



# MBG\*3350 Laboratory Methods in Molecular Biology

Winter 2024

Section(s): 01

Department of Molecular and Cellular Biology

Credit Weight: 0.75

Version 1.00 - January 05, 2024

---

## 1 Course Details

### 1.1 Calendar Description

This course involves laboratory based instruction in the basic methodologies of Molecular Biology. Students will have the opportunity to develop technical skills and practical knowledge sufficient to perform basic procedures independently, and to diagnose and analyze experimental results obtained with these techniques.

**Pre-Requisites:**

BIOC\*2580, MCB\*2050

**Restrictions:**

Registration in BSC.BIOC (major or minor), BIOC:C, BTOX, BTOX:C, BPCH, BPCH:C, MICR(major or minor), MICR:C, MBG (major or minor), PBTC, PLSC (major or minor), TOX, TOX:C

### 1.2 Course Description

This course offers laboratory-based instruction in the most important methods and techniques used in modern Molecular Biology, including the preparation and analysis of DNA, RNA, and protein; the use of cloning and expression vectors; and the theory and applications of the polymerase chain reaction (PCR).

The laboratory sessions are accompanied by classroom-based instruction.

Students will develop technical skills and practical knowledge sufficient to perform these procedures safely and independently, to analyze the experimental results obtained, and to trouble-shoot and solve laboratory problems.

### 1.3 Timetable

**Lecture:** Friday, 2:30 PM – 3:50 PM - MACS 209.

**Laboratory:** The lab exercises consist of experiments performed in the laboratory at SSC 4108/4109 (schedule below):

Section 0101: Lab in SSC 4108 Monday and Wednesday - 1:30-5:20 pm

Section 0102: Lab in SSC 4109 Monday and Wednesday - 1:30-5:20 pm

Section 0103: Lab in SSC 4108 Tuesday and Thursday - 1:30-5:20 pm

Section 0104: Lab in SSC 4109 Tuesday and Thursday - 1:30-5:20 pm

\*At 100% capacity students attend both labs days (2/week). Capacity limits are determined by the province and are subject to change.

## 1.4 Final Exam

There is no exam during the exam period, instead there are 2 term exams scheduled during lecture times.

---

# 2 Instructional Support

## 2.1 Instructional Support Team

**Instructor:** Stephen Seah  
**Email:** sseah@uoguelph.ca  
**Telephone:** +1-519-824-4120 x56750  
**Office:** SSC 4250  
**Office Hours:** I'm available to answer questions immediately following scheduled lecture times and by pre-arranged appointment, either in person or online. Please email me to arrange a time.

**Lab Co-ordinator:** Elspeth Smith  
**Email:** elspeths@uoguelph.ca  
**Telephone:** 519-825-4120 ex. 56583  
**Office:** SSC 3505, 4107b  
**Office Hours:** Elspeth will be available in lab or by appointment. Additional office hours will be posted throughout the semester.

---

# 3 Learning Resources

## 3.1 Required Resources

### Lab Manual (Lab Manual)

An MBG\*3350 Laboratory Manual is required. More information about how obtain the lab manual will be posted on Courselink and communicated via email. Note, the W22 MBG\*3350 Lab Manual available at the U of G bookstore was designed for 100% capacity/2 lab days per week. Do not purchase this unless instructed to do so by the course instructors.

### Laboratory Notebook (Other)

A bound Laboratory Notebook - Available of the University book store or a dollar store of your choice

### Lab Coat (Equipment)

### Indelible ("Sharpie") marker: ultra-fine point (Equipment)

### Computer Software (Software)

**Benchling:** Can be downloaded for free, link and more information posted on Courselink.

**ImageLab:** Free PC and Mac compatible versions are available on Courselink.

**CFX Manager:** A Free PC compatible software is available for download from Courselink. A free Mac version does not exist. **If you use a Mac computer you will need to use a library computer to complete some of the assignments which require the CFX software as it is not Mac compatible.** More details will be provided in lab.

### Courselink (Website)

<https://courselink.uoguelph.ca>

This course will use D2L (via Courselink). You are responsible for all information posted on the Courselink page for MBG\*3350. Please check it regularly.

## 3.2 Lecture Slides

Slides used in lectures are provided in courselink. Students are expected to supplement the slides with notes taken during lectures and from readings.

## 3.2 Self-study questions

Self-study questions based on lecture material will be provided in courselink. Do form virtual study groups or use google docs to discuss the questions and share answers.

---

# 4 Learning Outcomes

## 4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Explain the fundamental principles of practical molecular biology.
  2. Recognize and interpret experimental results.
  3. Implement the theoretical principles and apply them in the execution of lab experiments.
  4. Plan, design, monitor, troubleshoot, and optimize experiments.
  5. Develop technical laboratory skills including but not limited to: Working in aseptic conditions, following lab protocols, micropipetting, bacterial culture techniques, recording and interpreting results, nucleotide and protein purifications, loading DNA and protein gels, setting up molecular reactions
  6. Use online tools to research a particular topic and design experiments, and read primary research articles in molecular genetics.
  7. Manage time appropriately in order to perform laboratory techniques accurately within the time frame provided and meet deadlines while carrying out an ongoing research project.
  8. Identify skills gained in this course and describe how those skills can be applied in the workforce
- 

## 5 Teaching and Learning Activities

### 5.1 Course Format

- Lecture: One lecture per week will provide context and theory for skills covered in lab.
- Laboratory: Two lab sessions per week. The lab work covers 3 separate projects which overlap at times.
  - Project 1: Cloning and Isolation of GFP
  - Project 2: Detection of Environmental *E. coli*
  - Project 3: Gene Expression Analysis in Arabidopsis
- Online Material: Some independent online work will be posted on Courselink to be completed according to the lab schedule. This material consist of videos and activities that complement the lab work; complete within the week each activity is scheduled to stay on track.
- Assignments:
  - Lab Assignments: During the course of the semester you will be required to complete and hand in 7 Laboratory Assignments (LA) (see "Assessment" for due dates). These assignments cover all of your lab work and incorporate the online material as well. They are meant to assist you in monitoring the outcomes of your experiments. They are also designed to have you analyze your results to

assess your understanding of the concepts covered and so that your formal lab report is a compilation of results and work already analyzed.

Literature Review: Before research is conducted one should have a good grasp of what is currently known for the topic/area of study. As such, each student will be required to complete a literature review on Environmental *E. coli* and how we use molecular tools to detect it. Specific details will be presented in lab and on Courselink.

Formal Scientific Lab Report: You are required to write one formal lab report for this course, covering Project 2: Detection of Environmental *E. coli* only. Although the report will be written in the form of a scientific manuscript, you must remember that the purpose of a formal report and the audience for which it is written is somewhat different from that of a scientific paper. The aim is to show that you understand the principles and significance of the experiments you performed.

- Term Exams: Two term exams are held during lecture time throughout the semester. These test your knowledge of the theoretical concepts covered in lecture and lab.

More Information regarding all of these components can be found on Courselink and in the Lab Manual.

## 5.2 Schedule of Everything!

Week (Lab Week)/ Date	Laboratory schedule		Lectures/Assignments	Online Material
	Day 1: Mon./Tues.	Day 2: Wed./Thur.		
<b>Week 1</b> Jan 8 - 12	No Lab	No Lab	Lecture 1: Intro;  DNA analysis and plasmid purification	Create  Benchling  Account
<b>Week 2 (LW1)</b>	Intro to Lab, Lab Safety, Molecular	Purification of Plasmid DNA; pET-	Lecture 2: DNA restriction enzymes	Benchling RE

Jan 15 - 19	Biology Review; PubMed Search, Micropipetting;  Plating; Inoculating	28a Quantification; RE Digestion of pET28a	and ligations	Digests
<b>Week 3 (LW2)</b>  Jan 22 - 26	Agarose Gel Electrophoresis of DNA products; PCR of <i>gfp</i>	Analysis of PCR products; Purification of <i>gfp</i> PCR Product.  <b>LA#1: Day 2 - 1:30 pm</b>	Lecture 3: Plasmid vectors, <i>E. coli</i> strains and transformation	BLASTn
<b>Week 4 (LW3)</b>  Jan 29 - Feb 2	Preparing pET28a and <i>gfp</i> for Ligation;  Ligation of <i>gfp</i> into pET28	Transformation of Ligation Reactions into <i>E. coli</i> DH5 $\alpha$ .  qPCR Primer design  <b>LA#2: Day 2 - 1:30 pm</b>	Lecture 4: PCR	Basic Primer Design/Primer Design For Cloning
<b>Week 5 (LW4)</b>  Feb 5 - 9	Inoculation to screen for insert  <i>E. coli</i> PCR Detection Experimental Design	Isolation of transformed plasmid; Restriction Enzyme Digest and gel	Lecture 5: Revision  <b>Literature Review - Feb 9th 5:00pm</b>	Ligations in Benchling
<b>Week 6 (LW5)</b>  Feb 12 - 16	gDNA Isolation and quantification  <i>E. coli</i> Detection PCR -optimization	<i>E. coli</i> Detection PCR - optimization - gel  <i>E. coli</i> Detection PCR	<b>Term Exam 1 - Feb. 16</b>	N/A

		<b>LA#3: Day 2 – 1:30 pm</b>		
<b>Feb 19 – 23</b>	<b>Winter Study Break – No Labs/Lectures</b>			
<b>Week 7 (LW6)</b> Feb 26 – Mar 2	<i>E. coli</i> Detection PCR – gel  qPCR for <i>E. coli</i> quantification	No Lab  <b>LA#4: Day 2 – 1:30 pm</b>	Lecture 6: qPCR	qPCR Data Analysis
<b>Week 8 (LW7)</b> Mar 4 - 8	qRT-PCR - RNA Isolation from <i>Arabidopsis</i> ;  cDNA synthesis	qRT-PCR - <i>Arabidopsis</i> Gene Expression Assay  <b>LA#5: Day 2 – 1:30 pm</b>	Lecture 7: Protein expression and purification	Imidazole Gradient Research
<b>Week 9 (LW8)</b> Mar 11 - 15	His-GFP Purification Ni-NTA resin	SDS-PAGE and Coomassie Stain  <b>LA#6: Day 2 – 1:30 pm</b>	Lecture 8: Protein quantification and analysis	
<b>Week 10 (LW9)</b> Mar 18 - 22	SDS-PAGE and Western Immunoblotting (D1)	Western (D2)  <b>Submit Lab books</b>	Lecture 9: Revision	N/A
<b>Week 11</b> Mar 25 - 29	No Lab/Snow day make up	No Lab/Snow day make up  <b>LA#7: Day 2 – 1:30 pm</b>	Good Friday	N/A

<b>Week 12</b> Apr 1 - 5	No Lab/Snow day make up	No Lab/Snow day make up	<b>Term Exam 2 - Apr 5</b>	N/A
Week 13 April 8th	<b>Final Lab Report</b> <b>Monday April 8th</b>			

## 6 Assessments

### 6.1 Marking Schemes & Distributions

<b>Assessment</b>	<b>Weight</b>	<b>Due Date</b>	<b>Learning Outcome</b>
Literature Review	10%	Feb 9th	1,5,6
Lab Assignments (7) 4-5% each	35 %	Check schedule in the outline	2,3,4
Term Exam 1	15%	February 16	1 - 4
Term Exam 2	15%	April 5th	1 - 4
Final Lab Report	15%	April 8th	1 - 6
Lab Performance	10 %	Assessed in lab, Lab books submitted Mar 20/21	2 - 4

### 6.2 Assessment Details

- **All assignments must be completed independently.** Each student must prepare their own figures and data independent of their partner.
- Late assignments will be penalized 10% per day up to 50%. Submissions will not be accepted after five days late.
- Each student has one "48 hr Free Pass" which gives them a 48 hr extension on any one assignment. In order to use this, please leave a comment in the Dropbox when you submit your assignment. This is not valid for the Term Exams. Other than this, no



extensions will be granted for any reason regardless of SAS status.

- Lab Assignments are submitted via Dropbox. We will do our best to return them before the next assignment is due. This is to provide you with immediate feedback as to whether your analysis, interpretation and conclusions of your experimental results are correct.
- The lab performance grade (10%) is determined by your performance in the lab. Of this, 5% is based on your actual results (success of your experiments). The other 5% is based on your day to day performance in the lab: punctuality, attendance, attitude, preparedness, independence and graded lab notebook.

### **6.3 Term Exams #1 & #2**

Term Exams #1 and #2 will be held during regular lecture time; if you fail to write the Term Exam #1 a grade of 0% will be assigned unless an acceptable and documented cause such as illness or family emergency is documented. In the situation where academic consideration is given, Term Exam #2 will be adjusted to 30%. For missed Term Exam #2, an Incomplete grade will be submitted with a recommendation of 0% unless academic consideration is granted for a deferred exam.

### **6.4 Requirements for passing the course**

- Students must pass the Lecture component on its own AND the Laboratory component on its own to pass the course as a whole (i.e. students need to achieve an overall grade of at least 15/30 for the 2 exams and a minimum of 35/70 for the progress reports, lab performance and assignments). This means that a high laboratory mark cannot be used to secure a pass if the lecture component is failed or vice versa.
- Students cannot miss more than 4 lab days to receive a passing grade for the laboratory component, regardless of the reason for absence. In cases where this standard is not achieved, the final grade assigned will either be the calculated grade or 47%, whichever is less.
- Student must submit the Final Lab Report within 5 days of the due date in order to pass this course.

### **6.5 Lab Exemptions**

For students returning to MBG 3350 after failing to pass the Term Exams, a lab exemption may be granted under the following conditions:

- Student achieved a 60% or higher on the lab portion of the course; including the Lab Assignments, Literature review, Final Lab report and the Lab performance grade.
- Student submitted all lab assessments listed above.

- Student successfully completed the lab portion within one year of requesting an exemption.
- Did not miss more than 4 days of lab for any reason.

To confirm that you meet these criteria please contact Elspeth Smith (elspeths@uoguelph.ca). To register for MBG\*3350 Lecture with a lab exemption you must contact the CBS Academic Advising office and obtain approval from Elspeth.

---

## 7 Course Statements

### 7.1 Covid Safety, Procedures and Policy

Please note that all dates and schedules are subject to change depending on the status of the pandemic in Ontario. Hand washing, and sanitization practices will be in place in all labs. Lab will follow all University and provincial guidelines regarding Covid-19. **If you are feeling ill, and/or have symptoms of Covid-19 please see the University of Guelph guidelines to determine your next steps and when you can return to campus.**

<https://news.uoguelph.ca/covid-19/sick-exposed/>

Please reach out to Elspeth at elspeths@uoguelph.ca for a lab exemption.

### 7.2 You must come to lab prepared and ready to start working by 1:30 pm

It is disrespectful to arrive late as this interrupts the TA and your fellow classmates. Additionally, you will miss out on specific announcements for the day that the TA is not obligated to repeat. If you miss specific safety announcements you may be asked to leave. During the course of the lab there may be times where you can get a coffee or snack as you have a gel running. Feel free to do so, however, if any announcements or discussions take place during your absence you will be responsible for obtaining the information from a fellow classmate.

### 7.3 Lab Attendance is mandatory

This is a lab based course where the majority of your final grade is assigned based on the laboratory component rather than the lecture component of the course. The nature of the lab exercises also build on one another. As such there is no opportunity for make-up labs. Lab absence is only acceptable for medical or compassionate reasons. **You must not miss more than 4 labs in order to pass this course.**

**Lab exemptions can be provided for documented illness or compassionate reasons only. Course conflicts and appointment scheduling are not grounds for exemption.**

**Un-exempt lab absences result in grade penalty, see 'Assessments - Lab Performance' above for details.**

## 7.4 You must keep a lab notebook

- Before coming to lab each day you must prepare your lab notebook according to the lab manual instructions.
- In addition, you should record the variables of the experiment (reaction conditions), insert the actual results you obtained, in table format or gel image (labelled) and a statement of whether or not the experiment was successful (discussion). This information should be filled out during lab or immediately after obtaining results.
- Your lab notebook will be submitted at the end of the last lab of the semester for grading by your TA. This along with your preparedness, results and behavior in lab, comprise your lab performance grade.

## 7.5 All Assignments have to be completed

ALL lab assignments are an important part of the course. You must analyze your data to fully grasp concepts taught.

## 7.6 Academic Misconduct

It is the nature of undergraduate labs to complete experiments with a partner. Your results should be discussed with your partner as this is expected in all scientific research. However, ALL assignments must be completed INDEPENDENTLY.

## 7.7 Grading

- All assignments are submitted electronically to Dropbox on Courselink.
- Students who wish to have their assignments re-graded must submit the request to the Lab Demonstrator within 5 class days of their return. The entire assignment will be re-graded so the mark may go up, down or remain unchanged.

## 7.8 Turnitin

- In this course, your instructor 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.
- All submitted assignments will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use of the Turnitin.com service is subject to the Usage Policy posted on the Turnitin.com site.
- If you write your assignments properly by taking notes from sources (in your own words) and writing from your notes rather than writing from the sources directly, you do

not need to worry about academic misconduct or your Turnitin score.

## 8 Department of Molecular and Cellular Biology Statements

### 8.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. [B.Sc. Academic Advising](#) or [Program Counsellors](#)

### 8.2 Academic Support

If you are struggling to succeed academically:

- Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist.  
<http://www.learningcommons.uoguelph.ca/>
- Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: <http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help> and <http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help>

### 8.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance.  
<https://www.uoguelph.ca/counselling/>
- Student Health Services is located on campus and is available to provide medical attention. <https://www.uoguelph.ca/studenthealthservices/clinic>
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations.  
<http://www.selfregulationskills.ca/>

### 8.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) <http://www.e-laws.gov.on.ca/index.html>. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar. (<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml>)

## 8.5 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

# 9 University Statements

## 9.1 Email Communication

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

## 9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

## 9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

## 9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

## 9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website

<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website

<https://www.ridgetownc.com/services/accessibilityservices.cfm>

## 9.6 Academic Integrity

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 encourages academic integrity. Students need to remain aware that

instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct

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

Graduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

## 9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

## 9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>

## 9.9 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

---