College of Biological Science
Molecular and Cellular Biology

COURSE OUTLINE
MBG4040: Genetics and Molecular Biology of Development (3-2) [0.5]
Fall 2016

Course description

This course provides an examination of the genetic mechanisms that underlie organismal development. The molecular biology of cell determination and differentiation and the genetic control of morphogenesis and pattern formation will be emphasized.
Prerequisite(s): MCB2050 or MCB3010

Teaching team

Instructor: Dr. Andrew Bendall
abendall@uoguelph.ca
SCIE 3459

Office hours 1:30 pm – 3:00 pm, Wednesdays
I'm happy to meet with you at other times if you have a scheduling conflict with my regular office hours; simply send me an email to arrange a specific time.

Laboratory Demonstrator: Ms. Marissa Dahari
mdahari@uoguelph.ca

Teaching Assistant: Mr. Wadood Malik
wmalik@uoguelph.ca

Course schedule

Lectures: Tuesday & Thursday 11:30 am – 12:50 pm ALEX 309
Laboratory: Thursday 2:30 pm – 4:20 pm SSC 4101

Learning goals and rationale

This course will provide an exploration of the genetic and molecular mechanisms that underlie the processes by which animals develop from a single cell into a multicellular organism. In addition to being a fascinating and aesthetically pleasing subject, modern developmental biology represents a synthesis of many of the subjects you have already studied, including cell and molecular biology, genetics, and evolution. Thus, you will be reviewing, reinforcing, and synthesising many of the concepts you have learned in other classes. In the context of various model organisms, topics will include principles of developmental biology, tissue patterning, morphogenesis, size control, cell differentiation, and organogenesis. The molecular underpinnings of these embryological processes involve mechanisms of cell-to-cell communication and differential gene expression and these areas will be dealt with in some detail. Finally, the idea of the evolutionary conservation of developmental control genes will be a common thread of this course.

Learning outcomes
By the end of this course, students should be able to:

1. Apply an advanced understanding of the major regulatory mechanisms that impact gene expression and function

2. Demonstrate knowledge of the modalities of the major signalling pathways during vertebrate development, including proteins that have a positive and negative effect on transduction of the major ligand families (BMP, FGF, Hedgehog, Notch, Wnt).

3. Define discrete stages of cell fate restriction during development

4. Distinguish between cell-autonomous and non-cell-autonomous gene functions

5. Describe the actions of maternal gene products in *Drosophila* axial patterning

6. Contrast mechanisms of dorsal-ventral patterning in *Drosophila* and vertebrate embryos

7. Describe morphogenetic processes in the vertebrate central nervous system, skull, and limbs and link to the action of key genes and cell types

8. Describe the guidance cues for migrating embryonic cells

9. Recognize the conservation of developmental control genes across distantly related phyla

10. Evaluate different kinds of evidence in developmental biology

11. Identify the experimental advantages of different model organisms

12. Critically assess the methodology of modern developmental biology

13. Describe and justify suitable experimental controls

Course Resources
Recommended Textbook
Scott F. Gilbert (2016) *Developmental Biology*, 11th edition. Sinauer Associates.

The 10th edition (2013) may also be used if you have one; page numbers will be given for both 11th and 10th editions, wherever possible. Copies of the 10th edition been placed on 2-hour reserve at McLaughlin library.

Supplemental Textbooks (also on 2-hour reserve)
Lewis Wolpert, 2011. *Principles of Development* (4th edition) Oxford University Press
Jonathan Slack, 2006. *Essential Developmental Biology* (2nd edition), Blackwell, Malden

Laboratory manual
Available on D2L

Primary research articles for in-class presentations
Citations will be provided ahead of time. It will be each student's responsibility to locate these articles using library resources.

Tentative Lecture and Laboratory Schedule

Week	Date	Lecture Topic	Lab exercise
	Sep 8	Course introduction	
1	Sep 13 Sep 15	Nuclear cloning and the paradigm of differential gene expression Differential gene expression II	 No lab this week
2	Sep 20 Sep 22	Fates, potentials, and early development in selected invertebrates Evidence in developmental biology: the case of the myogenic determinant	 Chick development – early
3	Sep 27 Sep 29	Cell-cell communication Signal transduction pathways in development	 Chick development – late
4	Oct 4 Oct 6	Maternal axis specification in *Drosophila* Segmentation & axial identity in *Drosophila*	 AER ablation
5	Oct 11 Oct 13	Study Break (no lecture) Midterm exam	 Bead implantation
6	Oct 18 Oct 20	Axis formation in the amphibian embryo Presentation groups 1 & 2	 Limb dissection & RNA extraction
7	Oct 25 Oct 27	Making the central nervous system Presentation groups 3 & 4	 RT-PCR & midterm review
8	Nov 1 Nov 3	Neural crest Presentation groups 5 & 6	 Gel run
9	Nov 8 Nov 10	Development of the tetrapod limb Presentation groups 7 & 8	 Analysis of lab exp'ts
10	Nov 15 Nov 17	Development of the skeleton Presentation groups 9 & 10	 Lab exam (written)
11	Nov 22 Nov 24	RNA and development Presentation groups 11 & 12	
12	Nov 29 Dec 1	Stem cells – biology and medicine Evolutionary developmental biology	

*Specific sections of the course textbook and identity of assigned research articles will be available on the course D2L site on a rolling basis.

Methods of Assessment

Assessment	% of final grade	Date	Course activity	Learning outcomes assessed
Midterm	20%	Oct. 13	Lect. 1-9	1-5, 10
Class presentation	20%	schedule on D2L		(1-8)*, 10-13
Lab exam (written)	20%	Nov. 17	Labs 1-6	7, 10-13
Final exam	40%	Dec. **	Lect. 1-17 Pres. 3-12	1-4, 6-11

*depending on specific paper

Important Dates

Sept. 8 (Thurs)	First lecture & course introduction
Sept. 22 (Thurs)	First lab
Oct. 13 (Thurs)	Midterm exam, in class
Nov. 4 (Fri)	Last day to drop one-semester courses (40th class day)
Nov. 17 (Thurs)	Laboratory exam, during normal lab hours (room TBA)
Dec. 1 (Thurs)	Last lecture
Dec. ** ()	Final exam, ** (room TBA)

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 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

The nature of the consideration will depend on the specific circumstances but a likely outcome would be to have the final exam reweighted to include the value of the missed assessment.

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 (soon to be renamed 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: http://www.csd.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 <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students. Course instructors are not obliged to answer course-related emails from students that do not originate from official university student email accounts.

Drop Date
The last date to drop one-semester courses this fall, without academic penalty, is Nov. 4, 2016 (the 40th class day). 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.

Grading
Missed lecture or laboratory material as a result of absence is your responsibility. Grades will be assigned according to the standards outlined in the University of Guelph Undergraduate Calendar.

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:

- 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/