

Biology 376 – Animal Development – Fall 2006

Dr. Curtis Loer, SCST 437, 260-4129
Eddress: cloer@sandiego.edu

Lecture: Mon/Wed/Fri, 9:05 – 10:00, PJ214
Lab: Wednesday, 2:30 - 6:30, SCST 330.

Office Hours: Mon 2:00-4:00, Tues 8:30-10:30, Thurs 11:00-12:00 or by appointment. Email is also an excellent way to get a quick response to questions.

Course Home Page: home.sandiego.edu/~cloer/bio376.html
This is a good place to check for announcements and handouts.

Main text (required) - *Developmental Biology*, 7th Edition. Author - Scott Gilbert. Sinauer Associates, 2003. Note the text includes the CD-ROM *Vade Mecum*. (Textbook Home Page: www.devbio.com)

Items on reserve -

Analysis of Biological Development. Klaus Kalthoff. McGraw-Hill, 1996.

Excerpts from *An Introduction to Molecular Neurobiology*. Zach Hall, editor. Sinauer Associates, 1992.

Excerpt from *Introduction to Neurobiology*. Heinrich Reichert. Oxford University Press, 1992.
(Ch. 7 - Development)

Oncogenes and Cell Proliferation supplement

Genetics of Disease supplement

Books required for laboratory -

Atlas of Descriptive Embryology, 5th Ed. Mathews & Schoenwolf. Macmillan/Collier, 1999.

Animal Development Laboratory Manual. C. Loer, 2006 (this will be sold by the department).

See below or in the laboratory syllabus for information on additional lab supplies.

Goals of the Course

Students will become familiar with 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 the examination of 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. The relationships between developmental mechanisms and the molecular genetic basis of human disease will also be examined and discussed.

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. The instructor will gladly provide any printed material handed out, but not a repeat of material presented in lecture. Please note that attendance at class presentations/discussions is **required**. Four weekly sessions are scheduled during the Wednesday lecture time beginning in November. Attendance at any guest lectures is also **required**.

BIOLOGY 376 – ANIMAL DEVELOPMENT – FALL 2006 SYLLABUS

Missed quizzes or tests may be made up only for excused absences (e.g., sickness). Students should inform the instructor of the reason for their absence as soon as possible. Note also that grades on problem sets, papers or lab reports turned in late will be severely reduced except for excused absences.

Attendance at all laboratory sessions is **required**. If you miss a lab for a legitimate reason (e.g., sickness) you may have an opportunity to make it up later; however, if that lab session uses living material, this may be impossible. 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. Each will count for 20% of your grade. The final exam will cover mainly previously untested material (essentially a third hourly test) and also counts for 20% of your grade. The lab portion of the class will be 25% of your final grade (see the lab syllabus for more specifics). Your class presentation and participation will count for a total of 13%. Work done for the class home page will count for 2% 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:

1st hourly test	20%	Class presentation	10%
2nd hourly test	20%	Discussion participation/ reviewing	3%
Final (3rd hourly)	20%	'Read More About It' web page, etc.	2%
Lab	25%		

Academic Integrity

Please note that the text of all lab reports and papers must also be submitted electronically to Turnitin.com. (Be sure to submit a regular paper copy for grading purposes.) 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 manual 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, 2000), 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 information on plagiarism.

Provisional Lecture Schedule

Unless stated otherwise, readings are from Gilbert, *Developmental Biology*, 7th Edition.

Sept. 8 (F)	Introduction to animal development. Course mechanics. The questions and approaches of developmental biology. Reading: pp. 3–30.
Sept. 11 (M)	Development of unicellular organisms. Metazoan developmental patterns. Reading: pp. 31–35, 38–47. View <i>Vade Mecum</i> CD-ROM, section on slime molds. VIDEO in class: <i>Dictyostelium</i> development.
Sept. 13 (W)	Fertilization I. Gamete structure, gamete recognition, sperm activation and capacitation, acrosomal reaction. Reading: pp. 183–197.
Sept. 15 (F)	Fertilization II. Gamete fusion, blocks to polyspermy, cortical reaction, egg activation, cytoplasmic rearrangements. Reading: pp 197–213.
Sept. 18 (M)	Cleavage: Patterns of metazoan cleavage, cell cycle regulation, cytoskeletal mechanisms of karyokinesis and cytokinesis. Reading: pp 221–225.
Sept. 20 (W)	Gastrulation: Types of cell movement, creation of primary cell layers. Axis formation. Sea urchin and tunicate early development. Reading: pp 226–239. VIDEO: Sea urchin early development.
Sept. 22 (F)	Amphibian early development: cleavage and gastrulation. Reading: pp 305–317.
Sept. 25 (M)	Amniote early development: fish, birds & mammals. Reading: pp 345–360, 363–374. VIDEO: zebrafish development, mammalian early development.
Sept. 27 (W)	Vertebrate neurulation, neural crest. Reading: pp 391–400, 427–429. VIDEO: <i>Xenopus</i> (frog), chick development.
Sept. 29 (F)	Mesodermal derivatives, myogenesis, heart formation. Endodermal derivatives. Extraembryonic membranes. Reading: 465–474, 491–497, 510–517.
Oct. 2 (M)	Evidence for genomic equivalence, animal cloning, embryonic stem cells. Reading: pp 81–89, 708–711.
	Note: Molecular biological techniques used to study developmental biology will be discussed as needed throughout the course. Students should read this section of the book (pp 92–105) and review it as needed to understand experiments using particular molecular techniques.
Oct. 4 (W)	Differential gene expression: transcriptional & post-transcriptional regulation. Dosage compensation and X-chromosome inactivation. Reading: pp 107–137.
Oct. 6 (F)	FIRST HOURLY EXAM
Oct. 9 (M)	<i>Drosophila</i> development I. Early development and the maternal genes: determination of anterior-posterior polarity. Reading: pp 263–278. VIDEO: <i>Drosophila</i> embryogenesis
Oct. 11 (W)	<i>Drosophila</i> II. Zygotic genes: gap, pair-rule and segment polarity genes in anterior-posterior patterning. Homeotic selector genes. Reading: pp 278–290.
Oct. 13 (F)	<i>Drosophila</i> III. Dorsal/ventral patterning. Reading: pp 290–298.
Oct. 16 (M)	The Homeotic Complex/Hox genes: Conservation of anterior/posterior pattern formation, evolution via changes Hox gene number & expression. Reading: pp 377–380, 751–761.
Oct. 18 (W)	Pattern formation in tetrapod limb. Reading: pp 523–538.
Oct. 20 (F)	FALL HOLIDAY
Oct. 23 (M)	Mechanisms of cell specification. Experimental embryology. Reading: pp 56–76. Also, molecules and signaling pathways involved in cell-cell communication will be discussed throughout the course (especially beginning here). Students should read Chapter 6 (pp. 143–175) now, and refer to it as needed for the details of specific molecular pathways discussed during class.

BIOLOGY 376 – ANIMAL DEVELOPMENT – FALL 2006 SYLLABUS

Oct. 25 (W)	Autonomous and conditional cell specification in tunicate and nematode (<i>C. elegans</i>) development. Reading: pp 246–257. VIDEO: <i>Styela</i> development, <i>C. elegans</i> development.
Oct. 27 (F)	Cell-cell interactions in vertebrate development: Spemann & Mangold and the "organizer," primary embryonic induction. Reading: pp 317–325.
Oct. 30 (M)	Molecular mechanisms of vertebrate axis formation II. Reading: pp 325–338.
Nov. 1 (W)	Induction at the single cell level: <i>C. elegans</i> vulva. Reading: pp 154–158. Kalthoff (on reserve) pp 607–612.
Nov. 3 (F)	Lecture catch-up, review, etc.
Nov. 6 (M)	SECOND HOURLY EXAM
Nov. 8 (W)	Developmental Neurobiology I. Neurogenesis and patterning of vertebrate CNS. Reading: pp 401–407. Note: Reichert, Ch.7 is recommended as an excellent overview of developmental neurobiology lecture material.
Nov. 10 (F)	Developmental Neurobiology II. Neurogenesis. Neural crest cell migration and specification. Reading: pp 429–442; Hall/Anderson (on reserve) pp. 369–372.
Nov. 13 (M)	Developmental Neurobiology III. Axonal outgrowth and guidance. Reading: pp 410–412, 444–451. "Molecular Biology of Axon Guidance," Tessier-Lavigne & Goodman, 1996 (on reserve), especially pp 1123–4 (Introductory section) and pp 1130–31 (Conclusions). Also recommended: Hall/Patterson pp. 388–410. VIDEO: Retinal growth cone migration and repulsion.
Nov. 15 (W)	Developmental Neurobiology IV. Neuron-target interactions. Neurotrophic substances. Reading: pp 451–457. Hall/Patterson pp. 438–451.
Nov. 17 (F)	Programmed cell death/apoptosis I. Roles of PCD in normal development, genetics of PCD in <i>C. elegans</i> . Reading: pp 538–540. Kalthoff pp. 603–607.
Nov. 20 (M)	Programmed cell death/apoptosis II. Molecular mechanisms. pp. 164–166.
Nov. 22 (W)	CLASS PRESENTATIONS - GENES & DEVELOPMENT (attendance required)
Nov. 23–24	THANKSGIVING HOLIDAY
Nov. 27 (M)	Cancer and developmental biology I. Characteristics of transformed cells, causes of cancer. Reading: pp 621–622, 703–705. Kalthoff pp. 727–737.
Nov. 29 (W)	CLASS PRESENTATIONS - GENES & DEVELOPMENT (attendance required)
Dec. 1 (F)	Cancer and developmental biology II. Molecular mechanisms, genetics of cancers. Reading: Gilbert website 5.6, 8.1, 9.2
Dec. 4 (M)	Cancer and developmental biology III.
Dec. 6 (W)	CLASS PRESENTATIONS - GENES & DEVELOPMENT (attendance required)
Dec. 8 (F)	Evolution and development I. Reading: pp 751–780.
Dec. 11 (M)	Evolution and development II.
Dec. 13 (W)	CLASS PRESENTATIONS - (attendance required)
Dec. 15 (F)	Lecture catch-up, review, etc.
Dec. 20 (W)	FINAL EXAM - 8:00 - 10:00 AM

Provisional Lab Schedule - Fall 2006 – Animal Development

(a copy of this lab schedule is also included in your lab manual)

Preparation for lab always includes reading the appropriate sections of the class lab manual, and may include (as indicated below) viewing sections of the CD-ROM *Vade Mecum* (packaged with the main text).

Sept. 13	Introduction to lab, safety, microscopy and measurements Reading: "How cells are studied: Microscopy," Alberts et al., <i>Molecular Biology of the Cell</i> , pp 143-148, on reserve. <i>Vade Mecum</i> CD-ROM, sections on Microscopy and lab safety. Quiz before leaving lab
Sept. 20	Echinoderm Gametes, Fertilization and Cleavage <i>Vade Mecum</i> CD-ROM, section on sea urchin Lab report due in lab, Wed., Sept. 27
Sept. 27	Frog Embryogenesis (prepared slides and whole embryos) <i>Vade Mecum</i> CD-ROM, section on amphibian early development Quiz before leaving lab
Oct. 4	Chick Embryos I (prepared slides) <i>Vade Mecum</i> CD-ROM, sections on chick development, histotechniques
Oct. 11	Chick Embryos II (live embryos, wholemount chick preparation)
Oct. 18	LAB PRACTICAL/EXAM , turn in lab notebook and chick wholemount slide
Oct. 25	Begin Chick Teratogenesis experiments - Inject with teratogens; using ANOVA ANOVA practice report due Nov. 1 in lab
Nov. 1	Open eggs (Teratogenesis expt), begin evaluation and staining
Nov. 8	Complete chick embryo histology and evaluation Lab report due in lab, Wed., Nov. 15
Nov. 15	Homeobox-Polymerase Chain Reaction week 1. DNA purification, set up reactions
Nov. 22	Homeobox-Polymerase Chain Reaction week 2. Agarose gel electrophoresis - analysis of PCR products. Begin discussion of <i>C. elegans</i> project lab. Quiz at beginning of class. Lab report due in lab, Wed., Nov 29.
Nov. 29	<i>C. elegans</i> reporter fusions and developmental genetics. Begin RNAi project. Quiz likely (on supplemental reading for project lab)
Dec. 6	<i>C. elegans</i> developmental genetics and RNAi project, continued.
Dec. 13	Project lab wrap-up, etc., TBA Project lab report due by 5 PM, Mon., Dec 18

Additional Lab Supplies needed

Sharpie extra-fine or ultra-fine permanent marker (a few different colors may be useful or fun), used for marking slides and plates (they can write on glass or plastic).

Colored pencils or pens (Drawings of embryos should use standard embryological code: red = mesoderm, blue = ectoderm, yellow = endoderm; green is sometimes used for neural crest).

Lab notebook ~8.5 x 11 in.; I prefer a flat notebook to loose-leaf. Example: Bienfang 8.5x11 vertical "NoteSketch" book (BIE-239-101) – may be available at Office Depot or online.

Dissecting kit - If you do not already own one, I recommend that you borrow one or, if you anticipate needing one for other classes, purchase one. You will need it for only a few of the labs. A limited supply of tools is available in lab.

Lab coat (You should bring this to lab and wear it when so instructed.)

Class Presentations - Genes & Development

Think of this as a mini-senior seminar. (Many students have in fact used their topic as the starting point for a senior seminar.) Each student will present once, and act as a “reviewer” 2-3 times during the semester. In most cases, you will not have to review on the week of your presentation.

Format: Formal 8 - 10 minute oral presentation with about 2-4 minutes for questions and discussion. The talk must be very well prepared and rehearsed in advance so as to fit in the allotted time (including timed rehearsals). **(A 12 minute maximum per person will be strictly enforced.)** Also, there will be no time at the beginning of class for last minute preparations; the first talk must begin promptly at 8:55. Presenters are encouraged to use appropriate overheads and/or provide handouts to augment their presentations. Because of the limited time available (and chance for technical problems), Powerpoint presentations are not allowed. Please remember that your presentation represents 10% of your final grade.

Students will present a summary with appropriate background of a recent paper or few closely-related papers from the scientific literature (no older than 2001). The paper(s) must be **primary literature**, not a review article. Beside introductory material and conclusions, the talk should present some specific key experiments found in the paper(s). This part of the presentation usually is centered around showing and explaining one or more key figures and/or tables from the paper. Although some basics of the topics may be covered in lectures leading up to the presentations, the student is encouraged to read all necessary and appropriate background in preparation for the presentation. It is likely that you may need to obtain some materials by visiting the UCSD Biomedical library. Directions can be found on the Biology 376 home page.

Students should select the paper and submit a copy no later than 3 weeks prior to the date of presentation for approval by the instructor. Students are strongly encouraged to discuss paper selection with the instructor as soon as possible. It may be useful to show me several possible paper selections. The final paper selection must be completed by 2 weeks prior to the presentation. Once a topic is selected, the student should schedule at least one session with me to discuss the paper and the background/context for the paper. [As most students have limited experience reading the primary literature, you will likely need help to prepare an excellent presentation. Students without such preparation may not be able to achieve a top grade on the presentation.] It may be helpful for you to provide me a full copy of the paper several days in advance of our meeting (if you have not already given it to me).

One week prior to presentation, materials to be added to the class home page must be given to me for posting (see "Read More About It" below). Also one week prior, copies of the paper must be provided to assigned student “reviewers” and the instructor. Reviewers are required to read the paper and expected to ask questions following the presentation that reflect their knowledge of the paper, and examine the web materials provided by the presenter in the week prior to the presentation. Reviewers will also fill out a brief evaluation of the presentation in question. Following presentations, all students (not just assigned reviewers) are encouraged to ask questions or make comments; one’s participation here constitutes a portion of the “Discussion participation” grade.

Presenters for a given week may coordinate their talks to cover closely related topics if they wish. This can lend a coherence to the session that benefits everyone participating. Topics are listed by week below. By prior approval, a student may deviate from the suggested topics. There is considerable virtue in selecting an article that you believe will be accessible to the greatest number of your peers; for example, by choosing one directly related to course topics.

Presenter responsibilities:

Select paper in consultation with instructor
Meet with me at least once to discuss your chosen paper in detail
Provide web materials to instructor for posting
Distribute copies of paper to reviewers and instructor on selected day (emailing a good PDF of the article is acceptable – even preferable – and will save you the cost of reproduction.)
Complete tasks on the assigned schedule; it is not the responsibility of the instructor to remind you.

Reviewer responsibilities:

Receive paper from presenter on selected day [note: if you miss class that day, it becomes your responsibility to get the paper from the presenter].
Read paper and examine presenter's web materials prior to presentation.
Ask questions following presentation (that demonstrate your knowledge of the paper)
Fill in a one-page sheet evaluating the presenter's presentation and web page (due by next class date).

Additional Guidelines for selecting a paper:

The article must be a basic research article, not a clinical or epidemiological report (i.e., an article from a journal with the word "Clinical" in the title is highly unlikely to be acceptable). Note that some free online journals are obscure and not particularly good (that's why they're free). Please do not restrict yourself to articles that are available online (unless you are at the UCSD Biomedical Library, where many good journals are available online).

Check the "Read More about it" pages to see examples of papers presented by students last year (accessible from the class home page).

Preferred Journals

Developmental Biology	Development	Evolution & Development
Genes & Development	Science	Nature
Neuron	Cell	Development, Genes & Evolution
Developmental Cell	PLOS Biology	BMC Developmental Biology
Proceedings of the National Academy of Science (PNAS)		

Any PLOS (www.plos.org) or BMC (www.biomedcentral.com) journal is acceptable (these are all open access online).

Materials on reserve

(These review articles, along with your text, may serve as starting points for literature searches. More may be added during the semester.)

Neural cell adhesion molecule L1: relating disease to function. Kenwrick & Doherty (1998) *Bioessays* 8:668-675.

On the shoulders of giants: p63, p73 and the rise of p53. Yang *et al.* (2002) *Trends in Genetics* 18: 90-95.

From: Current Opinion in Genetics & Development (Genetics of Disease), June 2005

Dissecting contiguous gene defects: TBX1, Baldini

Preaxial polydactyly: a model for defective long-range regulation in congenital abnormalities, Lettice & Hill

The other trinucleotide repeat: polyalanine expansion disorders, Albrecht & Mundlos

Orofacial clefting: recent insights into a complex trait, Jugessur & Murray

From: Current Opinion in Genetics & Development (Oncogenes & cell proliferation) 2003-2005

Mutational analysis of gene families in human cancer, Bardelli
 PP2A: the expected tumor suppressor, Janssens et al.
 New and unexpected: forkhead meets ARF, Costa et al.
 p53: a heavily dictated dictator of life and death, Lu
 RUNX transcription factors as key targets of TGF- β superfamily signaling, Ito
 Tumor suppression by *Ink4a-Arf*: progress and puzzles, Lowe & Sherr
 Sonic hedgehog in normal and neoplastic proliferation: insight gained from human tumors
 and animal models, Wetmore
 You Wnt some, you lose some: oncogenes in the Wnt signaling pathway, Es et al.

A 'lottery' will be held to determine priority for presentation date selection (to be announced).
 Be sure not to miss class or arrive late on the appointed day. (Otherwise you go to the bottom
 of the list.) **Note: Nov. 22** is the Wednesday immediately prior to Thanksgiving holiday.
Attendance is required.

Presentation Topics and Dates

Nov. 22 Developmental Neurobiology-related or patterning genes. Examples:
 Neurotrophins (NGF, BDNF, NT-3, CNTF, CDF-LIF, etc.) in normal
 development and as therapeutic agents in human disease; The human L1 gene
 and fetal alcohol syndrome; Limb pattern formation genes (Tbx, Hox, sonic
 hedgehog, etc.)

Nov. 1: Copy of proposed paper(s) due to instructor

Nov. 8: Paper selection completed

**Nov. 15: Submission of "Read More About It" web materials to instructor
 Copies of complete paper distributed to "reviewers"**

Nov. 29 Cell death/ Apoptosis in normal development & disease. Examples: ced genes,
 bcl-2 gene, p53 gene, bax genes, caspase genes.

Nov. 8: Copy of proposed paper(s) due to instructor

Nov. 15: Paper selection completed

**Nov. 22: Submission of "Read More About It" web materials to instructor
 Copies of complete paper distributed to "reviewers"**

Dec. 6 Cancer: Oncogenes & Tumor suppressor genes. Examples: p53 gene, p21 gene,
 p73 gene, p16/p16Ink4a, BRCA genes, telomerase, sonic hedgehog, growth
 factor signaling pathways, Wnt signaling pathway genes, etc.

Nov. 15: Copy of proposed paper(s) due to instructor

Nov. 22: Paper selection completed

**Nov. 29: Submission of "Read More About It" web materials to instructor
 Copies of complete paper distributed to "reviewers"**

Dec. 13 Cancer: Oncogenes & Tumor suppressor genes.

Nov. 22: Copy of proposed paper(s) due to instructor

Nov. 29: Paper selection completed

**Dec. 6: Submission of "Read More About It" web materials to instructor
 Copies of complete paper distributed to "reviewers"**

"Read More About It" web page associated with your class presentation. This is due to the instructor one week prior to the presentation (by 5 PM).

Format: a few paragraphs, up to the equivalent of about a page of text that succinctly explains the background, significance, and main points of your paper - in your own words. This should be understandable to anyone in the class and should NOT be a copy of the paper abstract (see below).

The text will be followed by a list of at least 5 related links. The first of these links must be to the PubMed abstract of the paper being presented. Additional links may include links to review articles (especially good if you can link to an accessible full-text article) that you used to help understand the materials, laboratory websites of the paper authors, lay information about subject (there may be many of these if a human disease is involved). Not all the additional links should be to related literature. Note: in collecting web addresses ("URLs"), beware of websites that use "Frames" - it may be difficult or impossible to create a link directly to the page of interest. Be sure to test your web addresses prior to submission to make sure they work.

Use one of three different methods for submitting your mini-webpage:

- 1) Submission page on the class website - this is the easiest, most reliable method. Everything will be automatically formatted for you (assuming you input correctly). You don't have to know any HTML code. Try to get everything right the first time to avoid having to submit a corrected version.
- 2) Submitting a plain text file in HTML code - if you already know how to do this. This provides more flexibility in formatting. You can add 'bells & whistles' if you wish.
- 3) Setting up your own web page and providing the instructor with an appropriate link only. This requires the most knowledge about web publishing, etc., but the greatest flexibility, and the ability to change any errors without resubmitting to the instructor through the submission page.

Note that grading will be based on content - not by appearance. If you want to, and enjoy doing fancier web 'stuff,' then by all means do so. Otherwise take the simple route and use the provided web submission page. This assignment is NOT about teaching you HTML or web publishing, but rather to write about your article in your own words, and to provide links to related information.

After your web page has been posted, you should check it for errors and malfunctioning links. Corrections should be submitted as soon as possible.

As noted above, examples of previous year's pages are accessible from the class home page.