

## PREPARATION OF LABORATORY REPORTS

The purposes of the laboratory exercises in this course are to introduce you to the technique of studying the interactions between organisms and their environments and to illustrate selected principles of ecology. Most of these exercises are designed so that you and your classmates collect specific information (data) to test the validity of one or more hypotheses. Since the data collected and the conclusions drawn from them are much more valuable if they are recorded and made available to others, one important aspect of the course is to learn the technique of scientific writing. In preparing your laboratory report, follow the suggestions given below as well as those given in lecture.

Scientific writing is characterized most of all by being concise and to the point. The object is to convey information. By eliminating unnecessary words and phrases in your paper you 1) reduce the time required to read it, and 2) save money (many journals require you or your institution to pay for each page of print required by your article).

For the sake of uniformity, you should construct your report using the following divisions: 1) Abstract, 2) Introduction, 3) Materials and Methods, 4) Results, 5) Discussion, and 6) Literature Cited. When you peruse articles in the journal *Ecology*, you will find that this organization is most often used.

### **Title**

The title should be brief, but descriptive of the content of your paper.

### **Abstract**

Briefly summarize your findings. The abstract should be in complete sentences and report what you did, found and concluded. Again, see recent issues of *Ecology* for examples.

### **Introduction**

Describe briefly the nature of the problem under investigation and indicate the general objectives of the experiment. The introduction should specify the hypothesis tested and the specific predictions that the hypothesis makes when tested. The introduction also must summarize other pertinent work in this area and thus prepare the reader for what is to come.

**CAUTION:** 1) avoid beginning your paper with phrases such as “The purpose of this exercise was to ...”, 2) do not use future tense (e.g., do not write, “This paper will show...”) and 3) avoid the passive voice if possible.

### **Materials and Methods**

If the introduction answers the “why” question, the Materials and Methods section should answer the questions, “what”, “how”, “where”, and “when”. You should briefly describe the location of the study and the techniques and equipment used. This section should also always include the number of samples taken. Remember that after reading

your paper the reader should be able to repeat your procedures based on what you have written.

**CAUTION:** 1) do not write the Materials and Methods section as a recipe found in a cook book, 2) assume you did the work yourself (do not write, “The class divided into two groups...”).

### **Results**

The results section often gives problems to many students. This section should contain only what the heading states---results. No interpretation of the results should be included. Results can be presented in the text, in tables or in graphs (these are called figures). If tables or figures are used then the text should refer the reader to them and they should be given consecutive numbers.

### **Discussion**

In this section you pull together your results, draw conclusions and point out the significance of the data. This is the most important part of your paper and should entail the most thought. It is imperative that you indicate whether the results of your experiment support or reject your hypothesis outlined in the Introduction. You should also explore the ramifications of your results. How do your results compare with the published findings of others? This is your opportunity to exercise your imagination tempered with logic, to produce well-grounded speculation and generate additional testable hypotheses. What is the ecological/evolutionary meaning of your results?

### **Literature Cited**

When you refer to an idea or data taken from an article or book you are citing, you must give credit to the original authors by citing the reference from which you obtained the ideas or data. To do otherwise is to be guilty of plagiarism. In this section, list in alphabetical order any references cited in your report. In the text, refer to the papers cited in either of the following ways (Harvard System): “Heinrich (1976) reported a correlation between foraging efficiency and age in bumblebees.” Or “Foraging efficiency in bumblebees is a function of age (Heinrich 1976).” See the journal *Ecology* for examples.

The full citation in the literature cited section is given below. References listed in this section should be formatted with hanging indentation. See the journal *Ecology* and the instructions to authors for methods used in citing books, and other materials.

Heinrich, B. 1976. The foraging efficiency of ageing bees. *Psyche* 28:15-28.

### **Additional Information for Laboratory Reports :**

1. If you have a question regarding format, consult a recent issue of *Ecology*

2. All scientific names must follow these rules:

Kingdom through genus – capitalize

Genus and species – italicize

species – never capitalize

Use the vernacular name with the scientific name in parentheses the first time you mention an organism in your report. After that, the vernacular name is sufficient.

3. All measurements and figures must be in S.I. (metric) system.
4. You will receive instructions and data sheets to be used in some of the lab exercises. Do not include these in your reports.
5. Your report should be carefully organized and well-written. The highest standards of English composition and grammar are expected. There is no excuse for poor syntax, improper grammar, or frequent typographical errors.
6. Your report should be typed.
7. Do not hesitate to ask questions regarding the format or content of the report.

## Laboratory Report Format

From Ecology Instructions to Authors

Use American spellings (e.g., behavior, not behaviour). The *CBE Style Manual*, Fifth Edition, is recommended for details of style.

### ***Spaces, margins & fonts***

**The entire manuscript must be double-spaced** (text, quotations, figure legends, tables, literature cited, etc.) at three lines per inch (12 lines/ 10 cm). Print on only one side of letter (8.5 x 11 inch) or A4 (210 x 297 mm) paper. Leave at least 1 inch (2.4-cm) margins on all sides of each page. Use a 12-point font (proportionally-spaced type) or 10 characters/inch (4 characters/cm) if the letter spacing is uniform. Do not hyphenate words at the right margin or justify the right margin. Put the author's name in the header for each page and number all pages, starting with the title page.

### ***Equations, symbols and abbreviations***

Define all symbols, abbreviations and acronyms the first time they are used. Equations to be set separately from the text will be broken into two or more lines if they exceed the width of one column; mark equations for appropriate breaks. Subscripts and superscripts should be clarified by marginal notes. Use leading zeroes with *all* number  $<1$ , including probability values (e.g.,  $P < 0.001$ ). Use boldface roman type to denote matrices and vectors

### ***Underlining & italics***

Underlining indicates italicization. (If mathematical expressions are to be set with underbars, this must be indicated clearly on the manuscript, by means of a special note.) Underline or italicize scientific names and the symbols for all variables and constants *except* Greek letters. Symbols should be italic in the illustrations to match the text. Italics should rarely be used for emphasis.

### ***Footnotes***

Footnotes to text should be avoided; most footnote material can be incorporated in the text (parenthetically if necessary) to the benefit of readers, editors, and printers.

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## Organization of the paper

### ***Title page***

*Running Head.* -- A running head of not longer than 40 letters and spaces should be provided at the top of the title page.

*Title.* -- Titles should be concise, informative, tell what the paper is about and what it found. It should contain keywords necessary for digital search and retrieval methods. Avoid vague declarations (e.g., "effects of ..."); strive for information content (e.g., "fungi kill tardigrades"). The maximum length is 13 words or 100 characters.. Do not include the authority for taxonomic names in the title or in the abstract. Titles may not include numerical series designations.

### ***Abstract and key words***

The abstract should explain to the general reader why the research was done and why the results should be viewed as important. It should provide a brief summary of the research, including the purpose, methods, results, and major conclusions. Do not include literature citations in the Abstract. Avoid long lists of common methods or discursive explanations of what you set out to accomplish,

The primary purpose of an abstract is to allow readers to determine quickly and easily the content and results of a paper. Abstracts should not exceed 200 words for Reports, Notes, and Communications, and 350 words for articles and for Data Papers.

Following the Abstract, list up to 12 key words. Words from the title of the article may be included in the key words. Each key word should be useful as an entry point for a literature search.

### ***Body of the article***

If appropriate, organize your article in sections labeled Introduction, Methods, Results, and Discussion. You may need to add a section for Conclusions. Brief articles usually do not require a label for the Introduction. If the nature of your research requires a different organization, specify the level of each section heading (1<sup>st</sup>-order head, 2<sup>nd</sup>-order head, etc.) in the margin.

A brief **Introduction** describing the paper's significance should be intelligible to the general reader of the journal. The Introduction should state the reason for doing the research, the nature of the questions or hypotheses under consideration, and essential background. The Introduction is not a place for a lengthy review of the topic!

The **Methods** section should provide sufficient information to allow someone to repeat your work. A clear description of your experimental design, sampling procedures, and statistical procedures is especially important. Do not describe commonplace statistical tests in Methods, but allude to them briefly in Results. If you list a product (e.g., animal food, analytical device), supply the name and location of the manufacturer. Give the model number for equipment specified. Supply complete citations, including author (or editor), title, year, publisher and version number, for computer software mentioned in your article.

**Results** generally should be stated concisely and without interpretation, though in complex studies modest interpretation of individual parts can provide context helpful for understanding subsequent parts. The **Discussion** should explain the significance of the results. Distinguish factual results from speculation and interpretation. Avoid excessive review.

### ***Literature cited (and other citations)***

Avoid excessive citations; cite only essential sources. Before submitting the manuscript, check each citation in the text against the Literature Cited to see that they match exactly. Delete citations if they are not actually cited in the article. The list should conform in sequencing and punctuation to that in recent issues of the journal. All journal titles should be spelled out completely. Provide the publisher's name and location when you cite conference proceedings or other books.

Do not list abstracts or unpublished material in the Literature Cited. These materials may be listed in the text as *personal observations* (by an author of the present paper), *personal communications* (information from others), *public communications* (information in published abstracts, or information publicly distributed over the Internet but not permanently archived), *unpublished manuscript*, or *unpublished data*. The author(s) is expected to verify for all "personal communications" that the authority cited agrees to the use of his or her name. For public communications, the reference should include date printed or accessed, and title of the source, and basic access information such as URL.

### ***Tables***

Tables should supplement, not duplicate, the text. They should be numbered in the order of their citation in the text. Start each table on a separate page. Provide a short descriptive title at the top of each table; rather than simply repeating the labels on columns and rows of the table, the title should reveal the point of grouping certain data in the table. Statistical and other details should be provided as footnotes rather than appearing in the title. Do not add vertical or horizontal lines to tables unless essential to avoid ambiguity. Never repeat the same material in figures and tables; when either is equally clear, a figure is preferable. Do not include any class of information in tables that is not discussed in the text of the manuscript.

### ***Illustrations***

Each copy of the manuscript should include photocopies of illustrations. Number illustrations in the order in which they are discussed in the text. Group the figure legends in numerical order on one or more pages, separate from the figures. The figure title should be given as the first line of the legend.

Most illustrations will be reduced to single-column width in the journal (76 mm); symbols and lettering should be clearly legible after reduction. After reduction, all lettering should be at least as large as the smallest type used in the journal (6

points). Uppercase letters are preferred except where SI requires lowercase letters for unit abbreviations. Nomenclature, abbreviations, symbols, and units used in a figure should match those used in the text. Helvetica font is preferable for figures. Use italic lettering only as it is used in the text (e.g., variables, species names). Solid black bars in bar graphs tend to overwhelm the adjacent text; use white, shaded, or hatched bars in preference to black ones.

### ***Assembly of the manuscript***

Assemble the parts of each copy of the manuscript in this order: title page, abstract, key words, text, acknowledgments, literature cited, print appendices, tables, figure legends, figures, digital appendices and supplements. Number all pages (including appendices, tables, and figures) consecutively.

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## **Conventions**

### **Identification of the objects of study**

Early in the manuscript, identify the type(s) of organism or ecosystem you studied; e.g., "*Cornus florida* L. (flowering dogwood), a small deciduous tree". Avoid descriptive terms that may be familiar only to specialists. Provide the scientific names of all organisms. Common names may be used when convenient after stating the scientific names.

Genus names must be spelled out the first time they are used, but may be abbreviated to a single letter thereafter if no confusion will result. If the article contains several different scientific names, it is a good idea to spell out the generic name the first time it appears in each major section. Species names must always be spelled out in text; space limitations in tables or figures may require use of a "code," such as the first letter of the genus and species name; these letters should be in italics, like the original scientific name.

Check carefully the spelling of all scientific nomenclature. Copy editors cannot be expected to do this.

Authorities for scientific names must be provided (preferably when first used), or a reference can be given wherein the authorities can be found. Because usage of scientific names varies between investigators and can be ambiguous when out of context, conformance to a comprehensive nomenclatural standard is highly desirable. Suggestions for [nomenclature standards](#) are available for commonly studied groups.

### ***Statistical analyses and data presentation***

Authors are free to interpret statistical analyses as they see fit. The author, however, needs to provide the reader with information sufficient for an

independent assessment of the analysis. Thus, the assumptions and the model underlying any statistical analysis must be clearly stated, and the presentation of results must be sufficiently detailed. Sampling designs, experimental designs, data-collection protocols, precision of measurements, sampling units, and sample sizes must be succinctly described. Reported statistics usually include the sample size and some measure of their precision (standard error [SE] or specified confidence interval [CI]) except where this would interfere with graphical clarity. The specific statistical procedure must always be stated. Unusual statistical procedures need to be explained in sufficient detail, including references if appropriate, for the reader to reconstruct the analysis. If a software product was used, complete citation should be given, including version number. When reporting results, actual *P* values are preferred. For more information consult the guidelines on "[Statistical analysis and data presentation](#)" prepared by the Statistical Ecology Section of ESA.

### ***Units***

Units of measure should conform to the International System of Units (SI). If measurements were made in other units, include the SI equivalents.

Consult *Standard Practice for Use of the International System of Units* (ASTM Standard E-380-93) for guidance on unit conversions, style and usage. An abbreviated version may be downloaded from the [ASTM website](#). When preparing text and figures, note in particular that SI requires the use of the terms *mass* or *force* rather than *weight*. When one unit appears in a denominator, use the solidus (e.g., g/m<sup>2</sup>); for two or more units in a denominator, use negative exponents (e.g., g.m<sup>-2</sup>.d<sup>-1</sup>). Use a capital L as the symbol for liter.