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: Tuesday & Thursday 11:30 am – 12:50 pm ALEX 028

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

1.3 Final Exam

Currently scheduled for Wednesday, Dec. 12, 7-9 pm. Please see WebAdvisor for the latest information.

2 Instructional Support

2.1 Instructional Support Team

Instructor: Andrew Bendall
Email: abendall@uoguelph.ca
Telephone: +1-519-824-4120 x53491
Office: SSC 3459
Office Hours: Dr Bendall is available immediately following scheduled
lectures and by pre-arranged appointment. Please send an email to arrange a meeting time.

**Instructor:** Scott Ryan  
**Email:** sryan03@uoguelph.ca  
**Telephone:** +1-519-824-4120 x52919  
**Office:** SSC 3456  
**Office Hours:** Dr Ryan is available immediately following scheduled lectures and by pre-arranged appointment. Please send an email to arrange a meeting time.

**Lab Co-ordinator:** Jenna Penney  
**Email:** penneyj@uoguelph.ca  
**Telephone:** +1-519-824-4120 x53448  
**Office:** SSC 3516

### 2.2 Teaching Assistants

**Teaching Assistant:** Afshan Sohail  
**Email:** sohaila@uoguelph.ca

### 3 Learning Resources

#### 3.1 Required Resources

**Laboratory Manual (Lab Manual)**  
Available on D2L

**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 library resources.

#### 3.2 Recommended Resources

**Developmental Biology (Textbook)**  

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 11th edition have been placed on 2-hour reserve at McLaughlin library.

### 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
## 5 Teaching and Learning Activities

### 5.1 Tentative Lecture and Laboratory Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Instructor</th>
<th>Lecture Topic</th>
<th>Lab Exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sep 10</td>
<td>SR</td>
<td>Cell-cell communication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sep 12</td>
<td>SR</td>
<td>Signal transduction pathways in development</td>
<td>No lab this week</td>
</tr>
<tr>
<td>2</td>
<td>Sep 17</td>
<td>AB</td>
<td>Nuclear cloning and the paradigm of differential gene expression</td>
<td></td>
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<tr>
<td></td>
<td>Sep 19</td>
<td>AB</td>
<td>Differential gene expression II</td>
<td>Chick development – early</td>
</tr>
<tr>
<td>3</td>
<td>Sep 24</td>
<td>AB</td>
<td>Fates, potentials, and early development in selected invertebrates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sep 26</td>
<td>AB</td>
<td>Evidence in developmental biology: the case of the myogenic determinant</td>
<td>Chick development – later</td>
</tr>
<tr>
<td>4</td>
<td>Oct 1</td>
<td>SR</td>
<td>Stem cells - biology</td>
<td></td>
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<tr>
<td></td>
<td>Oct 3</td>
<td>SR</td>
<td>Stem cells - medicine</td>
<td>AER ablation &amp; Signal inhibition</td>
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<tr>
<td>5</td>
<td>Oct 8</td>
<td></td>
<td>Study Break (no lecture)</td>
<td></td>
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<tr>
<td></td>
<td>Oct 10</td>
<td></td>
<td>Midterm exam</td>
<td>RNA extraction from PA &amp; PCR</td>
</tr>
<tr>
<td>Week</td>
<td>Date</td>
<td>Instructor</td>
<td>Lecture Topic</td>
<td>Lab Exercise</td>
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<tr>
<td>6</td>
<td>Oct 15</td>
<td>SR</td>
<td>Neurogenesis</td>
<td></td>
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<tr>
<td></td>
<td>Oct 17</td>
<td></td>
<td>Presentation groups 1 &amp; 2</td>
<td></td>
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<tr>
<td></td>
<td>Oct 17</td>
<td></td>
<td>Limb dissection &amp; RNA extraction</td>
<td></td>
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<tr>
<td>7</td>
<td>Oct 22</td>
<td>SR</td>
<td>Neural crest</td>
<td></td>
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<tr>
<td></td>
<td>Oct 24</td>
<td></td>
<td>Presentation groups 3 &amp; 4</td>
<td></td>
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<tr>
<td></td>
<td>Oct 24</td>
<td></td>
<td>PCR from limb</td>
<td></td>
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<tr>
<td>8</td>
<td>Oct 29</td>
<td>SR</td>
<td>Disorders of neural development</td>
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<tr>
<td></td>
<td>Oct 31</td>
<td></td>
<td>Presentation groups 5 &amp; 6</td>
<td></td>
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<tr>
<td></td>
<td>Oct 31</td>
<td></td>
<td>Gel run</td>
<td></td>
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<tr>
<td>9</td>
<td>Nov 5</td>
<td>AB</td>
<td>Drosophila axis specification</td>
<td></td>
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<tr>
<td></td>
<td>Nov 7</td>
<td></td>
<td>Presentation groups 7 &amp; 8</td>
<td></td>
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<tr>
<td></td>
<td>Nov 7</td>
<td></td>
<td>Analysis of lab exp’ts</td>
<td></td>
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<tr>
<td>10</td>
<td>Nov 12</td>
<td>AB</td>
<td>Axis formation in the amphibian embryo</td>
<td></td>
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<tr>
<td></td>
<td>Nov 14</td>
<td></td>
<td>Presentation groups 9 &amp; 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nov 14</td>
<td></td>
<td>Lab exam (written)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Nov 19</td>
<td>AB</td>
<td>Development of the tetrapod limb</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nov 21</td>
<td></td>
<td>Presentation groups 11 &amp; 12</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Nov 26</td>
<td>AB</td>
<td>Evolutionary-developmental biology I</td>
<td></td>
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<tr>
<td></td>
<td>Nov 28</td>
<td></td>
<td>Evolutionary-developmental biology II</td>
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</tbody>
</table>

*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. 5 (Thurs) First lecture & course introduction

Sept. 19 (Thurs) First lab

Oct. 10 (Thurs) Midterm exam, in class

Nov. 14 (Thurs) Laboratory exam, during normal lab hours (SSC4101)

Nov. 28 (Thurs) Last lecture

Dec. 12 Final exam

6 Assessments

6.1 Methods of Assessment

<table>
<thead>
<tr>
<th>Assessment</th>
<th>% of Final Grade</th>
<th>Date</th>
<th>Course Activity</th>
<th>Learning Outcomes Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm</td>
<td>20%</td>
<td>Oct. 10</td>
<td>Lect. 1-9</td>
<td>1-5, 10</td>
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<tr>
<td>Class presentation</td>
<td>20%</td>
<td>schedule on D2L</td>
<td></td>
<td>(1-8)*, 10-13</td>
</tr>
<tr>
<td>Lab exam (written)</td>
<td>20%</td>
<td>Nov. 14</td>
<td>Labs 1-6</td>
<td>7, 10-13</td>
</tr>
<tr>
<td>Final exam</td>
<td>40%</td>
<td>TBD</td>
<td>Lect. 1-17, Pres. 1-12</td>
<td>1-13</td>
</tr>
</tbody>
</table>

*depending on specific paper

7 Course Statements
7.1 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.

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/

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

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-regregchg.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.

More information can be found on the SAS website
https://www.uoguelph.ca/sas

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