MBG*4240
Adv. Mol. Biol. Techniques
Winter 2016

Department of Molecular and Cellular Biology
University of Guelph

COURSE OBJECTIVES

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. eukaryotic gene expression and regulation. The covered topics include advanced DNA and RNA analysis, “omics” approaches in biomarker discovery, molecular diagnosis, gene therapy and transgenesis. Students will have the opportunity to learn and achieve professional level 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.

COURSE PERSONNEL

Instructor: Dr. Ray Lu

COURSE SCHEDULE

Lectures: Tuesday and Thursday, 11:30 AM – 12:50 PM, MCKN 116

Instructor’s Office Hours: Monday, 1:30 PM – 3:30 PM;
Wednesday, 1:00 PM – 3:00 PM;
Rm. SSC 3443

(* Students are welcome to see me as any time, although I might ask you to wait for a few minutes or come back later if I happen to be busy. If you don’t want to wait, you can make an appointment with me outside the regular office hours.)

LEARNING OUTCOMES

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 a biological problem, propose a hypothesis, identify appropriate molecular biology techniques and design appropriate experiments to test the hypothesis;
5. Summarize and critically review primary research articles in molecular genetics in working groups and individually;
6. Communicate science (in written and oral forms) effectively;

COURSE RESOURCES

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. J.M. Walker and R. Rapley, Royal Society of Chemistry, 5th ed. (2009)
Molecular Biology and Biotechnology. R. Rapley and D. Whitehouse, Royal Society of Chemistry, 6th ed. (2015)
Molecular Biotechnology: Principles and Applications of Recombinant DNA. B.R. Glick, Bernard et al., ASM Press, 4th ed. (2010)
An Introduction to Molecular Biotechnology: Fundamentals, Methods, and Applications. M. Wink, Wiley-Blackwell, 2nd ed. (2011)

Courselink:

This course will make use of the University of Guelph's course website Courselink. Consequently, you are responsible for all information posted on the Courselink page for MBG*4240. Please check it regularly.

Undergraduate Calendar:

The Undergraduate Calendar is the source of information about the University of Guelph's procedures, policies and regulations, which apply to undergraduate programs. It can be found at: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/.

COURSE FORMAT

Lectures

Two 80-minute lectures per week;

Tentative Lecture Topics and Schedule

TOPICS		Lec#	WEEK
Discussion of a primary research article		1-2	1
1. Recombinant DNA technologies		3-4	2
	1.1. DNA cloning vectors and strategies		
	1.2. Genomic and cDNA Libraries:		
	1.4. in vitro mutagenesis		
2. DNA analysis		5	3
	2.1. Molecular hybridization		
	2.2. DNA labeling		
	2.3. Quantitative (real-time) PCR		
	2.4. Sanger sequencing		
3. RNA analysis		6-7	3-4
	3.1. RT-PCR and RACE		
	3.3. RNA labeling, Northern blotting and in situ hybridization, and RNase protection assays		
4. Genome-wide DNA and RNA analysis		8	4
	4.1. Microarray		
	4.2. Next-generation sequencing: RNA-seq, and ChIP seq		
Quiz 1, in class on Tue Feb 9 (covers Week 1-4)			5
5. Genetic screens		9	5
	5.1. Screening of DNA libraries		
	5.2. Forward and reverse genetic screens		
6. Identification of biomarkers and molecular diagnosis		10	5
	6.1. DNA polymorphisms		
	6.2. Technologies and strategies for molecular biomarker discovery		
	6.3. Molecular diagnosis techniques		
Reading Week Feb 15-19			
7. Gene therapy: strategies and vectors		11	6
Group presentation 1; Thu Feb 25 (applications of next-gen sequencing)			6
Group presentation 2; Tue Mar 1 (genetic screens)			7

Group presentation 3; Thu Mar 3 (technologies and strategies for molecular biomarker discovery)			7
Group presentation 4; Tue Mar 8 (molecular diagnosis techniques)			8
8. Transgenic and gene-targeted mice in medical research		12	8
	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		
Quiz 2, in class on Tue March 15 (covers Week 6-9)			9
9. Transgenic plants and animals in biotech industry		13	9
Group presentation 5; Thu Mar 17 (gene therapy)			9
Group presentation 6; Tue Mar 22 (inducible gene switching)			10
Guest Lecture; Thu Mar 24		14	10
Group presentation 7; Tue Mar 29 (disease- and environmental-resistant transgenic plants or transgenic plants with health improving benefits)			11
Group presentation 8; Thu Mar 31 (production-enhanced transgenic animals)			11
10. Left-over topics and review			12
Final Exam Tue Apr 12, 8:30 AM – 10:30 PM			

(* Final exam covers all course materials of the semester, including student presentations and the guest lecture.)

METHODS OF ASSESSMENT

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 choose to 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 research proposals are due at **noon, Thursday March 17**, to a designated Dropbox on CourseLink.

Oral presentation groups will be assigned a group research proposal, to wrote a two-page double-spaced review of the assigned proposal. The review is due at **noon, Thursday March 31**, to a designated Dropbox on CourseLink.

Written proposal groups will be assigned a research paper used by oral presentation groups, and are required to 1) write a single-page double-space reading notes of the paper that describes the highlights of the paper, its strength and weakness, and any questions that you might have and hope that presenters could clarify during their talk. The students are also required to 2) submit another one-page double-spaced evaluation of the oral presentation, with comments on whether the presenters have provided answers to your questions and whether you agree with presenters' views about the paper. The reading notes are due at **noon three days before the oral presentation date**. The evaluation is due **at 11:59 PM on the same day of the presentation**. For instance, if you are assigned a paper that is presented on Thursday Feb 25, the one-page reading notes are due at noon Monday Feb. 22; the one-page presentation evaluation is due at 11:59 PM on Feb 25.

Key Dates

Feb. 9: 1st in-class quiz;
Feb. 25: Oral presentation begins*;
Mar. 11: Fortieth class day – last day to drop the semester courses;
Mar. 15: 2nd in class quiz;
Mar. 17: Research proposal due;
Mar. 31: Two-page review of research proposal due;
Apr. 12: Final Exam;
* Paper reading notes are due at noon three days before the oral presentation date; presentation evaluation is due at 11:59 PM on the same day of the presentation

Assessment				
Form of Assessment		**Weight of Assessment (% of final)**	**Course Content /Activity**	**Learning Outcome (see above)**
Quiz 1		10%	Lectures 1-8	1-4
Quiz 2		10%	Lectures 9-12; Group presentations 1-4;	1-6
Option 1	Oral presentation	25%	Non-lecture	1-6
	Two-page critical review	12%	Non-lecture	5-6

	of research proposal			
Option 2	Research proposal	25%	Non-lecture	1-6
	One-page reading notes of research paper	6%	Non-lecture	5-6
	One-page evaluation of oral presentation	6%	Non-lecture	5-6
Participation of Discussion		8%	Non-lecture	5-6
Final Exam		35%	All Lectures and Group Presentations of Week 1-12	1-5

COURSE AND UNIVERSITY POLICIES

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. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

If you miss one quiz or the one-page presentation evaluation, the weight of the component will be automatically transferred to the final exam.

If you miss the second quiz, with proper documentation, you will need to complete additional questions (worth 10%) in the final exam that are optional to others, and your final exam will be reweighed to account for the missed first quiz.

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.

Accessibility

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators.

This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

Academic Misconduct

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 discourages misconduct. 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.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

E-mail Communication

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

Drop Date

The last date to drop one-semester courses, without academic penalty, is the 40th class day. To confirm the actual date, please see the schedule of dates in the Undergraduate Calendar. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

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.

Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a

classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/index.cfm?index

Grading

Assignment are due by time indicated above, via submission to designated folders on the CourseLink web site. Late submissions on the same due date will result in 5% penalty, and 5% penalty for each additional day.

Students who wish to have their exams/quizzes re-graded must submit their exams to the instructor within 5 class days of the return of the midterm exam. The entire exams/quizzes will be re-graded so the mark may go up, down or remain unchanged.

CAMPUS RESOURCES

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

- make an appointment with a program counsellor in your degree program.
  http://www.bsc.uoguelph.ca/index.shtml or
  https://www.uoguelph.ca/uaic/programcounsellors

If you are struggling to succeed academically:

- 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/

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.uoguelph.ca/~ksomers/

If you have a documented disability or think you may have a disability:

- The Centre for Students with Disabilities (CSD) can provide services and support for students with a documented learning or physical disability. They can also provide information about how to be tested for a learning disability. For more information, including how to register with the centre please see: https://www.uoguelph.ca/csd/