**University of Guelph**
**College of Biological Science**
Department of Molecular and Cellular Biology

# COURSE OUTLINE

Advanced Cell Biology (MCB*4010)
Winter 2017

**Course description:**
This course will examine the cellular and molecular biology of signal transduction. The major theme is an understanding of how eukaryotic cells receive, transmit and respond to environmental signals. Topics will include cellular regulation of cell cycle progression and cell death as well as the consequences of deregulated signal transduction in terms of disease, primarily cancer. [0.5 credit] *Prerequisite:* MCB*2050.

**Instructors:**

Dr. George van der Merwe, Department of Molecular and Cellular Biology
Office: SSC 2243, extension: 54298, Email: gvanderm@uoguelph.ca
Office hours: by appointment

Dr. Richard Mosser, Department of Molecular and Cellular Biology
Office: SSC 3463, extension: 58059, Email: rmosser@uoguelph.ca
Office hours: by appointment

**Course schedule:**
Monday, Wednesday, Friday 10:30 – 11:20 AM (January 9th to April 7th, 2017)
MacKinnon (MCKN), room 117

**Learning goals and rationale:**
There will be a series of lectures on the topics of signal transduction, cell cycle regulation, apoptosis and cancer. Each topic series will be followed by student presentations. The presentations will complement the lectures by providing an overview of a particular topic through the in depth examination of a current research publication. All of the presentation papers are articles published within the last 3 years in the journal Cancer Cell.

By the end of this course, successful students should be able to:
1. Describe the molecular components and mechanisms controlling signal transduction pathways responsible for regulating cell proliferation and cell death.
2. Explain how mutations in genes controlling signal transduction pathways responsible for regulating cell proliferation and cell death contribute to the process of carcinogenesis.
3. Develop an understanding of the contributions made by key researchers that led to our current understanding of the mechanisms controlling cell signalling, cell cycle regulation and the control of cell death.
4. Describe the methods commonly used by cell biologists to study aspects of cell signalling with emphasis on the regulation of the cell cycle and cell death.
5. Interpret and evaluate the use of these methods and their outcomes in the context of recent research in the field of cancer cell biology.
6. Critically appraise the findings of recent research in cancer cell biology in terms of potential application to cancer therapy or diagnosis.

**Course Resources:**

Lectures and other resources for this course will be available on the MCB*4010 CourseLink web page. A textbook is not required for this course. A set of assigned research papers will be used for the student presentations and quizzes. As well, the lecture notes will include references to research articles and current review papers.

**Course Content:**
**(i) General Overview:**

Lectures will cover the 4 main topics of (i) signal transduction, (ii) cell cycle regulation, (iii) apoptosis and (iv) cancer. Student presentations will complement the lectures topics by evaluating a recent publication in the journal Cancer Cell. Each presentation will have 4 parts: (i) an overview of the signaling pathway, (ii) the relationship of this signaling pathway to cancer, (iii) a description of the assigned paper and (iv) a discussion of the assigned paper. Students will have the opportunity to either give an in-class presentation on one of the 4 parts or submitting a written report on all 4 parts. Each student is also required to prepare one multiple-choice question related to their topic. These questions will be posted on CourseLink (Quizzes) and students will have two weekdays to complete the quizzes online. Assigned papers and instructions for presentations, written reports and quizzes are available on CourseLink. IT IS CRITICAL THAT STUDENTS READ THESE INSTRUCTIONS. The midterm and final exam will cover the material presented in lecture only.

**(ii) Lecture and presentation schedule**

| Week/Date | Lecture/Presentation # and topic |
|---|---|
| Week 1<br>Jan. 9 (M) | Course overview |
| Week 1<br>Jan. 11 (W) | Lecture 1 - Cell signaling: Cell signalling overview |
| Week 1<br>Jan. 13 (F) | Lecture 2 - Cell signaling: G protein coupled receptors (PKA) |
| Week 2<br>Jan. 16 (M) | Lecture 3 - Cell signaling: G protein couple receptors: PKA (continued); PLCβ, IP3/DAG, PKC |
| Week 2<br>Jan. 18 (W) | Lecture 4 - Cell signaling: receptor tyrosine kinases, EGFR |
| Week 2<br>Jan. 20 (F) | Lecture 5 - Cell signaling: Ras, SH2, SH3 domains |
| Week 3<br>Jan. 23 (M) | Lecture 6 - Cell signaling: MAPK, Raf, SAPK, PLCγ, PI3K, AKT, PTEN |
| Week 3<br>Jan. 25 (W) | Lecture 7 - Cell signaling: TGFβ, SMADS, JAK-STAT |
| Week 3<br>Jan. 27 (F) | Lecture 8 - Cell signaling: NF-κB, regulated proteolysis |
| Week 4<br>Jan. 30 (M) | Lecture 9 - Cell signaling: mTOR |
| Week 4<br>Feb. 1 (W) | Lecture 10 - Cell signaling: Autophagy |

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| Week 4<br>Feb. 3 (F) | Presentation 1: ERK: Herrero et al. (2015) **Cancer Cell** 28:170. |
| Week 5<br>Feb. 6 (M) | Presentation 2: PIPP/PI3K/AKT: Ooms et al. (2015) **Cancer Cell** 28:115. |
| Week 5<br>Feb. 8 (W) | Presentation 3: TGF-β: Fournier et al. (2015) **Cancer Cell** 27:809. |
| Week 5<br>Feb. 10 (F) | Presentation 4: NF-κB: Liu et al. (2015) **Cancer Cell** 27:370. |
| Week 6<br>Feb. 13 (M) | Presentation 5: mTOR: Pusapati et al. (2016) **Cancer Cell** 29:548. |
| Week 6<br>Feb. 15 (W) | Presentation 6: Autophagy: Brisson et al. (2016) **Cancer Cell** 30:418. |
| Week 6<br>Feb. 17 (F) | No Class |
| Feb. 20 - 24 | **WINTER BREAK** |
| Week 7<br>Feb. 27 (M) | Lecture 11 - cell cycle L1: cell cycle engine, cell fusion studies, MPF |
| Week 7<br>Mar. 1 (W) | Lecture 12 - cell cycle L2: CDK, $cdc^{ts}$ mutants, Harwell (cdc28), Nurse (cdc2, wee1, cdc25) |
| Week 7<br>Mar. 3 (F) | Lecture 13 - cell cycle L3: regulation of CDK activity, CDK substrates, APC, mitotic exit |
| Mar. 4 (Sat) | **MIDTERM** (9-11 am; MCLN 102) |
| Week 8<br>Mar. 6 (M): | Lecture 14 - cell cycle L4: G1/S transition, Whi5/SBF/Sic/SCF, Rb/E2F/p27/SCF |
| Week 8<br>Mar. 8 (W) | Lecture 15 - cell cycle L5: Checkpoints |
| Week 8<br>Mar. 10 (F) | Presentation 7: G1 entry: Goel et al., (2016) **Cancer Cell** 29:255. |
| Week 9<br>Mar. 13 (M) | Presentation 8: mitotic exit: Topham et al., (2015) **Cancer Cell** 28:129. |
| Week 9<br>Mar. 15 (W) | Lecture 16 – apoptosis L1: Overview, C. elegans CED genes |
| Week 9<br>Mar. 17 (F) | Lecture 17 - apoptosis L2: Caspases, intrinsic/extrinsic pathways |
| Week 10<br>Mar. 20 (M) | Lecture 18 - apoptosis L3: Apoptosis regulators, Bcl-2 proteins, IAPs |
| Week 10<br>Mar. 22 (W) | Presentation 9: Caspases: Lalaoui et al., (2016) **Cancer Cell** 29:145. |
| Week 10<br>Mar. 24 (F) | Presentation 10: Bcl-2 proteins: Han et al., (2015) **Cancer Cell** 24:852. |
| Week 11<br>Mar. 27 (M) | Lecture 19 - cancer L1: properties of cancer cells, oncogenes / proto-oncogenes |
| Week 11<br>Mar. 29 (W) | Lecture 20 - cancer L2: oncogene activation, c-myc, tumor suppressor genes, p53 |
| Week 11<br>Mar. 31 (F) | Presentation 11: c-myc: Carroll et al., (2015) **Cancer Cell** 27:271. |

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| Week 12<br>Apr. 3 (M) | Presentation 12: p53: Soragni et al., (2016) **Cancer Cell** 29:90. |
| Week 12<br>Apr. 5 (W) | Lecture 21 - cancer L3: multi-step tumorigenesis, six essential acquired capabilities |
| Week 12<br>Apr. 7 (F) | No class |
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| Apr. 21 (F) | **FINAL EXAM** 7:00 - 9:00 PM - includes lectures 10 - 20 |

**Methods of Assessment**

| Form of Assessment | Weight of Assessment | Date and location | Course Content /Activity | Learning Outcome Addressed |
|---|---|---|---|---|
| Midterm Exam | 35% | Sat. Mar. 4th 9-11 AM. MCLN 102 | Lectures 1-10 | 1 - 3 |
| Quizzes | 10% | Quizzes are answered on CourseLink and must be completed within two weekdays after the class presentation. | Multiple-choice questions associated with each presentation. Each student must submit one question. | 1 - 6 |
| Presentation or written report | 20% | See schedule for class presentations | Either a 10 minute in class presentation or a 4 page written report on one of 12 assigned topics and associated article from the journal Cancer Cell | 4 - 6 |
| Final Exam | 35% | Wednesday April 21st 7:00-9:00 PM. Location to be determined | Lectures 11-21 | 1 - 3 |

**Important Dates**

Jan. 9 (Mon.): First lecture, 10:30 AM, MCKN117
Jan. 13 (Fri.): Deadline for CourseLink sign-up for presentation/written report topics.
Jan. 15 (Mon.): Final assignment of presentation/written report topics (see “Presentation & Report Instructions” on CourseLink).
Feb. 17 (Fri.): No class
Feb. 20-24 (Mon. – Fri.): Winter break, NO CLASSES
Mar. 4 (Sat): Midterm Exam, 9-11 AM, MCLN 102
Mar. 10 (Fri.): Course drop deadline (40th class day)
Apr. 21 (Fri.): Final exam, 7:00-9:00 PM, location to be determined

**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, and be prepared to provide supporting documentation. 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

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 Student Accessibility Services as soon as possible. For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: https://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 electronically copied (including the use of a cell phone camera) 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.

Grading

The instructor and a teaching assistant employed by the department of Molecular and Cellular Biology will mark the presentations, midterms and final exams. The teaching assistant is a graduate student in the department who is familiar with the content of the course. Students who do not write the midterm exam because of illness or compassionate reasons will have their final exam weighted at 70% rather than 40%. Written reports handed in late will be penalized 5% for every day that it is late.

**Campus Resources**

The Academic Calendar is 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

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:

- Student Accessibility Services 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