



MBG*3350 Laboratory Methods in Molecular Biology

Fall 2023
Section(s): C01

Department of Molecular and Cellular Biology
Credit Weight: 0.75
Version 1.00 - August 22, 2023

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 – 3:50 pm, ANNU156

Laboratory: The lab exercises consist of experiments performed in the laboratory at SSC 4108/4109 (schedule below) and some independent online activities that compliment the lab work and provide information for the lab assignments. These online activities typically take no more than 1 hour and can be completed at any time during the week they are assigned. Check “activities” in the course outline for a complete schedule.

Check your section number and attend the lab on the appropriate day indicated below.

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

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

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

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

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: Andrew Bendall
Email: abendall@uoguelph.ca
Telephone: +1-519-824-4120 x53491
Office: SSC 3459
Office Hours: Dr. Bendall will be available after class, otherwise please email to schedule a meeting.

Lab Co-ordinator: Elspeth Smith
Email: elspeths@uoguelph.ca
Telephone: 519-825-4120 ex. 56583
Office: SSC 3505
Office Hours: I 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)

MBG*3350 Laboratory Manual: Available for purchase at the University of Guelph Book Store.

Laboratory Notebook (Other)

A **bound** (ie. can not easily tear out pages) Laboratory Notebook - Available of the University book store or a dollar store of your choice.

Mask (Other)

Masks are optional in all labs and lectures.

Lab Coat (Equipment)

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

Computer Software (Software)

Benchling can be downloaded for free. ImageLab (PC and Mac compatible) and CFX Manager (PC compatible) software will be provided by the lab demonstrator for download on your computer. **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 Courserlink). You are responsible for all information posted on the Courserlink 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 Courserlink. Feel free to form study groups to discuss the questions and work on 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. Use online tools to research a particular topic, and read primary research articles in molecular genetics.
 6. 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.
 7. Identify skills gained in this course and describe how those skills can be applied in the workforce
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5 Teaching and Learning Activities

5.1 Course Format

Lecture: One lecture per week meant to provide context and theory for skills covered in lab.

Laboratory: 2 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 the week it is assigned. These materials consist of videos and activities that complement the lab work; students must complete this work the week it is scheduled in order to stay on track in lab. See Course Schedule for details.

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.

Lab Assignments: During the course of the semester you will be required to complete and hand in seven lab assignments (See "Assessments" for due dates). These reports 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. The assignments are 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. Note, only lab assignment questions pertaining to Project 2 are used for the final lab report. Details are indicated in the lab assignments.

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.

Self-reflection is an important aspect of science. Throughout the semester students are asked to reflect on their work and results with a goal of improving results. Lab Assignment 7 has a section dedicated to self reflection on the skills developed throughout the semester.

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

5.2 Course Schedule

Details may change in response to the ever evolving global pandemic. Updates and details will be posted on Courselink regularly or emailed to students prior to the beginning of the semester.

Week/ Date	Laboratory schedule		Lectures/Assignments	Online Material
	Day 1: Mon./Tues.	Day 2: Wed./Thur.		

Week 0.5 Sept 7 - 8	No Lab	No Lab	Lecture 1: PCR & primer design	Create Benchling Account; Benchling RE Digests
Week 1 Sept 11 - 15	Intro to Lab, Lab Safety, Molecular Biology Review; PubMed Search, Micropipetting; Plating Cultures; Inoculating Cultures	Purification of Plasmid DNA; pET-28a Quantification; RE Digestion of pET28a	Lecture 2: Working with plasmids	NCBI/BLAST
Week 2 Sept 18 - 22	Agarose Gel Electrophoresis of DNA products; PCR of <i>gfp</i>	Analysis of PCR products; Purification of <i>gfp</i> PCR Product. <i>gfp</i> Quantification LA#1: Day 2 - 1:30 pm	Lecture 3: Restriction enzymes & ligation	Benchling PCR Primer Design & Analysis
Week 3 Sept 25 - 29	Preparing pET28a and <i>gfp</i> for Ligation; Ligation of <i>gfp</i> into pET28	Transformation of Ligation Reactions into <i>E. coli</i> DH5a. qPCR Primer design LA#2: Day 2 - 1:30 pm	Lecture 4: <i>E. coli</i> , transformation, & screening recombinants	N/A
Week 4 Oct 2 - 6	Inoculation to screen for insert <i>E. coli</i> PCR Detection	Isolation of transformed plasmid;	Revision Literature Review - Oct 6th 5:00pm	Benchling Virtual Ligations

	Experimental Design	Restriction Enzyme Digest and gel		
Week 4.5 Oct 9 - 13	No Lab – Thanksgiving/Fall Study Break	No Lab LA#3: Day 2 – 1:30 pm	Term Exam # 1	N/A
Week 5 Oct 16 - 20	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	Lecture 5: More PCR tricks; RT-PCR	N/A
Week 6 Oct 23 - 27	<i>E. coli</i> Detection PCR – gel Standard Curve qPCR for <i>E. coli</i> quantification	No Lab LA#4: Day 2 – 1:30 pm	Lecture 6: qPCR	qPCR Data Analysis
Week 7 Oct. 30 – Nov. 3	qRT-PCR - RNA Isolation from <i>Arabidopsis</i> ; cDNA synthesis	qRT-PCR - <i>Arabidopsis</i> Gene Expression Assay LA#5: Day 2 – 1:30 pm	Lecture 7: Protein expression and purification	Imidazole Gradient Research
Week 8 Nov. 6 - 10	His-GFP Purification Ni-NTA resin	SDS-PAGE and Coomassie Stain LA#6: Day 2 – 1:30pm	Lecture 8: Protein quantification and analysis	

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Week 9 Nov. 13 - 17	SDS-PAGE and Western Immunoblotting (Day 1 - Gel and transfer)	SDS-PAGE and Western Immunoblotting (Day 2 - Ab detection) Submit Lab books end of Lab Day 2 - Nov. 16/17	Revision	
Week 10 Nov. 20 -24	No Lab	No Lab LA#7: Day 2 – 1:30 pm	Term Exam # 2	
Week 11 Nov. 27 – Dec. 1	No Lab	No Lab	No Lecture Final Lab Report: Dec. 1st – 5:00pm	

Assessments

6.1 Marking Schemes & Distributions

Please note these dates may change if their are pandemic related delays in the schedule. Students will be notified of any changes as soon as possible.

Assessment	Weight	Due Date	Learning Outcome
Literature Review	10%	Sept 30	1,5,6,7
Lab Assignments (7) 4% to 5% each	35 %	Check schedule in the outline	2,3,4, 6, 7

Assessment	Weight	Due Date	Learning Outcome
Term Exam 1	15%	Oct 14	1,2,3,4,7
Term Exam 2	15%	Nov 25	1 - 4
Final Lab Report	15%	Nov. 28/29	1 - 7
Lab Performance	10 %	Lab books submitted Nov. 16/17	2 - 4

6.2 Assessment Details

- **All assignments are submitted via Dropbox** and will be returned promptly so students can view their feedback in time for the next assignment.
- **Late assignments will be penalized 10% per day up to 50%. A grade of zero is assigned after 5 days late.**
- **Each student has a one "48 hour 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 regardless of ones SAS status.
- **The lab performance grade (10%) is determined by your performance in the lab.** Of this, 5% is based on the success of your experiments. Note results do not have to have perfect results to achieve full marks, students do need to improve and learn from their mistakes. The other 5% is based on day to day preparedness in the lab including punctuality, attendance, attitude, independence and the graded Lab Notebook. Unexcused absences from lab will result in a 1% (of the final grade) deduction per day.

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 reason, 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 condition. Note that a minimum grade of 15/30 for the term exams is required to pass the course (see requirements for passing the course).

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 Term exams and a minimum of 35/70 for the lab assignments, lab performance and writing 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.
- Students must submit the Final Lab Report within 5 days of the due date.
- In cases where this standard is not achieved, the final grade assigned will either be the calculated grade or 47%, whichever is less.

6.5 Lab Exemptions

For students returning to MBG*3350 after failing to pass the terms exams a lab exemption can be granted under the following conditions:

- The student achieved a 60% or higher on the lab portion of the course including the Lab Assignments, Literature Review, Final Lab Report and lab performance grade.
- Student submitted all lab assessments listed above within 5 days of the due date.
- Student did not miss more than 4 days of lab for any reason.
- Student successfully completed the labs within one year of requesting a exemption.

To confirm you meet these criteria please contact the MBG*3350 lab coordinator Elspeth Smith, elspeths@uoguelph.ca. To register for MBG*3350 Lecture with a lab exemption you must contact 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. Masks are optional in lectures and labs. **If you are feeling ill, have symptoms of Covid-19 or have been exposed to someone with a Covid-19 diagnosis do not come to lab or lecture.** Please reach out to Elspeth at elspeths@uoguelph.ca for a lab exemption. Data will be provided for you to complete the associated progress report. Don't hesitate to reach out if you have questions or concerns.

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 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. Unexcused missed labs will result in a penalty of 1% (of your final grade) deducted from your lab performance grade; up to 4%. A student can not pass the course if more than 4 labs are missed regardless of exemption status.

7.4 You must keep a lab notebook

- Before coming to lab you must record in your lab notebook: What are you doing in lab today?
- What are the expected results? You must have completed all calculations that are required to carry out the experiments.
- 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. Your lab notebook will be graded for the PCR assignment.

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. Copying from any source including AI natural language processors is academic misconduct.

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.

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 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website

(<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

9.10 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).

9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campusess/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campusess/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.
