BIOL 354
Developmental Biology

M W F 9:30 – 10:20 am ISC 137
Th lab 2:00 – 4:50 pm ISC 306

Instructor:
Travis J. Bailey, Ph.D.
E-Mail: baileyt@geneseo.edu
Phone: 245-5437
Office: ISC 350

Office hours:
TBD
Or by appointment

Textbook

Developmental Biology 13th Edition
Gilbert and Barresi

Optional Laboratory Notebook

Marble cover composition notebook
10" X 7 7/8" 80 sheets maximum 5 X 5 quad ruled, 20# paper

Course Description

This course will introduce the principles and concepts of genetics, epigenetics, metabolism, growth, morphogenesis, and differentiation in developing organisms. In the laboratory, you will make observations of, and perform experiments on, a variety of developing organisms, demonstrating a number of fundamental events of development.

Learning Outcomes-Students will:

- Understand the methods scientist use to explore the genetic, cellular, and tissue control of development.
- Compare and contrast developmental strategies of model organisms.
- Read primary literature critically and explain strengths and weaknesses.
- Test hypotheses with self-designed experimentation, measurement and data collection, evaluation of evidence, and employment of mathematical analysis.
- Relate discoveries from model animals to human conditions.
- Communicate findings orally and in writing.
- Integrate multiple bodies of knowledge with their personal experience by asking meaningful questions about real-world problems
- Apply skills, theories, and methods gained in academic study to new situations
- Reflect upon changes in their learning and outlook over time, and integrate into their future endeavors based on that self-reflection

How will you know that you are learning?

You will receive feedback on your progress with frequent assignments, including quizzes, as well as midterms, and a final exam. Each exam builds on previous concepts (is cumulative).

You can use the provided assignments to prepare for the midterms and the final exam. Please expect mistakes to be a natural part of the learning process. Midterms and the final exam are cumulative to

provide you with multiple opportunities to improve your understanding of difficult concepts. Each exam will stress concepts covered during that quarter of the semester. Midterms and the final exam will contain a variety of questions, including multiple choice, fill-in-the-blank, and mini essay format, and ask you to recall, apply, and synthesize your knowledge. Midterm exams are designed to take 20 minutes.

Your grades are primarily determined by your work as an individual. In addition, a portion of your grade will be calculated by your work in a team. For each midterm, during the first 30 minutes you will first answer questions on your own. Then, you will immediately have 20 minutes to retake the midterm exam with your teammates. Working with your team will benefit you, because a portion of your team effort will be added to your individual score, as follows:

Your exam score = your initial score points + 1/2 (team retake midterm points - your team's average initial midterm points)

For example.
You earn a score of 90 points.
1st groupmate earns 70 points
2nd groupmate earns 80 points. Thus: Initial Group Average = 80 points or 240/3

Team retake score is 85 points. → ½(Team Retake – Initial Group Average) = ½(85-80)
= 2.5 points

You earn 92.5 points (90 initial points + 2.5 retake points)
1st groupmate earns 72.5 points
2nd groupmate earns 82.5 points

The instructor exercises the right to deny any student this team midterm benefit if there is evidence that a student is not contributing fairly to the team effort. In the event of an excused absence on a midterm date, group points on the make-up midterm will be determined by taking the average of group points over the whole semester.

Grading

About 40% of course credit comes from lecture assignments, journal clubs, laboratory assignments, and experiments. The remaining credit comes from individual and group exams. Find rubrics with the assignment instructions on Canvas.
Note on letters of recommendation: Many students ask a letter of recommendation because this class gives opportunity to consider your critical thinking and lab attentiveness skills. I write letters using examples from your coursework. If you plan on asking for a helpful letter, make sure your work is impressive not merely passing.

Grading scale:

93 – 100%	A	83 – 86.9%	B	73 – 76.9%	C
90 – 92.9%	A-	80 – 82.9%	B-	70 – 72.9%	C-
87 – 89.9%	B+	77 – 79.9%	C+	60 – 69.9%	D

Grade Calculation:

Exams	400 points (100 points each)
Assignments (lab and class)	90 points
Experiment proposals	20 points
Written reports	45 points
Oral Presentations	45 points
Total	600 points

Schedule of Exams

EXAM 1: 12 February, Wednesday
Core Concepts, Sea Urchins, Fertilization
EXAM 2: 26 March, Wednesday
Model organisms, axis specification, invertebrates, and vertebrates.
EXAM 3: 5 May, Monday
Neurulation, ectodermal derivatives, paraxial mesoderm, limbs, aging, and regeneration.
Comprehensive FINAL: Tuesday, May 13, 8 am

Course materials

We will be using the 13th edition of Barresi and Gilbert's *Developmental Biology,* ISBN: 9780197574652 (eBook) or equivalent. Exam questions will be based concepts found in the textbook, additional assigned readings, lecture material, and laboratory work. Materials other than the textbook will be posted online for your convenience. Because this is a course at the highest undergraduate level you will be expected to read before class. I will provide you a .pptx file of my lecture notes for download so you can print off figures of note. Posting parts of someone else's work is illegal because it violates their copyright. Do not post online materials about this course that you do not create in full.

Assignments

In-class activities, homework assignments, and quizzes will combine for your final "Assignments" grade. To receive points for in-class activities, you must be present at the beginning of the exercise. Homework is designed to help you understand if you are learning the material necessary to do well on an exam. Most homework assignments will be completed in groups. For group homework assignments, each person is required to fully complete the assignment before meeting with the group. Often each person will submit their initial answers and then the group will submit a consensus document. You will receive the group assignment grade if your individual assignment is complete and you attended the group meetings (see *Evaluating self and group peers*). Homework is due at the start of class on the due date (there will be a 10%/day penalty for late homework). Upload a legible image to the course management software. One major group assignment will be posted online for free access by any person with internet access. Share with your friends and family!

Journal Clubs

We will critically evaluate current primary literature in this class using Journal Club formats. Each student should come prepared to present the paper; meaning being prepared to explain what the authors did in each experiment. Participation in the class discussion will contribute to the *Assignments* grade.

Laboratory experiments and reports

You will be evaluated on multiple phases of experimentation. 1) the experimental proposal 2) the oral presentation to your class 3) the written lab report. Further instructions and rubrics will be posted on Canvas during the semester. 4) the investigative laboratory notebook. You'll find it is important that you update the

notebook during labs, recording results, and experiments and other notes and thoughts. The notebook will be graded only at the end of the course, however, please give me the chance to look it over before the last week of the semester so I can give you feedback to ensure you earn an A grade. Make sure you *always* have access to all your notes in lab. Some laboratory work is observational, and so only the lab report is graded. Choose from the following options to create a laboratory notebook.

OneDrive Docx notebook

Record your work in a "living" document that you create in the shared OneDrive folder I create for you. Or alternatively you can share with me an alternative online file.

Paper laboratory notebook

Record your work in a paper laboratory notebook (Composition Book at Walmart is ~$0.80 – 1.00). Get either the quad ruled 5x5 or lined. Do not use loose leaf or books of other sizes.

Evaluating Self and Group Peers

In order to practice interpersonal skills you will evaluate the contributions of you and your group partners to assignments. The kind of partner you are judged to be by your peers you will factor into your *Assignments* grade and has the potential to alter your grade up to half of a grade. There will be up to four people in each group. You will evaluate yourself and the others in your group regarding professional integrity. You may divide up the work, but each person should understand what everyone in the group is doing. Comprehension questions show up frequently on the exams. Unparticipating people who force the others in the group to take up their share of the work will not receive full credit for group assignments.

Wireless Policy:

Laptop and hand-held computers are fine tools for learning, but can easily become a great distraction. Don't allow the tool to become a disruption. I use TopHat, which will use your smart phones or laptops to do in-class quizzes. Please keep them charged and handy. Bring a laptop to laboratory for ease of reference.

Course Schedule and Considerations

The lecture portion of this course is divided into three sections according to exams. The laboratory portion will be divided mainly into two sections. I will provide more detailed learning objectives outside of the syllabus for each section. The following pages have a table of the expected timeline. I may have to alter this plan. Living organisms are often uncooperative. For the most up-to-date scheduling, please consult Canvas.

Plan to be flexible with your schedule. It can take time to see the interesting stages. Group work allows for the sharing of time commitments. Let me know if there are religious observances and interviews that we need to work around.

In this course, we will explore how organisms develop from a single cell – the fertilized egg. We will begin examining the event of fertilization and then progress chronologically through several important events in development coming back to the establishment of germ cells. Although I will include more detailed learning objectives for each section on Canvas, the following broadly describes some of the major topics to cover:

SECTION 1

Fertilization: What are the cellular and molecular mechanisms that occur during fertilization? How do eggs ensure that they are fertilized only once? What changes happen upon fertilization that initiate development?

Early development and gastrulation: How do fertilized eggs divide and arrange daughter cells into germ layers (blastula, gastrula and later stages)? How do cells accomplish the movements that drive gastrulation?

Development of Model organisms: How can the studies of different animals help us understand human development?

SECTION 2

Axis and cell fate specification: How do embryos distinguish their head from tail? Back from front? Left from right? Tip from stump? How is cell identity determined? What are morphogens, activators, inhibitors, signaling loops, and cell autonomy and cell non-autonomy?

Invertebrates and Vertebrates: How do flies, frogs, fish, mice, and humans establish initial germ layers? What tissues and organs derive from the primary layers? What are maternal and zygotic genes? What is an Organizer?

SECTION 3

Organogenesis: How do different cells of tissues combine and remodel to make organs (example: the brain and limbs)? How is early development studied?

Regeneration: How are developmental processes utilized in repair of lost or damaged tissue?

Specification: How is sex determined? What is known about gender determination? How do stem cells "decide" what part of the body they will organize? How do tissues take form during development?

Environment: What environmental factors influence development and in what ways?

For these topics, we will be focusing on the **genetic, molecular, and cellular influences** on these events. We will examine how genetic and non-genetic regulation informs cellular behaviors, which in turn drive the physiological changes that occur during development. Background reading (to be read before class) and class lectures will provide the knowledge base. Student presentations and "journal club" will give you an opportunity to explore current research conducted in these fields. Laboratory experiments will allow you to practice techniques used by successful scientists.

Schedule

	Day	Date	Topic	Emphasis	Chapter
1	W	22-Jan	Developmental Biology	Introduction	Chapter 1
	Th	23-Jan	**Introduction to the Laboratory**		
2	F	24-Jan	Urchins		Chapter 11
3	M	27-Jan	Fertilization	Urchins	Chapter 7
4	W	29-Jan	Fertilization	Gametes	Chapter 7
	Th	**30-Jan**	**Sea Urchin fertilization and early development**		
5	F	31-Jan	Fertilization	Fertilization	Chapter 7
6	M	3-Feb	Determination of Cell Fate	Pathways	Chapter 2
7	W	5-Feb	Cell-to-Cell Communication	Cell Adhesion	Chapter 4

	Day	Date	Topic	Emphasis	Chapter
	Th	**6-Feb**	**Sea Urchin experiment proposals and reflection - Turn in Labbook for Feedback**		
8	F	7-Feb	Cell-to-Cell Communication	Cell Signaling	Chapter 4
9	M	10-Feb	Journal Club (Sperm and axis)	Fertilization	Online post
			Exam 1		
10	**W**	12-Feb	**Pattern formation, Fertilization, Urchins**	**Chapters 1, 2, 4, 7, parts of 11**	
	Th	**13-Feb**	**Sea Urchin experiment**		
11	F	14-Feb	Review Exam 1 & Drosophila axis specification	Drosophila	Chapter 10
12	M	17-Feb	Drosophila segmentation	Drosophila tools	Chapter 10
13	W	19-Feb	Drosophila segmentation and genetic tools	Drosophila tools	Chapter 10
	Th	**20-Feb**	**Sea Urchin experiment (if needed)**	exchange for peer review of laboratory notebooks	
14	F	21-Feb	Amphibians	The Organizer	Chapter 12
15	M	24-Feb	Amphibians	Gastrulation	Chapter 12
	Tu	**25-Feb**	**Diversity Summit Feb 25**		
16	W	26-Feb	Amphibians and Fish	Neural Induction	Chapter 12
	Th	**27-Feb**	**Sea Urchin research presentations - Feedback**		
17	W	28-Feb	Chicken	Amniotes	Chapter 13
18	M	3-Mar	Chicken	Gastrulation and Germ Layers	Chapter 13
19	W	5-Mar	Mouse	Gastrulation and Comparisons	Chapter 13
	Th	**6-Mar**	**Zebrafish introduction and time to work**		
20	F	7-Mar	Mouse and mammals	Gastrulation and Comparison	Chapter 13
21	M	10-Mar	Ectoderm	Neurulation	Chapter 15
22	W	12-Mar	Ectoderm derivatives	Evaluate and Placodes	Chapter 18
	Th	**13-Mar**	**Zebrafish proposals, reflection, and primer design**		
23	F	14-Mar	Ectoderm derivatives	Placodes	Chapter 18
	17-21-Mar		**Spring Break**		
24	M	24-Mar	Journal Club (ectopic fly eyes)	Specification Mechanisms	Online post
			Exam 2		
25	W	26-Mar	**Gastrulation, Invertebrates, vertebrates, ectoderm**	**Chapters 10, 12, 13, 15, 18**	
	Th	**27-Mar**	**Zebrafish mRNA isolation and RT-PCR**		
26	F	28-Mar	Review Exam 2 OMDS introduction		
27	M	31-Mar	Neural Crest	Regionalization	Chapter 17

	Day	Date	Topic	Emphasis	Chapter
28	W	2-Apr	OMDS class time for work and reflection	Developmental Subject	
	Th	**3-Apr**	**Zebrafish subcloning**		
29	F	4-Apr	Neural Crest	Migration	Chapter 17
30	M	7-Apr	Paraxial Mesoderm	Somites	Chapter 19
31	W	9-Apr	Paraxial Mesoderm	Somitic Derivatives	Chapter 19
	Th	**10-Apr**	**Zebrafish gel analysis**		
32	F	11-Apr	Tetrapod limb	Hox genes	Chapter 21
33	M	14-Apr	Tetrapod limb	Patterning	Chapter 21
34	W	16-Apr	Regeneration	Model systems	Chapter 24
	Th	**17-Apr**	**Sequence analysis of fe cDNA**		
35	F	18-Apr	Regeneration	Adult Regeneration	Chapter 24
36	M	21-Apr	Zebrafish regeneration		Online post
	W	23-Apr	GREAT DAY - No class		
	Th	**24-Apr**	**Presentations Zebrafish and reflection - Start Planarians**		
38	F	25-Apr	OMDS class time for work	Sustainable Development	
39	M	28-Apr	Sex Determination		Chapter 6
40	W	30-Apr	Human Early Development (not on midterm 3)		Chapter 14
	Th	**1-May**	**Finish Planarians**		
41	F	2-May	Ectopic eyes Xenopus tadpoles	Regenerative potential	Online post
42	**M**	**5-May**	**Exam 3 Neural crest, Axial patterning, Limb development, Regeneration, Sex**	**Chapters 6, 17, 19, 21, 24**	
43	**W**	**7-May**	**Review - Lab Books - All labbook assignments etc. due by 9:30 am**		
	Th	**8-May**	**Reading Day**		
	Tu	**13-May**	**Final Exam 8 am**	**Comprehensive**	

Plagiarism:

Please refer to the material in the "Plagiarism" pages on Geneseo.edu library website, which describes various types of plagiarism. Assignments containing plagiarism (which includes paraphrasing) will receive no points.

Library Research Help:

If you need assistance finding external information for an assignment, Milne Librarians can help. You can speak with the reference librarian on duty between 10 am and closing time most days (ask for help at the service desk) or with a librarian online (https://library.geneseo.edu/research-help).

Technology Support

CIT provides a range of technology support resources. For assistance with your computer or mobile device, visit the CIT HelpDesk in Fraser. Geneseo students, faculty and staff have free access to the entire LinkedIn Learning training library (over 7,500 courses, including tutorials for software, digital tools, web development, programming, and design) through Geneseo's site license.

Accommodations:

I will make reasonable accommodations for persons with documented physical, emotional, or cognitive disabilities. Accommodations will be made for medical conditions related to pregnancy or parenting. Students with approved accommodations may submit a Semester Request to renew their academic accommodations. Please visit the OAS website for information on the process for requesting academic accommodations. Students should contact the Office of Disability Services in Erwin Hall 22 or 585-245-5112 or disabilityservices@geneseo.edu to discuss needed accommodations as early as possible in the semester.

Please meet with me about how I can work with you to make sure you can participate in the group tests and receive accommodations. “Things” happen sometimes that aren’t welcome. Please discuss any that arise in your life so we can work things out.