Bi23 TUTORIALS
WINTER TERM 2019

1. The Future of Model Organisms: New Technologies and New Questions   (3 units)

Modern biology can be said to have begun one hundred years ago with the rediscovery of the gene and the development of the fruit fly Drosophila melanogaster as an experimental model system. Much of what we have learned in the past century has come from worldwide communities of researchers working on a small number of commonly-used laboratory organisms. Recently developed technologies including high-throughput sequencing and genome editing promise to enable the rapid and inexpensive development of new model organisms. An expansion into more diverse model systems will promote the study of questions that have not been accessible using traditional standard laboratory models, revolutionizing our understanding of genetics, neurobiology, physiology, and host-microbe interactions. We discuss past contributions from model organism research and new possibilities from the development of emerging model organisms.

Organizational Meeting on Tues. Jan 8th at 4pm in Braun 152

Tutors: Mengyi Cao, PhD, mengcao@caltech.edu, Chun-Hao Chen, PhD, chunhao@caltech.edu, Hillel Schwartz, PhD, hillels@caltech.edu, and Han Wang, PhD, hanw@caltech.edu, MC156-29, x2182

2. Current Advances in Gene Therapy   (3 units)

Gene therapy holds a promise of finding cures to some of the most problematic diseases. Unlike the commonly-used small molecule drugs genes expressed in the body can perform more complex tasks and be better targeted to the diseases' sites. In this course we will cover topics ranging from the need for gene therapy, through the methods of gene delivery, to emerging issues in the current therapies. We will finish the course with case studies of successful gene therapies that are already on the market and examine why gene therapies of the previous decades have failed.

Organizational Meeting on Weds. Jan. 9th at 4pm in Braun 152

Tutor: Jerzy Szablowski, PhD, x8519, MC 210-41, jszab@caltech.edu

3. Small RNAs with Big Roles   (3 units)

The discovery of RNA interference (RNAi) – regulation of gene expression by small RNAs – revealed an entire new layer of gene regulation. Different classes of small RNAs have been implicated in virtually all aspects of cellular functions. The use of RNAi as a tool to control gene expression has revolutionized molecular biology research, and small RNAs are regarded as promising therapeutic agents. In this class we will review the biogenesis and function of the three major classes of small RNAs – microRNAs, siRNAs and piRNAs, learn about principles and applications of RNAi in biology research, and discuss prospects and challenges of RNAi therapeutics.

Organizational Meeting on Thursday, January 10th at 4pm in Braun 152

Tutor: Maria Ninova, PhD, x3593, MC147-75, ninova@caltech.edu

4. Novel Approaches in Vaccine Research   (3 units)

Vaccines are among the most successful public health tools aimed to prevent disease and death. The class will briefly review a typical immune response to the pathogen before presenting traditional vaccination strategies that were instrumental in either the eradication or diminished incidence of major pathogens. The second part of the class will focus on future directions for vaccine development. Students will learn about new exciting techniques and approaches for vaccine design against complex pathogens.

Organizational Meeting on Tuesday, January 8 at 4pm in Kerckhoff 101

Tutor: Andrew Flyak, PhD, x8351, MC 114-96, flyaka@caltech.edu

5. From Spectacle to Acceptance: Underlying Molecular Mechanisms of Human   (3 units)
   Birth Defects and their Effect on Society

This tutorial will explore genetic and environmental causes of common developmental disorders with underlying molecular mechanisms. Every week we will focus on one disorder: present the background on the normal developmental process and the causes of the defect, review the recent literature to learn the status of our current understanding, and discuss potential treatments and prevention methods. Some birth defects that will be the focus of this course are: Zika virus and microcephaly, neurocristopathies (craniofacial malformations-cleft palate), spina bifida, chromosomal abnormalities (extra chromosomes), and cardiovascular defects among others.

Organizational Meeting on Weds. Jan. 9th at 4pm in Kerckhoff 101

Tutor: Ezgi Kunttas, PhD, x3361, MC 139-74, etatli@caltech.edu

6. Methods in Neural Data Analysis   (3 units)

Recent new technologies like multi-unit electrophysiology and calcium imaging have made it possible to simultaneously record from hundreds of neurons in a behaving animal. But what can we learn from all of these data? This tutorial will consist of a series of hands-on workshops introducing common data analysis methods from neuroscience. Topics will include toolboxes for processing raw data, event-triggered analyses, neural encoding and decoding, generalized linear models, and dimensionality reduction/latent variable models. Some familiarity with Matlab or Python is recommended to follow along, but not required. Students are welcome to bring or share their own datasets, or existing calcium imaging data may be provided.

Organizational Meeting on Weds. Jan. 9th at 4pm in Kerckhoff B136

Tutor: Ann Kennedy, PhD, MC 156-29, kennedya@caltech.edu

Faculty Responsible for Bi23: Dr. Alice S. Huang, x3446, MC 156-29