# Research Courses

**1. GENERAL INSTRUCTIONS FOR THE CONDUCT OF RESEARCH**

General guidance on how to perform project work, and your responsibilities as part of a team will be given by your supervisor or the person appointed to act as your mentor for this course. Please do not hesitate to ask for their advice if you are uncertain of any aspects (e.g. safety, rules and manners, expected hours of work, dress code, how to obtain specialised chemicals or commercially purified enzymes, how to use a piece of equipment, how to maintain an appropriate record of your work, data organisation and storage etc).

**2. WORKBOOK**

You need to maintain a record of the work you are doing (commonly using a laboratory notebook) as evidence that the work has been conducted. Recording your work allows others to see the details of what you have done, avoids needless repetition of experiments/data collection, facilitates progression of the work when you have moved on and is needed in support of future publication.

You are expected to keep a comprehensive record of your day-to-day work, fully dated and indexed. This notebook will contain protocols, details of exactly how work was performed day-to-day (including appropriate weightings, volumes, photographs, search strategies etc.), all raw data (or a note of where voluminous data collections, such as chart recorder traces, are held).

**3. PROJECT PLAN**

Early in your project you will be required to produce a project plan containing an introduction to your area of research (length is dependent on the unit value of your course), together with a brief description of the aims of your project and the methodologies you intend to use to achieve these aims (one page regardless of the course). For specific details of the outline, please refer to the outline student guide.

**4. RESEARCH REPORT**

The plan should be prepared using a word processor: page margins will be set to 2cm all round, pages will be numbered, font of 12pt Calibri or Times New Roman (or equivalent) is acceptable, line spacing of 1.5 will be used. The first page of the project plan (not counted in the total number pages) should carry your project title, course code your name and student number, and your supervisor's details. One of the arts of scientific writing is to organise ideas and results concisely and with little repetition. The total length, (NOT including references, figures, tables) cannot exceed the length specified in Table I (page 3) or penalties will be applied in marking. Most reports will consist of abstract, introduction, materials and methods (or experimental), results and discussion, conclusion and bibliography. However there may be instances, such as industrial placement, where an alternative format is justified, this should be agreed with the course coordinator.

4.1 Abstract

An abstract of 200-300 words should be included at the beginning of the report. This should present clearly and concisely the aims of your work, the most important observations that you have made and the salient conclusions drawn (i.e. what you wanted to do, what you found and what it means).

4.2 Introduction

The introduction should aim to provide a clear rationale for the experiments undertaken and put them in the context of available knowledge. Avoid producing a turgid review of the literature that just shows how many possibly useful papers you have found. It may be useful to clearly state your aims and any hypothesis being tested by your experimental program at the end of the introduction. Note that although the hypothesis or underlying assumption(s) is the most important part of any scientific endeavour, it may be so obvious that it may not need enunciation as such. For example, if you merely wish to purify and characterise an enzyme, the hypothesis is that such an enzyme exists in the particular sample of the organism under investigation, and that the enzyme resembles other enzymes which have been characterised by the sorts of analysis that you propose. On the other hand, active site investigation of an enzyme may rely on a working hypothesis involving the presence of particular amino acid residues that react with substrate via a particular mechanism.

4.3 Materials and Methods/Experimental

*For noting: In a biological project Materials and Methods are usually presented prior to the Results and Discussion section(s). In chemistry/drug discovery projects this is usually titled "Experimental" and comes after the Results and Discussion.*

This section should give a level of detail sufficient for the work to be repeated and which allows the reader to understand how the results described were obtained. Where published methods have been used, briefly describe the principle and acknowledge the method by citation rather than by reiteration of the methodological detail (details of the method should be present in your workbook). If methods are unpublished, are "in-house" recipes, have been substantially modified from those previously published, or if entirely new protocols have been developed, then these should be more fully described.

4.4 Results

This section should present, in the clearest manner possible, the data gathered relevant to your report. This does not mean you must include every result that you obtained. Present results in a logical order, not necessarily the order in which you carried out your work. Use diagrams and tables freely; many studies have shown that information is more effectively imparted in this manner. The text of this section should draw attention to features of your results that will be picked up for further consideration in the Discussion. The results should not just be stated, but should be presented in a reasonable context so that the reader does not have to work out for him/herself what is important. It is also extremely annoying (resulting in loss of marks) if the Discussion dwells at length on data not mentioned in the Results. Conversely, detailed discussion should not be presented in Results, but should be left to the Discussion section of your paper.

4.5 Discussion

Here is your opportunity to demonstrate your scientific insight, and flair for the synthesis of ideas and hypotheses, i.e. the ability to draw the appropriate conclusions from your data. Whilst a report is often the one opportunity that you have for scientific speculation, hard-nosed referees will not let you get away with it in the published literature unless it represents a useful working hypothesis for future experiments. Thus, you should not try to extend your interpretations of your data beyond the bounds of credibility. In some cases a combined Results and Discussion section is more appropriate for reporting your work. In this case a short, 1-2 page, Conclusions section helps highlight the most significant observations that you have made.

4.6 Bibliography

The references should all be collected together into a single bibliography and presented in a consistent manner. The use of in text citation software, such as EndNote, is strongly recommended. When using citation software YOU need to check the input of references into the software so that they are entered in a consistent manner. The software is not magic and can only give out what you put in (garbage in=garbage out).

If you do not have access to in text citation software, one way to organise the references is NOT to number them but to cite them in the text, e.g. as Smith and Jones (1998), Smith et al., (1999, 2002), and so on. As long as they are not numbered, it is easy to add in additional references found at (or forgotten until) the last minute. The bibliography can then be arranged in alphabetical order by your word processor.

References must be consistently presented using the punctuation style of any common journal, e.g. Foster, L., Mouse, M., & Rat, K. (1972). J. Irrep. Res. **23**: 490-512. Use standard abbreviations for journal names. Titles must be included as they assist the examiner to assess the scope of the articles. For example: Foster, L., Mouse, M., & Christ, J. (1972). The effect of hypoxia on free divers. J. Irrep. Res. **23**: 490-512. Titles must be presented consistently either capitalise or not but do not mix and match styles as you will lose marks.

4.7 Figures and Tables

Clearly labelled figures and tables should be inserted in the text as near as possible to the place they are first mentioned. This is important as it avoids your reader/assessor having to hunt through your document to find the figures/tables. Figures should be accompanied by a brief title and legend usually presented below the figure

(the title plus legend should make it possible to comprehend the figure without recourse to the text). Tables also require a title but this is typically placed above the table itself, the table also had a legend or footnotes.

4.8 Abbreviations

Use abbreviations and acronyms sparingly. A general rule of thumb is to use abbreviations when the term appears more than three (3) times in the report. Always define an abbreviation the first time it is used. Some abbreviations are in such general use that you don't need to define them e.g. DNA or RNA

**5. SUBMITTING YOUR RESEARCH REPORT**

At the end of the semester, you should submit your report by the due date and time given in the electronic course profile (ECP). Extensions beyond this deadline will only be granted under exceptional circumstances (full details are listed in the course ECP). The report will be assessed by two independent examiners.

**6. RESEARCH REPORT MARKING CRITERIA**

The marking criteria can be found in the ECP.

**7.TABLE I**

| Unit Value | Suggested length (in pages)** | | | | | |
|---|---|---|---|---|---|---|
| | **Max total length*** | **Abstract** | **Introduction** | **Materials and Methods/ Experimental** | **Results** | **Discussion** |
| **#2 units** | 15 | 1 | 3-4 | 2-3 | 4-5 | 2-4 |
| **#4 units** | 25 | 1 | 5-6 | 3-5 | 7-10 | 4-6 |
| **#8 units** | 40 | 1 | 8-11 | 4-6 | 12-15 | 5-8 |
| **#16 units** | 80 | 1 | 14-18 | 8-12 | 24-32 | 10-17 |

***excludes bibliography, tables and figures.**

****chemistry projects will often have a longer experimental section and merge results with discussion**