**THESIS TITLE**

**NAME OF STUDENT**

A0112345X

A THESIS SUBMITTED TO THE

# DEPARTMENT OF BIOLOGICAL SCIENCES

NATIONAL UNIVERSITY OF SINGAPORE

IN PARTIAL FULFILLMENT

FOR THE DEGREE OF BACHELOR OF SCIENCE

WITH HONOURS

IN LIFE SCIENCES

\*Please edit BIOLOGICAL SCIENCES to your project department if applicable.

\*\*Please edit BACHELOR OF SCIENCE to BACHELOR OF ENVIRONMENTAL STUDIES, and LIFE SCIENCES to ENVIRONMENTAL STUDIES if applicable.  
Please delete this instruction in red.

LIFE SCIENCES HONOURS COHORT

AY2017/2018 S1

**DECLARATION**

I hereby declare that this thesis is my original work and it has been written by me in its entirety. I have duly acknowledged all the sources of information which have been used in the thesis.

This thesis has also not been submitted for any degree in any university previously.

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Name of Student

XX April 2018

**LSM4199 HONOURS PROJECT IN LIFE SCIENCES (16 MCs)**

***Guide on Honours Thesis Writing (Version 7)*** *(dated 24th January 2018)*

This guide serves as a general reference for Life Science Major Students in writing the Honours Project Thesis. The items recommended here are fundamentally what an acceptable thesis report should encompass. Certain formatting such as font, reference and citations may deviate to match the common practices in the fields of Life Sciences research the project is based in. Length of text is described to give an estimate of the volume of the thesis expected.

1. **Order of Contents**

The order of contents should be as below:

Title Page

Declaration

Acknowledgements

Table of Contents

Abstract

Introduction (including Literature Review)

Materials and Methods

Observations and Results

Discussion

(Results and Discussion can also be combined as one section)

[A short section on General Conclusion(s) can also be included]

References

Appendices (if there is any)

1. **Pagination**

All sections before the *Introduction* (except the *Title Page*) should be numbered in Roman numerals (i, ii, iii, iv, etc.) at the bottom centre of the page. All other pages should be numbered with Arabic numbers (1, 2, 3, 4, etc.). Appendices need not be paginated.

1. **Length of Thesis**

A length of 100 pages from the *Introduction* to *References*, with a content text length of around 15,000 words (excluding sections before *Introduction* and after *Discussion* and wordings for figures and tables), is recommended. Nevertheless please do not ‘pad’ your thesis and reach this suggestion. This is detrimental!

1. **Typing**

The entire thesis must be type-written, printed on white background A4 size page, with double-spacing, using typically (not strictly) Times New Roman font of font size 11 to 12 points, and with 3.5 cm left margin and 2.5 cm margins on all other sides. The same font type and size should be used for the entire thesis (with possible exception for figures and appendices). The contents in the *References* section may be presented as single-spacing.

1. **Submission Format and Timeline**

***Two hardcopies of the thesis report (spiral- or ring-spine bound; both single-sided and double-sided printings are acceptable) as well as a softcopy (in PDF format) of the thesis*** must be submitted in accordance to the stipulated timeline. Details of thesis submission would be released nearing the corresponding submission period. Late submission will be penalized, except cases of special consideration (e.g. illness supported by submitted medical certificate). The penalty is 2-mark deduction to the final score per day after the date due, inclusive of University non-working days.

1. **Numeral and Unit Abbreviations**

Numbers under ten should be spelt out (e.g., nine for 9) unless accompanied by an abbreviation: e.g. two centimetres or 2 cm. Do not start a sentence with an Arabic or Roman number.

1. **Citations and Reference List**

Literature should be cited in the text by the author's surname and year of publication: e.g. “Smith (1997) reported ...” or “This result has been observed by at least one other worker (Smith, 1997)”. When there are two authors, the citation is as such: e.g. (Lim and Chee, 1997). But when there are more than two, all other authors except the first are indicated by the Latin abbreviation ‘*et al*.’, for example “Tan *et al*. (1997) discovered...”

Other variations include citing several references together, e.g. (Chung, 1996; Smith and Ho, 1998), and citing two or more references by the same author that were published in the same year, e.g. (Lim, 1991a, b).

In the *References* section, all literature should be listed in alphabetical and/or citing order by the lone or first author's surname. Only literature cited in the thesis text should be included here.

The following are examples of the formats that should be used, e.g. as in journal, *Cell*:

Greenfield, L., Simpson, L., and Kaplan, D. (1975). Conversion of close circular DNA

molecules to single nicked molecules by digestion with DNase I in the presence of ethidium bromide, Biochem. Biophys. Acta. *470*, 365-375.

Kikuchi, Y., and Nash, H.A (1979). Nicking-closing activity associated with bacteriophage int gene product. Proc. Natl. Acad. Sci. USA *76*, 3760-3764.

Krasnow, M.A., and Cozzarelli, N.R. (1983). Site-specific relaxation and recombination by the Tn3 resolvase: recognition of the DNA path between oriented sites. Cell *32*, 1313-1324.

Krasnow, M.A., Stasiak, A., Spengler, S.J, Dean, F., Koller, Th., and Cozzarelli, N.R. (1983a). Determination of the absolute handedness of knots and catenanes of DNA. Nature **304**, 559-560.

Krasnow, M.A., Matzuk, M.M., Dungan, J.M., Benjamin, H.W., Cozzarelli, N.R. (1998b). Site-specific recombination by Tn3 resolvase; models for pairing of recombination sites. In Mechanisms of DNA Replication and Recombination, vol. 10, N.R. Cozzarelli, ed. (New York: Alan R. Liss, Inc.), p. 637.

## Names of Organisms

Scientific names of organisms are Latinised binomials that must be in *italics* whenever used. The first or generic name is written with an initial capital, the second or specific epithet is written in lower case.

1. **Contents**

This segment considers the contents of each section of the thesis.

***Title***

The rules for formulating a good title are few. The title should identity the specific nature of the research and also some broader area within which the work occurred. The length of the title should be kept to a minimum, preferably approximately a dozen or so words. A good start is to avoid non-essential words or phrases, such as “Studies on the...”, “Some aspects of ….” and “Investigations into the.…..”

***Acknowledgements***

This section usually consists of a single paragraph of appreciation to the supervisor and other academic or technical staff, colleagues and institutions for ideas, advice, criticisms, facilities, services, etc. Contrary to common practice, this is not a place to ‘let your hair down’; it is not allowed to acknowledge your pets, religious leaders, and so on; and avoid expression of excessive gratitude to your supervisor, or anyone else.

***Table of Contents***

The *Table of Contents* lists all the major headings and sub-headings and the page numbers on which each starts.

***Abstract***

The *Abstract* should not exceed 200 words, and should be given within a single paragraph. The first few sentences identify the topic, the next few the research design, then the basic observations and/or results, and the last one or two the theoretical implications of the observations and/or results. It should not contain references to figures, tables or literature.

Being an overview of the thesis, the *Abstract* should be written last. Avoid jargon (i.e., “the language, especially the vocabulary, peculiar to a particular trade, profession, or group”).

***Introduction***

The *Introduction* (including literature review/citations) should preferably not exceed 10% of the whole thesis. It must form a bridge from past to the present work in a stimulating manner within a few paragraphs. The “bridge”, moreover, should have the shape of an inverted pyramid: In other words, a good introduction starts with a broad base and ends with a specific point. It first considers the importance of the major area being investigated, primarily to provide the reader with a frame of reference from which to consider your work. Then, within the chosen area, it identifies a gap in our knowledge, or a precise question, or a particular controversy. Finally, it pinpoints the intended value of the present research. New approaches and assumptions on which the work is based should also be identified at this point.

***Materials and Methods***

The *Materials and Methods* section consists of three sets of descriptions ⎯ those of the procedures, subjects and equipment used during the study. All three are traditionally given in sufficient detail to allow a competent researcher to duplicate the whole study. There are a number of ways of simplifying this task.

The first is to name but not describe commercially available equipment and well-known procedures. Specially built equipment must of course be described in detail, though they can often be illustrated with simple figures.

Another approach that can eliminate much trivia is to focus on the animal/plant material rather than on your activities. If the procedures are long and complex, they can often be succinctly presented in tables and/or figures. Commonly omitted information in experimental studies includes (i) precautions needed to ensure safety of the workers or accuracy of the data, (ii) preliminary experiments, (iii) advantages of the chosen design over related designs, and (iv) purity of the chemicals used.

***Results***

At first glance, an ideal *Results* section would be one that presents all the data in a completely objective manner. This is rarely possible. The major problem is that ‘raw’ data collected directly from experiments or observations seldom make sense unless summarized. The natural consequences of using summaries are a loss of precision in the information and some more or less subjective choices of summarizing techniques. Another departure from the ideal occurs when, for a number of possible reasons, some data must be excluded. Because of these qualifications, a good *Results* section should contain data that have been carefully but not overly simplified and are presented with as little interpretation as practicable.

A typical *Results* section is organized into discrete subunits without any overall order. An improvement would be to present the subunits in some logical and obvious pattern, such as chronological order, or from the most general to the most specific (e.g., from the simplest to the more complex analyses). An alternative improvement would be preface the *Results* with a description of the planned layout of the subunits.

Within each subunit, much data can be summarized within tables and figures. Doing so has several advantages. Tables and figures require less space than text for an equivalent amount of data; and their content is more easily deciphered. For example, a paragraph can begin with “Figure 3 shows ...” and then proceed to identify the major aspects of the figure.

Tables, Figures and Plates

Tables, figures and plates (photographs) should provide information that cannot be conveniently given in the text. Each must be accompanied by a legend that makes the figure understandable without reference to the text. The most common problem is poor labelling. Another is excessive information ⎯ Are the important data obvious to an informed reader?

***Discussion***

Data presented in the *Results* section are **critically discussed** here in relation to each other, to the results of other studies and to the proposed hypothesis (if any). These relationships are rarely so straight-forward that only one conclusion is possible. They must, therefore, be interpreted. But the ‘interpretations’ are not as subjective and arbitrary as the word implies: the arguments must be logical and firmly based on facts.

There are several elements to a good discussion. One is a brief introductory paragraph that refers to the problem raised in the *Introduction* and states how the results will be discussed. Lack of a preface or of any obvious order in the discussion's contents is a very common mistake. Another element is consideration of all subunits of the *Results*. Failure to do so is a surprisingly frequent error. A third feature of good discussions is that they never gloss over contradictory or apparently uninterpretable data. They also point out faults in the research design used. Another element is full recognition of the relevant findings and hypotheses of other researchers. And, lastly, speculations are given but only when they suggest testable hypotheses or fruitful observations. The discussion can end with suggestions for future work.

***Appendices***

Appendices are reserved for materials that are not strictly necessary for the presentation and interpretation of the data but may be useful to other researchers in duplicating the study, reanalyzing the data, avoiding time-consuming errors when conducting similar studies, etc. Examples of the type of material that can be included are data pro forma, computer programs, preliminary experiments and supplementary statistical data. Raw data should not be included. Like the *Introduction (which is coupled with Literature Review)*, this section is frequently ‘exploited’ for ‘padding’ the thesis.

**A Schedule for Writing**

Preparation of the thesis may be divided into four basic steps.

The first step is to decide, on the basis of the format given above, where the various bits of information go. This is usually a simple task.

The next stage of writing the major sections is the most challenging. The key is order. Can the information be framed within some logical pattern? Only the *Introduction* has a generally accepted form, the pyramid structure; so it is up to you to find patterns for the other sections. At this stage, you should prepare an ordered outline of each section ⎯ start with the easiest section, which is usually the *Materials and Methods*. Then rapidly write a ‘rough draft’ based on the outline and on tables and figures of data. After a readable (but not polished) draft has been completed, ask your supervisor to evaluate the overall organization (and analyses, if this has not already been done). Examine the criticisms carefully, not only for specific improvements but also for general rules.

The third step is to re-write the thesis with the useful criticisms included. An important problem is an absence of continuity between sections. This is not surprising since students commonly write each section separately and only bring all the parts together for the final draft. The solution is to treat the thesis as a single unit immediately after rough drafts of the sections have been completed. In other words, after receiving the criticisms from your supervisor, you should check the thesis from beginning to end.

The last stage is to seek further criticisms from your supervisor, but this time on all aspects of the work, including the grammar ⎯ remember that the thesis is a form of communication in the medium of English.

The following are some specific hints to help you write better science:

1. Vary the length of sentences within paragraphs.

2. Avoid slang, abbreviations, foreign words, the over-worked word ‘however’ and plural pronouns (e.g., we).

3. Use synonyms frequently to avoid sounding repetitious. For example, ‘research’ can be replaced with ‘study’, ‘investigation’ or ‘work’.

4. Use short common words in preference to long uncommon words.

5. Use the present tense when discussing general facts or concepts, but the past tense for specific results.

6. Consult a dictionary, thesaurus and manual of English usage (e.g., *Fowler's Modern English Usage*) frequently.

7. Use concrete examples to illustrate abstract ideas.

8. Practice speaking parts of the thesis.

9. Use double quotation marks (“) only for words or sentences quoted within another quote (that has been identified by single quotation marks (‘); e.g., Gould (1982) states ‘The reductionistic drive of scientists has resulted in many attempts to explain “motivation” as a unitary process.’