

**University of Guelph  
College of Biological Sciences  
Department of Integrative Biology**

**COURSE OUTLINE**

**Developmental Biology (ZOO\*3050)  
Winter 2017**

**Course description**

This course will focus on the development of vertebrates and invertebrates from fertilized egg to adult. It will examine fertilization, cell differentiation into tissues and organs, regulation of cell growth, and transmission of developmental information to the next generation. Throughout, the course will emphasize the evolutionary mechanisms that have shaped developmental patterns in animals.

Credit weighting: 0.5

Prerequisites: (MBG\*2000 or MBG\*2040), BIOL\*2400 is strongly recommended.

Restriction: ZOO\*2100

**Teaching team**

Professor Dr. Andreas Heyland, Office SSC 1468, aheyland@uoguelph.ca, ext. 56459,  
Office hours: by appointment.

Lab Instructor Dr. Colin DeMill, Office SSC3511, cdemill@uoguelph.ca, ext. 56557.

Teaching Assistant TBA

**Course schedule**

Lectures: Tuesday/Thursday 8:30-9:50 in MACN 105

Labs: Wednesday/Thursday/Friday 2:30-5:20 PM & Thursday 10:00AM-12:50PM  
Room SCIE 2313

\*\*On-line tutorial completed in week of January 9<sup>th</sup> (Week 1)

\*\*First lab session in week of January 16<sup>th</sup> (Week 2)

**Learning Outcomes**

To enable students to appreciate and understand some of the universal molecular and cellular events and processes that occur as an animal develops from an egg and a sperm into an adult organism.

By the end of this course, students should have an increased understanding of the gene signaling and gene regulatory events controlling developmental processes, and how the expression of these genes determine morphogenic and physiological transitions in development. Students should also have an appreciation of how environmental factors can interact with the genome to alter or vary the outcome of developmental events. Finally students should gain a heightened 3-D insight of how

vertebrate and invertebrate bodies are produced from a single cell and increase to sizes spanning up to a  $10^{14}$  cellular entity. By the end of this course, students should be able to:

### **Conceptual Goals**

1. Understand the process of gamete fusion and pronuclei interactions that activate development.
2. Understand the nature of genes regulating the sex determination process.
3. Understand gene signaling events that regulate early cleavage and gastrulation events in development
4. Understand how the three main germ layers in development (ectoderm, endoderm & mesoderm) are formed and which anatomical structures are derived from these three germ layers.
5. Understand gene signaling events that direct the process of limb development.
6. Understand how environmental factors may alter gene imprinting events and the consequences of such influences upon development.
7. Gain a heightened appreciation for the nature of genetic mutations in altering developmental programmes.

### **Course Resources**

#### Required Texts

- Gilbert, S.F. 2013. Developmental Biology. Sinauer Associates, Inc., Sunderland, Massachusetts. (10th edition). This book can be purchased in the book store.
- Note: A considerably cheaper (~60% of the list price) 'on-line' version of the textbook may be purchased directly from the publisher. Email: [orders@sinauer.com](mailto:orders@sinauer.com)
- ZOO\*3050 Developmental Biology Laboratory Manual (sold in the first week of class, \$10 cash)
- Top Hat Subscription for students (<https://tophat.com/pricing/>). To facilitate discussion and to enhance your learning in and out of class, we will be using educational software called Top Hat. Top Hat allows you to answer questions and engage in discussion using your smartphone, tablet or laptop. You will need to purchase the Top Hat app and instructions will be provided by e-mail/Courselink with instructions for purchasing, downloading and setting up the Top Hat software. We will practice using Top Hat in class before graded questions begin.

#### Library Reserve

- Gilbert, S.F. 2003. Developmental Biology. Sinauer Associates, Inc., Sunderland, Massachusetts. (7th edition). Call number: **QL 955 G48 2003**.
- Gilbert, S.F. 2006. Developmental Biology. Sinauer Associates, Inc., Sunderland, Massachusetts. (8th edition).

- Gilbert, S.F. 2009. *Developmental Biology*. Sinauer Associates, Inc., Sunderland, Massachusetts. (9th edition).
- Scadding, S.R. and Ackerley, S.K. 2003. *Developmental Biology Laboratory Manual*. University of Guelph (6th edition). Call number: **UGM PSN 03757**
- Mathews, Willis W. 1982. *Atlas of Descriptive Embryology*. Call number: **QL 956.M38 1986**
- Carlson, B.M. 1988. *Patten's Foundations of Embryology*. Call number: **QL 955.P23 1988**
- Pechenik, J. A. 2010. *A Short Guide to Writing about Biology*. Call number: **QH 304.P43 2010**

#### CourseLink and other websites

- A D2L site has been created for this course and it can be found by going to: <https://courselink.uoguelph.ca/shared/login/login.html>. This site contains all lecture material, a discussion board, on-line tutorials and other pertinent information.
- Additional information can be found on the developmental biology course website: <http://www.uoguelph.ca/devobio/>
- Another site with material intended as a supplement to the course textbook is at: <http://www.devbio.com/>

#### Undergraduate Calendar

- This is the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate programs. It can be found at: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/>

#### **Course Content**

This course deals with the development of animals. It considers how a single fertilized egg gives rise to hundreds of different cell types, how these differentiated cells are organized into tissues and organs, how the growth of cells is regulated, and how an adult transmits the instructions for making an organism from one generation to the next. Throughout, the emphasis is on the principles and key concepts that govern the process of development in vertebrates and invertebrates as well as the evolutionary mechanisms that shaped developmental patterns in animals.

*Developmental Biology* has a: i) lecture component; and ii) laboratory component. The laboratory component consists of 5 laboratories including two projects that require a formal report. Students are expected to attend class and take complete notes. Class material will also be supplemented through required textbook readings. In the lab, developmental biology is studied through experimental examination of live specimens, preserved specimens, slides and models. Attendance and participation in the laboratories and completion of the on-line modules is mandatory. These exercises are completed in the week before the laboratory. All components of the laboratory including on-line modules must be complete in order to receive credit for the lab. Excuses for absence are only adequate when properly documented.

## Tentative Lecture Topics

Note: The list of lecture topics below is meant to indicate the topics to be covered and in what order. It is meant as a guideline only.

- Introduction to Developmental Biology (Part 1)
  - Developmental Patterns in Animals (Chapter 6-9)
  - Differential Gene Expression in Development (Chapter 2)
  - Cell-Cell Communication in Development (Chapter 3)
- Cell Commitment and Early Embryogenesis (Part 2)
  - Gametogenesis and Fertilization (Chapter 4-5)
  - Cell Division, Blastulation and Gastrulation (Chapter 5-9)
- The Stem Cell Concept (Part 3)
  - Ectoderm, Neural Crest, Mesoderm, Endoderm (Chapter 10-13)
  - Limb Development (Chapter 14)
  - Sex Determination (Chapter 15)
  - Post-embryonic Development (Chapter 16)
- System Biology (Part 4)
  - Medical Aspects of Developmental Biology
  - Mechanisms of Evolutionary Change

## Methods of Assessment

Assessment				
Form of Assessment	Weight of Assessment	Due Date of Assessment	Course Content / Activity	Learning Outcome Addressed
Tutorial Quizzes (online)	2% each = 10%	Jan. 17 Jan. 31 Feb. 14 ♥ Mar. 7 Mar. 21	Online tutorials	1-7
Lab report 1	10%	Mar. 3 (submission) Mar. 17 (peer review)	Lab manual, primary literature	1
Primary Literature Essay	12%	3x TBD	Readings	1-7
In Lecture Quizzes	8%	4x TBD	Class Material	1-7
Lab Exam	20%	Week of Mar. 27	Lab manual, Online tutorials	1-7
Lab Report 2	10%	Week of Apr. 3	Lab manual, primary literature	6
Final Exam	30%	TBD	Lectures, readings	1-7



## Important Dates

Jan. 9	First day of class
Jan. 17	Tutorial 1 due
Jan. 31	Tutorial 2 due
Feb. 14	Tutorial 3 due
Feb. 20 (week of)	Winter break
Mar. 3	Lab report 1 due (11:00PM PEAR)
Mar. 7	Tutorial 4 due
Mar. 17	Review of Peer's Lab report 1 due (11:00PM PEAR)
Mar. 21	Tutorial 5 due
Mar. 27 (week of)	Lab Exam
Apr. 3 (week of)	Lab report 2 due (11:00PM of your lab day via dropbox)
Apr. 7	Last day of class
TBD	Final Exam

## Laboratory Exercises

Week 1	Tutorial 1
Week 2	Lab 1. Basic Laboratory Observations
Week 3	Tutorial 2
Week 4	Lab 2. Mitosis, Meiosis and Fertilization
Week 5	Tutorial 3
Week 6	Lab 3. Cleavage and Gastrulation
Week 7	WINTER BREAK
Week 8	Tutorial 4 /Report 1 Due
Week 9	Lab 4. Neurulation and Organogenesis
Week 10	Tutorial 5
Week 11	Lab 5. Zebrafish Development
Week 12	Final Lab Exam (in SCIE 2313)
Week 13	Report 2 due

## Course and University Policies

### Grading

**Quizzes:** Online tutorials and quizzes must be completed by 11:00PM on the date indicated to receive credit.

**Lab reports:** Students will work in groups and perform two experiments with live animals (sea urchin embryos and zebrafish embryos). Each student will be responsible for producing two independent lab reports written in the format of a scientific paper. The first lab report will be 'peer' reviewed using the on campus Peer Evaluation And Review (PEAR) system. Students can only take part in the peer review process if they submit a paper and will only receive full marks if they complete the two assigned reviews. The second lab report will be graded by TAs and will be submitted online via dropbox by 11:00PM on the date indicated. Late reports will accrue a penalty of 10% per day

including weekends.

**Lab Exam:** The lab exam will be performed during your final lab session.

**Midterm and Final Exams:** Are in scheduled during class or exam times.

#### 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. 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 the Centre for Students with Disabilities as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email [csd@uoguelph.ca](mailto:csd@uoguelph.ca) or see the website: <http://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, for Fall 2013 is October 31, 2013. 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.

### **Campus Resources**

The Academic Calendars are 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 (SAS) 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/>