

BIO 5620 - Developmental Biology Course Syllabus

Winter 2020

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Class Hours

Tues & Thurs – 4:00 PM to 5:15 PM at 1151 Old Main Building

Office Hours

Tues – 12:30 PM to 2:00 PM (beginning on Tues, Jan 14, 2020; or by appointment to be arranged by e-mail at least 24 hours in advance)

Text: Barresi, M. J. F., and Gilbert, S.F.. Developmental Biology, 12th Edition, Oxford Univ Press

Assigned research papers: posted on Canvas

Prerequisites: Students should have completed BIO 3070 or an equivalent Genetics course with a grade of C- or better.

Course Description and Objectives: This course introduces the student to the molecular and cellular principles behind how a single cell becomes an animal, a multicellular organism with specialized tissues and organs. The students will

- (1) learn to ask the key questions in development
- (2) construct how information flow within a cell and between cells promote the development of an animal
- (3) model how body plans of different animals are generated to give rise to specialized tissues and organs
- (4) reconstruct the conservation of the molecular and cellular principles across different animal species
- (5) outline how the external environment can influence the developmental process
- (6) predict outcomes when developmental processes are not correctly regulated, and
- (7) analyze and integrate the scientific data that are used to answer all these questions in development.

To meet these objectives, the course is divided into 6 units, which address the key questions in development. Developmental biology is a fascinating field that has benefited from major advances in cellular and molecular genetic approaches that include functional genomic and computer-based technologies. These advances allowed present-day developmental biologists to start answering the fundamental questions raised in the past centuries by developmental biologists gifted with keen powers of observation and imagination. The seminal findings of these past and present scientists have revolutionized many aspects of our society, including the treatment of many diseases, like different types of cancer or neurological disorders. This course hopes to impart the same excitement these scientists have experienced in their quest to find the answers to the major questions of this field.

Unit I: Introduction to Development (*Topics: key questions in development, life cycles, cell specification, differential gene expression and model organisms*)

Unit II: Cell Communication in the Context of Development (*Topics: extracellular/intracellular signaling pathways*)

Unit III: Pattern Formation (*Topics: polarity, axis formation and cell differentiation*)

Unit IV: Morphogenesis (*Topics: growth and division, organogenesis, cell death, sex determination*)

Unit V: Stem Cells (*Topics: embryonic and adult stem cells, regeneration and aging*)

Unit VI: Environmental Influence (*Topic: developmental plasticity*)

Course Schedule:

Week	Lectures	Unit Topic	Class Topic	Reading Assignment
1	Jan 7	<u>I. Introduction to Development</u>	Key questions in development	Ch. 1 (1-32; 36-38)
	Jan 9		Fertilization	Ch. 7 (pp. 215-240)
2	Jan 14		Cell specification (differential gene expression)	Ch. 3
	Jan 16		Cell specification (metazoan body plans): <i>Xenopus</i>	Ch. 8 (247-250); Ch. 11 (327-354)
3	Jan 21, Jan 23	<u>II. Cell Communication</u>	Cell commitment Cell signaling: induction and competence Paracrine and juxtacrine signalling	Ch 2; Ch. 4
4	Jan 28	Exam I		
	Jan 30	<u>III. Pattern Formation</u>	Axes formation: <i>Drosophila</i> – anterior-posterior polarity; dorsal-ventral polarity	Ch. 9 (273-288, 297-299)
5	Feb 4		Segmentation in <i>Drosophila</i> Homeotic genes	Ch. 9 (288-296; 300-301)
	Feb 6		Axes formation: Vertebrate Hox code hypothesis	Ch. 12
6	Feb 11	<u>IV. Morphogenesis</u>	Vertebrate neurulation, neural tube patterning	Ch. 13
	Feb 13		Research paper discussion	Ogden et al, Nature 2008
7	Feb 18	Exam II		
	Feb 20	<u>IV. Morphogenesis (continued)</u>	Somitogenesis and neural crest cells	Ch. 15 (441-454, 470-480); Ch 17
8	Feb 25		Limb bud formation	Ch. 19
	Feb 27		Developmental control: tissue growth (Hippo pathway) and body size (insulin pathway)	Pan, Genes Dev 2007; Shingleton, Curr Biol 2005
9	Mar 3		Research paper discussion Cell death program: apoptosis	Ellis and Horvitz, Cell 1986
	Mar 5		In-class activity	
10	Mar 10, Mar 12	No classes	Spring break	
11	Mar 17		Sex determination	Ch. 6 (179-195)

	Mar 19	Exam III		
12	Mar 24	<u>V. Stem Cells</u>	Germ cells; embryonic cells Adult stem cells	Ch. 5
	Mar 26		Research paper discussion	Bohnert and Kenyon, Nature 2017
13	Mar 31		Regeneration	Ch. 22 (643—650; 656-681)
	Apr 2		Aging	Kenyon, Cell 2005
14	Apr 7		Research paper discussion	Zullo et al, Nature 2019
	Apr 9	<u>VI. Environmental Influence</u>	Developmental plasticity: <i>C. elegans</i> Research paper discussion	Fielenbach and Antebi, Genes Dev 2008 Kim et al, Science 2009
15	Apr 14		In-class activity	
	Apr 16	Final Exam Review		
16	Apr 21	STUDY DAY		
	Apr 28	FINAL EXAM	2:45 PM - 4:45 PM in 1151 Old Main Building	

(Note: The course schedule is subject to change if circumstances arise that would require such changes. Any changes will be announced to the whole class and posted on Canvas.)

Dates to be aware of:

Jan 12 Last day to add

Jan 17 Last day to drop and receive tuition refund

Mar 22 Last day to withdraw. After Mar 22, a letter grade will be issued.

Reading assignments: The reading materials associated with each lecture are listed above. In addition to the Gilbert and Barresi textbook, they will be derived from research papers or review papers that are posted on Canvas under the folder “*Additional reading assignments*”.

Class Web Site:

Go to Canvas [<http://canvas.wayne.edu/>] to access the class web site and click on the link of “Developmental Bio Sec 001 / BIO_5620_2001_001”. This site has the syllabus, additional reading assignments and lecture slides. CHECK this site OFTEN: it is continuously updated with (1) new class materials and (2) announcements concerning the class, e.g., lecture materials and exams. In addition, you should be able to access through this site (1) all recorded lectures from the Echo Center and (2) the Discussion Board that will allow you to post concepts and questions that you want clarified. The instructor will check the Discussion Board often to reply to your posts. This Discussion Board can be a very important supplement to your understanding of course materials.

Quizzes: There will be **4 quizzes**, which will be administered randomly (*i.e.*, “pop quizzes”) throughout the Winter Term. Each quiz is worth 15 points. The students have the option to drop one quiz. **No make-up quiz** will be given under any circumstances.

Exams: There will be **3 closed-book mid-term exams** and **1 closed-book comprehensive final exam**. Each exam will be derived from class lecture materials and the reading assignments. Thus, students are expected to know **both** sets of materials prior to each exam. **Each mid-term exam will be worth 100 points** and the mid-term exam with the lowest score will be dropped. In contrast, **the final exam**, which is also worth **110 points**, cannot be dropped, *i.e.*, **the final is mandatory**. **The final exam will also be cumulative.**

Make-up exams will not be given. Exams will begin promptly. Students arriving late to an exam will not be given additional time to finish the exam. No students will be allowed to leave and re-enter the classroom once an exam has begun. No students will be allowed to enter the exam room after a student has completed the exam and left the room. **Students arriving more than 15 minutes late for an exam will receive a grade of 0 for that exam—no exceptions.**

The room in which all exams will be held will be the same as the regular classroom. All you need is a few sharp (#2) pencils to fill your name and answers on your answer sheet (e.g., Scantron). The Scantrons will be distributed at the beginning of each exam.

In-class activities: Students will carry out 2 in-class activities (**for a possible course total of 15 points**), where students will apply the concepts they have learned in lecture or in the reading assignments. These activities are designed to develop the students’ critical thinking skills, which should also prepare them to succeed as future biologists and health professionals. There are no make-up opportunities for any of these activities, which will be announced to the class ahead of time.

Research paper discussions: The class will be divided into 5 groups, and each group will be responsible in presenting an assigned research paper. Assigned research papers for presentation are posted on Canvas under the folder “*Research papers for presentation*”. The research paper presentation will be worth **30 points** for each member of the group. If a member provides no contribution to the group effort, then said member will earn no points. A documentation of individual contributions to the group effort, which should have the group’s consensus, should be submitted to the instructor.

For the presentation, which should be 45-50 minutes long, the group should demonstrate the following:

- a. Sufficient introduction to the topic (5 points)
- b. What is the question (hypothesis) that the paper is asking? Why is this question important? (5 points)
- c. How was the question answered? Or how was the hypothesis tested? (5 points)
- d. What were the key results that answer the question? Or what were the key results that prove/disprove the hypothesis? (5 pts)
- e. How has the field changed in the decade(s) after the paper has been published? Or if the paper is recently published, what are future implications of said paper? (5 pts)
- f. Be prepared to answer questions about the material (5 points)

Class participation: The course will be taught through a combination of prepared lectures, class discussions, and in-class activities. The idea is to ensure that the students are **thinking** about the developmental process: what are the questions; how to ask and address those questions; and how to interpret any answers to such questions. Thus, participation in class discussions and in-class activities would be highly encouraged.

Honors section: Students in the honors section will devise a research project, which will be documented in a report that has a 2000-2500 word count, excluding the reference list. The report should be divided into the following sections: an introduction to the hypothesis, aims, approaches, possible outcomes and

conclusions, caveats, alternative approaches, and references. The report, which will be worth **40 points**, should be submitted on Apr 16, the last day of class before the final exam. Please include the word count on the cover page of the report.

Grading policy:

In general, grades will be calculated on a straight scale, based on a **grand total of 400 points (440 points for the Honors section)**. However, the instructor may decide to use a “curve” in the required exams to achieve a more normalized grade distribution.

Grades will be calculated on the following %:

	A	92.5-100	A-	90.0-92.4	
B+	87.5-89.9	B	82.5-87.4	B-	80.0-82.4
C+	77.5-79.9	C	72.5-77.4	C-	70.0-72.4
D+	67.5-69.9	D	62.5-67.4	D-	60.0-62.4
	F	0-59.9			

Re-grading policy: Requests for re-grades should be submitted no later than one week after the quiz or exam has been returned to you. Completed exams and quizzes will be scanned before they are returned to you. Re-grading will be done on the scanned exams and quizzes. Any quiz or exam that has been requested for a re-grade, with the exception of addition errors, may be re-graded in its entirety and result in either an increase or decrease in your grade.

How to do well in class:

- (1) Attend the lectures.
- (2) Ask questions, especially if you do not understand the material under discussion.
- (3) Read the assigned material.
- (4) Take all exams and quizzes.
- (5) Work with your team to prepare for the research paper presentation.
- (6) Do not cram for the exams. The course covers a lot of material and cramming will not help you gain a solid understanding of the material, which is necessary for the exams.

Academic conduct:

The Wayne State University code of conduct (posted on Canvas) specifically prohibits cheating and plagiarism. Anyone caught cheating or plagiarizing will automatically receive a failing grade for the quiz, exam or class. The practice of science is based on trust. In real-life terms, violation of such trust automatically leads to loss of research grants, medical licenses and careers. This should serve as a reminder that cheating and plagiarism have real-life consequences.

Academic Success Center (ASC):

The ASC, located at 1600 David Adamany Undergraduate Library, can provide counseling and workshops on how to improve study skills and time management, and thus help in successfully completing this course. These services are free of charge to all students.

Students with disabilities:

If you have a documented disability that requires accommodations, please register as early as possible with the Student Disability Services (SDS), 1600 David Adamany Undergraduate Library, Student Academic Success Services Department (313-577-1851 or 313-577-3365; TTY--telecommunication device for hearing impaired students). I will be happy to meet with you during my office hours to discuss your needs, once you have your SDS academic accommodation letters. Please be aware that a delay in getting these letters may also delay the facilitation of your needed accommodations in a timely manner. The mission of the SDS at Wayne State University is to ensure that students with disabilities have equal educational opportunities.

Religious Holiday Conflicts:

If you have a conflict with any of the scheduled class or exam times due to religious reasons, you must notify the instructor in writing within the first two weeks of classes. Otherwise, no accommodations will be made due to religious reasons after this time. Exam times have already been scheduled with certain religious holidays in mind.

Unexpected University closures:

If the University is officially closed on an exam day, the exam will be held on the next regularly scheduled class day. Closure of the University is announced by the following mechanisms:

1. the University Newsline (313) 577-5345 *
2. WSU Homepage (www.wayne.edu) *
3. WSU Pipeline (www.pipeline.wayne.edu) *
4. WDET-FM (Public Radio 101.9)
5. by other local radio and television stations

* Note: The information on closures and class cancellations is likely to be found at these locations before it is broadcasted by local radio and television stations.

Finally, any specific issue not covered by this syllabus will be resolved using University policies. Disputes that cannot be resolved following the guidelines present in this syllabus will be resolved by following the guidelines of the University "Student Due Process".