BI 182 2020

Animal development and genomic regulatory network design

Professors: Angela Stathopoulos (x5855, angelike@caltech.edu**)**
Isabelle Peter (x5887, ipeter@caltech.edu)
Teaching Assistant: Peiwei Chen
Lectures 1:00-2:30PM Tuesday & Thursday, Br152

BI182 will be taught from a book by Eric Davidson and Isabelle Peter "Genomic Control Process, Development and Evolution" (Elsevier, 2015), plus various other materials assigned ad hoc. For some lectures students will be asked to read selected scientific papers. This is an advanced course, and some background in respect to molecular biology is expected. The course is offered for letter grades. The format is lecture plus discussion. Problems will be assigned after the Thursday lecture, and the solutions presented in class by students the following week on Tuesdays. Thursday meetings will include lecture + research article discussion.

Two exams will be given: one midterm and another at the end of the term. For those registered in the course attendance at lectures is required (except for emergencies). Any who might wish to audit this course are welcome to sit in.

The Course Syllabus will be as follows:

Tue January 7, Lecture 1: Introduction to genomic control of animal development (Stathopoulos/Peter)

Module 1: Control of developmental gene expression (Stathopoulos)

Thu January 9, Lecture 2. Animal genomes and what they encode. Homework presentations.

Tue January 14, Lecture 3. Interpretation of maternal inputs*:* Anisotropies, maternal mRNAs and other molecules present in the egg, start of the zygotic network, strategies used by different animals. Journal club group discussion.

Thu January 16, Lecture 4. Structure/function relations in developmental cis-regulatory modules. Homework presentations.

Tue January 21, Lecture 5. Dorsal-ventral patterning of the Drosophila embryo: dynamics and precision of the Dorsal gradient. Journal club group discussion.

Thu January 23, Lecture 6. Dorsal-ventral patterning of the *Drosophila* embryo: evidence for cis-regulatory codes. Homework presentations.

Tue January 28, Lecture 7. Anterior-posterior patterning of the *Drosophila* embryo: cis-regulatory modules and cross-repression. Journal club group discussion.

Thu January 30, Lecture 8. Hedgehog-dependent patterning: vertebral neural tube, limb bud, *Drosophila*. Homework presentations.

Tue February 4, Lecture 9. Hox genes as vectorial patterning devices. Journal club group discussion.

Thu February 6, no Lecture (midterm)

<u>Module 2: Developmental Gene Regulatory Networks (Peter)</u>

Tue February 11, Lecture 10. Introduction to gene regulatory networks and the genomic control of development**.** Journal club group discussion.

Thu February 13, Lecture 11. Network components and the molecular biology of gene regulation. Homework presentations.

Tue February 18, Lecture 12. Experimental evidence for gene regulatory networks: The sea urchin endomesoderm GRN. Journal club group discussion.

Thu February 20, Lecture 13. Design and function of small regulatory circuits**.** Homework presentations.

Tue February 25, Lecture 14. Hierarchical structure and modularity of gene regulatory networks**.** Journal club group discussion.

Thu February 27, Lecture 15. Modeling of network function I: ODE-based continuous models. Homework presentations.

Tue March 3, Lecture 16. Modeling of network function II: Discrete Boolean models. Journal club group discussion.

Thu March 5, Lecture 17. Evolution of gene regulatory networks. Homework presentations.

Tue March 10, Concluding Discussion

Tue March 17 FINAL DUE

Grading:

25% participation (attendance and contribution to discussions)

20% presentations (2-3 presentations to the class of answers to homework problems)

25% midterm (same format as homework but must be done individually, without consulting others – midterm will be available by Feb. 2nd; due by Feb. 6th to Prof. Stathopoulos's office 261 Broad)

30% final (same format as homework but must be done individually, without consulting others – final will available by Friday, March 9th; due by 5pm Thursday, March 15th to Prof. Stathopoulos's office 261 Broad)