Biology 376 – Animal Development – Fall 2017

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Lecture: Mon/Wed/Fri, 9:05 – 10:00, OH128 Lab: Wednesday, 2:30 - 6:30, SCST 330

Office Hours: Mon 10–11 AM, Tues 8-10 AM, 2:30-3:30 PM, Thurs 11-12 AM, or by appointment. Email is typically an good way to get a quick response to a question – although it is no substitute for one-on-one help with discussion in my office.

Course Home Page: **home.sandiego.edu/~cloer/bio376.html**
This is a good place to check for announcements and handouts. All lab handouts, lecture outlines and slides (in note-taking format), and non-text readings can be found here.

Main text (required) - *Developmental Biology,* 11th Edition. Authors – Gilbert & Barresi. Sinauer Associates, ©2016. (Textbook Home Page: www.devbio.com)

Books for laboratory (recommended) -
Atlas of Descriptive Embryology, 8th Ed., Mathews & Schoenwolf. Macmillan/Collier, 2006.
Student Handbook for Writing in Biology, 3rd Ed., Kinsely. W. H. Freeman Co., 2009 - this is the official writing manual for the Biology Department (so you should have a copy).
See the laboratory syllabus for information on additional lab supplies.

Goals of the Course

Students will learn patterns and mechanisms of animal development, with an emphasis on model organisms such as *C. elegans*, *Drosophila*, *Xenopus*, chick and mouse. A central theme will be development as a phenomenon of differential gene regulation. Stages of embryogenesis, morphogenesis, pattern formation and differentiation of developing organisms will be examined. Developmental mechanisms, especially at a molecular level, will be examined for differences and commonality among organisms, with a special focus on two specific signaling pathways: Wnt and RTK signaling. The relationships between developmental mechanisms and the molecular-genetic basis of human disease will also be examined and discussed.

At the end of Biology 376, a student should be able to:
* List and explain the principle features of animal development; compare and contrast these developmental stages in various organisms.
* Identify the three classical germ layers, understand how they arise and contribute to embryonic organization; explain conserved molecular mechanisms for their generation.
* Visualize embryonic development of selected organisms in four dimensions, from fertilization through early organogenesis; relate embryonic structure to cell/tissue interactions and mechanisms of cell/tissue specification.
* Explain how key historical experiments in developmental biology shape our current understanding of developmental events, mechanisms and evolution.
* Design an experiment to evaluate the role of a molecular component in a specific developmental decision, and critically analyze the results of such an experiment.
* Explain the components and functions of key molecular genetic and signaling pathways (especially RTK and Wnt), how they work to determine cell fate in selected organisms, and how their dysfunction causes human disease and malformation; use these understandings to hypothesize the function of conserved components in other organisms.
* Apply developmental principles to analyze and present current primary literature in the field, and integrate this new knowledge into the broader field.
* Consider the role of developmental biology in biomedical ethics and policies.

Course Mechanics

Attendance at all lectures is **strongly recommended**, but not required, except as noted below. If attendance appears to be lagging, however, I may begin taking attendance. Students who miss more than a few lectures often do poorly in class; such students will find little

sympathy for their plight. For any missed lecture, a student should consult a fellow student for notes; all lecture slides and outlines will be available online. Please note that attendance at class presentations /discussions and 'active learning' activities is **required**. There will be two group presentations earlier in the semester. Later in the semester, four sessions for individual literature presentations are scheduled during the Wednesday lecture time beginning in November. Attendance at any guest lectures during the semester is also **required**.

Missed quizzes, tests, presentations, laboratories, and other major class activities may be made up only for excused absences (e.g., serious illness). Students must inform the instructor of the reason for their absence as soon as possible by email or telephone; ideally, immediately prior to an anticipated absence (in the case of illness). Except in extraordinary circumstances, request for an excused absence must be made within 1-2 days after the absence (again, as soon as possible). Note also that grades on any assignments turned in late may be severely reduced except for excused absences.

Attendance at all laboratory sessions is **required**. If you miss a lab for an excused absence, you may have an opportunity to make it up later; however, if that lab session uses living material or requires a substantial lab preparation, this may be impossible or impractical. Some other form of makeup may be arranged.

Tests and Grading

There will be two hourly tests during the semester covering the material in lectures preceding them. The final exam will cover mainly previously untested material (essentially a third hourly test, although some material is cumulative by nature). The lab portion of the class will be 25% of your final grade (see the lab syllabus for more specifics). Class presentations and discussion participation on primary literature will count for a total of 14%. Work done for the class home page will count for 1% of your grade. More details will follow on class presentations and home page work. **Note that adjustments to grading percentages may be required if assignments are altered.** For breakdown on lab grade, see the syllabus in the lab manual.

Tests will emphasize lecture material. Assigned readings contain more material than will be covered in lecture. The quality of your writing on exams is important. Your answer to a question must be clear (and legible) to be correct. Spelling must also be correct, especially of new words you are adding to your biological vocabulary.

Grading Summary:

<table>
<tr><td>1st hourly test</td><td>20%</td><td>Class presentations</td><td>12%</td></tr>
<tr><td>2nd hourly test</td><td>20%</td><td rowspan="2">Discussion participation/reviewing, attendance at required events</td><td rowspan="2">2%</td></tr>
<tr><td>Final (3rd hourly)</td><td>20%</td></tr>
<tr><td>Lab</td><td>25%</td><td>'Read More About It' web page, etc.</td><td>1%</td></tr>
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Academic Integrity

Copying of any material from current or former Biology 376 students is plagiarism and will not be tolerated. Do your own work and demand that others do theirs. Take similar care in your use of material from the class lab handouts and the textbook. All portions of lab reports and papers are expected to reflect ONLY your own work and your own writing. When working in groups, each member of the group is expected to synthesize the information, analyze data and prepare an individual report. If you use literature in your report, cite it appropriately. [For example, copying sentences from the book, followed by a parenthetical citation (Gilbert, 2016), is plagiarism.] **Be sure you understand what constitutes plagiarism.** If you have any questions about this, or any other item related to academic integrity, please ask. USD Academic Integrity policy will be strictly enforced. Please see the lab syllabus for further discussion of plagiarism.

Lecture Schedule Readings from Gilbert & Barresi, *Developmental Biology*, 11th ed., © 2016; or as indicated otherwise.

Sept. 6 (W)	Introduction to animal development. Review of syllabus; course mechanics. 'Principle features of development.' Questions & approaches of developmental biology. Reading: pp. 1–28 (Chapter 1), pp. 45-47 (diff. gene expr./central dogma).
Sept. 8 (F)	Cell signaling, signal transduction Reading: pp. 108-113, 116-120 (RTK signaling), 125-128, 131 (Wnt signaling), esp. Figs. 4.24, 4.26, 4.34, 4.37 (in Chapter 4).
Sept. 11 (M)	Types of cell specification. Induction at single cell resolution: *C. elegans* vulva. Reading: pp. 29-41 (Chapter 2), 138-139 [Most *C. elegans* info not in text.]
Sept. 13 (W)	Differential cell adhesion & cadherins, extracellular matrix and ECM receptors (integrins). pp. 97-107 (plus Fig 4.14 on p. 108), in Chapter 4.
Sept. 15 (F)	Evidence for genomic equivalence, animal cloning; in-class exercise on gene regulation (attendance required) – review what you know about gene structure, promoters, enhancers, eukaryotic transcription, transcription factors, chromatin structure, etc. Reading: all of Chapter 3, but primarily pp. 45-72.
Sept. 18 (M)	Fertilization I: gamete structure, echinoderm fertilization, acrosome reaction, blocks to polyspermy, cortical reaction, egg activation. Reading: pp. 117–239 (Chapter 7).
Sept. 20 (W)	Sea urchin early development. Types of cell movement (esp. in gastrulation). Reading: p. 14, Table 1.1; pp. 311-326 (in Ch. 10). VIDEO: Sea urchin development.
Sept. 22 (F)	Fertilization II: Mammalian fertilization. Reading: pp. 239–248 (Chapter 7). Patterns of metazoan cleavage, cytoskeletal mechanisms of karyo- & cytokinesis. Reading: pp. 11-13 (Fig. 1.5); Web topic 1.2 (http://11e.devbio.com/wt0102.html)
Sept. 25 (M)	Cleavage and developmental regulation gone awry: Introduction to cancer. Reading: pp. 754-761; 'The Hallmarks of Cancer,' Hanahan & Weinberg, 2000.
Sept. 27 (W)	Amphibian development: cleavage, gastrulation, neurulation; intro to ectodermal, mesodermal, endodermal derivatives. Reading: pp. 333-343, 413-429, 538-543 (see also Figs 18.1, 18.11, 18.18A), 653-661 (emphasis on phenomenon vs. mechanism). VIDEO: *Xenopus* (frog)
Sept. 29 (F)	Amniote early development: birds & mammals. Reading: pp. 379-399. VIDEO: chick development, mammalian early development.
Oct. 2 (M)	Mesodermal derivatives, heart formation. Endodermal derivatives. Extraembryonic membranes. Reading: 538-543, 653-661.
Oct. 5 (W)	*C. elegans* early development and cell specification. Reading: pp. 265-273.
Oct. 7 (F)	*Drosophila* development I. Early development and the maternal genes: determination of anterior-posterior polarity. Reading: pp. 38-41 (syncitial specification), 115-116 (morphogen gradients), 277-293. VIDEO: *Drosophila* embryogenesis.
Oct. 9 (M)	*Drosophila* II. Maternal genes continued, Zygotic genes: gap, pair-rule and segment polarity genes in anterior-posterior patterning. Homeotic selector genes. Reading: pp 284-303.
Oct. 11 (W)	Lecture catch-up / review
Oct. 13 (F)	**FIRST HOURLY EXAM**
Oct. 16 (M)	*Drosophila* III. Zygotic genes (cont.): gap, pair-rule and segment polarity genes in anterior-posterior patterning. Homeotic selector genes. Reading: same as above.
Oct. 18 (W)	The Homeotic Complex/Hox genes: Conservation of anterior/posterior pattern formation, evolution via changes Hox gene number & expression. Reading: pp. 301-303, 402-404, 789-792.

Oct. 20 (F)	**FALL HOLIDAY**
Oct. 23 (M)	Pattern formation in tetrapod limb. Reading: pp. 613-644 (most of Chapter 19).
Oct. 25 (W)	**PRIMARY LITERATURE PRESENTATION / DISCUSSION 1** (attendance required) Reed et al., 2008 article
Oct. 27 (F)	Cell-cell interactions in vertebrate development: Spemann & Mangold and the 'organizer,' primary embryonic induction. Reading: pp. 343-348.
Oct. 30 (M)	**PRIMARY LITERATURE PRESENTATION / DISCUSSION 2** (attendance required) Misale et al., 2012 article
Nov. 1 (W)	Molecular mechanisms of vertebrate axis formation. Reading: pp. 348-364.
Nov. 3 (F)	Developmental Neurobiology I. Patterning of vertebrate CNS. Neural crest cell migration and specification. Reading: pp. 430-343, 463-486.
Nov. 6 (M)	Developmental Neurobiology II. Axonal outgrowth and guidance. Reading: pp. 488-509. 'Molecular Biology of Axon Guidance' [pp. 1123–1124, 1130–1131].
Nov. 8 (W)	Developmental Neurobiology III. Neuron-target interactions. Neurotrophic substances. Reading: pp. 511–513 (differential survival).
Nov. 10 (F)	**SECOND HOURLY EXAM**
Nov. 13 (M)	Guest lecture (attendance required)
Nov. 15 (W)	Programmed cell death/apoptosis I. Roles of PCD in normal development, genetics of PCD in *C. elegans*. Reading: pp. 645-646, 509–511.
Nov. 17 (F)	Programmed cell death/apoptosis II. Molecular mechanisms. Same as above.
Nov. 20 (M)	**INDIVIDUAL LITERATURE PRESENTATIONS** (attendance required)
Nov. 23-25	**THANKSGIVING HOLIDAY**
Nov. 27 (M)	Cancer and developmental biology II. More cancer molecular mechanisms, cell cycle regulation. Reading: Gilbert website, supplement(s).
Nov. 29 (W)	**INDIVIDUAL LITERATURE PRESENTATIONS** (attendance required)
Dec. 1 (F)	Cancer and developmental biology III.
Dec. 4 (M)	**INDIVIDUAL LITERATURE PRESENTATIONS** (attendance required)
Dec. 6 (W)	Evolution and development (Evo-devo) I. [or other topic(s) TBD]
Dec. 8 (F)	**INDIVIDUAL LITERATURE PRESENTATIONS** (attendance required)
Dec. 11 (M)	Evolution and development (Evo-devo) II. [or other topic(s) TBD]
Dec. 13 (W)	Evolution and development (Evo-devo) III. [or other topic(s) TBD]
Dec. 15 (F)	Lecture catch-up/review [last day of classes]
Dec. 18 - 22	**FINALS**
Dec. 20 (W)	**FINAL EXAM - 8:00 - 10:00 AM**