



# **MBG\*4040 Genetics and Molecular Biology of Development**

Fall 2021  
Section(s): C01

Department of Molecular and Cellular Biology  
Credit Weight: 0.50  
Version 1.00 - September 04, 2021

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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 Course Description**

I am planning for this course to be offered in-person in Fall 2021. Please also note that the proposed course format, schedule or location for the Fall 2021 semester may change up to the first day of classes due to personnel, resource, and public health circumstances and if conditions cannot be met to ensure the safety of our students and instructors. Continue to watch the Student Planning website as format information could be updated until the first day of classes. I will communicate the latest details to all registered MBG4040 students via email prior to the first class on Sept 9.

### **1.3 Timetable**

Lectures, SSC 2315: Tuesday & Thursday 11:30 am – 12:50 pm

Lectures will be held face-to-face. I am not planning to record lectures for asynchronous viewing.

Laboratory, SSC 4101: Thursday 2:30 pm – 4:20 pm

Laboratory exercises will focus on methodologies for developmental model organisms. Laboratory sessions are to be face-to-face and are a mandatory component of the course. Labs will be run at reduced capacity to allow for extra space between students. All lab

sessions will be run on Thursdays, with the class divided in two, on alternate weeks. This is reflected in the Lecture and Laboratory Schedule.

## 1.4 Final Exam

Final exam: Dec. 6, 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 during and 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 are best posted to the Discussion board on Courselink so everyone can benefit from responses.

### 2.2 Teaching Assistants

<b>Teaching Assistant (GTA):</b>	Afshan Sohail
<b>Email:</b>	sohaila@uoguelph.ca

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## 3 Learning Resources

### 3.1 Required Resources

#### Laboratory Manual (Lab Manual)

Laboratory materials can be accessed on Courselink

#### 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 (2019) *Developmental Biology*, 12th edition. Sinauer Associates.

The 11th edition (2016) may also be used if you have one; page numbers will be given for both 12th and 11th 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 and Laboratory Schedule

Week	Date	Lecture Topic	Lab
	Sep 9	Course introduction (classes and laboratory sessions to be held face-to-face)	
1	Sep 14 Sep 16	Nuclear cloning and the paradigm of differential gene expression Differential gene expression II	
2	Sep 21 Sep 23	Fates, potentials, and early development in selected invertebrates Evidence in developmental biology: the case of the myogenic determinant	Lab 1
3	Sep 28 Sep 30	Cell-cell communication Signal transduction pathways in development	Lab 1
4	Oct 5 Oct 7	Stem cells - biology & medicine RNA in development	Lab 2

<b>Week</b>	<b>Date</b>	<b>Lecture Topic</b>	<b>Lab</b>
5	Oct 12	Study Break (no lecture)	Lab 2
	Oct 14	Midterm exam	
6	Oct 19	Drosophila axis specification	Lab 3
	Oct 21	Presentation groups 1 & 2	
7	Oct 26	Axis formation in the amphibian embryo	Lab 3
	Oct 28	Presentation groups 3 & 4	
8	Nov 2	Development of the tetrapod limb	Lab 4
	Nov 4	Presentation groups 5 & 6	
9	Nov 9	Induction & patterning of the CNS	Lab 4
	Nov 11	Presentation groups 7 & 8	
10	Nov 16	Skeletogenesis	Lab 5
	Nov 18	Presentation groups 9 & 10	
11	Nov 23	Neural crest	

<b>Week</b>	<b>Date</b>	<b>Lecture Topic</b>	<b>Lab</b>
	Nov 25	Presentation groups 11 & 12	Lab 5
12	Nov 30	Evolutionary-developmental biology I	
	Dec 2	Evolutionary-developmental biology II	

\*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. 9 (Thurs) First lecture & course introduction

Sept. 23 (Thurs) First lab exercise

Oct. 14 (Thurs) Midterm exam

Dec. 2 (Thurs) Last lecture

Dec. 6 (Mon) 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	20%	Oct. 14	Lect. 1-9	1-5, 10
Class presentation	20%	schedule on D2L		(1-8)*, 10-13

<b>Assessment</b>	<b>% of Final Grade</b>	<b>Date</b>	<b>Course Activity</b>	<b>Learning Outcomes Assessed</b>
Lab quizzes	5x 4%	various	Labs 1-5	7, 10-13
Final exam	40%	Dec. 6	Lect. 1-17 Pres. 1-12	1-13

\*depending on specific paper

## 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 the ongoing COVID-19 pandemic, 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 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, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. 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

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).

## 9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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