University of Guelph - Department of Molecular and Cellular Biology

MCB*6500 M.Sc. Research Topics in MCB [1.0] &
MCB*7500 Ph.D. Research Topics in MCB [1.0]

Course Outline - Summer 2016

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The course will be taught by:
Prof. David Josephy and Prof. Rob Mullen

Welcome to the graduate program in Molecular and Cellular Biology! One of the degree requirements is completion of the two-semester course MCB*6500 (M.Sc.) or MCB*7500 (Ph.D.). This course is closely related to the development of your thesis project; you will prepare a written research proposal and present it to the department in a seminar. These tasks will help you to develop the writing and oral presentation skills upon which you will be relying, when you prepare and defend your thesis. This document serves as the Course Outline for both MCB*6500 and MCB*7500; the requirements are almost the same. Please read this outline carefully. If you have any questions, please ask the Course Co-ordinator.

Summary of your tasks:

In the first semester, you will write a **Literature Assignment (LA)**, a report in which you analyze a journal article related to your thesis topic; and you will write a **Research Proposal (RP)** describing your research plans.

Students present their Research Proposals as departmental seminars: the Friday noon-hour "brown-bag" seminar series. In the first semester (Summer 2016), you will attend the seminar presentations given by the students who started their programs one semester before you (Winter 2016). In the second semester (Fall 2016), you will make your own oral presentation and you will attend the presentations given by your classmates.

The final grade for the course will be weighted as follows:

Literature Assignment (LA)	10%
Research Proposal (RP)	40%
"Brown-bag" Seminar	50%
Total	**100%**

Grading rubrics:

The grading rubrics for all of the components of the course are posted at:
http://www.uoguelph.ca/mcb/news_events/event_brown_bag_seminars.shtml

The faculty will use these rubrics to evaluate your performance. You should review them; they provide a guide to the expectations for successful completion of each component of the course.

***The Literature Assignment (LA)*:**

The LA is accompanied by a comprehensive web site which will guide you through this component of the course; *please follow the instructions given on the web site.*

www.uoguelph.ca/mcb/teaching/mcb6500-7500/index.shtml

Your Advisor will assign a primary research article related to your thesis research - ideally, before the first class meeting. Detailed criteria for the choice of article are given on the web site and must be followed; please read them carefully. You will complete a guided analysis of this research article and prepare a written report. This assignment will strengthen your writing and critical analysis skills.

Document Format:

Both the LA and RP documents should be prepared single-sided, double-spaced, with a standard 12-point font (*e.g.*, Times New Roman) and 1" margins. (Please do not leave blank lines between paragraphs.)

LA Submission and Grading:

The LA will be graded independently by two members of the faculty panel; the grades will be averaged. The grading rubric indicates the expected (approximate) lengths of the sections. The total length of the LA will be about 15 pages (*i.e.*, fifteen double-spaced pages, or about 3,500 words.) Submit **two printed copies** of your LA to the Coordinator. Also deposit an **electronic** copy (.pdf format) in the Courselink Dropbox.

***The Research Proposal (RP*):**

This component of the course provides you with an opportunity to develop and refine your skills in scientific communication. The emphasis is on writing skills in the context of developing a thesis proposal. You are not expected to present preliminary data from your thesis research.

The RP is prepared under the guidance of your Advisor and Advisory Committee members. The *literature review* section gives an introduction to your area of research, a detailed description of the significance of the research, and a discussion of relevant background literature, focused on the key experiments leading to your proposal. The *research proposal* section includes a clear, testable hypothesis; specific objectives; experimental approaches (including rationale for choice of the experimental systems and techniques); possible pitfalls or limitations (and how they might be circumvented); anticipated outcomes and how they will be interpreted.

For MCB*6500, the RP should be *approximately 20 pages* in length, consisting of about 15 pages of literature review and five pages of research proposal. For MCB*7500, the RP should be *approximately 30 pages* in length, consisting of about 20 pages of literature review and 10 pages of research proposal. (References, tables, and figures are not counted as part of the page length.) Bibliography references must include article titles; please use the same format (*Molecular and Cellular Biology)* as is described for the LA.

Reproducing some tables and figures from the literature is acceptable, as long as the sources are clearly indicated; however, preparing your own figures is preferable, since that will allow you to focus on the specific message that you want to convey.

RP Submission and Grading:

Submit a **printed** copy of your RP to **each member of your Advisory Committee** + **two printed copies to the Course Coordinator**. Also deposit an electronic copy (.pdf format) in the Courselink Dropbox. Each member of your Advisory Committee will evaluate your RP independently and submit a grade to the Course Coordinator. These grades will be averaged (grade a). Two members from the faculty panel will submit grades (grades b and c). The three grades (a, b, and c) will be averaged to give the final grade. The RP evaluations will be returned to you two weeks before your brown-bag seminar.

The "Brown-bag" Seminar:

In the second semester, you will make your oral presentation ("brown-bag" seminar, based on your Research Proposal), providing you with the opportunity to develop your skills in scientific communication. You will prepare the seminar under the guidance and direction of your thesis advisor. This semester, the seminars will be held on Mondays; usually two seminars per week; 12:00 noon and 12:45 p.m.; SCIE 1511. Your seminar should be 30 min. long; **presentations which deviate more than 5 min from this timing will be penalized 5%.**

Prior to the start of the Fall 2016 semester, you must sign up for a seminar slot: Carol Schlaht (SC4481) will send an announcement by email when the sign-up period begins. Students should ensure that their Advisors and Advisory Committee members are available to attend, before confirming their seminar dates.

You must submit (electronically) your *seminar title* and an *abstract (maximum, 250 words) to Carol Schlaht by noon, Wednesday of the week before your seminar*. A 5% penalty will be applied for late submissions.

Each member of your Advisory Committee will evaluate the seminar independently and submit a grade to the Course Coordinator. These grades will be averaged (grade a). Two members from the faculty panel will each submit a grade (grades b and c). The three grades (a, b, and c) will be averaged to give the final grade.

Appendices:

1. Schedules and Checklists
2. Literature Assignment: Specifications for the Report
3. Learning Outcomes
4. Prof. Josephy's Writing Tips; Common Grammatical Errors
5. Weaknesses that are sometimes seen in MCB*6500/7500 Research Proposals
6. Policies

Appendix 1. Schedules and Checklists

When?	What?	✓
As soon as possible.	Discuss with your advisor the article that you will review for the *Literature Assignment*. Deposit an (electronic) copy of the article in the Courselink Dropbox.	
Friday, May 13; 10:00 a.m.	**First class meeting.** Room: SCIE 1511. All new graduate students are required to attend. *Advisors are also encouraged to attend.*	
During the Summer semester, **starting Monday, May 30; noon.**	Attend the **Monday noon** "brown-bag" seminar presentations by the Winter-cohort students. The talks are usually held in SCIE 1511. The seminar notices will be distributed to MCB department members one week in advance. **All students are required to attend all of these seminar presentations**. **Attendance will be recorded. Any absenteeism should be reported to the course coordinator prior to the date, providing an appropriate reason. An incomplete grade will be assigned for undocumented absenteeism.**	
Monday, May 30; noon.	Submit **two printed copies** of your LA to the Coordinator. Deposit an electronic copy in the Courselink Dropbox.	
Later in the semester	Ms. Carol Schlaht will advise you when you may contact her to schedule your seminar slot for the Fall semester.	
Thursday, Aug. 18; noon	Submit **two printed copies** of your RP to the Coordinator. Deposit an electronic copy in the Courselink Dropbox. **You are also responsible for delivering a copy of your RP to each member of your Advisory Committee.** The graded RPs will normally be returned to you two weeks before your "brown-bag" seminar. **A penalty of 10% will be applied for any late submission.**	

Appendix 2. Literature Assignment: Specifications for the Report

The content and editorial specifications of the LA report should follow these guidelines. Suggested page lengths for each section are given on the Grading Rubric.

Title Page: The title page should include:

- Title: your own concise statement of the topic of your analysis;
- The complete reference for your article, in the format used by the journal *"Molecular and Cellular Biology"* (http://mcb.asm.org/site/misc/journal-ita_org.xhtml#02);
- Your name, program (M.Sc. or Ph.D.), and your Advisor's name;
- Date of submission.

Abstract (Suitable for Press Release):

Place the Abstract at the beginning of your document, but it should be the *last* section that you write. Write an abstract of no more than 250 words, explaining the intellectual and scientific context, results, and outcome of the research reported in your article in a form that could be published in a general-interest magazine or newspaper - that is, in plain language for the general public. Do not paraphrase the authors' abstract or use technical terms. Define essential scientific words within your abstract. This may be the most challenging part of the assignment!

Intellectual and Human Context:

Summarize the intellectual and human contexts of the research reported in your article, including answers to all the questions considered during Steps 1 and 3. Discuss the research literature relevant to the work (the intellectual context).

Table of Methods:

Compile a list of the methods used by your researchers into a Table. Indicate which method will be described in your report. Include references to resources that explain the method. The table should follow the format below.

#	**Method**	**Reference**
1	Inoculation of petri plates	(1)
2	Bacterial cell culture	(1)
3	Cell disruption (French pressure cell)	(2)
4	Cell fractionation by differential centrifugation	(3)
5	Enzyme purification by Ni(NTA) affinity chromatography	(3)
6	Protein assay	(4)
7	A specific enzyme assay	(5)*

*This method is particularly critical to the reported research and is therefore described below.

In the table above, the references might refer to, for example: (1) appropriate pages in Gerhardt's Methods for General and Molecular Bacteriology; (2) Freifelder's Physical Biochemistry: Applications to

Biochemistry and Molecular Biology; (3) a document provided online by Qiagen, Inc.; (4) a journal article that describes a particular protein assay; and (5) a relevant volume of *Methods in Enzymology* or a journal article. If a method is described completely in the article you are analyzing, your article can be used as the citation for that method. Please do not cite undergraduate lab manuals, since they are not published documents.

Explanation of a Method:

After obtaining the Course Coordinator's approval for your selection, explain the method that you selected during Step 2 by answering these questions:

How is the method performed? What data are obtained? How are the data interpreted? What information is gained by using this method?

Diagrams often help to explain research methods; you may include diagrams in your report, and they are not included in the page limits.

In writing this explanation, imagine that you are answering the questions above for a student colleague who is not familiar with the selected method. For examples of explanations like the one you will write, see Nelson and Cox, Lehninger Principles of Biochemistry, 5th Edition (Section 3.3, "Working with Proteins") or the explanations of research methods provided by the reference books cited in Step 2. Also, think about the best lab manuals provided during your undergraduate studies. Your goal will be to write such an explanation of the most important/novel method used by your authors, in your own words. Note that you should explain the method (how it works, what it does) rather than writing an experimental protocol. Thus experimental details (1 mL of this added to 2 mL of that) are not usually required.

Hypothesis/ Question; Analysis of Results; Subsequent Work:

Target this report for other professionals in your discipline (faculty, students, staff). Summarize the experimental results obtained by your authors, as specified in Step 4. Do *not* paraphrase the Results section of your article... rather write your own, analytical summary of the results. Illustrate this section with flow charts (*e.g.*, for protein purification), tables and figures of your own design. Refer specifically to your Tables and Figures (*e.g.*, Smith *et al.* analyzed the effects of several mutations on chemotaxis. Their results are summarized in Table 1) and to the data in the article you are analyzing (*e.g.*, Smith *et al.* observed that bacteria lacking CheA were unable to respond to aspartate as a chemoattractant (Fig. 4 of Smith *et al.* (10).). *Do not* reproduce tables and figures from your article in your report.

Summarize the outcome of the research, including both the authors' own interpretation (summarized during Step 5), that of other authors, and subsequent research (summarized during Step 6). *Do not* paraphrase the Discussion section of your article! Look back at the review articles on your topic for examples of the style to be adopted here.

Use the on-line Science Citation Index to find subsequent articles citing a specific paper. One way to access the Science Citation Index is as follows:

1. Go to the Journal Articles page of the University Library web site.
   http://ja.lib.uoguelph.ca/
2. Search for Web of Science by database title and go to the Web of Science site.
3. Select Web of Science from the drop down menu next to the Orange Search tab.
4. The default search is "Basic Search". Instead, click the blue down-arrow to open the drop-down menu, and select "Cited Reference Search".

5. Enter minimal information to obtain a list of references including the one of interest. For example, search with the distinctive names of two authors. This approach will be easier than trying to enter detailed citation data for the particular article of interest.

6. Select the article of interest and click "Finish Search". The citing articles will be listed, with additional citation info.

Let's find the articles that have cited this paper: Romantsov, T., Helbig, S., Culham, D.E., Gill, C., Stalker, L., Wood, J.M., Cardiolipin promotes polar localization of osmosensory transporter ProP in *Escherichia coli*, *Mol. Microbiol.* 64:1455-1465, 2007.

At the "Cited Reference Search" screen, in the first window ("Cited Author"); enter the names: "Romantsov and Helbig" (which are probably more distinctive than "Wood" or "Gill"). Click "Search"; the target paper will be retrieved.

Select the article and click "Finish Search".

To prepare the citation summary table, list the number of citations per year, the number of self-citations per year, and up to three examples of journal names per year, selected to illustrate the breadth of impact of the work. Discuss a few of the citing articles (a few sentences each, including your citations of the articles discussed).

For example, a citation summary for the target article is given below.

Year	**Citations**	**Self-citations**	**Journals**
2007	2	0	*Mol. Microbiol.*, *Curr. Opin. Microbiol.*
2008	11	2	*Ann. Rev. Biochem.*, *Biophys. J.*, *Infect. Immun.*
2009	11	1	*Chem. Phys. Lipids*, *Cold Spring Harb. Persp. Biol.*, *J. Mol. Biol.*
2010	7	1	*Proc. Natl. Acad. Sci. U.S.A.*
2011	14	1	*Curr. Opin. Cell Biol.*, *New Engl. J. Med.*, *J. Food Prot.*
2012	15	1	*J. Med. Microbiol.*, *Rapid Commun. Mass Spectrom.*
2013	6	0	*Crit. Rev. Biochem. Molec. Biol.*, *Int. J. Molec. Sci.*
Total	66	6	

Reference List:

Using *Molecular and Cellular Biology* format, cite appropriate references in your text and list the references cited in your report. Marks will be deducted if the reference citation format is inconsistent/incorrect. Remember that this is a reference list, not a bibliography; every item in your reference list must be cited in the text of your report.

As stated in the Course Outline, the LA should be prepared single-sided, double-spaced, with a standard 12-point font (*e.g.*, Times New Roman) and 1" margins. Please do not leave blank lines between paragraphs. The total length of the LA should be about 15 pages.

Appendix 3. Learning Outcomes for MCB*6500 and MCB*7500

We are confident that you can already read and learn science; otherwise, you would not be in graduate school! Now, you are moving from passive to *active* involvement in your field. Instead of just learning what other scientists have done, you are now going to be creating new knowledge and putting your own ideas forward.

These courses are focused on the development of your *intellectual independence*. You will be learning how to study the literature: identifying important papers, reading them critically, summarizing them, and thinking about their significance. You will be learning how to *synthesize* what you have read: that is, rather than just reading specific papers or reviews one at a time, and repeating their conclusions, you will be trying to *integrate them into a coherent whole*, making a "mental map" of how they fit together. Perhaps you read a 1996 paper which hypothesized that one particular gene is regulated by another; and a 1999 paper that proved that this hypothesis is correct; but then a 2002 paper said, "No, it's not so". Finally, a 2005 paper resolved the apparent contradiction, by showing that the hypothesis is correct in yeast, but is incorrect in mammals. What you have now assembled is a *narrative*: a sequence of contributions that fit together to make a story, advancing our knowledge of the subject. Making coherent sense out of these distinct facts is *integration*, and learning to do this is an important part of your maturation as a student. Based on your understanding of the state of the field, you will then explain the contribution that you hope to make. Finally, in the seminar, you will convey all these ideas to your audience.

Reading the scientific literature: A naive reader will take everything he or she reads "for granted", as the plain truth. A sophisticated reader recognizes that each writer - even a scrupulously honest author - has a particular point of view, with biases, preconceptions, or misunderstandings that colour his or her work. Sorting out the true from the false, the brilliant from the mediocre, the innovative from the mundane - these are aspects of critical analysis. They are examples of the most general question that we all must grapple with: what is the nature of the "good"?

The understanding and wisdom you are developing as a graduate student will bring little reward unless you can express them in words that others can follow and understand. So, another key aspect of the course is development of your writing skills. Scientific writing is a specialized art: you need to learn the rules and practices of good general writing, and you also need to learn the disciplinary conventions. The skills you develop now will serve you throughout your career - when you write manuscripts, prepare your thesis, and, later, when you write grant applications, contract proposals, technical reports, and so on.

Originality: Your written and oral presentations for this course are understood to be *your own original creative work*. Putting your name on your presentations is a type of warranty, certifying that you are the author of the work and are responsible for its content. Scientists are deeply aware of the problem of plagiarism. This is because our most important outputs are our words, data, and drawings. Baseball players can point to their home runs; contractors can show off the houses they have built; but most scientists can only list their publications - their *ideas*. If someone else takes credit for those ideas, the real author feels violated. A person who advances his or her career by presenting other peoples' ideas as his own is cheating - gaining an undeserved advantage over his or her peers.

Plagiarism can be defined as "using others' work and misrepresenting that work as your own". The strategy for steering clear of accusations of plagiarism is the same as the strategy for productive studying. If you have studied a paper carefully and achieved a deep understanding of what you have read, then you should be able to put the paper away, go to bed, and get up the next morning and write down, in your own

words, the key ideas of the paper, without having to look at it again. If you can't do that, then you did not read the paper thoroughly enough. Anybody can copy out passages of a published paper; that does not make you a scientist, any more than copying out a Shakespeare sonnet makes you a poet.

From time to time, you may wish to quote from another's work. Perhaps you have read a statement or definition that was so apposite that you want to "show it off" to the reader. If so, put it in quotation marks. But this will be an occasional luxury, not a consistent pattern. *Even a single word* should be placed in quotation marks, *if it is a word that you would not normally have used yourself*, or if you wish to indicate a "coinage" - the introduction of a new expression into the language:

The philosophical theory known as "utilitarianism" was developed by John Stuart Mill.

In 1987, the Brundtland Commission of the United Nations put forward the concept of "sustainable development".

The same considerations apply to visual material as apply to writing. You should avoid reproducing figures from other sources, and never do so without acknowledging the source. Almost always, you will find that the published figure is not exactly what you need for your presentation, in any case. If you draw your own figure, then you will draw *exactly what you want to show*, and you will not need to "mold" your presentation to fit someone else's vision. In particular, if you take figures or slides from your advisor or your lab colleagues, this must be explicitly acknowledged.

When you discuss and analyze published work, you may need to reproduce figures from other sources. You could put a slide on the screen and say, for example, "Here is the dose-response curve measured by Higgins and colleagues in 1995. You can see that it is linear at low doses, and then drops off above 10 μmol." This is simply an appropriate analysis of previous work. In contrast, if you show a slide illustrating the structure of the plant cell wall, and use it to illustrate your ideas, *without acknowledging that the slide was taken from a textbook*, then you are plagiarizing, just as if you had used someone else's words.

The instructors will be using Turnitin, integrated with the CourseLink Dropbox tool, to detect possible plagiarism, unauthorized collaboration, or copying, as part of the ongoing efforts to maintain academic integrity at the University of Guelph.

If you have any questions or concerns about the topics discussed here, please feel free to discuss them with the course instructors.

Appendix 4. Prof. Josephy's Writing Tips

Commonly misspelled words

derivative; electrophilic/ hydrophilic/ nucleophilic/ lipophilic (only one "l"); fluor, fluorescent ("u" before "o"); gauge; inoculate (only one "n"); innocuous (two "n" s); naphthalene ("h"s both before and after the "t"); occurs (single "r"); occurring, occurred (double "r"); parallel; phosphorus (element) vs. phosphorous (+3 oxidation state of phosphorus); separate.

"i" before "e", except after "c", or when sounded as "ay", as in *neighbour* and *weigh*:

yield; receipt; freight (but "protein" is an exception to this rule!)

The word "alot" does not exist.

Frequently confused words

"its" = *possessive case of the pronoun it*; "it's" = *contraction of "it is"*

Compare: "Virtue is its own reward" *vs* "It's a nice day for a walk."

Note: Contractions ("it's", "don't", "can't", etc.) are best avoided altogether, in formal writing!

The nouns *affect* and *effect*:

An *effect* is a result or consequence. "The main effect of the recent recession was a rise in the unemployment rate." (There is also a noun *affect*, but it is rarely used, except in psychology or psychiatry; it means an emotion or mood: "Her affect was subdued because of chronic depression".)

The verbs *affect* and *effect*:

To *affect* means to influence: "The presence of contaminating proteins affected the yield of the ligation reaction."

To *effect* means to bring about, to accomplish: "The implementation of all of our standard operating procedures has now been effected."

(The verb "to affect" also has another meaning: to pretend: "The actor, although English, affected an Australian accent." This meaning is related to the noun "affectation"; you are unlikely to encounter this meaning in scientific writing.)

The nouns *dependent* and *dependant*:

A dependant (noun) is a person supported by another: "The tax credit is made available to the parent and his or her dependants." Dependent (adjective) means *influenced by*: "The rate of the reaction is dependent on substrate concentration."

The verbs *ensure* and *insure*:

To *insure* is to protect against loss: "I have insured my bicycle against theft." To *ensure* is to make certain: "I have ensured that all the campfires have been put out."

***Than* and *then*:**
than (conjunction used in comparisons) vs. ***then*** (adverb describing temporal order)
Correct: The incubator is warmer than room temperature.
Correct: The cells were lysed and then the lysate was centrifuged.

Numerals and units:

In English, we distinguish between things that can be counted (such as books and bricks) and things that cannot, such as a length of time or a weight of sand. The word "fewer" is used in the former case and the word "less" in the latter. Compare: "Our department hired fewer faculty in 2014 than in 2013." *vs* "My laptop uses less power than my desktop computer."

Counting numbers (integers) less than ten should be *written out as words*. "Our book club has 127 members. Seven members serve on the Board of Directors and three on the Newsletter Committee".

If a quantity is *not* a counting number, then it should be written as a numeral: "The temperature is 4 °C"; not "The temperature is four °C". (After all, the temperature might be 4.14 °C, and it would be absurd to write ""The temperature is four point one four °C"!)

A measure is singular, regardless of size. "1 mL of water was added." "12 mL of water was added." (If we write "12 mL of water were added", this would imply that we added 1 mL of water at a time, 12 times!)

The *best* practice is simply to avoid using measures and units as subjects. Instead, use the substance as the subject. Write: "Water (12 mL) was added" rather than "12 mL of water was added." This construction is simpler and it focuses attention where it belongs: on the subject (water) rather than on the measure and the units.

Common Latin abbreviations:
i.e. = id est = that is: "The test is mandatory; *i.e.*, it must be written."
e.g. = exempli gratia = for example: "Many different countries have hosted the football World Cup, *e.g.*, France, Japan, the U.S.A., and Brazil."
et al. = et alia = and others. "The authors of the paper are Wright, Wakabayashi, et al."

Note that "et" is *not* an abbreviation and is *not* followed by a period.

When writing these abbreviations (or other foreign-language terms), it is standard to use *italic* font.
When speaking, it is best to substitute the English equivalent.

Bibliographies

In your bibliographies, **capitalize only the first word of a title - even if different conventions are used in the journal itself** (some journals capitalize every major word of a title, when typesetting a paper). Include volume and page numbers but not issue numbers; do not include "doi" information.

Correct:
Poon, J.C., and Josephy, P.D., Hydrolysis of S-aryl-cysteinylglycine conjugates catalyzed by porcine kidney cortex membrane dipeptidase, Xenobiotica 42: 1178-1186, 2012.

Incorrect (in several ways):
Poon, J.C., and Josephy, P.D., Hydrolysis of S-Aryl-cysteinylglycine Conjugates Catalyzed by Porcine Kidney Cortex Membrane Dipeptidase, Xenobiotica. 42(12): 1178-86, 2012.

doi: 10.3109/00498254.2012.700427.

In a title and at the beginning of a sentence, the first non-Greek letter after a lowercase Greek letter should be capitalized.

Correct: γ-Globulin from the same sample but containing no Cu salt served as copper control.
Incorrect: γ-globulin from the same sample but containing no Cu salt served as copper control.

The same rule applies to numerals:

Correct: 1-Naphthol 2-hydroxylase catalyzes the conversion of 1-naphthol to 1,2-dihydroxynaphthalene.
Incorrect: 1-naphthol 2-hydroxylase catalyzes the conversion of 1-naphthol to 1,2-dihydroxynaphthalene.

The most common grammatical errors that one sees in MCB*6500 papers.

1. Failure to use a comma where it is appropriate (especially after an introductory phrase or clause).

Correct: To perform the assay, substrate is added to the enzyme at time t=0.
Incorrect: To perform the assay substrate is added to the enzyme at time t=0.

The failure to use commas to set off a nonrestrictive phrase or clause is a similar error.

Correct: Hemoglobin, which is the body's major reservoir of iron, can undergo autoxidation.
Incorrect: Hemoglobin which is the body's major reservoir of iron can undergo autoxidation.

(Note that, when reading these sentences, you would naturally pause at the comma. In most cases, the written comma corresponds to the pause in speech.)

2. **Unnecessary** (intruding) **commas**; *e.g.*, do not use a comma between a single subject and its verb.

Correct: The recombinant protein will be purified by IMAC.
Incorrect: The recombinant protein, will be purified by IMAC.

3. **Comma splice**: joining two independent clauses with a comma.

Correct: Use a semi-colon: "The enzyme assay was highly sensitive; fluorescence spectroscopy was used for detecting the product". Or, as a better solution, join the clauses with an appropriate conjunction: "The enzyme assay was highly sensitive because fluorescence spectroscopy was used for detecting the product."

Incorrect: The enzyme assay was highly sensitive, fluorescence spectroscopy was used for detecting the product.

3. Failure of **subject-verb agreement**; most commonly, this causes difficulties when a phrase or clause comes between the subject and the predicate.

Correct: Misfolded intermediates of this protein cause cytotoxicity. (The subject is "intermediates" (plural), not "protein" (singular).

Incorrect: Misfolded intermediates of this protein causes cytotoxicity.

4. Failure to **hyphenate compound modifiers.** *Compound adjectives* are two or more words that together make an adjective. When they come directly before a noun, they're known as "compound modifiers" and are usually hyphenated: noise-canceling headphones; blunt-end ligation. The hyphen prevents confusion: would a "public school opening" be the opening of a public school, or the public ceremony opening some other type of school? "Public-school opening" makes it clear that we mean the former, not the latter. (I saw a headline recently that referred to an accident causing "non-life threatening injuries!).

Correct: I will need a wake-up call in the morning. *(Wake-up* is a compound modifier of *call*.)
Incorrect: I will need a wake up call in the morning.

Correct: I need to wake up at 6 a.m. (*Wake up* is a phrasal verb and should <u>not</u> be hyphenated.)
Incorrect: I need to wake-up at 6 a.m.

5. Use a **semicolon**, not a comma, to join two independent clauses separated by a conjunctive adverb. The conjunctive adverbs include **accordingly**, **consequently**, **hence**, **however**, **moreover**, **otherwise**, **therefore**, and **thus**.

Correct: The basement membrane does not contribute to selectivity; however, damage to this membrane leads to proteinuria.

Incorrect: The basement membrane does not contribute to selectivity, however damage to this membrane leads to proteinuria.

<u>Appendix 5.</u> Weaknesses that are sometimes seen in MCB*6500/7500 Research Proposals

1. Conclusions from the published literature are simply stated as received facts, *without explaining the evidence on which they are based*, and *without critical analysis* of their limitations or possible alternative explanations.

Note that a good way to provide an integrated overview of a body of literature is by construction of a "synoptic table", as illustrated below.

2. Findings based on studies of specific biological systems (e.g., particular organisms or cell lines) are presented *without identifying the system used*, and without considering whether the results obtained in that system are more generally applicable.

3. *Teleological* reasoning (see below) is invoked to explain biological phenomena; a sound argument should be grounded in an understanding of natural selection and evolution.

4. The hypothesis is weak; that is, *the hypothesis is almost certain to be true*, and so it does not provide new insight; e.g., "using shRNA to knock down expression of protein X will have an effect on the cell's behaviour" - without defining what the effect is predicted to be.

5. In the proposed experiments, particular experimental systems (e.g., particular organisms or cell lines) are chosen for study, without explaining *why* they were chosen and without considering possible *alternatives*.

6. In describing the proposed experiments, statistical issues are not considered. The proposal should indicate (at least in general terms) how many technical replicates and biological replicates of each experiment will be performed, and how the statistical significance of any effects will be assessed.

7. In the proposed experiments, the student has assumed that all of the techniques and measurements will work as planned; pitfalls and obstacles should be anticipated and possible "work-arounds" and alternatives considered.

8. The significance of the proposed work is exaggerated; unjustified claims are made; e.g. "These results will lead to development of a new form of cancer therapy".

9. The Proposal was not carefully proof-read; there are obvious spelling or typographical errors, missing text, etc.

10. The References were not carefully proof-read; there are missing article titles, journal titles, page numbers, etc.

Use of a synoptic table to organize a review of recent literature (Ivanov *et al*., Epigenetic mechanisms of importance for drug treatment, *Trends Pharmacol Sci.* 35: 384-396, 2014)

Table 1. Relevant examples of epigenetic biomarkers of drug responses

Drug	Gene	Function	Evidence for epigenetic regulation	Power	Refs
Anthracyclines	*ABCB1*	Transport	Promoter methylation correlated with survival in breast cancer patients and may be a marker for the efficacy of doxorubicin treatment	$n = 75$, $P = 0.004$ (validation cohort $n = 163$)	[75]
	GSTP1	**Detoxification**			
	PITX2	Cell proliferation	Promoter methylation correlated with clinical outcome for anthracycline-based chemotherapy	$n = 241$, $P = 0.002$	[76]
Alkylating agents	***BRCA1***	**DNA damage response**	Promoter hypermethylation of *BRCA1* predicted enhanced sensitivity to platinum-derived drugs in cancer cell lines and xenografted tumors; it also predicted increased time to relapse ($P = 0.0087$) and survival ($P = 6.4 \times 10^{-7}$) in ovarian cancer patients under cisplatin treatment	$n = 30$	[77]
	GPX3	Detoxification of hydrogen peroxide	Loss of *GPX3* expression due to promoter hypermethylation correlated with resistance to cisplatin ($P = 0.014$) and with reduced disease-free survival ($P = 0.02$) in head and neck cancer patients	$n = 46$	[78]
	MGMT [a]	**DNA repair**	Promoter methylation of *MGMT* associated with improved overall survival (21.2 vs 14 months; HR 1.74, $P < 0.001$), progression-free survival (8.7 vs 5.7 months; HR 1.63, $P < 0.001$), and response ($P = 0.012$) in glioma patients treated with temozolomide	$n = 411$	[79]
	PLK2	Tumor suppression	Promoter methylation of *PLK2* associated with a higher risk of relapse in ovarian cancer patients	$n = 54$, $P = 0.003$	[80]
Fluoropyrimidines	*TFAP2E*	Transcriptional regulation	Hypermethylation of *TFAP2E* associated with clinical nonresponsiveness in colorectal cancer patients	$n = 220$, $P < 0.001$	[81]
DNMTi	***GSTP1***	**Detoxification**	DNA methylation of *GSTP1* correlated with efficiency of DNMTi therapy in prostate cancer cells		[82]
Tyrosine kinase inhibitors	*OSCP1*	Transport	Patients with higher methylation of *OSCP1* were resistant to imatinib treatment	$n = 90$, $P = 0.0003$	[83]
	SFRP5	WNT signaling	DNA methylation of *SFRP5* correlates with lower progression-free survival rate in non-small-cell lung cancer patients in response to EGFR tyrosine-kinase inhibitors	$n = 155$, $P = 0.011$	[38]
Docetaxel	***RASSF1A***	**Cell cycle, DNA repair**	Promoter methylation of *RASSF1A* is associated with nonresponsiveness to docetaxel in breast cancer patients	$n = 45$, $P = 0.042$	[84]

Bold font denotes biomarkers also reported as circulating biomarkers. HR, hazard ratios.

[a]Tested using a commercially available pharmacoepigenetic test for the efficiency of glioma chemotherapy.

The fallacy of teleology (explanations based on purpose)

(excerpt from: Gregory, T.R., Understanding natural selection: essential concepts and common misconceptions, *Evo. Edu. Outreach* 2: 156-175, 2009).

Much of human experience involves overcoming obstacles, achieving goals, and fulfilling needs. Not surprisingly, human psychology includes a powerful bias toward thoughts about the "purpose" or "function" of objects and behaviors - what Kelemen and Rosset (2009) dub the "human function compunction." ...

A related conceptual bias to teleology is anthropomorphism, in which human-like conscious intent is ascribed either to the objects of natural selection or to the process itself. The penchant for seeing conscious intent is often sufficiently strong that it is applied not only to nonhuman vertebrates ... but also to plants and even to single-celled organisms. Thus, adaptations in any taxon may be described as "innovations," "inventions," or "solutions" ... Even the evolution of antibiotic resistance is characterized as a process whereby bacteria "learn" to "outsmart" antibiotics, with frustrating regularity. Anthropomorphism with an emphasis on forethought is also behind the common misconception that *organisms behave as they do in order to enhance the long-term well-being of their species*. Once again, a consideration of the actual mechanics of natural selection should reveal why this is fallacious.

This tendency toward explanations based on purpose ("teleology") runs very deep ... Consider this particularly egregious example from a website maintained by the National Institutes of Health:

"As microbes evolve, they adapt to their environment. If something stops them from growing and spreading - such as an antimicrobial - they evolve new mechanisms to resist the antimicrobials by changing their genetic structure. Changing the genetic structure ensures that the offspring of the resistant microbes are also resistant."

Fundamentally inaccurate descriptions such as this are alarmingly common. As a corrective, it is a useful exercise to translate such faulty characterizations into accurate language. For example, the antimicrobial-resistance explanation could read:

"Bacteria that cause disease exist in large populations, and not all individuals are alike. If some individuals happen to possess genetic characteristics that make them resistant to antibiotics, these individuals will survive the treatment, while the rest gradually are killed off. As a result of their greater survival, the resistant individuals will leave more offspring than susceptible individuals, such that the proportion of resistant individuals will increase each time a new generation is produced. When only the descendants of the resistant individuals are left, the population of bacteria can be said to have evolved resistance to the antibiotics."

Appendix 6. Policies:

E-mail Communication: As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

When You Cannot Meet a Course Requirement: If you are unable to meet an in-course requirement because of illness or compassionate reasons, please advise the Coordinator in writing, as soon as possible, giving your name, id#, and e-mail contact. See the Graduate Calendar for information on regulations and procedures for Academic Consideration.

Drop Date: The last date to drop one-semester courses, without academic penalty, is March 6.

Academic Misconduct: The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community - faculty, staff, and students - to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection. The Academic Misconduct Policy is detailed in the Graduate Calendar.

Recording: Presentations cannot be recorded without the prior written permission of the presenter (whether instructor, student, or guest lecturer.)

Resources: The University Graduate Calendar is the source of information about the University of Guelph's procedures, policies, and regulations which apply to graduate programs.