



MBG*3350 Laboratory Methods in Molecular Biology

Winter 2023

Section(s): C01

Department of Molecular and Cellular Biology

Credit Weight: 0.75

Version 1.00 - December 21, 2022

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 - ANNU 156.

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: Andrew Bendall
Email: abendall@uoguelph.ca
Telephone: +1-519-824-4120 x53491
Office: SSC 3459
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: Set office hours held at various 'high need' times throughout the semester:

Feb. 1 and 2, 3:30 - 4:30 pm

March 1 and 2; 1:30 - 3 pm

March 27 and 28; 1:30 - 3 pm

Additional office hours available on an appointment basis,

please email to arrange.

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. Use online tools to research a particular topic, and read primary research articles in molecular genetics.
 6. 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: Two lab sessions per week, Mon./Wed. OR Tues./Thur. 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 Activities: Some independent online work will be posted on Courouselink to be completed the week it is assigned. These activities consist of short videos, readings and un-grades assignments that complement the lab work, ensure you are prepared for future labs and demonstrate how to use the various software programs we work with.

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 7 lab assignments (see "Assessment" for due dates). These assignments cover all of your lab work and incorporate the online content as well. They are meant to assist you in monitoring the outcomes of your experiments. These 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.

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. In this assignment you will be compiling work already completed in your lab assignments into one cohesive report. Students will work on their scientific writing skills and demonstrate their understanding of the concepts covered in lab.

Self-reflection assignment: This assignment requires you to reflect on the skills you developed in this course and how they might affect your future activities.

Two term exams will be held during regular class time to assess your knowledge of the theoretical concepts covered. Each exam is worth 15% of your final grade. You are required to pass this portion of the course in order to pass the course.

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)/	Laboratory schedule		Lectures/Assignments	Online
	Day 1: Mon./Tues.	Day 2: Wed./Thur.		

Date				Material
Week 1 Jan 9 - 13	No Lab	No Lab	Lecture 1: Intro; DNA analysis and plasmid purification	Create Benchling Account Benchling RE Digests
Week 2 (LW1) Sept 16 - 20	Intro to Lab, Lab Safety, Molecular Biology Review; PubMed Search, Micropipetting; Plating; Inoculating	Purification of Plasmid DNA; pET-28a Quantification; RE Digestion of pET28a	Lecture 2: DNA restriction enzymes and ligations	BLASTn
Week 3 (LW2) Jan 23 – 27	Agarose Gel Electrophoresis of DNA products; PCR of <i>gfp</i>	Analysis of PCR products; Purification of <i>gfp</i> PCR Product. LA#1: Day 2 – 1:30 pm	Lecture 3: PCR	Basic Primer Design
Week 4 (LW3) Jan 30 – Feb 3	Preparing pET28a and <i>gfp</i> for Ligation; Ligation of <i>gfp</i> into pET28	Transformation of Ligation Reactions into <i>E. coli</i> DH5α. qPCR Primer design	Lecture 4: PCR primer design & cloning strategies Literature Review – Feb 3rd 5:00pm	Benchling PCR Primer Design & Analysis
Week 5 (LW4)	Inoculation to screen for insert	Isolation of transformed		N/A

Feb 6 - 10	<i>E. coli</i> PCR Detection Experimental Design	plasmid; Restriction Enzyme Digest and gel LA#2: Day 2 – 1:30 pm	Lecture 5: RT-PCR, <i>E. coli</i> and transformation	
Week 6 (LW5) Feb 13 - 17	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 LA#3: Day 2 – 1:30 pm	Term Exam 1 - Feb. 17	N/A
Feb 20 – 24	Winter Study Break – No Labs/Lectures			
Week 7 (LW6) Feb 27 – Mar 3	<i>E. coli</i> Detection PCR – gel qPCR for <i>E. coli</i> quantification	No Lab/ Make up for poor results LA#4: Day 2 – 1:30 pm	Lecture 6: qPCR	qPCR Data Analysis
Week 8 (LW7) Mar 6 - 10	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 9 (LW8) Mar 13 - 17	His-GFP Purification Ni- NTA resin	SDS-PAGE and Coomassie Stain LA#6: Day 2 – 1:30 pm	Lecture 8: Protein quantification and analysis	

Week 10 (LW9) Mar 20 - 24	SDS-PAGE and Western Immunoblotting (D1)	Western (D2) Submit Lab books	Revision Self-Reflection A. – Fri. Mar. 24th at 5:00 pm	N/A
Week 11 Mar 27 - 31	No Lab/Snow day make up	No Lab/Snow day make up LA#7: Day 2 – 1:30 pm	Term Exam # 2 - Mar. 31	N/A
Week 12 Apr 3 -7	No Lab/Snow day make up	No Lab/Snow day make up Final Lab Report: Day 2; 5:00 pm	No Lecture	N/A

6 Assessments

6.1 Marking Schemes & Distributions

Assessment	Weight	Due Date	Learning Outcome
Literature Review	10%	Feb 3rd	1,5,6
Lab Assignments (7) 4-5% each	30 %	Check schedule in the outline	2,3,4
Term Exam 1	15%	February 17	1 - 4
Term Exam 2	15%	March 31	1 - 4
Self-Reflection Assignment	4 %	March 24	6
Final Lab Report	15%	April 3/4	1 - 6
Lab Performance	11 %	Assessed in lab, Lab books submitted	2 - 4

Assessment	Weight	Due Date	Learning Outcome
		Mar 22/23	

6.2 Assessment Details

All assignments will be posted well in advance so that students can begin working on them early and schedule their time according to their own schedules. Late assignments will be penalized 10% per day up to 50%. A grade of zero is assigned after 5 days late. **Extensions will only be provided for medical or compassionate reasons with documentation.** This includes students registered in SAS.

Lab Assignments will be marked and feedback provided before the next assignment is due so that students are able to use their feedback to improve future work.

The lab performance grade is determined by your performance in the lab. Of this, 4% is based on your actual results (success of your experiments) and 4% is based on your lab book. The other 3% is based on your day to day performance in the lab: punctuality, attitude, preparedness, independence etc. Lab attendance is mandatory, 1% of your final grade will be deducted for each unexempt absence from lab, up to 11%. See below for details regarding exemption.

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 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 (virtual or in-person) to receive a passing grade for the laboratory component. In cases where this standard is not achieved, the final grade assigned will either be the calculated grade or 47%, whichever is less.

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

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