

**MOLECULAR AND CELLULAR BIOLOGY COOP 1000, 2000, 3000, 4000**

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**Course Description:** The co-op work terms in the MBG.C program are semester-long experiences in a paid work setting. The MBG:C program includes 3 mandatory work terms (COOP1000, 2000, 3000) as well as an optional fourth work term (COOP4000). Students must obtain a passing grade after each work term in order to continue in the program. The assignment of a “**pass**” is based on the employer’s Work Performance Evaluation and on the Faculty Advisor’s Evaluation of the Written Work Report.

**Credit weight:** [0.00]

**Prerequisite(s):** COOP1100 [0.00] (and successful completion of any previous work terms). COOP1100 is a prep course offered by Co-operative Education & Career Services and is required for your application for a co-op work position. It is taken in semester 3 (Fall semester) of your degree program.

**Course/Learning Objectives:**

**A. Problem Solving & Critical Thinking**

1. Critically evaluate the connections between knowledge gained within the curriculum and the application of knowledge to the workplace by gathering and integrating relevant information, assessing its relevance, and synthesizing evidence to draw conclusions
2. Propose and produce creative solutions, independently and within teams, using skills and knowledge gained from within the classroom and acquired through the workplace experiences

**B. Communication**

1. Accurately and effectively communicate ideas, arguments and analyses, at a level appropriate to a range of audiences, in written, oral and visual form.

**C. Professional and Ethical Behaviour**

1. Reflect and describe your understanding of how personal and professional integrity is practiced in the workplace, and how it impacts both the work environment and society at large.
2. Describe how this work term has enabled you to grow both personally and professionally with regards to self-management, leadership and teamwork.
3. Reflect on what this work term has taught you about yourself, your skills, knowledge level and interests, and how this affects your plans for within and beyond the undergraduate program.
4. Evaluate and reflect on learning in the workplace to plan for professional growth and personal development within and beyond the undergraduate program.

#### D. Scientific Method

1. Reflect on the direct or indirect application of the scientific method within the position
2. Evaluate the benefits and limitations of applying experimental approaches within the constraints and complexity of an authentic workplace environment

#### E. Scientific Technology and Techniques

1. Compare and contrast the application of knowledge, methodologies and techniques between the workplace and classroom.
2. Acquire competence and/or awareness of various techniques and methodologies that are being used at the workplace.

**Resources:** There are no textbooks or supporting materials for the course. It is expected that you will make full use of the primary and secondary literature and, in some cases, government and industry publications, when researching and writing your work term reports. Detailed guidelines can be found in the *Appendix* of this outline.

Prior to the submission due date *for the COOP1000 work term report only*, students are given the opportunity to arrange with the faculty advisor (time-permitting) to submit electronically a draft of the report for editorial feedback. If you would like to do so, **you must submit the draft at least one week prior to the due date for submission (the 5<sup>th</sup> class day of the semester)**. Late submissions will not be accepted for feedback.

For information on the writing services offered by the University of Guelph Learning Commons, go to: [http://www.lib.uoguelph.ca/assistance/writing\\_services/](http://www.lib.uoguelph.ca/assistance/writing_services/)

**Work Term Evaluation:** Successful completion of each work term is based on evaluation by your employer of your work term performance as well as a minimal grade of “Satisfactory” by the Faculty Advisor or designate, of your work term report (written – experimental or literature review). The work term report may be assigned grades of Outstanding, Very Good, Good, Satisfactory or Unsatisfactory (see *Courselink* for grading rubric. Note that certain parts of the rubric is not applicable for a literature review type report). ***You will be given only one opportunity, over your entire co-op program, to rewrite an UNSATISFACTORY report. If the revised report is deemed acceptable, you will be given a grade of satisfactory only.***

**Submission:** Students are required to submit a work report by **the 5<sup>th</sup> class day of the following semester**, as both a Word file (docx) and PDF, to the *Molecular and Cellular Biology Faculty Advising* site in *Courselink*, in the Dropbox for the appropriate semester (e.g. if you worked S22, you will submit to the S22 Reports Dropbox). The guidelines for writing the report is provided in Appendix of this outline.

**Letter of submittal:** A separate Letter addressed to the Faculty advisor must also be submitted in the Dropbox on the due date of the report. This should be a Word file (docx) separate from your term report. The letter should follow a standard business format and include:  
(a) Name of the employing organization and name of your immediate supervisor.  
(b) A brief outline of your general responsibilities and/or specific project. Contributions of other co-workers (if applicable) should be indicated

(c) Briefly describe/discuss how this project relates to other work that you did for the employer (if you are reporting only part of your work in the report).

(d) Lastly, include your general goals in the B.Sc. program and how this project allowed you to achieve some of those goals.

An example of a letter of submittal is provided in the COOP section of the *Courselink* site for Microbiology and Biotechnology Faculty advising.

**Important Dates:**

1. Obtain final approval from the faculty advisor for your work report topic and format

**Week 6 of work term**

2. Work report due (including interim reports)

**The 5<sup>th</sup> class day of the following semester**

**Academic Misconduct:** The University of Guelph takes Academic Integrity and Academic Misconduct very seriously. You are expected to understand what constitutes Academic Misconduct (e.g. plagiarism); ignorance of the rules is NOT an accepted excuse for committing Academic Misconduct. The rules and regulations are described at

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>.

Suspected cases of academic misconduct, including plagiarism, will be reported to the Associate Dean Academic, College of Biological Science.

## APPENDIX Work Term Report Guidelines

### Work Term Report

The work term report provides an important opportunity for students to reflect on what they have learned during their recent work experience. This learning can, in part, take the form of a better understanding of the material you have been learning in the classroom – deeper appreciation of a specific method you have now gained extensive experience with, or a better appreciation of how iterative rounds of experimentation and optimization can help solve a difficult scientific or technical problem. Work experiences also help improve one's communication skills, provide opportunities to better understand one's own strengths, weaknesses and interests, or simply better understand how science works in a professional environment. The work term report provides opportunities to reflect on all these aspects of your work experience, with options that should allow you to explore those topics that most closely reflect your work placement experience. **Since you are in the science program, you are strongly encouraged to write a Scientific or task based report when possible.**

### Work Term Report Format

The report should include the following items:

- Front Cover
- Letter of Submittal
- Title page
- Table of Contents
- Main body (see below for details of format depending on type of report)

You may include figures, tables and graphs as needed. These should be captioned, and should be placed in the text near where they are first referenced. Figures etc. must be attributed if taken from another source. Figures, tables and graphs do not count towards the total page count.

- References

Please reference sources in the document, and then provide references at the end of the document. Please follow the reference format of the Journal of Biological Chemistry (<https://www.elsevier.com/journals/journal-of-biological-chemistry/0021-9258/guide-for-authors>). Using a reference manager (Mendeley, Papers, Zotero, Endnote etc.) is recommended.

- Acknowledgements

**Length of the Report:**

A typical 4-month work term report should be approximately 10 pages, an 8 month work report 12 pages, and a 12 month report 14 pages, while an interim report should be approximately 5 pages. These page counts assume double spaced text, and only include the main body of the writing. These lengths *exclude* the front cover, letter of submittal, title page, abstract, acknowledgements, table of contents, figures, tables and references. Note that it is fine to go somewhat over this target length (e.g. you need space to describe the various methods you used), but it might prove difficult to obtain a good grade with a report that is significantly below the requested length.

**Two or three semester work terms**

For multiple work-term placements, a report will be required after each semester – so, for example, 3 reports total will need to be submitted for a 12-month work term. If your duties/project are the same over the entire 8- or 12-month work term, you can submit a full report after the end of the work term and interim reports in the intermediate semesters. The interim reports follow the basic structure of full reports, but are significantly shorter. The interim reports should include a short summary (not more than half a page) of how the content will be expanded in subsequent work term reports. Note that successive reports from a given placement should explore different themes for reflection.

## ***Option A: A research-focused report***

*A research-focused report is suited for students whose co-op work term was focussed on testing a scientific hypothesis or optimizing a process through iterative experimentation. Examples of such positions might include performing research in an academic, government or industrial laboratory, or developing or improving a protocol, instrument or process for a work task. These experiments do not necessarily need to use methods associated with your major. Note that if your work term meets these criteria, you are strongly encouraged to write a research-focused report.*

The structure of a research-focused report incorporates key aspects of a scientific paper and is organized as follows:

### A. Abstract (one paragraph, maximum 200 words)

- Summarize the scientific content of the report.

### B. Description of the position (one page)

- Describe the organization as a whole, the specific unit you work within, and how the work you are doing fits into the bigger picture of what your unit and organization is doing.
- Describe how your project contributes to the organization's goals (for an academic placement, this might mean how your experiments fit into a larger research project or program).
- Summarize the outcomes you achieved over the work term.

### C. Introduction (two to three pages).

Discuss the background to the problem you are trying to solve. Refer to the literature to support your claims, ideally with reference to the primary literature (research articles) rather than the secondary literature (reviews, books etc.). An introductory figure may be used to help frame the problem.

### D. Results (three to five pages)

Document the key results you achieved over the semester. Use tables, figures and graphs as appropriate and make sure that they are clearly labelled with informative legends. Make sure that these are then referred to in the text. Use statistical methods where appropriate.

### E. Discussion (one to two pages)

Discuss what you can conclude from your results. Where appropriate, refer back to the literature to place your findings in the larger context. If the work did not reach a definite end point, please make concrete suggestions for the project going forward. You should not simply restate your results in the Discussion section.

### F. Materials and Methods

The methods provide a condensed explanation as to how the experiments were performed, with enough detail that another researcher could reproduce your results. Methods should be divided into subsections for the various types of methods used, and are written in the past tense (and not as a set of instructions to be followed). Standard methods (e.g.

performing PCR, running an SDS PAGE gel) or those using a commercial kit can be described very briefly; methods which are more unusual, specific to the problem, or you have developed yourself will require more detail. Be sure to include critical details of materials and reagents such as the specific cell lines, bacterial strains, plasmids, primers and enzymes used. If your work involved development of a particular lab protocol, you may include the protocol as a set of instructions in an appendix.

**G. Reflection (approximately one page)**

Please choose a specific sub-theme from the reflective writing suggestions below and write about what you have learned personally, professionally or academically during from your recent workplace experience.

For the scientific portions of a research focused report, please follow the general style outlined in the Journal of Biological Chemistry author instructions

(<https://www.elsevier.com/journals/journal-of-biological-chemistry/0021-9258/guide-for-authors>) where applicable. The guidelines for presenting data

(<http://jbcresources.asbmb.org/collecting-and-presenting-data>) are particularly useful.

## ***Option B: A task-focused report***

*A task-focused report is suited for students who spent most of their co-op work term performing experimental tasks, but whose tasks did not test a scientific hypothesis. Examples of such positions might include working in an analytical or quality control lab, preparing reagents, or operating a large-volume fermenter.*

The structure of a task-focused report is as follows:

### **A. Summary (one paragraph)**

- Summarize the report, focusing on the key messages.

### **B. Description of the position (one to two pages)**

- Describe the organization as a whole, the specific unit you work within, and how the work you are doing fits in to the bigger picture of what your unit and organization is doing.
- Describe the position. Include a discussion of how the position contributes to the organization's goals, and the position's relationship to other individuals within the organization (e.g. who you report too, whose work your work relies on, who uses the products of your work).
- Describe the tasks you performed, and the criteria by which performance of the task(s) would be considered a "success".
- Describe what outcomes you achieved over the work term. Indicate any challenges associated with the task(s) you performed?
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### **C. Scientific foundations of key workplace tasks (five to seven pages)**

- Choose between one to three tasks or instruments to focus upon (depending on their complexity). For each task:
  - Describe the overall task you performed.
  - For each specific scientific instrument or method you wish to discuss in detail (no more than three), give a detailed background describing this instrument or how the method works. Refer where appropriate to the scientific principles (e.g. physical, chemical, biochemical, microbiological, molecular biological etc.) that underpin the method/instrument. While it is important to discuss the method in terms of generalities, try to relate this discussion back to the specific tasks you were performing.
  - Operational manuals or manufacturers webpages will likely provide a useful starting point. Importantly, it is expected that you research the method in the scientific literature to acquire a more technical viewpoint.
  - Feel free to include figures if they help clarify points.

### **D. Reflect upon what you have learned (two to three pages)**

Please choose one or two sub-themes from the reflective writing suggestions below and write about what you have learned personally, professionally or academically during from your recent workplace experience.



### ***Option C: A reflection-focused report***

*A reflection-focused report is intended primarily for students who spent most of their co-op work term performing tasks that were not explicitly scientific in nature. This might include clerical positions, working on a production line, or a job that involved primarily producing communication materials (such as writing or making presentations). This report is primarily reflective in nature.*

The structure of a reflection-focussed report is as follows:

A. Summary (one paragraph)

- Summarize the report, focusing on capturing the main ideas.

B. Description of the position (approximately two pages)

- Describe the organization as a whole, the specific unit you work within, and how the work you are doing fits in to the bigger picture of what your unit and organization is doing.
- Describe the position. Include a discussion of how the position contributes to the organization's goals, and the position's relationship to other individuals within the organization (e.g. who you report too, whose work your work relies on, who uses the products of your work).
- Describe the tasks you performed, and the criteria by which performance of the task(s) would be considered a success.
- Describe what outcomes you achieved over the work term. Are there any challenges associated with the task(s) you performed?
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C. Reflections (approximately eight pages)

- Please choose two to four sub-themes from the reflective writing suggestions below and write about what you have learned from your recent workplace experience. Because this is the main focus of your report, it is expected that you research your chosen themes, and relate your ideas back to the available literature. Generally, themes 2 and 3 will be most applicable if you were not generally engaged in scientific tasks. You can divide this section by the different themes you wish to explore, giving each section a heading that reflects the content.

## **Possible themes for reflective writing**

In your reflective writing, you are asked to reflect on what you have learned personally, professionally and/or academically over the course of this work term. Learning is a continuous process, so connecting what you have learned in school and to this and other work terms is encouraged. Many of the themes outlined below are supported by extensive literature, with books, articles and other writings available; some background readings might be helpful in formulating your thoughts and can be included as references.

The list below includes suggested themes for discussion. It is expected that you will explore a diversity of these themes over the course of your work terms; do not write on the same theme(s) after every placement. Not all themes will be suitable for all work positions. This list is not exhaustive; if there is a topic you wish to explore in your reflective writing that is not captured in this list, feel free to discuss your idea with your academic advisor.

### **Theme 1: Application of scientific skills and knowledge:**

#### **1a. Application of discipline-specific knowledge in the workplace**

In what ways does this position connect back to what you have been learning within the classroom and teaching labs? How did you apply academic knowledge, methodologies or techniques learned in the classroom within the workplace? E.g. did you enter the workplace knowing everything you needed to know. If not, what foundational learning helped you learn what you needed to know for this job? What do you understand about these methods now that was not apparent when studying them in a classroom or lab setting?

#### **1b. Experimental methods and the workplace**

How do the constraints and complexity of an authentic workplace environment or research laboratory limit, alter or expand the ways in which experimental approaches, as you learn them in the classroom, are actually practiced? In what obvious and non-obvious senses were you using the scientific method within the position, either directly or indirectly?

#### **1c. Potential for improvement in the tasks you perform**

What opportunities do you see for possibly improving the execution of the tasks you were assigned? Are there ways to make a task more efficient, or to achieve other desirable improvements in outcome? Are there alternative instruments or methods that might work better (e.g. ones that were developed more recently than those currently in use)? What are the potential costs, risks and/or downsides in trying to implement these improvements?

### **Theme 2: Development and application of skills:**

#### **2a. Application of your skills to the role**

How have the skills that have developed within the classroom and/or acquired through your workplace experiences helped you succeed in this workplace. Please discuss the application of these skills in context of specific workplace experiences – for example times when you were able to propose or implement creative solutions, or deal with a specific challenge that arose.

### 2b: Development of personal and professional skills

How have your communication, self-management, organization, leadership and/or teamwork skills grown over the course of this work term? As far as possible, try to identify the key drivers for this development within specific workplace experiences, interactions with co-workers, training you have received, or tasks you have been performing.

### 2c: Personal and professional growth

What do you see as your current professional strengths and weaknesses? What potential actions might help shore up your weaknesses, and further develop your strengths? How has this work experience impacted your understanding of your academic and professional interests, and your plans within and beyond the undergraduate program? How will you apply what you have learned to future academic and workplace experiences?

## Theme 3: You and the workplace:

### 3a. Management and being managed

During this work term, you were working under the supervision of one or more individuals. Please reflect on your experience of being managed. Was communication always clear both ways? Were you working closely with your manager, or were you mostly working independently? Were you given detailed daily instructions, or high-level goals that you were given independence in how you pursued? What aspects of your supervisor's management style worked well for you, and where might you have preferred a different approach? What does this say about you and your manager's assessment of your current abilities, your personal preferences, the management culture of the institution, and the basic demands of the position? What did you learn about managing people that you intend to practice when you yourself have a supervisory role? Note: please be respectful and professional!

### 3b: Professional integrity.

How is professional integrity practiced in your workplace environment? How does the practice of professional integrity impact immediate colleagues, the larger work environment and society at large? If you wish to discuss any specific incidences that arose, please anonymize the identities of the individuals involved if the matter is at all sensitive.

### 3c: Workplace safety

How is safety practiced in your workplace? What risks are you exposed to within your position? What specific training, safeguards, protective equipment, practices and procedures are in place to minimize the risks as you execute your tasks? Can you identify any risks that are not fully addressed by current procedures, or ways in which the safety practices or culture of the workplace could be improved upon?

## **Tips for good scientific writing**

Prior to submitting your final report, regardless of the format, you are advised to go through the following checklist and make the necessary corrections.

1. **Proof-read:** grammar, sentence structure, spelling and punctuation. Much of this can be done through the appropriate Word functions.
2. **Be succinct:** this is the hallmark of all scientific papers and the majority of review or opinion articles. Until you become familiar with this writing style, you will need to proof read numerous times, in order to identify and correct areas of redundancy or “wordiness”.
3. **Avoid the use of** first person pronouns in the text, informal styles (i.e. non-scientific, colloquial or slang terms) and excessive abbreviations (when used, they should be first identified in full, with the abbreviation you plan to use in brackets after the full term).
4. The adoption of some **numbering system** (e.g. 1.2,3, etc., for major sections; 1.1, 2.2, 1.3, etc., for main sections) can improve the readability of the report.
5. **Formatting of sections:** each major section should carry the title in italics, bold-faced or otherwise highlighted. The adopted practice should be followed throughout. Minor section headings are best given in normal type at the margin. Sub-section headings of a minor section are given in normal type at the margin and are immediately followed on the same line by the text. A new page should not be used for each major or minor section.
6. **Tables and Figures:** all tables (numbered as Table 1, 2, etc.) and figures (numbered as Figure 1, 2, etc.) must carry a self-explanatory heading or legend, so that the reader can interpret the figure without having to refer to the main text. Both the data and the legend should make sense to the readers by themselves, and together would allow the reader to repeat the work. For tables, additional experimental information may be included in a footnote.
7. **Units of measurement:** Use the standard rules for SI Units giving commonly used industrial terms, if any, in parenthesis.
8. **Footnotes:** except in the description of tables and figures, should be kept to a minimum.
9. **In-text citations:** a) Give surnames (no initials) and year of publication, e.g. Smith and Jones, 2001. b) If the same authors have more than one paper in a year, distinguish them with letters *a, b etc.* after the year, e.g. Smith and Jones, 2002a; Smith and Jones, 2002b.  
c) When the author list includes 3 or more names, second and subsequent authors are abbreviated *et al.* e.g. Smith *et al.* 2003. d) When citation occurs without mention of the name, the names and year are enclosed in parentheses: e.g. “Cells were isolated by standard methods (Smith and Jones, 2001)”. e) When the authors are specifically mentioned in the body of the text, only the year need be in parentheses: e.g. “These results contradict the findings of Smith and Jones (2002a)”.
10. **Types of cited sources:** try to use the primary literature articles as much as possible. These articles can be searched through *Pubmed* database ([www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)). Secondary sources may include reviews, textbooks and industry guidelines. Textbooks

are only appropriate when discussing very basic, well-known information (e.g. *E. coli* is a Gram negative bacterium that has a heterotrophic metabolism...). Restrict the use of websites. If necessary, only cite reputable sites. Websites such as Wikipedia is not appropriate as it relies on online contributors that may not necessarily provide accurate information.

11. ***Unpublished information***: with the relevant party's permission, you may cite someone else's unpublished data (give the name in the text; this does not go in the references section), manuscript in preparation (cited in text as you would the published paper; this does not go in the references section) or *in press* (cited in text as you would the published paper and in the references section just providing the journal in which the paper will appear).