

## Biology 540: Genetic Analysis

T-Th, 10:30-12, LL109

Instructor: Scott Poethig

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This course describes the logic and practice of genetic analysis, i.e., the use of mutations for the analysis of gene function. The course is divided in two parts. The first part provides a general overview of the logic and methodology of genetic analysis. The second part introduces several widely used experimental systems—*Zea mays* (corn), *Arabidopsis thaliana*, *Drosophila melanogaster* (fruit fly), *Caenorhabditis elegans* (nematode), *Mus musculus* (mouse)--and how the methods described in the first part of the class have been used to study various processes in these organisms. Each case study highlights a different aspect of genetic analysis. The course is appropriate for graduate students and undergraduates and who have had an introductory course in genetics and molecular biology.

Grading is based on a midterm (100 points) and final exam (150 points), and a 10-15 page term paper (100 points).

### Reading

Meneely, P., 2020. *Genetic Analysis: Genes, Genomes, Networks*, 3<sup>rd</sup> edition, Oxford University Press, New York.

PDF: papers available available on Canvas

Date	Topic	Lecturer	Reading
Jan. 12	Principles of genetic analysis	Poethig	PDF
17	Genes and genomes	Poethig	PDF
19	Chromosomes	Poethig	PDF
24	Forward genetics: inducing and characterizing mutations	Poethig	Chap. 4
26	Genotypes and phenotypes: a complex relationship	Poethig	Chap. 14
31	Genetic mapping and positional cloning	Poethig	Chap. 5
Feb. 2	Reverse genetics: techniques and screens	Poethig	Chap. 6
7	Analyzing gene function 1: methods for regulating gene expression	Poethig	PDF
9	Analyzing gene function 2: Mosaic analysis	Poethig	PDF
14	Pathway analysis: epistasis and other genetic interactions	Poethig	Chap. 12
16	Suppressor and enhancer screens	Poethig	Chap. 11
21	Genetic analysis of natural variation	Poethig	Chap. 8, 10

23	Genetics of food		
28	<b>Midterm Exam</b>		
March 2	<u>Corn and Arabidopsis: Life history, genetics,</u>	Poethig	Chap. 2, PDF
7	<b>Spring break</b>		
9	<b>Spring break</b>		
14	- transposable elements	Poethig	PDF
16	- the evolutionary genetics of corn	Poethig	PDF
21	- genetic analysis of a stem cell niche	Poethig	
23	<u>Drosophila: Life history, genetics, genomics</u>	Levine	Chap. 2, PDF
28	- patterning the fly embryo	Poethig	PDF
30	- genetic analysis of a complex locus: <i>bithorax</i>	Poethig	PDF
April 4	- signal transduction: the <i>RAS</i> pathway	Poethig	PDF
6	<u>C. elegans: Life history, genetics, genomics</u>	Sundaram	Chap. 2, PDF
11	- epistasis and the heterochronic pathway	Poethig	PDF
13	- <i>lin-4</i> and the discovery of miRNAs	Poethig	PDF
18	<u>Mus musculus: Life history, genetics, genomics</u>	Bucan	Chap. 2, PDF
20	- behavioral genetics: from mouse to human	Bucan	PDF
25	- disease genetics: Min, Mom, and colon cancer	Poethig	PDF
May ?	<b>Final Exam</b>		

### Term paper

The genetic basis for organismal diversity is receiving increasing attention, aided by the development of new experimental systems. Choose an organism that has not been extensively studied—something other than Arabidopsis, corn, flies, *C. elegans*, zebrafish, mouse, or yeast—and a biological problem of interest to you. In a 10-15 page, double-spaced paper, describe how you would go about studying this problem using genetic analysis. The paper should have three parts: 1) an introduction; 2) a description of the experimental system, and 3) the experimental approach. In the introduction, describe the problem of interest, and why it is important. The second section should provide a brief description of the life cycle of the organism of interest, with special attention to features important for genetic analysis. In the final section, describe how you would go about studying the problem of interest, using the approaches described in this course. You should provide enough detail to convince me that you understand the logic of genetic analysis and how the biology of your organism influences how you will conduct this analysis (e.g., does it self-fertilize?). The purpose of this paper is to get you to think carefully about how genetic analysis is performed. You should limit your experiments to things that might be feasible, even if they take a relatively long time. In other words, don't propose to study the genetic basis of zebra striping. You may propose to use tools that are not yet available in your system, so long as you indicate how these tools could be generated. Although you may certainly use various molecular techniques, your strategy should involve the use of mutations.