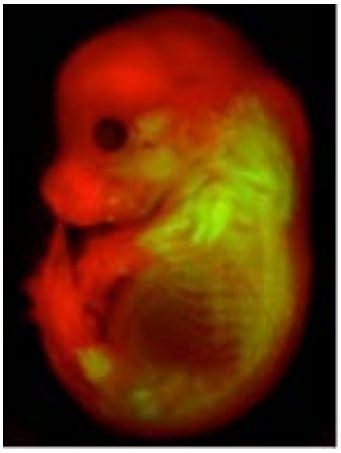
MCB 3219: Developmental and Regenerative Biology

Course Description

MCB 3219 provides an introduction to animal development, emphasizing molecular, cellular and genetic mechanisms that regulate embryonic development and tissue regeneration. At a fundamental level, there are remarkable similarities in the mechanisms by which animals develop, and it is these similarities in gene regulatory networks, signaling mechanisms and cellular processes that will be emphasized. The course will integrate classical and modern experimental approaches in order to convey the rich history and continuity of the discipline. One overarching goal is for students to gain an appreciation for the process of scientific discovery and build a conceptual framework by which to understand and approach the study of development. Knowledge gained from developmental biology research is increasingly being applied in clinical settings in the rapidly growing field of regenerative medicine. Thus, the practical value of understanding development is enormous, and the relationship between embryology and clinical application will be a theme that runs throughout the course.

Syllabus - MCB 3219
Developmental & Regenerative Biology
Spring, 2019



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"Our real teacher has been and still is the embryo, who is, incidentally, the only teacher who is always right." Viktor Hamburger

"It is not birth, marriage or death, but gastrulation which is truly the most important time in your life." Lewis Wolpert

Course Description and Introduction: This course provides an introduction to animal development, emphasizing molecular, cellular and genetic mechanisms that regulate developmental processes. Embryology is the study of the emergence of living form, which occurs through a series of orderly changes that vary widely among species. At a fundamental level, however, there are remarkable similarities in the mechanisms by which animals develop. It is these similarities in gene regulatory networks, signaling mechanisms and cellular processes that will be emphasized. Yet, variations (sometimes enormous) on fundamental themes will also be highlighted to give a sense of the richness and diversity by which embryos of different species accomplish the monumental task of creating anew the next generation.

Throughout the course, we will emphasize both classical and modern experimental approaches that have been used to unravel mechanisms of development. Hopefully, you will gain an appreciation for the process of discovery and a conceptual framework by which to understand and approach the study of development, as well as other disciplines. Although intellectual curiosity has driven the study of development since the times of Aristotle, we are fortunate to live in an age of an emerging understanding of the developmental mechanisms underlying a number of congenital defects. In addition, knowledge gained from the study of embryonic development is increasingly being applied in a clinical setting in the rapidly growing field of regenerative medicine. Thus, the practical value of understanding development is enormous, and the relationship between embryology and clinical application will be a theme that runs throughout the course.

Prerequisites: Biology 1107. Recommended preparation: MCB 2410 (Genetics) and 2210 (Cell Biology), or equivalents.

Office Hours: I will hold weekly office hours in my office (G24 Biology-Physics Building) on Thursdays immediately following lecture. I will be available by appointment at other times to meet with students who have a conflict during regularly scheduled office hours, or who would like additional help.

Class Meetings and Format: Tuesdays and Thursdays, 11:00-12:15, Room 175, UTEB. Lectures will begin promptly at 11:00 (timing is everything in development). Most lectures will include both PowerPoint and white board material. PowerPoint slides in pdf format will be available on HuskyCT by the evening prior to each lecture.

Attendance: Attendance will not be recorded. However, the PowerPoint slides include only a portion of the material covered in class and attendance is essential to earn a good grade in the course.

Optional Textbooks: 1) Developmental Biology 11th edition, 2016, by Gilbert and Barresi; 2) Principles of Development, 5th Edition, 2015, by Lewis Wolpert, Cheryll Tickle, and Alfonso Martinez Arias. **I will not be lecturing from the textbooks and all exam questions will come from material covered in lecture**. The texts are intended to serve as resources to solidify concepts and facts discussed in lecture, or to dig deeper into a particular subject of interest. If you intend on purchasing one or both of these texts solely for this course, earlier versions are available online at much-reduced cost, and they would be fine for this purpose. If you plan on a career in Developmental Biology, the most recent versions are probably best. In order to encourage exploration and more active learning, I will not assign specific reading for each lecture. Explore the textbooks and enjoy!

Exams and Grading: Exams will be multiple-choice format and will emphasize conceptual material, problem solving, and interpretation of data. There will be three exams, each covering approximately one third of the course (the third exam will not be cumulative). There will be no homework assignments, quizzes, or extra-credit, so please keep up with the material and seek extra help when needed!

The approximate grade cut-offs will be: **A**: 93-100%; **A-**: 90-92%; **B+**: 87-89%; **B**: 83-86%; **B-**: 80-82; **C+**: 77-79%; **C**: 73-76%; **C-**: 70-72; **D+**: 67-69%; **D**: 63-66%; **D-**: 60-62; **F**: below 60%

Practice Exams and Review Sessions: There will be an in-class review session during the class period preceding each exam. Each review session will be based on a take-home practice exam that will be posted on HuskyCT approximately one week before the exam. Practice exams will be identical in style and difficulty to the real exams and are the best way to gauge your level of understanding of the course material. I strongly recommend that you take these practice exams seriously and work on them at home prior to the review sessions. Practice exams will not be graded and you are free to work on them with others.

Other Resources:

Companion Website to Gilbert's Developmental Biology, 11th Edition (www.devbio.com): Excellent Web companion to the textbook that includes supplemental materials, details of some experiments not included in the textbook, historical perspectives, ethical issues raised by

new technologies, and other information. Topics are referenced throughout the textbook. You do not need to purchase the book for access to the website.

Vade Mecum[3]: Web resource to Developmental Biology, 11th Edition available to those who purchase the book. It provides an overview of life cycles and development of various species, interactive videos, and more.

MGI (Mouse Genome Informatics; www.informatics.jax.org): The definitive international database of mouse development and disease, hosted by Jackson Laboratories. It provides comprehensive information on gene structure, expression, function and gene relationships across species (orthology).

OMIM (Online Mendelian Inheritance in Man; www.ncbi.nlm.nih.gov/omim): This is an excellent web site that catalogs human genes and genetic disorders. The database contains textual information, clinical synopses, reference information, links to Medline and pictures of genetic disorders.

University Policy on Academic Misconduct (excerpted from the Student Conduct Code): "Academic misconduct is dishonest or unethical academic behavior that includes, but is not limited, to misrepresenting mastery in an academic area (e.g., cheating), failing to properly credit information, research or ideas to their rightful originators or representing such information, research or ideas as your own (e.g., plagiarism)." Academic misconduct of any kind will not be tolerated. The complete Student Conduct Code can be found at: http://community.uconn.edu/wp-content/uploads/sites/523/2016/06/1617-The-Student-Code.pdf

Next Page: Lecture and Exam Schedule

Lecture and Exam Schedule

Week	Lecture	Date	Topic	Notes
1	1	1/22	Course structure. Introduction to development, model organisms	
	2	1/24	Fertilization	
2	3	1/29	Cleavage, cell fate, potency, and determination	
	4	1/31	Genomic equivalence I: evidence and exceptions	
3	5	2/5	Genomic equivalence II: differential gene expression, methods to study gene expression and function	
	6	2/7	The cytoplasmic environment and localized cytoplasmic determinants	
4	7	2/12	Anterior-posterior patterning in *Drosophila* I: maternal genes, morphogens	*Post practice exam questions*
	8	2/14	Anterior-posterior patterning in *Drosophila* II: segmentation and segment identity	
5		2/19	**Review (based on take-home practice exam)**	*Most beneficial if you complete the practice exam prior to class.*
		2/21	***First Midterm Exam***	*Bring #2 Pencil*
6	9	2/26	Axis formation in vertebrates	
	10	2/28	Germ layers and mesoderm induction	
7	11	3/5	Neural induction, formation of the neural tube	
	12	3/7	Patterning of the neural tube	

8	13	3/12	Anterior-posterior patterning, segmentation in vertebrates	
	14	3/14	Somite patterning and derivatives	
9		3/19 3/21	**SPRING BREAK**	
10	15	3/26	Determination and differentiation programs: skeletal muscle I	*Post practice exam questions*
	16	3/28	Determination and differentiation programs: skeletal muscle II	
11		4/2	**Review** **(based on take-home practice exam)**	
		4/4	***Second Midterm Exam***	*Bring #2 Pencil*
12	17	4/9	Neural crest cells	
	18	4/11	Development of sensory organs: the eye	
13	19	4/16	Limb development I: limb fields, induction of limb bud, limb identity	
	20	4/18	Limb development II: generation of the 3 axes	
14	21	4/23	*Limb regeneration*	*Course evaluations*
	22	4/25	Stem cell-mediated regeneration: Skeletal Muscle	*Post practice exam questions*
15	23	4/30	Stem cells in disease	
		5/2	**Review** **(based on take-home practice exam)**	
16		TBD	***Final Exam (not cumulative)***	*Bring #2 Pencil*