School of Chemistry
UNSW

A guide to professional and ethical conduct for students in Chemistry

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These guidelines are intended to inform students of their responsibility to act in a professional and ethical manner, and to abide by the principles of academic and scientific honesty. They include extracts from official UNSW policy in this area along with more specific examples and guidelines relevant to different types of work which students in Chemistry will carry out during the course of their studies.

These principles apply not only in a university environment but will also be expected of you in your future career. The various professional bodies to which scientists belong all subscribe to codes of ethical behaviour.

For example, the American Chemical Society Code of Conduct can be found at http://chemistry.org/portal/Chemistry?PID=acsdisplay.html&DOC=membership%5Cconduct.html or go to www.acs.org and search for 'conduct'.

Excerpts from the official UNSW policy on academic misconduct

From https://my.unsw.edu.au/student/academiclife/assessment/AcademicMisconductStudentMisconduct.html

Students are expected to familiarize themselves with all aspects of the University policies on misconduct and to adhere to these policies during their university career. Some important aspects relevant to handing in work for assessment are reproduced below.

The UNSW Learning Centre also has a guide to plagiarism and how to avoid it – see http://www.lc.unsw.edu.au/onlib/plag.html

Academic Misconduct

"Students and staff are governed by the normal laws which regulate our daily lives.
But in addition the University has its own code of rules and conduct. This is because good conduct and academic honesty are fundamental to the mission of the University as an institution devoted to the pursuit of excellence in scholarship and research, and to the service of society. These principles apply not only to students but to the whole University community, including staff engaged in research. They have been developed over many years and are widely supported by staff and students. Staff and students are committed to good conduct and academic honesty and are keen to see that these values and principles are upheld."

"Some aspects of academic misconduct are obvious (eg cheating in exams), while others are perhaps less obvious."

"It is important that students realise just how broad the definition of academic misconduct may be. It certainly covers practices such as cheating or copying. Furthermore, practices which may be acceptable in other situations are considered to be misconduct according to current academic usage within a University.

Misconduct concerning academic works
• failing to acknowledge the source of material in an assignment;
• quoting without the use of quotation marks even if the source is acknowledged;
• plagiarism
• submitting work for assessment knowing it to be the work of another person"

Plagiarism
"Plagiarism involves using the work of another person and presenting it as one's own. Acts of plagiarism include copying parts of a document without acknowledging and providing the source for each quotation or piece of borrowed material. These rules against plagiarism apply whatever the source of the work relied upon may be, whether printed, stored on a compact disc or other medium, found on the World Wide Web or Internet."

"Similarly, using or extracting another person's concepts, experimental results or conclusions, summarising another person's work or, where, there is collaborative preparatory work, submitting substantially the same final version of any material as another student constitutes plagiarism. It is your responsibility to make sure you acknowledge within your writing where you have "sourced" the information, ideas and facts etc. The basic principles are that you should not attempt to pass off the work of person as your own, and it should be possible for a reader to check the information and ideas that you have used by going to the original source material. Acknowledgment should be sufficiently accurate to enable the source to be located speedily. If you are unsure whether, or how, to make acknowledgment consult your lecturer."

"The following are some examples of breaches of these principles:
a) Quotation without the use of quotation marks.
It is a serious breach of these rules to quote another's work without using quotation marks, even if one then refers to the quoted source. The fact that it is quoted must be acknowledged in your work.

b) Significant paraphrasing, eg. several , or one very important sentence, which in wording are very similar to the source. This applies even if the source is mentioned, unless there is also due acknowledgment of the fact that the source has been paraphrased.

c) Unacknowledged use of information or ideas, unless such information or ideas are commonplace.

d) Citing sources (eg texts) which you have not read, without acknowledging the 'secondary' source from which knowledge of them has been obtained. These principles apply to both text and

footnotes of sources. They also apply to sources such as teaching materials, and to any work by any student (including the student submitting the work) which has been or will be otherwise submitted for assessment. You must obtain the prior approval of your lecturer if you wish to submit to that lecturer an essay substantially similar to one which has already been, or will be, submitted to another lecturer.

Using the principles mentioned above proper acknowledgment, you should also proceed on the general assumption that any work to be submitted for assessment should in fact be your own work. It ought not be the result of collaboration with others unless your lecturer gives clear indication that, for that assignment, joint work or collaborative work is acceptable. In this latter situation, you should specify the nature and extent of the collaboration and the identity of your co-workers. Students should note that essays and written assignments may be tested for a match ie source documents on the Internet."

All of the above quotes are from UNSW policy given in full at
http://www.student.unsw.edu.au/academiclife/assessment/academic_misconduct.shtml

Scenarios relevant to laboratory courses in Chemistry

(1) Laboratory data and reports

The scenario
Student X makes a mistake preparing standard solutions and as a result does not have time to complete the experiment during the scheduled lab time.

3 different student responses

a) Student X sees another student's results lying on the bench, copies their calibration data and writes up the lab. report using the copied data

b) The student consults another student who agrees to share the data. Student X writes up the report using the shared data

c) The student consults the demonstrator, who agrees that it will not be possible to repeat the calibration. They approach another student who agrees to share the data. Student X writes up the report using the shared data

Which of these (if any) is the best approach and what are the implications?

Copying another student's data without permission is unacceptable – this is academic misconduct.

Sharing data with the agreement of the other person *may* be acceptable with some important provisos (1) sharing data is not against the specific policies of the laboratory course (2) the (agreed) use of the second student's data is clearly acknowledged in Student X's report (3) the

reasons for sharing the data AND the possible impact on the experimental results are also acknowledged – otherwise another ethical problem may arise, that of presenting misleading scientific results.

Consulting the laboratory demonstrator for advice is the best action. If it is agreed that shared data can be used, the same requirements for acknowledging the use of the data are required as before. *Alternatively, the advice might be to repeat the experiment at another time or to write up a report on the experiment using incomplete data.*

(2) Group laboratory work

The scenario
Laboratory work in a course is carried out in pairs or small groups. All students in the group are responsible for collecting the data. However, individual lab reports are expected and students work is individually assessed.

> Students in one group arrange that one person writes the report each week and emails it to the others, who each modify it slightly and submit their own version for assessment.

Is anything wrong with this? After all, the students each contributed to the same experimental work.

The implications
By the act of using copies of a report written by someone else and then 'individualising' them, the students are knowingly concealing the fact that they are each handing in the same work for assessment. This is definitely academic misconduct. Note that the person who *supplies* the work for copying by others is equally guilty of misconduct as those who do the copying.

Unless otherwise notified by the course coordinator, it is normally acceptable (and even encouraged) for students to consult each other on such things as how to process their joint experimental results, on whether their method of calculation is correct and on what the interpretation of the results might be. But if individual laboratory reports are required, they must each then take the results away and write up individual reports containing their own discussion and conclusions.

Laboratory work in pairs or groups can present some uncertainties in terms of what is expected. Clear guidelines should be provided by the course coordinator. If in doubt, you should always ask for clarification.

(3) Manipulation of Experimental Data

The scenario

A student measures a series of data points for a calibration curve. A linear calibration is expected. One data point in the middle of the calibration is much too high and distorts the entire calibration. However this is not noticed by the student until after they leave the lab.

3 different student responses

a) The student estimates what the 'expected' value should be and substitutes that into the calibration set. They then write the report using the apparently linear calibration data.

b) The student leaves the suspect data point out of the report and uses the remaining points to do the calibration

c) The student performs statistical tests on the data and shows that the suspect point is an 'outlier' at some high level of probability. All the data are recorded and the tests are written up with a full justification for using the revised data set for the calibration.

Is there anything wrong with any these actions? What is the best approach?

The implications

(a) and (b) are scientifically unacceptable. Both are dishonest in that they seek to conceal a problem with the data rather than address it.

Deleting data which doesn't 'look right' is not only dishonest, it undermines the entire scientific process. It is possible that the odd-looking data point is the only correct one – the problem might be with the seemingly well-behaved data. The only way to find out is to go back and do further measurements. Ideally of course the experiment would be repeated in order to determine what the correct calibration is. If this is not feasible, then the data must be evaluated as best as possible, within its limitations (see action c above).

Statistical procedures are available to test outliers in repeated data sets and in calibrations (see, for example Miller & Miller Statistics for Analytical Chemistry, or Prof Hibbert's CHEM 2041 statistics lectures – see http://www.chem.unsw.edu.au/UGNotes/chem2041/notes.html.). However the existence of a problem point must never be concealed. It should be investigated and rationalised as far as possible.

Blatant cheating, such as inventing data or observations for an experiment is clearly academic misconduct. However, it may not always be obvious to students that other forms of data manipulation are also considered scientifically unsound even if they do not qualify as academic misconduct. You should not hesitate to get advice on how to handle unusual or unexpected experimental outcomes.

School of Chemistry
Brief Checklist for Submission of Reports or Assignments

Individual report / assignment

- The submission is all your own work, except where clearly acknowledged
- No sections are copied from another student
- All material directly quoted from another source (textbook, lab manual, web or other source) is in quotation marks or otherwise distinguished from your own writing AND is fully referenced.
- All pictures, graphics or data obtained from a literature or web source are fully referenced
- All material, information or ideas summarized from other sources are fully referenced.
- You have not given your report to another student to enable them to copy from it.
- All experimental data and observations are honestly presented and not invented or altered to fit a preconceived outcome
- You have included a signed coversheet with your assignment
- You have kept a copy of the assignment

Group report / assignment – additional requirements

- All contributors to the group work are acknowledged
- Any additional guidelines specific to the particular group work are followed.

For full UNSW policy, consult
http://www.student.unsw.edu.au/academiclife/assessment/academic_misconduct.shtml

For UNSW Learning Centre guidelines on writing scientific reports, consult
http://www.lc.unsw.edu.au/olib.html#Science and for avoiding plagiarism in reports, consult
http://www.lc.unsw.edu.au/onlib/plag.html

Guidelines for literature reviews and essays in Chemistry

Scientific literature reviews and essays …

In some advanced courses, and during the Honours year, students will be required to write Essays and present Literature Reviews on specific chemical topics.

An essay is a literary composition of limited length (generally just a few pages) where the author highlights and explains some key aspects of a topic. It is not intended to be a comprehensive presentation of material on the subject, and so there is usually scope to select aspects of the topic that are judged by you to be most important, relevant, or of greatest interest. Thus, although many facts will be presented in an essay, there is also room for expressing your own views on the subject. In essence, we want to hear your own account of what the topic is all about.

A Literature review is a more formal composition intended to summarise all significant aspects of a given subject. Hence it is likely to be shorter on opinions, and longer on facts and technical data. However, conclusions drawn from these will be highly important. Literature reviews are essential prior to undertaking a new area of research work in the laboratory. Therefore before commencing a research project it will be necessary to review your intended research area to find out what is already known about it, which workers did this work (and how thoroughly and competently), and what aspects remain unknown and unexplored.

Reviews are also widely used in science when much work has been published in the primary research journals on some topic of interest. Such articles are intended to summarise and clarify what has been achieved to date, to bring the topic to a wider audience, and are an excellent starting point for anyone wishing to learn about interesting areas of work that are new to them.

In your own words…..

In your University careers and beyond, you will constantly be reading and using the work of others. Whether you are attending lectures or seminars, reading texts or the primary literature, using Internet resources, or merely talking with other relevant people, you will be hearing new concepts and ultimately you may wish to use some elements in your own work. Is there anything wrong with the incorporation of others' work into your own documents? If this is so, when is it wrong, and why can it sometimes be wrong?

First, it is necessary to understand and accept that people have ownership over their ideas and thoughts; this is often known as copyright. To use someone else's words, or ideas, without properly acknowledging the source, is not really a shortcut; it is stealing, and it is called plagiarism. The penalties for plagiarism can be severe at the University of New South Wales and can, in the worst cases, lead to outright failure in the subject and exclusion from the University for one or two years. The School of Chemical Sciences believes that it is important that all students are aware of the possible penalties, however the School also emphasises that these penalties do not

exist merely to punish students who act wrongly, but also to ensure that the work of honest students is valued, rewarded and acknowledged.

So what defines unacceptable use of someone else's work? Plagiarism, or the unacceptable use of someone else's work as your own, can take many forms, and some are more obvious than others. You MUST realise, however, that all forms are equally unacceptable.

So what does this all mean? Let's look at a piece of text, and see some examples of acceptable and unacceptable use of the language.

The text

> "Asymmetric reactions and processes give rise to two kinds of stereoisomeric products: diastereomers and enantiomers. The physical separation of these isomers with simultaneous analysis of isomer distribution (peak integration) is an excellent way to determine the selectivity of a reaction."
>
> From: "Principles of Asymmetric Synthesis" , p. 65, by RE Gawley and J Aubé, Tetrahedron Organic Chemistry Series Volume 14, Pergamon, Elsevier Science, Great Britain, 1996.

The most blatant form of plagiarism is direct, unattributed copying from an original source (whether a text, journal, newspaper, or Internet site). You MUST NOT directly copy ANY text into an essay or other document you are compiling. Remember that plagiarism does not just relate to the act of copying whole paragraphs – even sentences or significant phrases, if copied directly, can constitute plagiarism. If you intend to include a direct quote from any source, then you should enclose the entire section of text in quotation marks, and give a full reference.

Note that an essay or other piece of work that is merely a collection of properly attributed quotes may not constitute plagiarism, but is likely to be deemed unsatisfactory because it displays little original thought or input from the student.

If you are not going to include a full and complete quote, then you MUST present the work in your own words. It is NOT sufficient merely to change a few words, swap around phrases or alter tenses. This still constitutes unacceptable plagiarism.

The following might be considered an unacceptable paraphrase of the above sample of text:

> Asymmetric reactions can produce two kinds of stereoisomers: diastereomers and enantiomers. The selectivity of a reaction can be determined by physical separation of the isomers, with analysis of the isomer distribution using a peak integrator.

Why is this unacceptable?

If you look closely, you will see that most of the text has merely been rearranged, and occasional words have been altered.

It would be better to completely reword or paraphrase the text; the following may be considered an acceptable paraphrase of the above sample of text:

> An asymmetric reaction is one which generates at least one new stereogenic centre, and can therefore produce either enantiomers or diastereoisomers. It is desirable to determine the relative ratios of the isomers produced by the reactions, and one method involves separation – usually using a chromatographic method – followed by determination of the ratio using an electronic integrator.

An even better solution would be to incorporate ideas from several sources, and write the whole section in your own words. An example could be:

> One of the greatest challenges that has faced synthetic chemists over the past 40 years has been the development of reactions that can provide one enantiomer or diastereoisomer selectively. Asymmetric reactions are reactions that use the existing chirality that is present in a catalyst or chiral auxiliary to give at least one new stereogenic centre. The effectiveness of these asymmetric processes is determined not just in terms of overall yield, but also in terms of the reaction's ability to produce one enantiomer or diastereoisomer selectively. Methods like HPLC and GC can be used where chromatographic processes separate the isomers (enantiomers either need to be converted into diastereomeric derivatives, or separated on a chiral column), and their ratios are determined using electronic integrators.

Referencing, or "They are my words, but it's not my work"

Whenever you write a thesis or essay, you will be incorporating a substantial proportion of other people's ideas into the body of your work. The correct manner to present their ideas has been discussed above, however rewording or paraphrasing facts or opinions does not make them your own. You still need to cite the original source.

Firstly, it is not sufficient simply to include a list of references at the end of your essay, thesis, etc. You must link the reference to the place(s) in the text of your document where it is used. If a reference is used more than once throughout your document, it is only necessary to LIST it once in your bibliography, but there should be an indicator in the body of your work at EVERY place you have used it.

Citing the reference in the body of the text

There are three main ways to cite the references throughout the body of your work; one is a bracketed text system that includes at least one author's name and the year of publication, another places the number of the reference from the reference list in parentheses, and the final method places the reference number as a superscript.

Formation of a ring by a *5-endo-trigonal* mechanism is rarely successful (Baldwin *et al.*, 1976)

Formation of a ring by a *5-endo-trigonal* mechanism is rarely successful (5).

Formation of a ring by a *5-endo-trigonal* mechanism is rarely successful.[5]

Figures, diagrams, data

Diagrams and Figures from literature sources may be used in UNSW Essays and Literature Reviews only with due acknowledgement being given; e.g. Figure 3 is reproduced from A. Smith and B. Jones, *Aust. J. Science*, 1997, 55, 122. Copyright permission (and often payment) is necessary if diagrams and figures are reproduced in new articles available to the public.

The reference list

All references that you have used should be listed at the end of your thesis or essay. Note that it is more important to make a judicious choice of references, rather than provide an endless list. There are many formats that can be used for your reference list, and you need to determine which is appropriate, in consultation with your lecturer / supervisor. Usually, you would follow the style of a popular and reputable chemical sciences journal, such as the *Journal of the American Chemical Society*. The amount of detail and formatting of references also differs, depending on whether the source is a journal, or book, or the World Wide Web. Some examples are given below.

Journals

The key pieces of information here are the authors' names (as family name and initials), the journal name (which is usually given using standard abbreviations), the year of publication and the starting page number of the relevant article. Sometimes people also include the final page of the article as well. Note that you do NOT merely cite the relevant page number; you cite the entire article. Also note that it is not necessary to quote the name of the article, although some people prefer to include this information. One example:

Baldwin, J.E., Cutting, J., Dupont, W., Kruse, L., Silberman, L., and Thomas, R.C., *J. Chem. Soc., Chem. Commun.*, **1976**, 736-738.

There are several acceptable formats, however it is important that you are consistent and use the same format throughout your work.

Books

Where you refer to a book, the key information to give includes the authors' names, book title, volume number (if part of a set), edition number (if it is not the first), name of publisher, where the book was published, year of publication, and page number(s). Note that, unlike journals, you only cite the page(s) that you used.

Coultate, T.P., "Food The Chemistry of Its Components" 3rd Edition, Royal Society of Chemistry Paperbacks, Cambridge, 1996, pp. 40-43.

World Wide Web sources

The World Wide Web provides a vast online network from which students can draw information for essays and reports. However every student needs to be aware that the WWW is largely unregulated *i.e.*, while the content of journals and books has usually been scrutinised by referees and/or editors, there is no such "quality control" on Web sites. There is a lot of very good information out there, and there is a lot of nonsense. You should assess any document that you read on the Web critically.

In providing a reference to a WWW site, it is NOT sufficient merely to quote the search engine that you used. This would be similar to saying that your reference was "UNSW Library OnLine Index". If you use any Web-based sources, you should aim to give as much standard information as possible. Give the author's name and date of publication (if known), the title of the work that you have used, the full URL for the specific document that you used, and finally the date that you visited the site. This last piece of information is important because authors of documents on the WWW can change content, and it may not be immediately obvious when someone visits the site at a later date.

Vigue, D.I., (1997) "Educators fighting a Web of Deceit",
http://computernewsdaily.com/147_052797_130001_8138.html (14 Feb. 2002)

When is it not necessary to acknowledge a fact or opinion?

The only time when it is acceptable to include facts that remain unacknowledged, is when they form part of what is termed "common knowledge" or "general knowledge". Fact that are considered "common knowledge" would generally be known by many people, and can be found unacknowledged in many different places.

Examples could include:

Sugar, or sucrose, is a naturally occurring sweetener.
Ethanol is the intoxicant in alcoholic beverages.
Politicians cannot be trusted.

An example of a statement that could NOT be accepted as "common knowledge"; a reference would need to be provided:

Sucrose is a non-reducing disaccharide composed of glucose and fructose.

The brief tale below provides examples of the styles that might be used in a review article.

The Kryptothiadiol Puzzle

The natural product Kryptothiadiol was originally isolated from pine needles of the tree *Pinus nipponica* which is endemic to Shikoku Island in Japan. Matsuyama and Mori[1] isolated a few milligrams of crystalline Kryptothiadiol, melting point 224-225^{o}C, and assigned its molecular structure using IR, NMR, and MS techniques.

Woodcock and Heathward[2] decided to synthesise the proposed Krytothiadiol structure and reported their success in 1987. Their synthetic material was almost identical to that originally reported based on comparison of the spectral data. There were, however, slight differences between the IR spectra of the two samples, and the synthetic material melted at 176-177^{o}C.

Doubt therefore arose about the structure assigned to the original compound. Furthermore, subsequent attempts by other Japanese groups to isolate the natural product from *P. nipponica* were completely unsuccessful,[3] which led to heated exchanges during the Tokyo Natural Products Symposium in September 1990.[4] This minor scientific controversy would, however, probably have been forgotten rapidly had the synthetic compound not been tested for biological activity. In 1993 it was found to be a potent rodenticide,[5] patented[6], and now (marketed as Exterminator®) it is the lead product[7] in its field with annual sales of around US $150 million.

The lengthy, and ultimately unsuccessful, legal attempts by Matsuyama and Mori to obtain royalty payments from Megacorp (on the grounds of prior discovery) are beyond the scope of this short article but have been described elsewhere in full.[8] Their claim that Kryptothiadiol and Exterminator® were the same chemical compound was disallowed by the trial judge. His chief grounds were based on X-Ray structure investigations[9] that revealed Kryptothiadiol as being the monohydrate of the synthetic compound, and hence a different (though very closely-related) substance.

It is ironic that the presence of water would have been detected by the Japanese group had they carried out a combustion microanalysis on their compound, instead of determining its molecular weight by high resolution mass spectroscopy.

1) T. Matsuyama and T. Mori, *Nippon J. Chem.*., 1985, **45**, 176.
2) C.H. Woodcock and R.B. Heathward, *USA J. Chem.*, 1987, **126**, 4591.
3) H. Scrivener, *Rev. Asian Chem.*, 2001, **6**, 193.
4) T. Mori, Shikoku University, personal communication to the author.
5) A. Rattenfänger, P. Pfeifer and H. Von Hameln, *J. Animal Test., Sect. B*, 1993, **67**, 825.
6) Ger. Pat. G27,294,942: I. Katzenellenbogen and A. Rheinländer (Megacorp GmbH), Berlin, 1995.
7) Exterminator®: Registered Trademark of Megacorp GmbH, Berlin.
8) P. Foot, *Rat Race: Money versus Morality in the Megacorp Trial*, Rabblerouser Press: London, ISBN 0-9234571-17X, 2000.
9) C. Kent, *J. X-Ray Spectrosc*., 1999, **21**, 56.