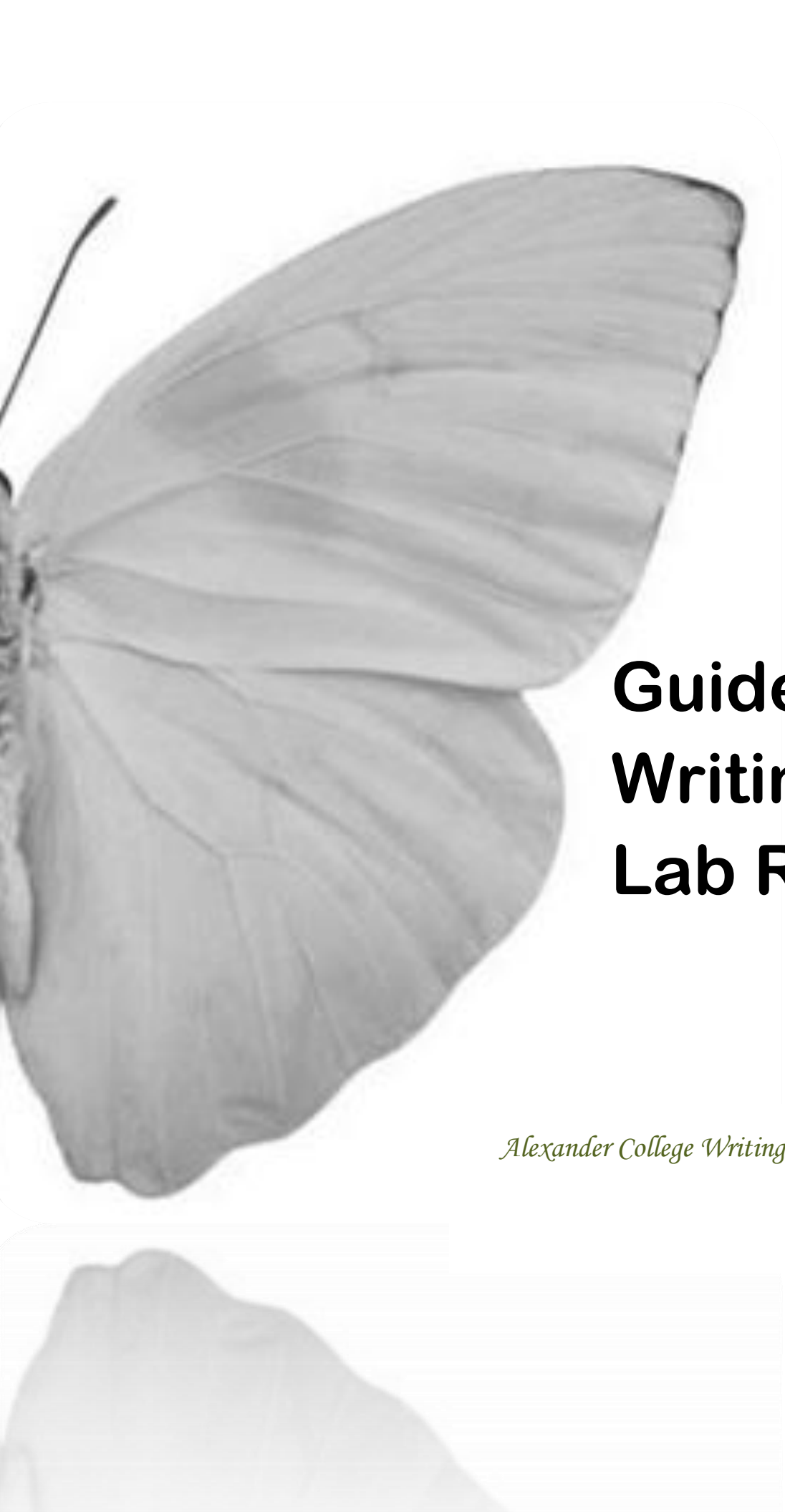
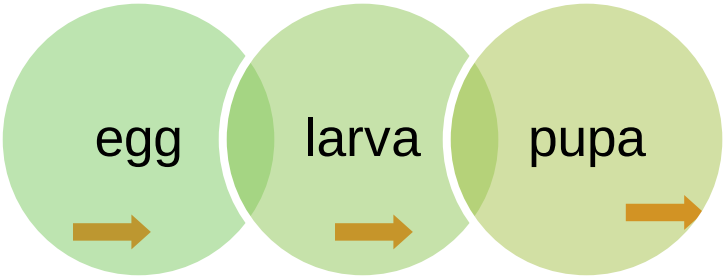


# Guide to Writing a Lab Report

*Alexander College Writing & Learning Centres*

*Updated April 2015*




## BACKGROUND

The purpose of the formal lab report is to assess your ability to perform the experiment, to analyze and interpret the data, and to convey the information in a clear, concise fashion. Being a scientist involves critical thinking. A scientist makes observations, asks questions, formulates hypotheses and designs experiments to test their hypotheses. The results of the experiments are analyzed, and may lead to the formulation of new questions and hypotheses. In fact, everything you learn in lecture and from textbooks is based on interpretation of scientific data. Therefore in all fields of science it is extremely important to be able to clearly communicate scientific results to others.

## WHY WRITE A LAB REPORT?

Scientific reports are the primary means of communicating amongst scientists and researchers. Formal lab reports written in university science courses are modeled after scientific reports that are submitted to scientific journals. They are an essential component of the laboratory portion of any biology course as they are used to convey your understanding of the scientific process. If you are intent on pursuing a career in research, learning to write scientific reports today will be an investment in your future. ***No matter how brilliant a scientist you are in the lab, if you cannot effectively and clearly communicate your results, then all your hard work in the lab is pointless***. Treat writing your report as you would any essay assignment – pay attention to organisation, grammar and clarity of expression. Book an appointment with a writing instructor at the Writing & Learning Centre for assistance: https://alexander.mywconline.com

## FORMATTING A LAB REPORT

A formal lab report should be:

- Handed in stapled at the top left hand corner (no booklets please)
- Printed on one side only on 8.5 x 11 paper
- It should be typed in 12 point font, double spaced, and have 1 inch margins
- Do not submit electronic files!
- A lab report is always written in paragraph form.
- Although you may collect data as a group, all lab reports must be written individually unless otherwise indicated.

## PARTS OF A BIOLOGY LAB REPORT

Chapter 9 in the book, *A Short Guide to Writing about Biology* written by Jan A. Pechenik (2013) is an excellent in depth guide to writing lab reports for biology. It is recommended that you obtain this book if you do not already have it. You will find it useful throughout your undergraduate studies in Biology and beyond. The following information is a brief summary of Pechenik's recommendations of how to write a lab report.

### A formal lab report is divided into 6 major sections and has a title page:

### 1. Title page:

**The title should be specific and informative.**

Captivate the audience in 150 characters or less. The title page should include a descriptive title, your name, your partner's name in brackets (if you had one), the course name, the lab section number, and the lab instructor's name.

### 2. Abstract:

**An abstract is a concise summary of the essence of the lab report.**

It is written last, at the end of the lab report writing process, because it summarizes the full report. It is placed directly after the title page before the introduction section. An abstract should be a single paragraph written in the passive voice that contains approximately 250 words and addresses the following:

- What problem was addressed? Or what was the purpose of the experiment/study?
  - How was the investigation approached? Or summarize the methods used.
  - What were the major results?
  - What conclusions did you draw?
- It should be straight forward, making sense to someone who has not read the whole paper.

### 3. Introduction:

**A good introduction is brief. An introduction begins with a broad statement that identifies the problem being investigated.**

- The introduction should also provide background information about the organism(s) studied, including common name and full scientific name.
  - Once the full scientific name has been given subsequent references may be shortened
    - Example- *Homo sapien* becomes *H.sapien*
- Definitions of all relevant terms and a brief review of previous research conducted on the problem should also be included.

- The background information is followed by a clear statement of the specific issue(s) being addressed in the body of the lab report.
  - Generally this is the hypothesis being tested
    - The purpose of the experiment should be described in a single sentence and written in the past tense since the experiment t has already been completed.
- Next, when appropriate, provide the rationale for selecting the specific organism or study system that was used.
- Like the abstract section, an introduction is most easily composed after the materials and methods, results, and discussion sections are written
  - Background research can be started before the experiment is conducted.
- In the introduction, support all statements of fact with reference to your sources:
  - Textbook, laboratory manual, journal articles, or lecture notes
- All sources must be cited by including in-text citations.
  - These citations appear in brackets with the name of the author, then a coma followed by the year of the publication.

For information about citing your sources see the **Citation Style Guides** links on our **'Academic Writing Styles'** page: http://alexandercollege.ca/writing-and-learning-centre/english-and-humanities/academic-writing-styles/

## 4. Materials and Methods:

- In introductory biology courses it may not be necessary to rewrite the materials and methods section as it is often provided for you in your laboratory manual.
  - If this is the case, it is important to write a statement that says the materials and methods used for this lab are listed in the Biology XXXX lab manual on pages XXXX and to provide an in-text citation.
    - Remember to include the lab manual in your literature citation if this is the case.
  - Any departures from the materials and methods outlined in the lab manual should be mentioned in this section as well.
- If the experimental design is your own, then you must clearly describe the procedure, equipment, and materials used.
  - It is essential that you describe the methods in sufficient detail for the experiment to be repeatable exactly as originally performed.
- Students commonly give too little or too much information.
  - This section should be brief but informative and remember to make it clear why certain steps were taken.

## 5. Results:

**The results section summarizes the experimental findings using tables, figures (graphs, diagrams, & photographs) and written text.**

- The results section of a formal lab report is written in ***past tense*** and is the centrepiece of any lab report, providing a framework for the discussion section that follows. Other parts of a lab report are subject to the author's interpretation of the data and reflect opinions, hopes, biases, etc. If data is carefully collected, analyzed, and presented, the results are valid regardless of how those opinions may change over time.
- The **purpose of a results section** is to clearly present the results (good and bad) of the experiment, draw the attention of the reader to any major observations, and identify any obvious trends in the data.
- **There is no single right way to present your experimental data.** You should decide on the most appropriate format, (tables and graphs, or diagrams), to reveal trends in a simple fashion, making it easy for the reader to understand.
  - This may mean you need to include summary statistics to describe the results (examples: estimate of means, standard deviations, and statistical tests such as confidence intervals and Chi-square tests).
- The results should focus on the specific issues being addressed but need not be limited to these as other information may have arisen once the data was collected and examined.

**A results section is all about data presentation and should NOT include:**

- Interpretation of the results
- Discussion about why the experiment was performed
- Discussion of expectations or opinions

### Methods of Summarizing your Results:

- You need to determine what relationships in the data are worth examining and how best to present those relationships. Experimental findings are usually presented using tables, figures (graphs, diagrams, and photographs), and a written summary.
- **Figures and tables do not always need to be present to properly present the results, but a written summary should always be included.**
  - A proper figure or table must be self-sufficient, meaning it should make perfect sense to any reader as long as it is accompanied by a good caption.
- Data should generally only be represented once
  - It is time consuming and unnecessary to include both a figure and a table that contain the same information.

**a) Tables**: Tables are a useful way of summarizing numerous categories of data.

- They usually organize data related to a specific characteristic into columns, making it easy for the reader to scan.

- A table is not necessary if the data can easily be summarized in one sentence.

**b) Figures**: While tables are sometimes useful, in some instances it is better to present the data in a graph, allowing the reader to visualize trends and differences between experimental groups.

- Figures, especially graphs, can reveal more subtle variations in the data that would not be clearly seen otherwise.
- A variety of graphical styles are used in biological studies, including scatter plots, line graphs, pie charts and bar graphs.
    - Note: diagrams and photographs are also categorized as figures in a lab report.
- Graphs can be generated using a computer but unless your instructor indicates otherwise, they should be neatly hand drawn.
    - When preparing a graph by hand it should always be on graph paper.
    - Once you have mastered graphing data, it is important to learn to use computer graphing software such as Microsoft Excel as it is widely used today.

## 6. Discussion:

In this section of a lab report the author interprets the results in the context of the specific question being addressed by the experiment and in the context of relevant broader issues that have been raised in lecture, textbook readings, and possibly library research.

**In the discussion section you want to discuss the following:**

- What you expected to find and why? Support this with references to other similar experiments or theories (text, lecture, lab manual, etc.) when possible.
- How your results compared to your predicted results (example- hypotheses)? How would you explain unexpected results? In other words, causes of significant variation and sources of error.
- How would you go about testing these potential explanations?
- Based on the results, what question(s) might you want to investigate next?

It is important to remember to distinguish “possibility” from “fact”:

- **Experiments do not prove anything**
- **They simply support or fail to support hypotheses**
- Interpretations of data are not necessarily correct
- They are subject to change in light of new information.

The discussion section is ***always written in paragraph form***:

- It is written in the past tense when describing your experiment
- It is written in present tense when comparing results to current literature.

The discussion section should be organized in a similar order and manner to the results section. When the lab manual includes questions to be answered in the discussion, the answers need to be integrated into the discussion in a logical manner (not simply answered in order).

The final paragraph of a discussion is generally the conclusion (some journals require a separate conclusion section) and should include a brief restatement of the purpose of the experiment, the results and conclusions, and how the findings are relevant to the field of study. Finish the concluding paragraph with a statement about the possible direction(s) this experiment could take in the future to improve it or produce more significant or noteworthy results.

Every experiment that is properly executed tells us something even if it is not what you specifically intended to find out. Thus it is important to include an explanation of any unexpected results. It is common for students to suggest that unexpected data is due to equipment failure or human error, but often there is a much more scientifically interesting explanation for experimental abnormalities. It is always a good idea to look for alternative scientific explanations other than faulty equipment and human error. See what you can come up with and impress the lab instructor! The best location for this portion of a discussion is often just prior to the concluding paragraph.

## 7. In-Text Citations and References:

**The reference section contains a list of all of the references you cited in the lab report including the lab manual and the textbook so that you give credit for ideas that belong to another author.**

- The reference section is sometimes referred to as the literature cited section.
- In papers, lab reports, *etc*. it is important to support factual statements and opinions by referring to the source(s) of the statement presented.
- It is common to use references in the introduction and discussion sections of a lab report, but in many introductory biology courses you may be asked to cite the lab manual in the materials and methods section rather than rewriting the procedure.
- In research journals, in the area of biology there are many different reference and citation formats used and one must look up the requirements for a specific journal before writing the research paper for that specific journal.
- **APA Citation Style is usually recommended**, but use the citation style designated by your instructor.

**For information about citing your sources see the Citation Style Guides links on our 'Academic Writing Styles' page:** http://alexandercollege.ca/writing-and-learning-centre/english-and-humanities/academic-writing-styles/