Bi23 TUTORIALS WINTER TERM 2017
SECTIONS 1 – 4

1. Inside Cancer (3 units)

Egyptians have written about cancer since 3000 BC, so human beings and animals have had cancer throughout recorded history. However, the origin of the word cancer is credited to the Greek physician Hippocrates (460-370 BC), who used the terms *carcinos* and *carcinoma* to describe non-ulcer forming and ulcer-forming tumors. Therefore, humans have been fighting cancer for a long time, but this war still continues. Basic and clinical research have made considerable efforts into a better understanding of the biology of cancer and developing new techniques that help diagnosis and treatment of patients. This course invites you to gain insights about the cellular and molecular aspect of the disease, but also will allow you to better understand the progress that has been made through critical analysis and discussion of selected papers from literature.

Organizational Meeting on Thursday January 5, 2017, at 4PM in Broad 100

Tutor: Adela Nano, PhD, x 3201, MC 127-72, anano@caltech.edu

2. Evolution of Ideas and Methods in Modern Molecular Biology (3 units)

The course will review all the main ideas in modern molecular biology and their evolution. The main breakthroughs will be introduced as previously unexplained phenomena. Students will be encouraged to discover and arrive at currently known theories, rather than list them through memorization. This will provoke scientific thinking and lead to new hypotheses to test. We will discuss how each discovery led to new methods and technologies, which in turn have allowed the next generation of ideas to be experimentally tested. The last part of the course will consider examples of a developed biotechnology that has impacted medicine and diagnostics, and discuss the scientific topics currently most actively researched. The main goal of this course is to foster students' interest in molecular biology, provide knowledge about its main concepts, invoke questions about the future of molecular biology, and generate an appreciation for the joy of scientific thinking.

Organizational Meeting on Fri. January 6, 2017 at 4pm in Broad 200

Tutor: Eugenia Khorosheva, PhD, x3464, MC 101-20, jenia@caltech.edu

3. Nanorobotics (3 units)

Nanorobotics holds a potential to transform science, medicine, and engineering. It was recognized by the 2016 Nobel Prize in Chemistry. Students will learn how to design, build, and study several types of nanoscale robots. Through a combination of interactive lectures, exercises, and literature research students will gain an understanding of engineering principles and techniques necessary to construct and investigate biologically inspired robots. Each student will design a nanobot for applications in medicine, computer science, and engineering.

Organizational Meeting on Thursday, January 5th, at 4PM in Kerckhoff 101

Tutor: Greg Tikhomirov, PhD, x1231, MC 138-78, dnano@caltech.edu

4. Scientific Writing for Biologists (3 units)

Writing well is fundamental to success in science. In this course, we will cover the basic principles of scientific writing, helping students to prepare effective papers, proposals, CVs and cover letters. Through a combination of in-class and at-home writing exercises, students will learn how to master the rules of style and composition and train themselves to describe their work concisely and coherently. We will also emphasize strategies for "selling" research to audiences with diverse scientific backgrounds. This course is intended for both graduate students and undergraduates with demonstrated proficiency in research and critically reviewing the scientific literature. Although students will be given priority for enrollment, postdocs are also invited to audit. However, since writing well requires writing often, auditing class members will be expected to participate fully.

Organizational Meeting on Wednesday, January 4th, at 4PM in Braun 320

Tutors: Brittany Belin, PhD, x3974, MC 147-75, bbelin@caltech.edu & Noah Ollikainen, PhD, x8723, MC 156-29, nollikai@caltech.edu

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

Bi23 TUTORIALS WINTER TERM 2017
SECTIONS 5 - 8

5. Introduction to the Biology of Plants (3 units)

Plants are the other kingdom of complex multicellular eukaryotes, and their physiology, cell biology, and development have evolved separately from those of animals since the last common ancestor around 1.5 billion years ago. They represent, therefore, another view of life, in which many principles of organization and molecular processes are alternatives to those familiar from animal studies. Many other elements of plant biology are similar to those in animals, but nonetheless represent novel mechanisms and uses: among the common features of both kingdoms that were discovered first in plants are cells, nuclei, genes, viruses, the cytoskeleton, transposons, and microRNAs, each of which has plant-specific aspects. Plants are also dominant elements in ecosystems on land - land plants are the major source of carbon sequestration from the atmosphere, thus controlling the carbon cycle. Plants are also the source of almost all human food, as well as the original source of many pharmaceuticals, building materials, fibers for clothing, energy sources, and more - they are the basis for many human technologies and for human civilization. The lectures and discussion in the course will cover aspects of plant evolution, ecology, physiology, cell biology, developmental biology, genetics, genomics, and systems biology, and will also touch on the interaction of plants and humans in medicine and agriculture.

Organizational Meeting on Thursday, January 5th, at 4PM in Braun 152

Tutor: Professor Elliot Meyerowitz, x6889, MC 156-29, meyerow@caltech.edu

6. Silver Bullets for Cancer (3 units)

Very rarely does a therapy cure cancer. This class covers the history and future of our pursuit towards that goal. Although a cure is still elusive, there have been several breakthroughs along the way. We will discuss primary literature that reported some of these breakthroughs and key milestones in the development of promising "silver bullets" of tomorrow. Class topics will include development of Gleevec, Immunotherapies, cancer vaccines among others.

Organizational Meeting on Wednesday, January 4th, at 4PM in Braun 152

Tutors: Alok Joglekar, PhD, x3580, alok.joglekar@gmail.com & Devdoot Majumdar, PhD, x8712, MC 147-75, devdoot@gmail.com

7. From Symbiosis to Dysbiosis Topics in Host-Microbe Interactions (3 units)

Multicellular organisms have evolved within a microbial world, consisting of bacteria, archaea, protozoa, and viruses. Microbes impact both the ecosystem that surrounds organisms, as well as multiple organ systems within the body. Adaptions and reactions to these microbial counterparts have become increasingly studied in recent years as new technologies and techniques have emerged. This course will discuss the co-evolution of microbial communities and their hosts, as well as the beneficial and pathogenic implications of these relationships. The first two classes will give an overview of the models and tools used in the field. The curriculum will then be divided into examples of symbiotic and dysbiotic interactions in the context of ecology, immunity, nutrition, and behavior. In the final class, we will discuss the reality of the future of the field, with a particular focus on public perception and therapeutics. Classes will each start with a short lecture followed by a discussion of primary literature.

Organizational Meeting on Thursday, January 5th, at 4PM Broad 200

Tutors: Hiutung Chu, PhD, x6362, hiuchu@caltech.edu, Katie Schretter, BS, x8979, cschrett@caltech.edu, Gil Sharon, PhD, x8978, gsharon@caltech.edu, Wei-Li Wu, PhD, x8979, wlwu@caltech.edu. M/C 156-29

8. Introduction to Phylogenetic Inference (3 units)

Phylogenetic inference is central to evolutionary biology. The aim of this tutorial is to introduce students to the fundamental principles of phylogenetic reconstruction. The tutorial will integrate readings, discussion and an analysis of real datasets. The main arguments discussed will be: How to identify homologs, orthologs, and paralogs; Alignment procedure; Model selection (AIC, BIC, and Bayesian Cross Validation); Neighbor Joining, Maximum Parsimony, Maximum Likelihood and Bayesian; How to compare phylogenetic tree (Approximately unbiased test and Bayes Factor; and Dealing with systematic error (Long Branch Attraction, Compositional heterogeneity).

Organizational Meeting on Monday, January 9th, at 4PM in Braun 152

Tutor: Robert Feuda, PhD, x4933, MC 156- 29, rfeuda @caltech.edu

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