MBG*4240 Applied Molecular Genetics in Medicine and Biotechnology

Winter 2021
Section(s): C01

Department of Molecular and Cellular Biology
Credit Weight: 0.50
Version 1.00 - January 12, 2021

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1 Course Details

1.1 Calendar Description

This course will examine advanced techniques and methods used in molecular biology, medicine and biotechnology such as genome, transcriptome and proteome analysis, contemporary genetic screens, genetic engineering, transgenic organisms and gene therapy. The course will highlight the most recent developments and applications of such techniques.

Pre-Requisites: MBG*3040

1.2 Course Description

This is a molecular genetics course focused on the principles and the application of advanced molecular techniques and methods used in genetic research, medicine and biotech industries. The covered topics include advanced DNA and RNA analysis, “omics” approaches in biomarker discovery, molecular diagnosis, gene therapy and transgenesis. Students will have opportunity to learn and achieve professional levels of understanding of modern molecular biology technology and its applications through lectures, contemporary reviews and primary literature in classroom, as well as by independent study and peer learning.

1.3 Timetable

Timetable is subject to change. Please see WebAdvisor for the latest information.

Lectures: Tuesday and Thursday, 11:30 AM – 12:50 PM, Online via Zoom

Key Dates:

Date	Activity
Feb. 11, 11:35am-12:35pm	Midterm (in-class; covers lecture material up to Fed. 9)
Mar. 2, noon	Assignment due
Mar. 18, noon	Research Proposal due
Mar. 25, noon	Review of Research Proposal due
11:59 PM on the same day of the presentation	Evaluation of Presentation due
April 24, 2021; 08:30AM - 10:30AM	Final Exam (covers all lectures, guest lectures and student presentations)

* Presentation file is due in the designated Dropbox folder 9am on the day of presentation.

* Late submissions will result in 5% penalty per day.

1.4 Final Exam

Time: Sat April 24, 2021; 08:30AM - 10:30AM

Location: online

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2 Instructional Support

2.1 Instructional Support Team

Instructor: Ray Lu
Email: rlu@uoguelph.ca

Telephone: +1-519-824-4120 x56247
Office: SSC 3443

Office Hours: **By appointments; I will make every effort in accommodate your schedule and meet you online**

2.2 Teaching Assistants

Teaching Assistant: Briana Locke
Email: blocke@uoguelph.ca
Office Hours: TBA
Please do not contact your TA outside the office hours.

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3 Learning Resources

3.1 Recommended Resources

Recommended Textbooks for Reference (Textbook)
Textbooks on Course Reserves in the Library:

There is no designated textbook for this course. The following texts that are recommended as main references are on reserve in the library –

Molecular Biology. R.F. Weaver, McGraw-Hill Higher Education, 5th ed. (2012) edition

Molecular Biology and Biotechnology. R. Rapley and D. Whitehouse, Royal Society of Chemistry, 6th ed. (2015)

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4 Learning Outcomes

4.1 Course Learning Outcomes

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

1. **By the end of this course, students should be able to:**

1. Describe and explain the principles and the applications of current advanced molecular techniques and methods;
2. Recognize the difference between various molecular techniques as well as their strength and limitations;
3. Anticipate, analyze and interpret the results of an experimental design;
4. Critically evaluate biological problems, propose hypotheses, identify appropriate molecular biology techniques and design experiments to test the hypotheses;
5. Summarize and critically review primary research articles in molecular genetics in groups and individually;
6. Communicate science (in written and oral forms) effectively;

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5 Teaching and Learning Activities

5.1 Lecture

Week 1

Topics: Discussion of a primary research article

Week 2

Topics: 1. Recombinant DNA technologies

1.1. DNA cloning vectors and strategies
1.2. Genomic and cDNA Libraries:
1.3. in vitro mutagenesis

Week 3

Topics: 2. DNA analysis

2.1. Molecular hybridization
2.2. DNA labeling
2.3. Quantitative (real-time) PCR

2.4. Sanger sequencing

Week 4

Topics:

3. RNA analysis

3.1. RT-PCR and RACE
3.2. RNA labeling, Northern blotting and in situ hybridization, and RNase protection assays

4. Genome-wide DNA and RNA analysis

4.1. Microarray
4.2. Next-generation sequencing: RNA-seq, and ChIP seq

Week 5

Topics:

5. Genetic screens

5.1. Screening of DNA libraries
5.2. Forward and reverse genetic screens

Week 6

Topics:

6. Identification of biomarkers and molecular diagnosis

6.1. DNA polymorphisms
6.2. Technologies and strategies for molecular biomarker discovery
6.3. Molecular diagnosis techniques

7. Gene therapy: strategies and vectors

Week 7

Topics:

8. Transgenic and gene-targeted mice in medical research

8.1. Transgenic mice
8.2. Knock-out and Knock-in mice
8.3. Conditional gene targeting (Cre/LoxP) system
8.4. (Inducible gene switching)
8.5. Genome Editing with CRISPR-Cas9

9. Transgenic plants and animals in biotech industry

5.2 Seminar

Week 8

Topics: Group presentation 1; Thu Mar 4 (applications of next-gen sequencing)

Week 9

Topics: Group presentation 2; Tue Mar 9 (genetic screens)

Group presentation 3; Thu Mar 11 (technologies and strategies for molecular biomarker discovery)

Week 10

Topics: Group presentation 4; Tue Mar 16 (molecular diagnosis techniques)
Group presentation 5; Thu Mar 18 (gene therapy)

Week 11

Topics: Group presentation 6; Tue Mar 23 (inducible gene switching)
Group presentation 7; Thu Mar 25(disease- and environmental-resistant transgenic plants or transgenic plants with health improving benefits)

Week 12

Topics:	Group presentation 8; Tue Mar 30 (production-enhanced transgenic animals)

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6 Assessments

6.1 Marking Schemes & Distributions

Oral Presentation **OR** Research Proposal

Students will form groups of three. Approximately half of the class will get to choose the oral presentation format, while the other half will write a research proposal. This is a key component of learning activities and student assessment of this course. Dr. Lu is available **throughout** this process, to give you guidance and help in gathering research material, organizing and planning your presentation/proposal and the final presentation/writing the proposal. Detailed instructions on the oral presentation and the written research proposal will be given separately on CourseLink.

Oral presentation topics and schedules are given in the Tentative Lecture Topics and Schedule (above). A primary research paper needs to be chosen at least four weeks ahead of the presentation date.

Written proposal topics use the same topics. The proposal is due at **noon, Thursday March 18**, to a designated group Dropbox folder on CourseLink.

Oral presentation groups will be matched with a research proposal group, to write a 2 -3 page double-spaced review of the corresponding proposal. The review is due at **noon, Thursday March 25**, to a designated Dropbox on CourseLink.

Written proposal groups will write a 2-3 page double-spaced evaluation of the matched oral presentation. The evaluation is due **at 11:59 PM on the same day of the presentation**.

Both proposals and presentations should be created in Word or PowerPoint and shared with Dr. Lu in Microsoft OneDrive, **from the beginning when your group start to work in the project. It will help Dr. Lu to resolve potential workload distribution when it arises.**

***** The assignment is to be completed and submitted individually. *****

6.2 Assessment Distribution

Distribution Scheme				
Form of Assessment		**Weight of Assessment (% of final)**	**Course Content /Activity**	**Learning Outcome**
Midterm		20%	Lectures	1-4
Assignment		10%	Non-lecture	1-5
Option 1	Oral presentation	30%	Non-lecture	1-6
	Critical review of research proposal	5%	Non-lecture	5-6
Option 2	Research proposal	30%	Non-lecture	1-6
	Evaluation of oral presentation	5%	Non-lecture	5-6
Participation of Discussion		5%	Non-lecture	5-6

Final Exam	30%	Lecture and Non-lecture	1-6

*** Use Microsoft Teams web app for all communications and discussions among group members regarding the group project. This information may be used as a reference when a complaint is filed by a group member.**

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7 Course Statements

7.1 Course Policies

If you miss the Presentation Evaluation, under acceptable circumstances, you will be asked to submit a 3-page Reading Notes of the presented article instead.

If you miss a quiz, with proper documentation, the weight will be transferred to the final exam.

If one of the group members dropped the course, the remaining two students shall finish the project as usual. If two group members dropped the course, proper accommodation will be given to the remaining student.

Only under exceptional circumstances your oral presentation can be rescheduled to the last week of the classes. You will need to be granted academic consideration to do so.

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)

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 book their exams at least 7 days in advance and not later than the 40th Class Day.

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 and academic schedules. Any such changes will be announced via CourseLink and/or class email. 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

The University will not normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.
