Spring 2-1-2019

BIOB 567.01: Molecular Analysis of Development

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BIOB 567/467 Molecular Analysis of Development

Seminar Course for Graduate Students and Senior Undergraduates Spring 2019 Thursdays 3pm-5pm ISB 103b

Instructor: Ekaterina Voronina, ekaterina.voronina@umontana.edu

This course covers key topics in developmental biology through the detailed study of the primary literature. Seminar topics are updated for each year the course is offered and listed below. With help of the instructor, the students present each topic and lead a discussion each class period based on the assigned research paper and one or two review articles to provide background on the topic and research.

Learning outcomes:

- Know and understand basic developmental mechanisms
- Be able to critically read and discuss scientific literature
- Become fluent in development terminology
- Be able to design and interpret developmental biology experiments

Class Format:

The class is based on presentation and detailed analysis of primary journal articles, which are required reading. Topics and papers for students' presentations will be assigned in advance to allow sufficient time for preparation. The student's presentation should start with introducing the topic drawing on the recent reviews. When presenting the paper, keep in mind the important questions addressed in the reading summaries assignments, and bring them up for discussion in class. Discuss the experiments performed in the paper, with an eye to whether the experiments address the stated question, is the interpretation of the experiments valid, and are proper controls included? It is very important for our own scientific development to look critically at the data, the methods, and the interpretations in published manuscripts.

All students in the class need to read the paper assignments before class in order to productively participate in discussion. You will complete reading summaries assignments for each class in order to encourage this practice. All students *will be required* to ask questions of the presenter. The instructor will ask questions about the experimental techniques used in the paper; the *participants are expected* to understand the published approaches or approach the instructor with questions before class. Participation includes: bringing up significant questions regarding the paper and being able to describe each figure in terms of how the data was generated, and how to interpret it to draw conclusions.

Assignments and Assessments:

1. **Reading Summaries**. Assigned readings can be obtained for free from Pubmed (on campus), or will be distributed to the class by email. Before each session, students will prepare five items regarding the assigned reading:

-What is the major question, problem or a technical issue addressed in the paper?
-What is the hypothesis or idea leading the authors to perform the described experiments?
-What experiment you think is the most interesting or important, and why?
-Do the experiments address the hypothesis? Do the experimental results support the authors' conclusions?
-Additionally, include two questions to ask of the presenter.

Each of required answers can be 1-2 sentences. Reading summaries are expected of all students, except the presenter of the day.

2. **Oral Assignments**. ***Long Presentation***: Each student will use PowerPoint or similar presentation software to present the paper, including a brief introduction, figures, and a summary. Students should present a critical analysis of the paper. For each figure, answer the following questions: what is the hypothesis that the authors are addressing? What are the experiments and techniques used to address the question? What are the controls for the experiments? What is the conclusion stated by the authors? Is this conclusion substantiated? Most importantly, students should identify the key figure(s)/table(s) of the paper and the key control experiment(s) for that figure or table.

Conference-Style Presentation. Much cutting-edge research is presented in scientific conferences, where the time allotted for each speaker is quite brief. To gain practice in this presentation format, one of the class meetings will be in the format of Developmental Biology Mini-Conference. Each student will select with help from the instructor a recent (within the past 3 years) publication in the field of Developmental Biology, which they will present in the final class session. All presentations will be limited to 10 minutes, with 5 minutes for questions. Presentation will have 1 or 2 introduction slides, 4 figures, and a brief summary.

Grading:

credit/no credit

Students with disabilities:

Students with disabilities may request reasonable modifications by contacting the instructor. The University of Montana assures equal access to instruction for students with disabilities in collaboration with instructors and Disability Services for Students, which is located in Lommasson Center 154. The University does not permit fundamental alterations of academic standards or retroactive modifications.

Manuscripts for Discussion

* = the paper for reading summary

Week 1. Jan 10. Introduction to class, discussion of topics and expectations for presentations

Week 2. Jan 17. Effective presentations of scientific data

Week 3. Jan 14. Cyclin B regulation in embryogenesis: Pumilio, PNG, and Polyadenylation

***** Vardy L, Orr-Weaver TL. The *Drosophila* PNG Kinase Complex Regulates the Translation of Cyclin B. *Dev Cell* 2007; 12:157. https://doi.org/10.1016/j.devcel.2006.10.017

(This is just a sidebar, and has to do with immunology not development, but describes another cool cell cycle regulator repressed by Pumilio in B cells! =>) Brocard M, Khasnis S, Wood CD, Shannon-Lowe C, West MJ. Pumilio directs deadenylation-associated translational repression of the cyclindependent kinase 1 activator RGC-32. *Nucleic Acids Res*. 2018; 46:3707. https://doi.org/10.1093/nar/gky038

Week 4. Jan 31. RNA granules and cancer

* Valentin-Vega YA, Wang YD, Parker M, Patmore DM, Kanagaraj A, Moore J, Rusch M, Finkelstein D, Ellison DW, Gilbertson RJ, Zhang J, Kim HJ, Taylor JP. Cancer-associated DDX3X mutations drive stress granule assembly and impair global translation. *Sci Rep.* 2016; 6:25996. https://doi.org/10.1038/srep25996

Anderson P, Kedersha N, Ivanov P. Stress granules, P-bodies and cancer. *Biochim Biophys Acta*. 2015; 1849(7):861-70. https://doi.org/10.1016/j.bbagrm.2014.11.009

Week 5. Feb 7. lncRNA, an unusual tumor culprit

***** Landskron L, Steinmann V, Bonnay F, Burkard TR, Steinmann J, Reichardt I, Harzer H, Laurenson AS, Reichert H, Knoblich JA. The asymmetrically segregating lncRNA cherub is required for transforming stem cells into malignant cells. *eLife* 2018; 7:e31347; https://doi.org/10.7554/eLife.31347

Malin JA and Desplan C. Cherub versus brat. *eLife* 2018; 7:e36030; https://doi.org/10.7554/eLife.36030

Week 6. Feb 14. Cellular regulation of epithelial-mesenchymal transition

***** Hardy SD, Shinde A, Wang WH, Wendt MK, Geahlen RL. Regulation of epithelial-mesenchymal transition and metastasis by TGF-β, P-bodies, and autophagy. *Oncotarget*. 2017; 8(61):103302-103314. https://doi.org/10.18632/oncotarget.21871

Week 7. Feb 21. Who really promotes mitotic entry, Cyclin A or Cyclin B?

* Vigneron S, Sundermann L, Labbe´ J-C, Pintard L, Radulescu O, Castro A, Lorca T. Cyclin A-cdk1Dependent Phosphorylation of Bora Is the Triggering Factor Promoting Mitotic Entry. *Dev Cell* 2018; 45:637. https://doi.org/10.1016/j.devcel.2018.05.005

Zheng G, Yu H. Cyclin A Turns on Bora to Light the Path to Mitosis. *Dev Cell* 2018; 45:P542. https://doi.org/10.1016/j.devcel.2018.05.017

Week 8. Feb 28. Can you survive without cell death?

* Ke FFS, Vanyai HK, Cowan AD, Delbridge ARD, Whitehead L, Grabow S, Czabotar PE, Voss AK, Strasser A. Embryogenesis and Adult Life in the Absence of Intrinsic Apoptosis Effectors BAX, BAK, and BOK. *Cell* 2018; 173(5):1217-1230.e17. https://doi.org/10.1016/j.cell.2018.04.036

Cosentino K, García-Sáez AJ. Bax and Bak Pores: Are We Closing the Circle? *Trends Cell Biol* 2017; 27(4):266-275. https://doi.org/10.1016/j.tcb.2016.11.004

Week 9. Mar 7. Zinc fireworks at fertilization

* Tokuhiro K, Dean J. Glycan-Independent Gamete Recognition Triggers Egg Zinc Sparks and ZP2 Cleavage to Prevent Polyspermy. *Dev Cell* 2018; 46:627. https://doi.org/10.1016/j.devcel.2018.07.020

Gupta SK. Role of zona pellucida glycoproteins during fertilization in humans. *J Reprod Immunol*. 2015; 108:90. https://doi.org/10.1016/j.jri.2014.08.006

Week 10. Mar 14. Non-genetic inheritance

* Chen Q, Yan M, Cao Z, Li X, Zhang Y, Shi J, Feng GH, Peng H, Zhang X, Zhang Y, Qian J, Duan E, Zhai Q, Zhou Q. Sperm tsRNAs contribute to intergenerational inheritance of an acquired metabolic disorder. *Science* 2016; 351:397; https://doi.org/10.1126/science.aad7977

Waldron D. Inheritance of diet-induced metabolic changes via tsRNAs. *Nature Reviews Genetics* 2016; 17:128; https://doi.org/10.1038/nrg.2016.1

Spadafora C. Sperm-Mediated Transgenerational Inheritance. *Front Microbiol.* 2017; 8:2401. https://doi.org/10.3389/fmicb.2017.02401. eCollection 2017

Champroux A, Cocquet J, Henry-Berger J, Drevet JR, Kocer A. A Decade of Exploring the Mammalian Sperm Epigenome: Paternal Epigenetic and Transgenerational Inheritance. *Front Cell Dev Biol.* 2018; 6:50. https://doi.org/10.3389/fcell.2018.00050. eCollection 2018

Week 11. Mar 21. Choosing between proliferation and differentiation in worm somatic cells

***** Nimmo R, Antebi A, Woollard A. *mab-2* encodes RNT-1, a *C. elegans Runx* homologue essential for controlling cell proliferation in a stem cell-like developmental lineage. *Development* 2005; 132:5043. https://doi.org/10.1242/dev.02102

Coffman JA. Runx transcription factors and the developmental balance between cell proliferation and differentiation. *Cell Biol Int*. 2003; 27:315. https://doi.org/10.1016/S1065-6995(03)00018-0

Week 12. Mar 28. Spring break, no seminar

Week 13. Apr 4. Cyclin B translational control through RNA granules

* Kotani T, Yasuda K, Ota R, Yamashita M. Cyclin B1 mRNA translation is temporally controlled through formation and disassembly of RNA granules. *J Cell Biol*. 2013; 202:1041. https://doi.org/10.1083/jcb.201302139

Baumann K. Gene expression: RNA granules: the clock within. *Nat Rev Mol Cell Biol*. 2013; 14:688. https://doi.org/10.1038/nrm3684

Winata CL, Korzh V. The translational regulation of maternal mRNAs in time and space. *FEBS Lett*. 2018; 592:3007. https://doi.org/10.1002/1873-3468.13183

Week 14**.** Ap**r** 11**.** Students**'** Presentations**.** Developmental Biology mini-conference **Week** 15**.** Ap**r** 18**.** Yo**u** ar**e** wha**t** yo**u** eat**:** th**e** effec**t** o**f** die**t** o**n** developmen**t**

* Obniski R, Sieber M, Spradling AC. Dietary Lipids Modulate Notch Signaling and Influence Adult Intestinal Development and Metabolism in *Drosophila*. *Dev Cell*. 2018; 47:98. https://doi.org/10.1016/j.devcel.2018.08.013

Beebe K, Thummel CS. For Intestinal Homeostasis, You Are What You Eat. *Dev Cell*. 2018; 47:P1 https://doi.org/10.1016/j.devcel.2018.09.018

Week 16. Apr 25. Embryonic stem cell self-renewal

* Wu CC, Wu HJ, Wang CH, Lin CH, Hsu SC, Chen YR, Hsiao M, Schuyler SC, Lu FL, Ma N, Lu J. Akt suppresses DLK for maintaining self-renewal of mouse embryonic stem cells. *Cell Cycle*. 2015; 14:1207. https://doi.org/10.1080/15384101.2015.1014144.

Kareta MS, Sage J, Wernig M. Crosstalk between stem cell and cell cycle machineries. *Curr Opin Cell Biol*. 2015; 37:68. https://doi.org/10.1016/j.ceb.2015.10.001