BIOL 354
Developmental Biology

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
- Analyze and discuss 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.
- Propose experiments to test hypotheses and interpret experimental data.
- Test hypotheses with self-designed experimentation.
- Relate discoveries from model animals to human conditions.
- Communicate findings orally and in writing.

Evaluation
The points from both the lecture and laboratory assignment portions of the course will be combined. The majority of the credit will come from lecture (~60%) with the remaining (~40%) from lab.

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

Midterm Exams  300 pts
Final Exam (comprehensive)  (100 pts optional as part of 600 pts)
Assignments (lab and class)  110 pts
Experiment proposals  20 pts
Written lab reports  50 pts
Experiment presentation  20 pts
Total  500 pts
Grading
The course is divided into two parts with unequal weight. About 60% of course credit comes in the course materials (i.e. readings). The remaining credit comes from the lecture assignments, journal clubs, laboratory assignments, and experiments. There may be assignments that overlap between lecture and laboratory. Rubrics for each assignment will be posted in the Google drive folder posted (URL is on myCourses). There is no extra credit offered to individuals. Any extra credit opportunities will be offered to the entire class.

Note on letters of recommendation: Many students ask for 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 good letter, make sure your work is impressive not merely passing.

Course materials
We will be using the 5th edition of Lewis Wolpert’s Principles of Development, ISBN: 0198709889. The exams will be based on the textbook, additional assigned readings, and lecture material. Because this is a course at the highest undergraduate level you will be expected to read before class. I recommend bringing the text to class and marking up the book, but will provide you a .ppt file of my lecture notes for download so you can print off figures of note.

Assignments
In-class activities, homework assignments, and quizzes will combine for your final grade. To receive points for in-class activities, you must be present at the beginning of the exercise. There are no make-ups for the in-class activities; however, you can miss one with no penalty. 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. Each group will submit one completed assignment, and each person’s initial answers. You will receive the group assignment grade if your individual assignment is complete and you attended the group meetings (see Evaluating group peers). Homework is due at the start of class on the due date (there will be a penalty for homework handed in late). In order to facilitate the photocopy and email return of homework, please follow these instructions. Homework must be written single-sided on clean, un wrinkled paper fastened with a paperclip (no staples). Double-sided, damaged, and/or stapled work will be graded, but not distributed to all group members.

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 need to purchase a laboratory notebook. Get either the quad ruled 5x5 or lined Investigative laboratory work will be evaluated in three stages. It is important that you bring a “laboratory notebook” to labs when you can record results, and write experiments and notes. I will look at your lab notes to make suggestions to help you improve and succeed. Make sure you bring all of your notes to lab each week. Some laboratories will be observational only, and therefore you will only be graded on the lab report. The notebook will be turned in at the end of the course.

You will be evaluated on three phases of experimentation. First, formulate and propose an experiment. Second, orally present your data in class. Third, submit a written lab report. Further instructions and a rubric will be posted on myCourses during the course of the semester.

Evaluating Group Peers.
In order to ensure that helpful lab/homework partners are recognized you will evaluate your peers at the end of the semester. This will factor into your Assignments grade and has the potential to alter your grade up to one half of a grade. There will be four people in each group. You will be given 30 points to distribute anonymously to the other members of the group. If each person did equal work, then you will assign each 10 points. If one person contributed more to the success of the group than another, the first would receive more than 10 points and the second less. I will not disclose your evaluations to the other group members.
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.

Course Schedule
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 time line. As living organisms are often uncooperative I reserve the right to alter this plan. For the most up-to-date scheduling, please consult myCourses.

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 myCourses, the following broadly describes some of the major topics that we will cover:

**SECTION 1**
**Specification:** How do cells decide what they will become and how they will organize. Cellular and genetic concepts will be combined. How do tissues acquire shape and form during development? How does the nervous system develop?

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

**Early development and gastrulation:** How do fertilized eggs develop into blastocyst stage embryos? How is gastrulation (establishment of the germ layers) initiated? How do cells accomplish the movements that drive gastrulation?

**SECTION 2**
**Development of Model organisms:** How does the studies of different animals complement each other?

**Axis and cell fate specification:** How do embryos specify their head from tail? Back from front? Left from right? Tip from stump? How do morphogens work? How is cell identity determined?

**Gastrulation in vertebrates:** How do frogs, fish, mice, and humans establish initial germ layers? What tissues and organs derive from the primary layers?

**SECTION 3**
**Organogenesis:** How do different 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?

**Sex determination:** How does the animal know to be male or female? What do we know about gender?

For these topics, we will be focusing on the genetic, molecular and cellular basis of 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.
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<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Topic</th>
<th>Emphasis</th>
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<td>Introduction to Developmental Biology</td>
<td>Introduction</td>
<td>Chapter 1</td>
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<td>Th</td>
<td>19-Jan</td>
<td><strong>Introduction to the Laboratory</strong></td>
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<td>2 F</td>
<td>20-Jan</td>
<td>Review Cell biology and Genetics</td>
<td>Urchins</td>
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<td>4 W</td>
<td>25-Jan</td>
<td>Fertilization</td>
<td>Gametes</td>
<td>Chapter 7</td>
<td>217-248</td>
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<td>Th</td>
<td>26-Jan</td>
<td><strong>Sea Urchin fertilization and early development</strong></td>
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<td>27-Jan</td>
<td>Fertilization</td>
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<td>7 W</td>
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<td>Cell-to-Cell Communication</td>
<td>Cell Adhesions</td>
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<td>Th</td>
<td>2-Feb</td>
<td><strong>Sea Urchin experiment proposals</strong></td>
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<td>8 F</td>
<td>3-Feb</td>
<td>Cell-to-Cell Communication</td>
<td>Drosophila</td>
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<td>9 M</td>
<td>6-Feb</td>
<td>Drosophila axis specification</td>
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<td>10 W</td>
<td>8-Feb</td>
<td>Journal Club (Sperm and axis)</td>
<td>Fertilization</td>
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<td>Th</td>
<td>9-Feb</td>
<td><strong>Sea Urchin experiment</strong></td>
<td>Exams 1 Pattern formation, Fertilization, Urchins</td>
<td>Chapters 1-4, 7, parts of 10</td>
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<td>11 F</td>
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<td>13-Feb</td>
<td>Exam 1 review &amp; Drosophila</td>
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<td>Fly genetic tools</td>
<td>Drosophila tools</td>
<td>Chapter 9</td>
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<td><strong>Sea Urchin experiment (if needed)</strong></td>
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<td>14 F</td>
<td>17-Feb</td>
<td>Nematodes</td>
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<td>16 W</td>
<td>22-Feb</td>
<td>Amphibians and Fish</td>
<td>The Organizer</td>
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<td><strong>Sea Urchin research presentations</strong></td>
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<td>Amphibians and Fish</td>
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<td>19 W</td>
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<td>20 F</td>
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<td>Mammals</td>
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<td>21 M</td>
<td>6-Mar</td>
<td>Mammals</td>
<td>Birds</td>
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<td>22 W</td>
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<td>25 W</td>
<td>22-Mar</td>
<td>Journal Club (ectopic eyes)</td>
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<td><strong>Zebrafish RT-PCR</strong></td>
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<td>26 F</td>
<td>24-Mar</td>
<td>Exam 2 Gastrulation, Invertebrates, vertebrates</td>
<td>Chapters 8, 9, 11, 12</td>
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27 M 27-Mar Review Exam 2
28 W 29-Mar Paraxial and Intermediate Mesoderm
**Th 30-Mar ** Zebrafish subcloning
29 F 31-Mar Ectoderm derivatives

30 M 3-Apr Ectoderm derivatives
31 W 5-Apr Paraxial Mesoderm
**Th 6-Apr ** Zebrafish gel analysis Drosophila observations
32 F 7-Apr Paraxial Mesoderm

33 M 10-Apr Tetrapod limb
34 W 12-Apr Limb axis formation
**Th 13-Apr ** Sequence analysis of fe cDNA
35 F 14-Apr Regeneration

36 M 17-Apr Ectopic eyes Xenopus tadpoles
37 W 19-Apr Zebrafish regeneration
**Th 20-Apr ** Presentations Zebrafish start Planarians
38 F 21-Apr Midterm 3

39 M 24-Apr Aging and Senescence
40 W 26-Apr Sex Determination
**Th 27-Apr ** Planarians finish
41 F 28-Apr TBA

42 M 1-May Sex Determination Lab Books Due
W 3-May Reading Day
F 5-May Laboratory reports and labbooks due 2 pm
**W 10-May ** Final Exam 8:00 am

**Plagiarism:**
Please refer to the material in the “Plagiarism” folder on myCourses, which describes various different types of plagiarism. Assignments containing plagiarism (which includes paraphrasing) will receive no points.

**Library Research Help:**
If you need assistance finding information for an assignment, Milne Librarians may be able to help. You can speak with the reference librarian on duty between 10am and closing time most days (ask for help at the service desk) or chat with a librarian online by clicking the "IM a Librarian" button on the library website ([http://www.geneseo.edu/library](http://www.geneseo.edu/library)).

You can also contact Milne Library's Science Librarian, Bonnie Swoger, by emailing her ([swoger@geneseo.edu](mailto:swoger@geneseo.edu)) or requesting an in-person meeting ([http://bit.ly/milneresearchconsultation](http://bit.ly/milneresearchconsultation)).

**Accommodations:**
SUNY Geneseo 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 should contact Dean Buggie-Hunt in the Office of Disability Services ([tbuggieh@geneseo.edu](mailto:tbuggieh@geneseo.edu) or 585-245-5112) and their faculty to discuss needed accommodations as early as possible in the semester.

Developmental Biology 354  
Spring 2017