



# MBG\*4040 Genetics and Molecular Biology of Development

Fall 2023

Section(s): C01

Department of Molecular and Cellular Biology

Credit Weight: 0.50

Version 1.00 - August 31, 2023

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## 1 Course Details

### 1.1 Calendar 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.

**Pre-Requisites:** MBG\*3040

### 1.2 Timetable

Lectures, ALEX 309: Tuesday & Thursday 11:30 am – 12:50 pm

### 1.3 Final Exam

Final exam: Friday Dec. 15, 8:30 - 10:30 AM

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## 2 Instructional Support

### 2.1 Instructional Support Team

<b>Instructor:</b>	Andrew Bendall
<b>Email:</b>	abendall@uoguelph.ca
<b>Telephone:</b>	+1-519-824-4120 x53491
<b>Office:</b>	SSC 3459
<b>Office Hours:</b>	Dr Bendall is available immediately following scheduled lecture times and by pre-arranged appointment. Please send an email to arrange a meeting time. Keep in mind that questions about course content can also be posted to the Discussion board on CourseLink so everyone can benefit from

responses.

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## 3 Learning Resources

### 3.1 Required Resources

#### Research Articles (Readings)

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

### 3.2 Recommended Resources

#### Developmental Biology (Textbook)

Barresi & Gilbert (2023) *Developmental Biology*, 13th edition. Oxford.

The 12th edition (2019) may also be used if you have one; page numbers will be given for both 13th and 12th editions, wherever possible.

A copy of the textbook will be available at the 2 hour reserve desk in McLaughlin Library.

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## 4 Learning Outcomes

### Learning Goals & 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 theme in this course.

### 4.1 Course Learning Outcomes

By the end of this course, you 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
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## 5 Teaching and Learning Activities

### 5.1 Lecture Schedule

Week	Date	Lecture Topic
	Sep 7	First class: course introduction etc.
1	Sep 12	Nuclear cloning and the paradigm of differential gene expression
	Sep 14	Differential gene expression II
2	Sep 19	Fates, potentials, and early development in selected invertebrates
	Sep 21	Evidence in developmental biology: the case of the myogenic determinant
3	Sep 26	Cell-cell communication
	Sep 28	Signal transduction pathways in development

<b>Week</b>	<b>Date</b>	<b>Lecture Topic</b>
4	Oct 3	Stem cells - biology & medicine
	Oct 5	RNA in development
5	Oct 10	Study Break (no lecture)
	Oct 12	Development and evolution I
6	Oct 17	Development and evolution II
	Oct 19	Midterm exam (in-class)
7	Oct 24	Drosophila axis specification
	Oct 26	Presentation groups 1 & 2
8	Oct 31	Axis formation in the amphibian embryo
	Nov 2	Presentation groups 3 & 4
9	Nov 7	Development of the tetrapod limb
	Nov 9	Presentation groups 5 & 6
10	Nov 14	Induction & patterning of the CNS
	Nov 16	Presentation groups 7 & 8
11	Nov 21	Skeletogenesis
	Nov 23	Presentation groups 9 & 10
12	Nov 28	Neural crest

<b>Week</b>	<b>Date</b>	<b>Lecture Topic</b>
	Nov 30	Presentation groups 11 & 12

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

## 5.2 Important Dates

Sept. 7 (Thursday) First class day

Oct. 19 (Thursday) Midterm exam

Nov. 30 (Thursday) Last class day

Dec. 15 (Friday) Final exam

## 6 Assessments

### 6.1 Methods of Assessment

<b>Assessment</b>	<b>% of Final Grade</b>	<b>Date</b>	<b>Course Activity</b>	<b>Learning Outcomes Assessed</b>
Midterm	25%	Oct. 19	Lect. 1-10	1-5, 10
Article assignment	10%	posted schedule	Pres. 1-12	10-13
Class Presentation	25%	posted schedule	Pres. 1-12	(1-8)*, 10-13
Final exam	40%	Dec. 15	Lect. 1-17 Pres. 1-12	1-13

\*depending on specific paper

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## 7 Course Statements

### 7.1 Grading

Grades will be assigned according to the standards outlined in the University of Guelph Undergraduate Calendar.

### 7.2 Privacy and online course delivery

Should the University of Guelph's primary mode of course delivery shift from face-to-face instruction to remote and online learning due to public health advice, some learning activities (e.g., synchronous lectures or student presentations) may be recorded by faculty, instructors and TAs and posted to CourseLink for grading and dissemination; students may be recorded during these sessions.

By enrolling in a course, unless explicitly stated and brought forward to their instructor, it is assumed that students agree to the possibility of being recorded during lecture, seminar or other "live" course activities, whether delivery is in-class or online/remote.

If a student prefers not to be distinguishable during a recording, they may:

1. turn off their camera
2. mute their microphone
3. edit their name (e.g., initials only) upon entry to each session
4. use the chat function to pose questions.

Students who express to their instructor that they, or a reference to their name or person, do not wish to be recorded may discuss possible alternatives or accommodations with their instructor.

### 7.3 Online Behaviour

**Inappropriate online behaviour will not be tolerated. Examples of inappropriate online behaviour include:**

- Posting inflammatory messages about your instructor or fellow students
- Using obscene or offensive language online
- Copying or presenting someone else's work as your own
- Adapting information from the Internet without using proper citations or references
- Buying or selling term papers or assignments
- Posting or selling course materials to course notes websites
- Having someone else complete your quiz or completing a quiz for/with another student
- Stating false claims about lost quiz answers or other assignment submissions
- Threatening or harassing a student or instructor online
- Discriminating against fellow students, instructors and/or TAs

- Using the course website to promote profit-driven products or services
- Attempting to compromise the security or functionality of the learning management system
- Sharing your user name and password
- Recording lectures without the permission of the instructor

## 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 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).

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