

BIO 5620 - Developmental Biology Course Syllabus

Winter 2021

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Class Hours

Tues & Thurs – 4:00 PM to 5:15 PM (Virtual)

Office Hours

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*)

Class Web Site:

Go to Canvas [<http://canvas.wayne.edu/>] to access the class web site and click on the link of “Winter 2021 Developmental Bio Sec 001 / BIO_5620_2101_001”. This site has the syllabus and lecture slides and recordings. 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. Each set of lecture slides that is uploaded as a PowerPoint file before the associated class will be found on under “Files” > “Lectures”.

In addition, you should be able to access through this site (1) all recorded lectures (under “Echo360 Recordings”, (2) Zoom links for live discussions under “Zoom”, (3) cloud recordings of live discussions under “Zoom”, and (4) a Discussion Board under “Discussions” that will allow you to post concepts and questions that you want clarified.

Virtual Attendance:

The first lecture (Tues, Jan 12) will be conducted live via Zoom (link will be provided) at the given class period from 4.00 pm – 5.15 pm. Exams will also **only** be conducted at these times, with the exception of the final exam that has a 2-h format. All exams will be proctored via Zoom (again link will be provided), which means that you **must** be virtually present at these times. Please see the exam schedule below. There will also be **two** graded in-class activities, where students are expected to be present during the class time. In addition, each student is expected to participate in a team research paper presentation and should be virtually present during the presentation.

All other lectures will be pre-recorded and accessible at or before class time and until the semester ends, unless the situation calls for a live discussion. Many of the lectures will be about 50 min in duration, which will then be followed by virtual discussions via Zoom during the last 25 min of the allotted class time. These discussions will be announced beforehand, as well as at the end of the associated pre-recorded lecture. They will cover concepts presented during the formal lectures.

Course Schedule:

Week	Lectures	Unit Topic	Class Topic	Reading Assignment
1	Jan 12	<u>I. Introduction to Development</u>	Key questions in development	Ch. 1 (pp. 1-38)
	Jan 14		Fertilization	Ch. 7 (pp. 215-240)
2	Jan 19		Cell specification (differential gene expression)	Ch. 3 (pp. 55-97)
	Jan 21		Cell specification (metazoan body plans): <i>Xenopus</i>	Ch. 8 (248-250); Ch. 11 (325-355)
3	Jan 26, Jan 28	<u>II. Cell Communication</u>	Cell commitment Cell signaling: induction and competence Paracrine and juxtacrine signalling	Ch 2; Ch. 4
4	Feb 2	Exam I		
	Feb 4	<u>III. Pattern Formation</u>	Axes formation: <i>Drosophila</i> – anterior-posterior polarity; dorsal-ventral polarity	Ch. 9 (273-288, 297-299)
5	Feb 9		Segmentation in <i>Drosophila</i> Homeotic genes	Ch. 9 (288-296; 300-301)

	Feb 11		Axes formation: Vertebrate Hox code hypothesis	Ch. 12
6	Feb 16	<u>IV. Morphogenesis</u>	Vertebrate neurulation, neural tube patterning	Ch. 13
	Feb 18	In-class activity		
7	Feb 23	Exam II		
	Feb 25	<u>IV. Morphogenesis (continued)</u>	Somitogenesis and neural crest cells	Ch. 15 (441-454, 470-480); Ch 17
8	Mar 2		Limb bud formation	Ch. 19
	Mar 4		Developmental control: tissue growth (Hippo pathway); body size (insulin pathway); apoptosis (cell death pathway)	Pan, Genes Dev 2007; Shingleton, Curr Biol 2005; Green, Cell 2000
9	Mar 9		Sex determination	Ch. 6 (179-195)
	Mar 11	In-class activity		
10	Mar 16, Mar 18	No classes	Spring break	
11	Mar 23	Exam III		
	Mar 25	<u>V. Stem Cells</u>	Germ cells; embryonic cells Adult stem cells	Ch. 5
12	Mar 30		Regeneration	Ch. 22 (643—650; 656-681)
	Apr 1		Aging	Kenyon, Cell 2005
13	Apr 6		Hedgehog (morphogen) signalling pathway: Research paper presentation I	Ogden et al, Nature 2008
	Apr 8		Apoptosis: Research paper presentation II	Conradt and Horvitz, Cell 1998
14	Apr 13		Germ stem cells: Research paper presentation III	Bohnert and Kenyon, Nature 2017
	Apr 15		Aging: Research paper presentation IV	Zullo et al, Nature 2019
15	Apr 20	<u>VI. Environmental Influence</u>	Developmental plasticity: <i>C. elegans</i> Research paper presentation V	Kim et al, Science 2009
	Apr 22	Final Exam Review		
16	Apr 27	STUDY DAY		
	May 4	FINAL EXAM	2:45 PM - 4:45 PM (Virtual)	

(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 18	Last day to add
Jan 25	Last day to <u>drop and receive tuition refund</u>
Mar 28	Last day to withdraw. After Mar 28, a <u>letter grade</u> will be issued.

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

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.**

In-class activities: Students will carry out **two** in-class activities (**15 points each**). In-class activities will allow students to apply the concepts they have learned in lecture or in the reading assignments and/or begin preparation of their research paper presentations. 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 presentations: 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.

Grading policy:

In general, grades will be calculated on a straight scale, based on a **grand total of 370 points**. 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 %:

B+ 87.5-89.9	A 92.5-100	A- 90.0-92.4
C+ 77.5-79.9	B 82.5-87.4	B- 80.0-82.4
D+ 67.5-69.9	C 72.5-77.4	C- 70.0-72.4
	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 exam has been returned to you. Completed exams will be scanned before they are returned to you. Re-grading will be done on the scanned exams. Any 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 finish all in-class activities.
- (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 Newslines (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".