BI428/528 Developmental Genetics, Spring 2016

Instructor:

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Course Overview:
The development of a complicated organism, best exemplified by you or me, from a single cell is a truly remarkable process and one of the most fascinating mysteries in science. Modern developmental biology research emphasizes, for good reason, the roles of genes in driving the elaborate coordinated sequence of events that direct development. Genes, clearly, are not sufficient on their own -- consider that every cell in our bodies contains the exact (with a few exceptions) same set of genomic DNA (and therefore, genes). Yet, these cells express vastly different sets of transcripts and proteins that confer each cell type with its unique identity and function. Much of the study of development then becomes a pursuit to understand how cells and tissues acquire unique expression patterns as they organize into a progressively more complicated organism. This theme will be pursued throughout the course.

Rather than describe detailed developmental anatomy or specific sets of transcription factors and signaling factors that direct development of a given tissue or organ, the goal of this course is to understand general principles of how gene expression patterns are established during development. We will emphasize the scientific research process of pursuing interesting questions, proposing specific hypotheses, designing well-controlled experiments, and rigorously interpreting results into conclusions. We will use primary literature publications as examples to pursue, as a group, these educational goals. Many, but not all, papers we will discuss will all be in the field of vertebrate intestinal development. Doing so allows us to maintain a common theme throughout the course and to gain an exposure to the mouse as a powerful model organism. It does not mean you will need to become an expert in intestinal development.

The course approach will be very different from lecture-based classes. Material learned in Bi320 Molecular Genetics and Bi328 Developmental Biology will help you relate basic principles and experimental methods to primary research papers. Be prepared to challenge yourself, participate, and explore one of the most exciting areas of biology.

Class Format:
Classes are held Tuesdays and Thursdays, from 10:00-11:20am. The Tuesday class will consist of a lecture relevant to the week's selected paper. These lectures will cover developmental genetics principles, background on the week's paper, and an introduction to

techniques used in the paper. On Thursdays, we will have a brief in-class quiz on the material covered in the previous lecture and the paper being discussed. The quiz could also cover material from earlier weeks. Following the quiz, student groups will present the week's paper in a "journal club" format and encourage discussion among all members of the class. Some weeks, we will be accompanied by the senior author from the selected publication, either in person or via Skype, where we will be able to ask them questions about the selected publication, below these are referred to as "Quiz the Expert" sessions. The quiz will be briefly reviewed the following Tuesday.

Reading Materials:
There is no required textbook. Some of the lecture materials are taken from the text, Developmental Biology, Gilbert, 10th edition. This textbook (9th edition) is on reserve at the Science library. The 6th edition is also freely available online.
(http://www.ncbi.nlm.nih.gov/books/NBK9983/)

The paper for each week will be available in PDF format on Canvas (including supplemental material). All the chosen papers (including high resolution figures) are also available online through UO library institutional access. Any other supporting papers (reviews, etc.) will also be uploaded to Canvas.

The lectures will be posted on Canvas the day they are given.

Grading:
1) Weekly Quizzes:
There will be seven weekly quizzes of 15 minutes duration. You may refer to a printed copy of the paper and any hand-written notes during the quizzes. Your six highest scores will count towards your final grade. Combined, the quizzes will comprise **30%** of your grade.

2) Paper Presentation and Discussion:
As groups of two or three, students will be responsible for presenting and leading discussions on the week's paper. This requires preparing a presentation (Powerpoint, PDF, or otherwise) of the figures in the paper. You will need to present the significance, background, the questions being addressed, hypotheses, aims, and conclusions derived from the paper. Each group MUST meet with me at least two days in advance to discuss their preparation. At that meeting, you will bring a draft of your presentation and discussion points your group intends to raise that week. It is your responsibility to coordinate a meeting time.

Your grade will be assigned based on your ability to present the content of the paper in a clear and concise manner and to encourage discussion. All group members must participate. **20%** of your course grade will be based on this presentation.

3) Research Proposal:

As individuals, each student will prepare a 2-3 page research proposal on a topic of interest in the field of developmental genetics. This requires identifying an interesting unresolved question, proposing a hypothesis to explain it, and describing an experimental approach to test that hypothesis. The written proposal is due on June 7th. You will also defend your proposal, with slides, through a presentation to the rest of the class. **20%** of your grade will be based on the written proposal and **15%** for the oral presentation.

4) Participation:

This course depends on productive discussions among the entire group. Those who consistently participate in both paper discussions and in Q/A sessions during the student presentations will be rewarded with full credit worth **15%** of your final grade.

Class Schedule:

Date	Class content	Week's Paper/Quiz the Expert
March 31	Lecture #1: Introduction, Course Goals and Syllabus Review: Gene Expression, Scientific Process and Paper Analysis	
April 5	Lecture #2: Transcription Factors and Enhancers	Paper: Hedgehog-responsive mesenchymal clusters direct patterning and emergence of intestinal villi, Walton et al., *PNAS*, 2012
April 7	Quiz #1 / Paper Discussion	**Assigned discussion:**
April 12	15' Review / Lecture #3: Cell signals and differentiation	Paper: SAM pointed domain ETS factor (SPDEF) regulates terminal differentiation and maturation of intestinal goblet cells, Noah et al., *Experimental Cell Research*, 2010
April 14	15' Quiz #2 / Paper Discussion	**Assigned discussion:** Quiz the Expert- Noah Shroyer, Ph.D.
April 19	15' Review / Lecture #4: Post-transcriptional regulation & microRNAs	Paper: microRNAs regulate β-catenin of the Wnt signaling pathway in early sea urchin development; Stepicheva et al., *Developmental Biology*, 2015
April 21	15' Quiz #3 / Paper Discussion	**Assigned discussion:**
April 26	15' Review /	Paper: Inactivating the permanent neonatal diabetes

	Lecture #5: Chromatin & the epigenome	gene Mnx1 switches insulin-producing β-cells to a δ-like fate and reveals a facultative proliferative capacity in aged β-cells, Pan et al., *Development* 2015
April 28	15' Quiz #4/ Paper Discussion	**Assigned discussion:** Quiz the Expert- Chris Wright, Ph.D.
May 3	15' Review / Lecture #6: Cell-cell signaling through direct interactions	Paper: Stem cell regulation. Bidirectional Notch signaling regulates Drosophila intestinal stem cell multipotency, Guo et al., *Science*, 2015
May 5	15' Quiz #5 / Paper Discussion	**Assigned discussion:**
May 10	15' Review / Lecture #7: Asymmetric cell division and cell fates	Paper: Identification of an Aurora-A/Pins^{Linker}/ Dlg Spindle Orientation Pathway using Induced Cell Polarity in S2 Cells; Johnston et al., *Cell*, 2009 Quiz the Expert- Chris Doe, Ph.D.
May 12	15' Quiz #6 / Paper Discussion	**Assigned discussion:**
May 17	15' Review / Lecture #8: Stem Cells, Reprogramming, & Regeneration	Paper: An in vivo model of human small intestine using pluripotent stem cells, Watson et al., *Nature Medicine*, 2014
May 19	15' Quiz #7/ Paper Discussion	**Assigned discussion:**
May 24	No class	Use this day to prepare!
May 26	Student Presentations	3 presenters
May 31	Student Presentations	3 presenters
June 2	Student Presentations	3 presenters
June 7	Due date for research proposal	