OUTLINE

This course examines fundamental mechanisms underlying development, from an embryological and molecular genetic point of view. Besides class material presented by the course instructor (Dr. Campos), we have also invited Dr. Gupta (Biology), Dr. Wilson (Biology), Dr. West-Mays (Pathology), Dr. Gillespie (Psychology) and Dr. Dworkin (Biology) to showcase their research programme. Lecture material will be complemented by laboratory demonstrations, research papers and videos posted to Avenue. The first part of the course will focus on early development using three classical model systems (sea urchins, chicks and flies). We will begin by examining how pattern and identity is established in early embryogenesis by discussing classical experiments and the role of model organisms. The second part of the course will examine specific processes underlying cellular diversity and morphogenesis and the role of environment in shaping developmental processes. The laboratory modules will employ the model organisms, *C. elegans*, Hydra, Zebrafish and mouse. We will explore how cells acquire their fate, and build the intricate morphology of the maturing embryo and the adult form. We will discuss the role of genes and environmental factors in developmental pathways in the context of research conducted at McMaster University. Throughout this course experimental evidence supporting the concepts under study will be emphasized. Students are expected to be familiar with experimental design. The course provides an opportunity to improve scientific literacy.

PREREQUISITES
BIOLOGY 2B03 (or ISCI 2A18), BIOLOGY 2C03 OR MOL BIO 2C03

INSTRUCTOR
Dr. Ana Campos
LSB 541, Ext. 23095
camposa@mcmaster.ca

INSTRUCTIONAL ASSISTANT
Mr. Ryan Belowitz
LSB 106/119, Ext. 24241
belowir@mcmaster.ca (do not email me through avenue)

OFFICE HOURS
For questions related to course content please make an appointment by email with Dr. Campos or contact the professor in class. For administrative questions (lab conflicts etc.) please contact Mr. Ryan Belowitz.

LAB DEMONSTRATORS
Siavash (Scott) Amon  Meryl Acker
LSB 322, Ext. 23594  LSB 420, Ext. 27991
amons@mcmaster.ca  ackermeryl@gmail.com

LECTURES
Monday and Wednesday 11:30 – 12:20 in ABB 136
LABORATORY SECTIONS
Tuesday and Wednesday, 14:30 – 17:20 p.m. in LSB 104/105
Note: You may be required to return to the lab outside of these hours to take pictures or perform other tasks.

READING MATERIAL
Textbook: Gilbert, Developmental Biology, either 9th edition or the latest 10th edition is highly recommended. It can be purchased from the McMaster bookstore or directly from the publisher (Sinauer). In addition to standard hard-bound format, you may be able to purchase Looseleaf (binder ready) or subscribe for 180 days to a eBook format (the cheapest version). Relevant videos, research papers and reviews will be uploaded on Avenue.

LABORATORY MANUAL
Laboratory handouts will be available on Avenue to Learn.

STATEMENT FROM (AREB) REGARDING THE USE OF ANIMALS IN LAB
Some of the labs involve the use of animals for teaching purposes. These labs have been reviewed and approved by McMaster University’s Animal Research Ethics Board (AREB). AREB is responsible for ensuring appropriate procurement, care and use of animals for research or teaching at all McMaster University affiliated Animal Facilities and Laboratories, including those located at Hamilton teaching hospitals under its jurisdiction. AREB follows guidelines and policy statements established by the Canadian Council on Animal Care (CCAC), and legislation as presented in the Animals for Research Act, Ontario (1980) and administered by the Ontario Ministry of Agriculture and Food and Rural Affairs (OMAFRA). The Board ensures that procedures commensurate with current veterinary standards outlined by the Canadian Association of Laboratory Animal Medicine to ensure that:

- Unnecessary pain or distress is avoided, and animal stress and injuries are avoided, whether during transfers of animals or in their normal quarters;
- Anaesthesia and analgesia are properly and effectively used;
- Appropriate post-operative care is provided;
- All due consideration is given to animal welfare, including environmental enrichment; and
- Animal users and teaching assistants are properly trained and experienced in animal handling and procedures.

IMPORTANT NOTE:
This course involves mandatory laboratory exercises (attendance will be taken) involving the use of animals. In some of the exercises, animals will be killed (painless) either as part of the experiment, or to provide tissues for the experiment. IF YOU HAVE OBJECTIONS TO ANY OF THESE PROCEDURES, YOU SHOULD NOT TAKE THIS COURSE.

EVALUATION
25% - Midterm I (Jan 27, in class)
25% - Midterm II (March 2, in class)
30% - Midterm III (TBA )
20% - Laboratory Component
   Mini Reports 1-3: Sea Urchin, Chick, and Zebrafish Labs (2% each)
   Lab Report: Drosophila Lab (3%)
   Mini Research Project 1: C elegans Lab (4%)
   Mini Research Project 2: Hydra Lab (5%)
   Assignment: Covering guest lectures by Dr. Dworkin and Dr. Ratcliff (2%)
MSAF POLICY:
In the event of an absence for medical or other reasons, students should review and follow the
Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term
Work”.

Please note these regulations have changed beginning Fall 2015, most notably:
  • The timeframe within which the MSAF is valid has been reduced from 5 days to 3 days.
  • The upper limit for which an MSAF can be submitted has been reduced from ‘less than 30%’ to ‘less than 25%’ of the course weight.

The entire MSAF policy is available in the Undergraduate Calendar 2015-16 (Fall/Winter) > General
Academic Regulations > Requests for Relief for Missed Academic Term work.
Please review the entire policy prior to submitting any requests.

When using the MSAF, report your absence to the Instructional Assistant (Ryan Belowitz)
immediately (normally within two working days) by email (belowir@mcmaster.ca). This form should
be filled out immediately when you are about to return to class after your absence.
It is the prerogative of the instructor of the course to determine the appropriate relief for
missed term work.

GRADES
Grades will be converted according to the scheme used at McMaster University.

<table>
<thead>
<tr>
<th>90-100%</th>
<th>A+</th>
<th>12</th>
<th>63-66%</th>
<th>C</th>
<th>5</th>
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<tr>
<td>85-89%</td>
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<td>11</td>
<td>60-62%</td>
<td>C-</td>
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<tr>
<td>80-84%</td>
<td>A-</td>
<td>10</td>
<td>57-59%</td>
<td>D+</td>
<td>3</td>
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<td>77-79%</td>
<td>B+</td>
<td>9</td>
<td>53-56%</td>
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<td>73-76%</td>
<td>B</td>
<td>8</td>
<td>50-52%</td>
<td>D-</td>
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<td>70-72%</td>
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<td>67-69%</td>
<td>C+</td>
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ACADEMIC DISHONESTY
You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process.
Academic credentials you earn are rooted in principles of honesty and academic integrity. Academic
dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic
credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an
assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for
academic dishonesty”), and/or suspension or expulsion from the university. It is your responsibility to
understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at http://www.mcmaster.ca/academicintegrity.

The following illustrates only three forms of academic dishonesty:
1. Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
2. Improper collaboration in group work. While we encourage you to work with your peers in solving problems on your assignments, copying of answers is not acceptable. Your final work must be your own.
3. Copying or using unauthorized aids in tests and examinations.

CHANGES TO THE COURSE OUTLINE
At certain points in the course it may make good sense to modify the schedule outlined. The instructor reserves the right to modify elements of the course and will notify students accordingly, both in class and on Avenue to Learn. Posted changes take precedence over this course outline. The University may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course website (Avenue) regularly during the term and to note any changes.
# Course Schedule*

## Part I – The developmental biology landscape

**Learning objectives:**

1. Examination of early events underlying the development of an organism from a single cell
2. Survey of model organisms employed in developmental biology
3. Discussion of the concepts of differentiation, commitment, (conditional) specification and determination, lineage-dependent mosaic development versus regulatory development, morphogens (conceptual and empirical definition)
4. Review of tools employed in molecular genetic analysis of development

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture (Lab)</th>
<th>Lab Topic</th>
<th>Lecture Topics</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan 06</td>
<td>No Lab</td>
<td>Introduction to Developmental Biology</td>
<td>Dr. Campos</td>
</tr>
<tr>
<td>2</td>
<td>Jan 11, 13 (Jan 12, 13)</td>
<td>Intro Lab</td>
<td>Fertilization and role of maternal determinants in early embryonic development</td>
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<tr>
<td>3</td>
<td>Jan 18, 20 (Jan 19, 20)</td>
<td>Sea urchin</td>
<td>Fate maps, specification and gene regulatory networks: How to be a good enough mom</td>
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<tr>
<td>4</td>
<td>Jan 25, 27 (Jan 26, 27) <strong>Midterm I Jan 27 in class</strong></td>
<td>Chick</td>
<td>Gastrulation and the formation of the three-layered embryo. The role of the organizer and induction in the establishment of major axis and neural fate specification</td>
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<tr>
<td>5</td>
<td>Feb 1, 3 (Feb 2,3)</td>
<td><em>Drosophila I</em></td>
<td>Genetic analysis of development: tools and model organisms Drosophila segmentation and pattern formation</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Feb 8, 10 (Feb 9, 10)</td>
<td><em>Drosophila II</em></td>
<td>Drosophila segmentation and pattern formation</td>
<td></td>
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<tr>
<td>7</td>
<td>NONE Feb15-19</td>
<td>MIDTERM RECESS</td>
<td>Reading week- no classes</td>
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</table>
# Part II-TOPICS IN DEVELOPMENTAL BIOLOGY

**Learning objectives:**
1. Examination of specific developmental processes from the mechanistic point of view
2. Critical analysis of experimental design and evidence
3. Understanding and applying the concept of “find it-move it-lose it” and the difference between correlative and functional evidence
4. Exposure to research programs from McMaster University

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topic</th>
<th>Discussion</th>
<th>Instructor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Feb 22, 24 (Feb 23, 24)</td>
<td><strong>C.elegans I</strong></td>
<td>C.elegans as a model organism to study cell lineage. “Genetic Analysis of vulval development in C. elegans”</td>
<td>Dr. Gupta</td>
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<tr>
<td>9</td>
<td>Feb 29, Mar 2 (Mar 1, 2) Midterm II Mar 2 in class</td>
<td><strong>C.elegans II</strong></td>
<td>Nervous system development: generation of cell diversity</td>
<td>Dr. Campos</td>
</tr>
<tr>
<td>10</td>
<td>Mar 7, 9 (Mar 8, 9)</td>
<td><strong>Mouse (Hydra lab prep)</strong></td>
<td>“Vertebrate lens development”</td>
<td>Dr. West-Mays</td>
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<tr>
<td>11</td>
<td>Mar 14, 16 (Mar 15, 16)</td>
<td><strong>Hydra I</strong></td>
<td>Ecological developmental biology/ Developmental biology informs environmental science Regeneration and the stem cell concept</td>
<td>Dr. Campos</td>
</tr>
<tr>
<td>12</td>
<td>Mar 21, 23 (Mar 22, 23)</td>
<td><strong>Hydra II</strong></td>
<td>“Effect of environmental contaminants on aquatic species” (Dr. Wilson’s research) March 21</td>
<td>Dr. Wilson Dr. Campos</td>
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<td>13</td>
<td>Mar 28, 30 (Mar 29, 30) Midterm III TBA</td>
<td>Left over Hydra?/Zebr afish</td>
<td>&quot;Neural activity and developmental refinement of topographic maps&quot;</td>
<td>Dr. Gillespie</td>
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<tr>
<td>14</td>
<td>Apr 4, 6 (Apr 5, 6)</td>
<td>No lab</td>
<td>Role of microbiome on gut development Evo-Devo</td>
<td>Dr. Ratcliff Dr. Dworkin</td>
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* May be subject to change without prior notice at the instructor’s discretion
**Chapters refer to the 10th edition of the course text.
*** Due to the nature of labs involving live animals, sometimes the laboratory schedule does not go as planned. We may have to try some experiments and demonstrations again during the “no lab” weeks. We will notify you if that is the case.