date of communication, and the words “personal communication” (abbreviated, “pers. comm.”), for example, “Brown tree snakes have been observed on Cocos Island (R. McCarthy, pers. comm. April 1 2001).”

You may also have the occasion to quote text verbatim from an author. However, direct quotes should be avoided under most circumstances. Most of the time you should be writing in your own words. When you must quote text directly from an author, you should indicate the page numbers within the publication where the quote may be found, as well as the author’s name and year of publication.

Internet sources may also be cited. But, despite the convenience of using the Internet, you should rely more heavily on “hard copy” documents published by reputable sources (e.g., scientific journals). Fortunately, many reputable journals make their “hard copy” articles available through the Internet as digital (usually pdf files). In this case, there is no real difference in validity between the “hard copy” and the digital version. Downloaded digital pdf versions of journal articles may be cited in a fashion similar to conventional journal articles.

Regardless, caution should be exercised when using the Internet as a source of information. Anyone can post a webpage and say anything on that webpage, factual or not. In general, you should avoid using webpages as your primary source of information.

Any sources cited in the body of your text must be referred to in the “Literature Cited” or “References” section of your paper (see below).

Types of Literature Sources

SCHOLARLY LITERATURE Scholarly literature is characterized as being discipline-specific and is produced and reviewed by
experts in the field. Scholarly literature containing original information, such as that resulting from experimental research is also known as the "primary literature". Most of this kind of literature will be found published in professional or technical journals, symposium or conference proceedings, technical reports to governmental agencies, and historical documents. The "secondary literature" reviews, summarizes and analyzes the primary literature. A scientific review paper is an example of this kind of literature. The secondary literature may be published in professional or technical journals, technical books, discipline-specific textbooks, discipline-specific magazines (e.g., Scientific American), and trade magazines. The "tertiary literature" consists of collections of information from primary and secondary sources. This kind of literature includes encyclopedias, bibliographies, handbooks, guides, almanacs, and fact books.

POPULAR LITERATURE  The popular literature is produced for general public consumption (although some forms of popular literature may target individuals with specific educational backgrounds). These kinds of literature sources may or may not be well-documented – a "grain of salt" may be needed in judging the validity of this literature. The popular literature includes popular magazines, editorials and opinion pieces, brochures and flyers, and fictional books and articles.

The Bibliography or Literature Cited Section

The Literature Cited section of a scholarly paper presents the bibliographic details for all of the literature sources cited in the paper. As mentioned above, the format varies, depending upon the type of literature source used.

References and citations are often needed (and expected). They are short-cuts, preventing you from excessive writing by simply quoting or mentioning what they suggested or said or thought. In the text, citations are inserted directly after information from a literature source is given, and written either in parentheses with only the author's last name, and the date of the publication (Moody, 1994) or if more than one author as (Mooschy, et al., 1993). If used as part of a sentence than only the date goes into parentheses "as Mooschy (1992) describes...". For citations from published scientific papers, this is enough. For citations from books, however, include the pages within the book where you are citing from (Moody, 1994, p. xx-xx).

There are standard formats for presenting bibliographic details for citations in the Literature Cited section of scholarly research paper. Some general formats are presented below. Some examples are also presented. More details on bibliography formats (especially Internet source formats) will be given later.

For an article from a professional journal or magazine:

Author's last name, initial (s) (list additional authors the same way], date; title of article, Journal/magazine name, volume # or month, p.

For a book:

Author's last name, initial (s) [list additional authors the same way], date: title of book: edition number (only if there is more than one edition), volume # (if it is a set of multiple volumes), publisher, city of publisher, total number of pages in the book (only for the volume you used, should there be more than one volume).

For an edited book of papers:

Author's last name, initial (s) [list additional authors the same way, date; title of article: in: title of book, editor (s) name (s), Editor (s): volume # [if there is one], p. xx-v-x [pages of the article within the book, not the total number of pages in the book].
Wilkinson, C.P.  1992.  Coral reefs of the world are facing widespread devastation: can we prevent this through sustainable management

Arrange the references in alphabetical order according to the first author’s last name.

Procedures and Assignment

I. IDENTIFY A RESEARCH TOPIC

Identify a research topic about which you wish to study. This topic could either be a scientific review paper or an experimental research paper (harder to do!). This topic must be biological in nature.

Write a short summary of the topic and why you are interested in it.

Provide a descriptive title for this topic.

II. RETRIEVE THREE PRIMARY LITERATURE SOURCES

Use the Internet to retrieve at least three literature sources (from the primary literature) relevant to your topic.

Provide the bibliographic details for these sources.

Print out “hard copies” of the abstracts for these sources.

Summary of Assignment to be Turned In

1. Descriptive title for assignment.
2. Descriptive title of the research topic.
3. Brief description of the topic including an explanation why it is of interest to you.
4. List the full bibliographic details for three literature sources, relevant to your topic, from the primary literature.
5. Print out of the abstracts from these literature sources.