**Developmental Biology, BIO 302**  
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Smith College, Northampton, MA.

**Goals:**  
Developmental Biology is a synergy of nearly all the biological disciplines serving to address the big question of why we are the way we are. The main focus of this course is to gain a global perspective of Development as a synthesis of gene regulation, molecular signal transduction, cellular architecture, cell behavior, and tissue morphogenesis. With this global perspective in mind, this course should prepare students to think critically about what is currently accepted and unknown in the field of biology. Students will learn key concepts in development from fertilization to cloning that will provide the foundation for those destined for careers in research and medicine or those who wish to become conscious citizens of the science based issues facing today’s society. To encourage students to think critically and develop their communication skills on several levels, they be immersed in the analysis of primary literature, required to present one article during class, and construct a research grant proposal.

**Instructor Information:**  
Michael J.F. Barresi, Ph.D.  
Associate Professor,  
Neuro-Developmental Biologist (Vertebrate Brain Development)  
Biology Department  
Sabin-Reed 401A (inside my lab (401))  
Phone: 413-585-3697  
Email: mbarresi@smith.edu  
Office Hours: Tuesday 1:30 – 3:30 and by appointment.

**Course Construction:**  
This course is broken into 5 main Units with each unit consisting of around 6-9 class meetings. A unit is focused on a particular key concept in the field of developmental biology. Specific unit themes are listed below. There will be an exam after every two units and all exams are “take-home”, semi-cumulative exams.

**Text:** Principle material for this course will come from the Eleventh Edition of *Developmental Biology* by Scott Gilbert and Michael Barresi. Note: this edition is unique and past editions are not advised for use in this course. Additionally, each unit will also be accompanied with review articles and original research articles made available from our moodle site prior to each schedule unit.

**Unit Themes:**  
1. In the Beginning: Specification, Stem Cells, and Sex.  
2. Early Development and Axis Determination  
3. Neural Tube Formation and Nervous System Patterning  
4. A/P patterning and Trunk Development (Somite and Limb Development)  
5. Evolution, Ecology and Development

**Assessment:**  
3 Exams:  
1st exam 50pts; 2nd and 3rd exam 80pts each = 210 points (35%)  
*Case Study Notes can be submitted to add value to final exam grades for that unit.*  
Grant proposal  
200 points (33.3%)  
Grant peer review  
30 points (5%)  
1 Oral presentation  
100 points (16.7%)  
Presentation Questions  
60 points (10 pts each) (10%)  
Total points = 600
**Exams:** The 3 exams will be designed to assess how well you can use the learned content to conceptually solve a novel problem in developmental biology. The main purpose of these exams is to highlight important concepts and challenge you to think and solve problems like a developmental biologist. While these exams largely focused on the current unit topic, they will be cumulative as the information naturally builds upon itself. All exams are “take-home” exams. Feel free to use your book or any other resources, the answers to these exam questions cannot be found anywhere. I will be assessing your logic and understanding of the concepts in developmental biology being used to justify your proposed ideas. **You are not allowed to work with any other individual on these exams.** Honor code will be enforced should violations to this rule are determined.

No early, late or make up exams will be offered, except in health related situations. In order to accommodate the uncontrollable illnesses and challenging schedules these exams will be made available for multiple days via our moodle site as downloadable MSWord Docs. Completed exams are to be emailed to mbarresi@smith.edu with the subject identifier of “exam1”, “exam2”, or “exam3”. The only file type accepted for a completed exam is in PDF format.

On a personal note, I have tried many different types of exam formats in the past, and this take-home form is by far the most informative to a student’s ability to work with the knowledge of the field. There is a lot of detailed information we cover, and this form helps lower student stress from having to memorize painful facts they would never possibly retain in the long-run. Lastly, the ability to infuse creativity into these exams makes them a lot of intellectual fun – you’ll have to trust me on that one!

**Midterm or Final Exam:** There are no designated midterm or final exams! The third and “final” exam will be given during the semester. The first of the three exam will be the same format, but valued at a lower percentage as to soften any adjustments necessary in taking this type of exam style.

**Case Study Notes:** There will be random class periods when we conduct a case study activity. For some of these I will be handing out a worksheet. Students can submit these for added credit toward a final exam grade. Case study notes can only be applied to the exam of the same unit they pertain to.

**Oral presentation:** There will be 1 presentations for each unit. Several students will work together to organized a Powerpoint presentation of the designated articles for that Unit. Students will prioritize the units they are interested in presenting articles from, and I will assign articles that are as close to your first choice as possible. I select the research articles to be presented in each Unit. Students are highly advised to attend a workshop I will hold to cover some of the key features to effective presentations of scientific material. Students should plan to present for no more than 30 minutes including time for questions – and there will be many!

**Grant Proposal:** Individual students will prepare a grant “pre-proposal” according to Biological directorate at the National Science Foundation. Throughout this course students will learn much of the current knowledge that exists to explain how a single celled embryo can develop into an adult organism. For every proposed model of embryonic development new questions emerge. The challenge for Developmental Biologists is to devise answerable questions to further our understanding of the genetic, molecular, and cellular processes controlling development. Students will be asked to generate several possible proposal ideas that will get refined into tractable “Aims”. To complete this writing assignment students will devise a hypothesis to explain an unknown aspect of development, come up with experiments to test this hypothesis, and suggest what the possible outcomes are of those experiments. This is a very significant portion of your final grade. Only the final product will be graded, however there are several dates suggested for successive versions of your proposal to be submitted for feedback. I will only accept versions of your proposal on those prescribed dates. The only mandatory date you must participate in is the Peer Review Exchange (which is graded). Further details about grant structure and expectations will be provided elsewhere.

**Paper Questions:** All students are required to read the research articles being presented by their classmates and come to class prepared with questions to engage in a discussion of the articles. Prior to a scheduled presentation,
ALL students are required to submit 3 critical questions or comments about the article and/or field for a given unit. I will look over these questions and some of them will be selected for a special Q&A at the end of the presentation. For some units we will be joined by the lead investigator from the article to participate in the Q&A session at the end of class. This is a rare experience in which video conferencing will actually bring these highly respected scientists into our classroom. They will add a very personal perspective of the work to our discussion enabling us to ask questions that we would otherwise never be able to address on our own. Because this addition to the class requires taking these video visitors precious time, students must take reading these articles and generating critical questions very, very seriously. These will be graded (10% of grade) based on the timely submission and quality of questions. When assessing these questions I will ask whether they suggest you have thoroughly analyzed and contemplated the researcher’s objectives, experimental design, and conclusions of results and how they impact the field (relating it to unit content).

Why conduct these web conferences? I have determined that these web conferences not only encourage students to more thoroughly read and critically think about the research, but they help student truly become part of the actual dialog occurring between scientists in the field. We will push the knowledge of these varied topics in Developmental Biology as far as they can possibly go, to the point where even the experts don’t know the answers. Only then can one feel they have a grounded grasp of the content as it currently exists and what the next steps in the field may be. I openly admit that while some students may feel speaking with these extremely prominent scientists can be intimidating, it will foster the breaking down of many misconceptions of scientists and provide you the opportunity to develop your self-confidence to find your voice and become part of the scientific community. Lastly, it is super fun and exciting too!

Extra Credit:
1. “Stump the Scientist”. There is a constant opportunity for students to gain extra credit. If a question arises during class that the instructor cannot immediately answer, then the student may do a literature search on the topic and give a 2 min. presentation on the topic at the beginning of the next available class. Determination of whether the topic merits investigation and whether it is suitable for extra credit requires approval by the instructor. The maximum extra credit per presentation is 6 points, with a maximum of 12pts per unit. The availability of this type of extra credit encourages students to be interactive during class and to delve deeper into the subject matter outside of class.
2. In addition, certain seminars that cover material related to Developmental Biology may also be considered for extra credit. Attending and writing a one-paragraph summary of the seminar’s main points can provide up to 5 points toward your final grade. Must be submitted within 7 days of scheduled talk. There are many suitable talks offered at Smith or one of the other Five Colleges.

Late work: Penalties will be given for any assignment handed in after the end of class on the listed due date. 5% will be deducted from the final grade of that assignment for each day late. (5min after the class period 5% will be deducted. After the next 24h another 5% will be deducted. An additional 10% will be deducted for every day thereafter.

Special Accommodations: Any student requiring additional preliverages during and out of class must provide formal written documentation of the requested accommodations. It should be noted that most of the approaches I take (unlimited time on exams, recorded lectures, etc) often make these request unnecessary. But obviously feel free to provide me any information so that I can best tailor this class to meet your learning objectives.
### 1. In the Beginning: Specification; Stem Cells; & Sex

<table>
<thead>
<tr>
<th>Date</th>
<th>Introduction</th>
<th>Required Readings</th>
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<tbody>
<tr>
<td>September 8</td>
<td><em>Introduction to Developmental Biology, From Fertilization to Evolutionary Adaptations</em>&lt;br&gt;Required Readings: Making new bodies, Chapter 1. Emphasis on Axes and Lifecycle.</td>
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<tr>
<td>September 13</td>
<td><em>Foundational Developmental Concepts Part 1: Cell Differentiation and Cell Communication</em>&lt;br&gt;Required Readings: Must have already watched Dev Tutorial entitled: Cell Specification Chapters 1, 2, 3, 4</td>
<td>Must have already watched Dev Tutorial entitled: Cell Specification Chapters 1, 2, 3, 4</td>
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<tr>
<td>September 15</td>
<td><em>Foundational Developmental Concepts Part 2: Part 1 - Cell Differentiation; Part 2 - Cell Communication</em>&lt;br&gt;Required Readings: Must have already watched Dev Tutorial entitled: Cell Specification Chapters 1, 2, 3, 4</td>
<td>Submit 3 questions regarding one or more developmental processes of interest. This is the first step toward “developing” your grant idea.</td>
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<td>September 19</td>
<td><em>Life Sciences Colloquium. Ruth Johnson, Shaping tissues and organs</em> 4:00 McConnell 103</td>
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<td>September 22</td>
<td><em>Stem Cells continued: ESC, Adult Cells and the Stem Cell Niche.</em>&lt;br&gt;Required Readings: Must have already watched Dev Tutorial entitled: Stem Cells Ch 5&lt;br&gt;-Suggested to Watch: BIO323: Stem Cell Documentaries: Embryonic SC (10); Adult SC (10); Regenerative Medicine (11); Modeling human disease (12).</td>
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**Due Today as Email**<br>Submit 2 questions on article scheduled on Sept 19 by 5PM; (subject: Johnson questions)
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<tr>
<th>Date</th>
<th>Activity</th>
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<tbody>
<tr>
<td>October 11</td>
<td>NO CLASS – FALL BREAK</td>
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<tr>
<td>October 13</td>
<td>Fertilization, Cleavages, and the Midblastula transition.</td>
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<tr>
<td>Required Readings</td>
<td>-Must have already watched Dev Tutorial entitled: Find it. Move it, Lose it. (actually about fertilization)</td>
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<td></td>
<td>Fertilization Ch 7: Maternal RNA Cleavage Ch 3, p80-83</td>
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<td></td>
<td>-Lecture support-</td>
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<tr>
<td>Assignment</td>
<td>Generate 3 AIMS to show me at a multi-student meeting on Friday Oct 14th.</td>
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<tr>
<td>Required Readings</td>
<td>Early Dev p 265-272; 311-326; Ch 11: 382-399.</td>
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<td>October 20</td>
<td>Molecular Regulation of Gastrulation</td>
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<tr>
<td>Required Readings</td>
<td>Nothing new.</td>
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<td>October 25</td>
<td>Axis Determination: Defining the organizer.</td>
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<tr>
<td>Required Readings</td>
<td>-Must have already watched Barresi Morphogens in Axis Specification Devi Dorial</td>
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<tr>
<td>October 27</td>
<td>Molecular Regulation of D/V Axis Specification - From Cortical Rotation to Mesoderm Induction</td>
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<tr>
<td>Assignment</td>
<td>Grant Outline Due Oct 27: by start of class – Submit by email – subject: grant outline</td>
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<tr>
<td>November 1</td>
<td>Extra Class Period for flexibility.</td>
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<tr>
<td>Due Tue Nov 1</td>
<td>3 questions regarding posted Articles for presentation no later than 5PM Subject: Mullins Questions</td>
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<tr>
<td>November 3</td>
<td>Paper Presentation: From Mom to Morphogenesis. Web conference with Dr. Mary Mullins</td>
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<td></td>
<td>SUPPORTIVE ARTICLES:</td>
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<tr>
<td>November 8</td>
<td>2nd Induction: Neurulation, NT Closure, and NT patterning.</td>
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<tr>
<td>Required Readings</td>
<td>-Must have already watched Devi Dorial on Neurulation</td>
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<tr>
<td>November 10</td>
<td>NT Patterning (and maybe... Cortex Development).</td>
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<tr>
<td>Required Readings</td>
<td>Neural Tube formation and Patterning Ch 13.</td>
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<td>November 15</td>
<td>Development of the Neural Crest Fates and the pattern of Axon Connections</td>
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<tr>
<td>Required Readings</td>
<td>-Must have already watched Devi Dorial on Neural Crest Development</td>
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<tr>
<td>November 17</td>
<td>Paper Presentation: Neural crest and collective migration (Request for Web con with Dr. Mayor)</td>
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<tr>
<td>Required Readings</td>
<td>Research Article (for which presentation is largely based):</td>
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<td>Supportive Review Articles (Required – read 1 of your choice; Recommended – read 3 of your choice.</td>
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<tr>
<td>Date</td>
<td>Assignment</td>
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<tr>
<td>November 22</td>
<td>Required Readings: Paraxial Mesoderm Ch 17</td>
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<tr>
<td>November 27</td>
<td>NO CLASS - - THANKSGIVING RECESS</td>
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<tr>
<td>November 29</td>
<td>Required Readings: -Must have already watched Devidetorial on Somitogenesis</td>
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<tr>
<td>December 1</td>
<td>Required Readings: -Must have already watched Devidetorial on Limb Development (if available)</td>
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<tr>
<td>Assignment DUE Thursday Dec 1</td>
<td>Peer Review Exchange (BRING TWO HARD COPIES OF YOUR GRANT WITH NO NAME – THESE SHOULD BE PROVIDED IN A LARGE ENVELOPE WITH YOUR NAME ON THE FOLDER). Bring to class. Come to my research lab (SR401) to pick up your folder outside lab anytime after 2PM</td>
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<tr>
<td>Due Sun Dec 4</td>
<td>3 questions regarding posted Articles for presentation no later than 5PM. Subject: Marcelle questions</td>
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<tr>
<td>December 8</td>
<td>Required Readings: -Research: Evo- and Eco-Devo Introduction and Key Concepts</td>
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<tr>
<td>Due Sun Dec 11</td>
<td>Email 3 questions regarding posted Articles no later than 5PM. Subject: Sears questions</td>
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<tr>
<td>Assignment Due Thursday Dec 8</td>
<td>Peer Review Return (RETURN YOUR EDITED GRANTS IN YOUR FOLDER TO MY MAILBOX OUTSIDE MY RESEARCH LAB NO LATER THEN 10AM. COME BACK TO PICK UP YOUR FOLDER ANYTIME AFTER 5PM)</td>
</tr>
<tr>
<td>Assignment Due Dec. 13 by 5PM</td>
<td>Final Grant Submission. Email one PDF file with your GRANT NAME on it. (sub: Final Grant)</td>
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### Exam 3

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<thead>
<tr>
<th><strong>Exam 3</strong></th>
<th><strong>Take HOME EXAM - FROM FRIDAY DEC 15th TO DEC 20 by 11:59PM</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Dec. 15</strong></td>
<td><strong>Grant Panel Discussions and Priority Scoring.</strong></td>
</tr>
<tr>
<td><strong>Extended Class</strong></td>
<td><strong>Complete a Review and Scoring Sheet for your primary and secondary grant applications. (Expect the final copy of your primary and secondary grants to be emailed to you on Dec 13th.</strong></td>
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<tr>
<td><strong>(lunch provided)</strong></td>
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