



ZOO*3050 Developmental Biology

Winter 2022

Section(s): C01

Department of Integrative Biology

Credit Weight: 0.50

Version 2.00 - December 01, 2021

1 Course Details

1.1 Calendar 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.

Pre-Requisites: MBG*2040, BIOL*2400 is strongly recommended.

1.2 Course Description

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.

1.3 Timetable

First lecture and laboratory sessions start week of January 10, 2022

Lectures: Asynchronous video lectures will be available at the beginning of each week on Courselink. Synchronous in person (F2F) lecture review times will be held on Thursdays during the normal lecture time slot (8:30-9:50 AM). A synchronous virtual review and discussion session will also be held on Tuesday's from 8:30 - 9:50 AM via zoom. Details will be provided at the beginning of the semester.

Labs: Bi-weekly labs will be offered face-to-face in W22 in SSC 2304. Each lab will run over a two-week period ("Week A" and "Week B"), with each lab section divided into two cohorts ("A" and "B"). (Wednesdays 2:30 - 5:20 PM/Thursday AM 10:00 AM - 12:50 PM/Thursday PM 2:30 - 5:20 PM/Friday 11:30 AM - 2:20 PM).

1.4 Final Exam

Exam time and location is subject to change. Please see WebAdvisor for the latest information.

2 Instructional Support

2.1 Instructional Support Team

Instructor:	Andreas Heyland
Email:	aheyland@uoguelph.ca
Telephone:	+1-519-824-4120 x56459
Office:	SSC 1468
Office Hours:	Virtual Office Hour Wednesday's from 9.30-10.30 by appointment
Lab Co-ordinator:	Sarah Schorno
Email:	sschorno@uoguelph.ca
Telephone:	+1-519-824-4120 x52949
Office:	SSC 3510
Office Hours:	Virtual Office Hours By Appointment

3 Learning Resources

3.1 Required Resources

Kritik (Website)

<https://www.kritik.io/>

We will be using Kritik for this course, a peer to peer learning platform. This tool is required and a subscription has to be purchased for \$24 for the semester. More information on Kritik can be found here: <https://intercom.help/Kritik/en/collections/2347837-student-guide>.

NOTE: This tool is linked to 20% of your final mark. You will receive an invite to join the course at the beginning of the semester. Please make sure you sign-up before the first day of classes.

Developmental Biology: Lab Activities (Lab Manual)

ZOO*3050 – Developmental Biology (Digital Copy provided to all students on Courselink)

3.2 Additional Resources**Developmental Biology (Textbook)**

- Barresi & Gilbert. 2019. Developmental Biology. Sinauer Associates, Inc., Sunderland, Massachusetts. (12th edition). Call number: QL 955 G48 2019.
- Available on reserve
- This book can be purchased in the book store.
- You can also use the 10th or 11th edition of this book.
- Available "used"
- 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
- Another site with material intended as a supplement to the course textbook is at: <http://www.devbio.com/>
- An older version of the textbook is available through NCBI for free. Note however that some information in this version is not up to date and even incorrect in some cases.

Atlas of Descriptive Embryology (Textbook)

- Mathews, Willis W. 1982. Atlas of Descriptive Embryology. Call number: QL 956.M38 1986
- Available of reserve

Patten's Foundations of Embryology (Textbook)

- Carlson, B.M. 1988. Patten's Foundations of Embryology. Call number: QL 955.P23 1988
- Available on reserve

A Short Guide to Writing about Biology (Textbook)

- Pechenik, J. A. 2010. A Short Guide to Writing about Biology. Call number: QH 304.P43 2010
- Available on reserve

4 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.

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

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
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5 Teaching and Learning Activities

5.1 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.

1. What is developmental biology (Chapter 1)
2. Differential gene expression and genome organization (Chapters 3 & 25)
3. Cell-Cell communication and differentiation (Chapters 2, 3, 4 & 5)
4. Sex determination, gametogenesis, and fertilization (Chapters 6 & 7)
5. Cell division, blastulation, gastrulation, and body polarity (Chapters 8 - 12)
6. Ectoderm, Neural Crest, Mesoderm, Endoderm (Chapters 13 - 18 & 20)
7. Limb Development (Chapter 19)
8. Post-embryonic development (Chapters 21 & 22)

Week (Dates)	Lecture Assignments
1 (Jan. 10-14)	None
2 (Jan. 17-21)	Kritik Assignment 1 Creation/Courselink Quiz
3 (Jan. 24-28)	Kritik Assignment 1 Review and Feedback/Courselink Quiz
4 (Jan. 31-Feb. 4)	Kritik Assignment 2 Creation/Courselink Quiz
5 (Feb. 7-11)	Kritik Assignment 2 Review and Feedback/Courselink Quiz
6 (Feb. 14-18)	Courselink Quiz
(Feb. 21-25)	Reading Week

Week (Dates)	Lecture Assignments
7 (Feb. 28-March 4)	Kritik Assignment 3 Creation/Courselink Quiz
8 (March 7-11)	Kritik Assignment 3 Review and Feedback/Courselink Quiz
9 (March 14-18)	Kritik Assignment 4 Creation/Courselink Quiz
10 (March 21-25)	Kritik Assignment 4 Review and Feedback/Courselink Quiz
11 (March 28-April 1)	Kritik Assignment 5 Creation/Courselink Quiz
12 (April 4-8)	Kritik Assignment 5 Review and Feedback/Courselink Quiz

5.2 Laboratory Exercises

Week (Dates)	Lab Topic	Lab Cohort	Lab Assessments
1 (Jan. 10-14)	Lab 1: Basic Lab Observations	Cohort "A"	Lab 1 Quiz (Cohort "A")
2 (Jan. 17-21)		Cohort "B"	Lab 1 Quiz (Cohort "B")

Week (Dates)	Lab Topic	Lab Cohort	Lab Assessments
3 (Jan. 24-28)	Lab 2: Sea Urchin Fertilization	Cohort "A"	
4 (Jan. 31-Feb. 4)		Cohort "B"	Lab Assignment 1 (Cohort "A")
5 (Feb. 7-11)	Lab 3: Cleavage & Gastrulation	Cohort "A"	Lab Assignment 1 (Cohort "B") Lab 3 Quiz (Cohort "A")
6 (Feb. 14-18)		Cohort "B"	Lab 3 Quiz (Cohort "B")
(Feb. 21-25)	Reading Week		
7 (Feb. 28-March 4)	Lab 4: Neurulation & Organogenesis	Cohort "A"	Lab 4 Quiz (Cohort "A")
8 (March 7-11)		Cohort "B"	Lab 4 Quiz (Cohort "B")
9 (March 14-18)	Lab 5: Zebrafish Development	Cohort "A"	
10		Cohort "B"	

Week (Dates)	Lab Topic	Lab Cohort	Lab Assessments
(March 21-25)			
11 (March 28-April 1)	No Lab		Lab Assignment 2 (Cohort "A")
12 (April 4-8)	No Lab		Lab Assignment 2 (Cohort "B")

6 Assessments

FACE-TO-FACE (IN-PERSON) LAB FORMAT: Students will be divided into two weekly "Lab Cohorts" (A and B) in order to reduce capacity (50% capacity) and allow for physical distancing in our labs. Our 5 labs will run for two weeks each (please see schedule), with students attending either in "Week A" or "Week B". Lab cohorts will be posted on Courselink during the first week of classes, and all lab assessment due dates will differ depending on your assigned lab cohort schedule (see assessment details below).

Masks will be mandatory in face-to-face labs at all times, and contact tracing forms must be completed prior to entering the lab. Please complete the daily COVID-19 screening form before coming to campus each day (https://uoguelph.eu.qualtrics.com/jfe/form/SV_6lh1bNRMHDEU1OR).

6.1 Assessment Details

Lecture Quizzes (10%)

Learning Outcome: 1, 2, 3, 4, 5, 6, 7

Weekly lecture quizzes using the Courselink quizzes tool will be due Fridays at 11:59PM.

The time commitment for each quiz is 5 minutes and there will be a quiz every week unless otherwise noted in our course schedule.

Lecture Assignments - Kritik (20%)

Learning Outcome: 1, 2, 3, 4, 5, 6, 7

Lecture Assignments (5 x 4% each) (Using Kritik Peer Review System)

Due Dates for Lecture Assignments (note that each assignment has specific deadlines further communicated in Kritik for the creation of the assignment, review of the assignment and review of assessment):

Kritik Assignment 1 - January 17 - 28, 2022

Kritik Assignment 2 - January 31 - February 11, 2022

Kritik Assignment 3 - February 28 - 11, 2022

Kritik Assignment 4 - March 14 - 25 2022

Kritik Assignment 5 - March 28 - April 8, 2022

The time commitment for each assignment is 2h and there are 5 assignments during the semester

Final Exam (20%)

Date: TBD, TBD

Learning Outcome: 1, 2, 3, 4, 5, 6, 7

Students will complete a timed exam composed of randomly assigned multiple choice questions using the quiz tool in Courselink.

Please note: Time and format is subject to change.

Lab Quizzes (15%)

Learning Outcome: 1, 2, 3, 4, 5, 6, 7

Lab quizzes will be completed in-person during your normally scheduled lab cohort time slot. Each quiz will contain roughly 20-30 multiple choice questions and should take approximately 30 minutes to complete. Each lab quiz will be worth 5% each, for a total of 15% of the lab mark.

Lab quizzes will be completed in-person during the following lab periods:

Lab 1 Quiz - Cohort A (Week of Jan. 10, 2022), Cohort B (Week of Jan. 17, 2022)

Lab 3 Quiz - Cohort A (Week of Feb. 7, 2022), Cohort B (Week of Feb. 14, 2022)

Lab 4 Quiz - Cohort A (Week of Feb. 28, 2022), Cohort B (Week of March 7, 2022)

Lab Assignment I (15%)

Learning Outcome: 6

Lab Assignment I will focus on formulating questions/hypotheses/predictions and data visualization/analysis based on our sea urchin fertilization experiment in Lab 2.

Lab Assignment I should take around 2-3 hours to complete.

Lab Assignment I due dates (due 1 week after your regularly scheduled lab section):

Lab Cohort A - Lab Assignment I is due 1 week after Lab 2 (Wed. Feb 2/Thu. Feb 3/Fri. Feb 4)

Lab Cohort B - Lab Assignment I is due 1 week after Lab 2 (Wed. Feb 9/Thu. Feb 10/Fri. Feb 11)

Lab Assignment II (20%)

Learning Outcome: 6

Lab Assignment II will focus on writing a full scientific lab report based on our zebrafish embryo experiment in Lab 5.

Lab Assignment II should take around 5-8 hours to complete.

Lab Assignment II due dates (due 2 weeks after your regularly scheduled lab section):

Lab Cohort A - Lab Assignment II is due 2 week after Lab 5 (Wed. March 30/Thu. March 31/Fri. April 1)

Lab Cohort B - Lab Assignment II is due 2 week after Lab 5 (Wed. April 6/Thu. April 7/Fri. April 8)

6.2 Lab Manual Bonus Marks

A fillable PDF version of our lab manual will be provided to all students on Coureslink at the beginning of our semester. The lab manual should be opened/filled/saved using Adobe Acrobat Reader (free to download).

Our lab manual is filled with diagrams /images to label as well as some pointed questions for students to answer using the information contained in the manual as well as from our online labs on Courselink.

Students who submit a complete lab manual to our Dropbox by the end of the semester (Friday, April 8, 2022 at the latest) will be eligible to receive 2% bonus marks for the semester. All figures must be complete and all questions answered in order to receive full bonus marks for the semester.

7 Course Statements

7.1 Absence and Illness

If you cannot complete assignments for medical or other authorized reasons, please contact the instructors in advance of an assignment deadline to discuss the situation.

No medical documentation will be required but clear communication with the instructor well ahead of the deadline is expected.

7.2 Late Penalty on Assignments

The assignments will have a late penalty of 10% per day.

Thus, assignments that are ten (10) days late will receive 0%.

7.3 Online Behaviour (Netiquette)

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 Integrative 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 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.
