WRITING LAB REPORTS OR RESEARCH REPORTS

A scientific research report is a primary means of communication among scientists and researchers. It allows an individual researcher or team or researchers with similar interests to share their findings and ideas with their peers in an organized and official manner. The formal lab reports you will write as an undergraduate student are modelled on the reports written and submitted by scientists, professors and other researchers to professional and scientific journals. These reports are peer reviewed and, if accepted for publication, are published in journals available globally. Scientists and researchers read these journal articles, and use the information to further their own research or to collaborate with others. This is how the body of knowledge in a certain discipline grows.

The format of the journal article is structured to allow readers to quickly identify what they are looking for and to follow in a logical manner the work done by the author. Whether you are writing a lab report for a course, a graduate thesis, or a paper for publication in a scholarly research journal, the format is similar to the one described below. However, because some courses have special needs, **always consult your instructor to find out the particular requirements for your assignment.**

Parts of a Lab or Research Report

Title

- The title of a report should indicate exactly what you have studied. e.g.,

The Effects of Light and Temperature on the Growth of the Bacterium, Escherichia coli.

This title explains the environmental factors manipulated (light and temperature), the parameter measured (growth), and the specific organism used (*E. coli*).

- If a large number of variables or organisms were used, the title could say "*Several Factors...*" or "*Various Chemicals....*"
- It is unnecessary to include words such as "**Observations on** *the Effects of...*" or "**A Report on** *the Effects of...*" or "**A Study on** *the Effects of....*"

Other examples of titles could include the following:

- Morphological studies on the effect of methyl mercury on Black Duck liver (biology)
- Relationships between perceptual mechanisms for color and pattern in human vision (psychology)
- Relationship between mineralogy and trace element chemistry in sediments from two fresh water deltas and one marine delta within the Fraser River Basin (geology)

Abstract

The abstract is a condensed version of the entire lab report (approximately 250 words). A reader uses the abstract to quickly understand the purpose, methods, results and significance of your research without reading the entire paper.

Abstracts or papers published in scholarly journals are useful to you when you are conducting library research, because you can quickly determine whether the research report will be relevant to your topic.

The material in the abstract is written in the same order as that within the paper, and has the same emphasis. An effective abstract should include a sentence or two summarizing the highlights from each of the sections: introduction (including purpose), methods, results, and discussion. To reflect the content (especially results and conclusions) of the paper accurately, the abstract should be written **after** the final draft of your paper is complete, although it is placed at the beginning of the paper.

- Begin the abstract with a brief, but specific, background statement to introduce your report.
- State your main purpose or objective and hypothesis.
- Describe the important points of your methodology (species/reagents/ingredients, the number of subjects or samples, and techniques or instruments used to make measurements).
- Summarize the main results numerically and qualitatively (include standard errors and p values as required)

- Summarize the major points from the discussion/conclusion. Focus on the points that directly relate to your hypothesis/question.
- For each type of information, use the same tense as in each corresponding section (i.e., past tense for methods and results, present tense for theory and conclusions).

Introduction

Why did you study this problem?
The introduction should identify the problem or issue and provide the background information (on previous work and/or theories) that the reader needs to understand your experiment. To do this, the introduction contains a brief literature review to describe previous research conducted on the problem, and to explain how the current experiment will help to clarify or expand the knowledge. The introduction should end with a purpose statement (sometimes in the form of a hypothesis or null hypothesis): one sentence which specifically states the question your experiment was designed to answer. e.g.,

The purpose of this investigation was to determine the effects of environmentally realistic exposures of acid precipitation on productivity of field-grown and chamber-grown peanuts. (as a purpose statement)

or

The hypothesis was that environmentally realistic exposures of acid precipitation would affect the productivity of both field-grown and chamber-grown peanuts. (as a hypothesis)

or

The null hypothesis was that environmentally realistic exposures of acid precipitation would not affect the productivity of either field-grown or chamber-grown peanuts. (as a null hypothesis)

Use resources such as your textbook, course notes, and journal articles to build the foundation, and use examples of similar experiments/results that others have done that support your hypothesis. Don't forget to document your sources using appropriate referencing style for your discipline (see the Fastfacts series on referencing).

- Use any appropriate background information from the lab manual and the lectures.
- Clearly state your purpose and hypothesis at the end.
- Use the present tense for most of the information in the Introduction (for current or accepted theory), but the present perfect and the past where logic demands (for specific results of previous studies).

Materials and Methods

What did you do? How did you do it?
In this section you will describe how and when you did your work, including experimental design, experimental apparatus, methods of gathering and analyzing data, and types of control.

- Include complete details and write this section clearly enough to allow readers to duplicate the experiment if they so wish. (In writing lab reports for undergraduate courses, you may not always be required to write a detailed materials and methods section because the methods are already described in the laboratory manual; check with your instructors about how much information to include in the written report.)
- Write in past tense because you have already done the experiment. Use complete sentences, and do not write in the form of instructions or as a list of materials as in a laboratory manual.
- Use either first person active voice or in passive voice to describe what you did. Check whether your professors will accept the use of the first person in your report. e.g.,
  (first person active voice) *I filled six petri plates with agar.*
  (passive voice) *Six petri plates were filled with agar.*
- Methods adapted from other sources should be referenced.
- Photographs, maps and diagrams may be used to help describe the experimental setup (see Tables and Figures in this Fastfacts handout).
- Describe any procedures that you altered compared to the lab manual or published procedures.

Results

What did you find?
In the results, you present your observations and data with no interpretations or conclusions about what they mean. A well-written and well-organized results section will provide the framework for the discussion section.

- Record all your results, using complete sentences, usually in the order the observations were made.

- Tables and graphs should be used to supplement the text and to present the data in a more understandable form (see Tables and Figures in this Fastfacts handout). Raw data will probably be most effective in table format, with the highlights summarized in graph form.
- The written text of the results section **may** be as short as one sentence summarizing the highlights and directing the reader to specific tables and figures.
- Include results that went "wrong" or were unexpected. This may be useful information for someone trying to repeat the experiment.
- Use both words and numbers to describe your results, and use proper terminology.
- Use past tense to describe your results.
- Sample or detailed calculations for a lab report in a course may be included in a separate section titled "*Calculations*" or in an Appendix at the end of the report. Check with your course instructors for specific requirements in a particular course.

Discussion

What does it mean? How does it relate to previous work in the field?
Explain what you think your data mean.

- Describe patterns and relationships that emerged.
- Discuss why you observed what you did, how it happened (or the most likely reason), and how it relates to the purpose of the experiment.
- Compare these results to trends described in the literature and to theoretical behaviour.
- Support your interpretations with references to course material, the lab manual, and comments from the TA or instructor during the lab. You may also be asked to use other resources (peer reviewed journal articles) for a more in-depth discussion; if you do, remember to reference properly (see References in this handout).
- Continue to be descriptive; the readers may not read each result and jump to the discussion to find out why it happened, so provide them with enough information to understand the discussion. Remind the reader of your own results, when relevant, **without** repeating endless details from Results. e.g.,

The temperature increased during the second phase because of the drug treatment. (Discussion statement)

not

The temperature increased during the second phase. (repetition of Results statement)

- If your result section was well organized, you can follow it as a guide while you are writing the discussion. You can refer to the same tables and figures to explain the changes/trends/unexpected results.
- Accept or reject your hypothesis and explain why. It is acceptable to reject your hypothesis as long as you can prove it to be untrue and explain why the results did not turn out as you predicated. You can't argue the results, but if something went wrong or was damaged, disturbed, or contaminated; if there were changes to the experimental procedure; or if equipment was faulty, you need to include this information and explain how it may have affected the results.
- If your lab manual includes questions to be answered in the Discussion, integrate your responses into a logical discussion, rather than answering them one by one. And don't include **only** the answers to the questions – use them as a guideline for supplementing your discussion, not limiting it.
- Your final paragraph is the conclusion. Include a brief restatement of the purpose and the main results and how they are relevant to the field of study. Also include any future direction for your results or changes you would make the next time to produce results that are more significant or noteworthy.
- This section will be written in the past tense when you are describing your experiment, and present tense when comparing to current theory.

Tables and Figures

Tables and figures are often used in a report to present complicated data. Use the following guidelines to incorporate them effectively.

- Tables are referred to as tables, and all other items (graphs, photographs, drawings, diagrams, maps, etc.) are referred to as figures.

- Numbering: All tables and figures must be numbered. Tables and figures are assigned numbers in the order they are mentioned in the text. Tables and figures are numbered independently of each other (i.e., Table 1 and 2, and then Figure 1 and 2 as well).
- All tables and figures must have self-explanatory titles so that the reader can understand their content without the text. e.g.,

Table 1. Percent of soybean plants exhibiting visible injury after exposure to acid precipitation.

- Labeling: Tables are usually labeled at the top and figures at the bottom.
- Each table or figure MUST be introduced within the text, with a comment that should point out the highlight(s) or significant trend(s), not every piece of data that is shown. e.g., Do not write:

The plant was 4.0 cm on day 1, 4.2 cm on day 3, and 5.0 cm on day 4.

Simply state:

The plant increased in height over a 4-day period (Figure 1).

- Tables and figures may be placed at the end of the paper, or within the text as soon as possible after they are mentioned without interrupting the text (i.e., at the end of a paragraph or section). Check with your professors for their preference.
- Avoid referring to *the table below* because you don't know exactly what the final placement of the table will be. Refer to the specific table or figure number, and the readers will always be able to find the information.
- The tables and figures should enhance the report, but the reader should be able to understand and follow the results even if the tables/figures were removed.

References

Also called "Literature Cited" or "References Cited," this is a list only of **papers and resources actually mentioned** (cited) within the report. (NOTE: A "Bibliography," on the other hand, refers to a list of all materials used to get background knowledge on a subject; you will not usually be required to include one in a scientific lab report.)

Scientific lab reports are written for the sole purpose of sharing information. If readers want more information about something, they need to be able to find the exact place it was originally written. References also give credit to the person who did the work and provide your work with authority.

- The reference list is provided on a separate page at the end of the report.
- Remember that ALL information within the report that is not your original work or ideas should be referenced (even if not quoted directly, but paraphrased or summarized – quotations are rare in scientific writing).
- Reference your lab manual, textbook, and any journal articles used.
- In-text citations usually occur in one of two places in the sentence: *Smith (1999) has also found that E.coli is one of the only microbes to . . . .* or *E.coli is one of the only microbes to . . . (Smith 1999).*
- There are several standard styles for documenting references. Check with your lab manual, your professors, or your TA for their preference. You may be asked to follow the format of a particular journal in your field. If so, follow that format exactly. For more information about standard formats, see the Fastfacts handouts CBE Referencing Style.

General Tips about the Formal Lab Report

Lab reports are the foundation of scientific research. They allow scientists to share information and lead to new discoveries. Consider your lab report to be a part of this body of knowledge and write it effectively. Following are some general tips.

- A formal lab report may take several hours to write properly, so plan ahead.
- The more depth and thought you put into the report, especially the discussion, the better it will help you to understand the course material and improve your grade.
- Do not copy from friends. This is a form of academic misconduct that is easily detected and is subject to severe penalties.
- Always check with your instructor or TA for detailed instructions about the format: for example, you might ask if the tables and figures should be included in the Results section or at the end of your report.

Additional Relevant Fastfacts

- Improving Your Writing
- Plagiarism and Academic Integrity

Need Advice or More Information?

Writing Services, located in the Learning Commons on the 1st floor of the Library, is the best source on campus and online for advice and information on writing issues.

- Peer Helpers from a variety of disciplines offer individual writing assistance to first-year students and ESL students. And all University of Guelph students – undergraduate and graduate – are entitled to three free individual writing consultations per semester with our professional staff. Appointments are recommended.

- Visit the Learning Commons home page to find out about all our writing programs and services, or e-mail questions to writing@uoguelph.ca.

- Fastfacts handouts (like this one) provide information on a range of learning, writing, and academic computing issues and are free to registered students. The complete range of Fastfacts is available on the Learning Commons website.

- More detailed information on writing university papers can be found in our Learning Commons publications, available for purchase at the Learning Commons reception desk or the campus bookstore.

- Workshops, seminars, and short courses on learning, studying and writing topics are offered regularly each semester. Please contact the Learning Commons for details.

Writing Services
The Learning Commons, 1st Floor, Library
www.learningcommons.uoguelph.ca
writing@uoguelph.ca
(519) 824-4120 ext. 53632

UNIVERSITY of GUELPH