Faculty of Science Course Syllabus
Department of Biology
BIOL 3050: Developmental Biology
Fall 2019

Instructor(s):	Sophia Stone	S.Stone@dal.ca	LSC 5132
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Lectures: 9:35-10:25 MWF LSC 242

Laboratories: Eight three-hour lab sessions in LSC 4016

Course Description

Lectures describe development as a sequence of processes and events, in which 'simple' structures such as fertilized eggs are progressively transformed into complex organisms. These events are governed by developmental 'rules' which have been determined through experimental study of animal and plant model organisms. Laboratories use live material whenever possible.

Course Prerequisites

BIOL 2020 and BIOL 2030

Course Objectives/Learning Outcomes

- Identify a few major researchers in the development of the field of Developmental Biology and outline how our understanding of embryonic development has changed over time.
- Know the characteristics of the major experimental model organisms
- Identify and define the major stages in the development of model organisms
- Demonstrate an understanding of selected molecular techniques used in the field of Developmental Biology
- Demonstrate an understanding of the process of gamete production and fertilization
- Understand the steps involved in cleavage and gastrulation and also identify the types of cell movements involved in gastrulation
- Distinguish between germ layers and list what tissues/organs develop from each germ layer
- Describe mechanisms by which embryonic cells communicate and their role in regulating embryonic development
- Describe the mechanism of gene expression regulation and explain their importance in controlling developmental processes
- Outline the processes involved in generating a nervous system
- Outline the process involved in limb development
- Identify and differentiate between mechanisms used to develop a complex, multicellular organism.

- Outline the differences and similarities between plant and animal development and demonstrate an understanding for the basis for these differences
- Demonstrate an understanding of the process of pollination and fertilization
- Describe the structure of apical meristems and their role in development
- Demonstrate an understanding of the principal mechanisms that regulate leaf, flower and root development
- Explain the significance of hormones in plant development and describe the role of each of the five major hormones in development
- Identify embryonic structures in slide preparations, photographs and diagrams
- Relate the appearance of two-dimensional microscope sections to three-dimensional embryos
- Carry out simple experiments using selected model species
- Write formal laboratory reports

Course Materials

Although there is not a REQUIRED text assigned to the class, we strongly recommend that you purchase the text, ***Principles of Development*, 6th*. Ed., 2019; by Wolpert et al***. It is particularly helpful for the Animal Development section, has a good chapter on Plant Development and Dr. Stone will be referring to figures in the text during lecture. Specific sections of the text will also be assigned as recommended pre-lab reading. Copies of the text are on Reserve in the Killam Library if you don't wish to purchase one. The 4th and 5th editions of the text can also be used, however, you will be responsible or determining the appropriate sections and pages to read.

We also recommend that you consider purchasing the text ***A Student Handbook for Writing in Biology; 4th ed., 2013 by Karin Knisely,*** which is available in the reference section of the University Bookstore. This text is relatively inexpensive and is a very good reference text to consult when writing your laboratory reports.

There is no printed lab manual for this course. Your labs will be posted on Brightspace throughout the term. This will allow flexibility in how you can view the lab information during your lab session. If you have a tablet or small laptop that you normally carry with you, you can view the introductory portion of the lab electronically during lab and only print the Lab Exercises that you will hand in at the end of lab. If you prefer to have a hard copy with you in lab, simply print the entire lab. I should warn everyone though that WiFi in the Life Sciences Centre is notoriously poor. So, if you plan to view an electronic copy of the lab during your lab session, make sure it is downloaded to your device prior to coming to lab. **It is mandatory that every student has the lab information with them in some form during their lab sessions and that everyone has a printed copy of the Lab Exercises**.

Course Assessment

Component	Weight (% of final grade)	Date
Lecture		
Exam I	10 %	September 25th
CRISPR Assignment	5 %	September 29th
Lightning Talk	5 %	October 8th
Exam II	15 %	October 30th
Flower Assignment	5 %	November 25th
Exam III	20 %	December 3rd
Lab		
Pre-Lab Quizzes	2.5 %	Throughout term
Lab Assignments	22.5 %	Throughout term
Lab Report	15 %	Week of November 4h

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (<50)
A- (80-84)	B- (70-72)	C- (55-59)	

Course Policies

To avoid any misunderstanding or confusion during the term, please note the following policies which will be enforced by the staff of Biology 3050. These regulations have been put in place to try to ensure fair and equal treatment for all. Extenuating circumstances can arise however, so please feel free to see Dr. Stone or Dr. Cooper if you have problems with any of these regulations at any time during the term.

Running of Labs:

a) Labs will start promptly at 2:35 a pre-lab overview of the material you will be studying and clarification of any instructions if necessary. You will each work at your own pace and can feel free to leave or take a break whenever you wish, but the lab will be closed at 5:30 and at that time, everyone will be expected to submit their assignments for evaluation and will be asked to leave.

b) You will select a bench position where you will be expected to sit for the entire term. You are each responsible for the proper use, maintenance and storage of the microscopes located in the cupboard in front of your position. Before leaving the lab, put away all equipment, tidy up your work area and wash and dry all dirty glassware as instructed.

c) Pairs of students will be assigned slide boxes containing all the prepared slides for the term. You will be expected to check that all the slides are in your box before you start each lab, and to likewise ensure that all slides are in their proper slots when you leave.

d) We will be using live animals in two of the lab sessions (i.e. sea urchins to study fertilization and early development and planaria to study regeneration). If you have strong objections to working with this material, please speak to the Instructor in advance to make alternate arrangements for the lab.

Illness and Extensions:

There will be times during your term when you will have deadlines in several different courses at the same time. **PLAN AHEAD. WORK CONSISTENTLY.** Your time at University should, among other things, teach you to develop effective time management skills and study habits. On the other hand, unforeseen events such as personal/family crisis, or illness can occur during the term. These occurrences are unavoidable and the staff of BIOL 3050 will be most understanding. Special arrangements for examinations and assignments in the event of illness or other exceptional circumstances will be made at the discretion of the teaching staff. Alternate arrangements will be considered provided that:

- a student who misses class work (i.e. exam, deadline for submission of an assignment, etc.) because of illness **NOTIFIES THE INSTRUCTOR OR PROFESSOR ON THE DAY IN QUESTION**, and submits a Student Declaration of Absence (SDA). A maximum of two SDA may be used in this course throughout the term.

- a student who, for medical reasons (e.g., scheduled day surgery, physiotherapy etc.), anticipates missing class work notifies the instructor at least one week in advance;

- a student who misses class work due to other exceptional circumstances **NOTIFIES THE INSTRUCTOR OR PROFESSOR ON OR BEFORE THE DAY IN QUESTION**, and is willing to produce appropriate documentation upon request.

Late Assignments:

Any material submitted for evaluation after the designated deadline, where an extension has not been granted, will have marks **DEDUCTED AT THE RATE OF 10% PER DAY LATE. To avoid excessive late**

deductions over a weekend, email the file to the Instructor when it is completed and submit the hard copy that Monday morning.

Plagiarism and Academic Integrity:

You are expected to abide by Dalhousie University's policies on academic integrity. There will be times in lab when you work as a group, but **every assignment that you submit must be independent and entirely your own wording**. The lab reports submitted for this class will be assessed using Urkund plagiarism software.

Grade Changes:

We do not encourage requests for considerations of grade changes with the weekly submissions from the laboratory sessions. These small assignments are graded by the teaching assistants using an outline provided by the Instructor. While every effort has been made to ensure that the assessments are fair and as objective as possible, some individual variation in evaluations is inevitable. However, each week's material is worth only a few marks towards your total grades so any minor variations would be insignificant. Overall, prolonged discussions over fractions of points takes time away from the current week's activities and can create an unhealthy, confrontational atmosphere. **ON THE OTHER HAND**, we **DO ENCOURAGE** discussion about "where you went wrong" so that you will not make the same mistakes the next time and you will learn, and improve. In all cases, the procedure is to approach the person who graded your material and to do so as soon as possible after receiving the evaluation. **THERE WILL BE <u>NO</u> CONSIDERATIONS OF GRADE CHANGES FOR LAB ASSIGNMENTS BEYOND 1 WEEK AFTER YOUR ASSIGNMENT IS RETURNED** (i.e., do not bring assignments for re-evaluation at the end of term!). In regards to exams given during the lecture portion, requests for grade reassessment must be done in writing. The written request must be made within one week of the date the exam was returned.

Course Content

Tentative Lecture Topic Outline

PART I – Animal Development

Lecture I.1: Introduction to animal developmental biology
Goals and outline of the course
What is developmental biology?
Model organisms
Overview and comparison of early development in vertebrates (Xenopus)

Lecture I.2: Origin and approaches to animal developmental biology
Origins of developmental biology (early theories)
Anatomical approaches
Experimental approaches
Genetic approaches

Lecture I.3: Germ cells, gametogenesis and fertilization
Specification of germ cells
Oogenesis and spermatogenesis
Fertilization and prevention of polyspermy
Parthenogenesis

Lectures I.4: Cleavage: mechanisms, patterns and consequences
Cleavage cycle
Patterns and type of cleavage
Formation of the blastula

Lecture I.5 and 6: Morphogenesis
Cell shape, adhesion and movements
Morphogenic processes in gastrulation and neurulation
Molecular basis of gastrulation and neurulation

Lecture I.7: Axis formation: setting up the body axis
Dorsoventral and anteroposterior axis formation
Establishing left-right asymmetry

Lecture I.8: Cell specification and determination
Progressive determination of cell fate
Cell-cell communication
Acquisition of commitment
Eye development as an example of induction in development

Lecture I.9: Germ layer origin and specification
Mesoderm induction
Mesoderm patterning along the dorso-ventral and antero-posterior axes
Ectoderm and endoderm specification (Xenopus)

Lecture I.10: Guest lecture – CRISPR and human genome editing

Lecture I.12: Antero-posterior patterning and somites; Neural tube induction
Somite specification and formation
Role of Hox genes in A-P patterning
Neural tube induction

Lecture I.13: Neural crest cells; cell differentiation
Neural crest cells origin, migration and patterning
Differential gene expression
Models of cell differentiation
Plasticity of gene expression

Lecture I.14: Guest lecture (current research) – Neural tube patterning/organizing the developing nervous system

Lecture I.15: Limb development
Limb bud induction and formation
Development along the proximal-distal axis
Development in the dorsal ventral-axis
Digit specification and separation

PART II – Plant Development

Lecture II.1: Embryogenesis, seed development and germination
Stages in embryo development
Seed structure
Endosperm development
Germination

Lecture II.2: Introduction to phytohormones
What are phytohormones?
How hormones work –roles in development

Lecture II.3 and 4: Establishing the body plan: apical-basal and radial patterning
Embryo fate map
Specification of cell fate along the apical-basal axis
Hormones in apical-basal patterning
Radial pattern formation

Lecture II.5 : Meristems
Types of meristems
Shoot apical meristems organization and maintenance
Root apical meristem, structure, specification and maintenance
Hormonal regulation of apical meristem activity

Lecture II.6: Development of lateral organs
Auxillary meristems and shoot branching
Positioning of lateral organs on the shoot apical meristem
Initiation and development of lateral roots

Lecture II.7: Axis formation in leaves
Leaf morphology
Initiation of leaf development
Genetic control of leaf identity and complexity
Establishing leaf polarity and patterning

Lecture II.8 and 9: Patterning the epidermis (stomata, trichome and root hair)
Stomata structure and function
Guard cell fate specification and patterning
Trichome structure and function
Trichome fate specification and patterning
Root hair structure and function

Root hair fate specification and patterning

Lecture II.10: Gametophyte development and fertilization
Alternation of generations – haploid phase
Pollen grain structure and development
Ovule and embryo sac structure and development
Cell fate specification in the embryo sac

Lecture II.11: Flower development
Floral meristems
How to make a flower
Establishing floral meristem identity and determinacy
Determining floral organ identity: The ABC model
