# Bi23 BIOLOGY TUTORIALS
# WINTER TERM 2014
# SECTIONS 1 – 3

## The Function and Regulation of Sleep (3 units) 1-14

Sleep is conserved throughout the animal kingdom, with a typical human being spending one third of their life asleep. Despite the amount of time we dedicate to this behavior, the function and regulation of sleep remain poorly understood. Furthermore, sleep and circadian disturbances and disorders affect millions of Americans across all demographic groups, making sleep a high research priority. In this class, we discuss theories on the function of sleep, sleep disorders, genetic and neural regulation of sleep, as well as the environmental and homeostatic regulation of sleep. This class will be structured as a short lecture and discussion of assigned primary literature.

***Organizational Meeting on Wednesday, January 8th, at 4 PM in Braun 151***

Tutors: Audrey Chen, PhD, x8123, MC 156-29, audchen@caltech.edu
Daniel Lee, PhD, x8123, MC 156-29, leed@caltech.edu
Grigorios Oikonomou, PhD, x8123, MC 156-29, grigoris@caltech.edu

## Antibody Engineering & Therapeutics (3 units) 2-14

We will cover antibody engineering as related to therapeutics from the bench to the clinic. General topics will include methods for engineering antibodies, clinical development, and market considerations. We will examine antibody variants such as antibody-drug conjugates and alternative scaffolds. We may also have invited speakers.

***Organizational Meeting on Wednesday, January 8th, at 4 PM in Broad 156***

Tutor: Gene Kym, MS, x6407, MC 114-96, gene@caltech.edu

## Animal Behavior: From Single Cells to Free Will (3 units) 3-14

Often university courses delineate sharply between the study of philosophy and that of biology. We aim to provide a brief and practical demonstration of the continuousness of these two fields as they relate to the basic movements and emotional lives of living organisms, the brain structures and operation of physiological systems, and in general, the place of man and woman in their world. Starting with an introduction on the question of being and how philosophers have tried to answer it, we will move through the laws of attraction and aversion and the principles of reflex action from Loeb and Sherrington, respectfully. We will then follow the historical development of the field of ethology and the idea of state-dependent behavior before delving into the principles of animal conditioning and learning propounded by Pavlov, Watson, and Skinner. We will then cover the psychology and neuroscience of sense, perception, emotion and animal rationality. We will then derive from material covered thus far the nature and problems of consciousness and their implications for understanding the freedom of the will. Finally, from the standpoint of the individual in society, we will discuss the implications of biology on the attribution of moral responsibility and the attainment of happiness.

***Organizational Meeting on Wednesday, January 8th, at 4 PM in Kerckhoff 101***

Tutors: Brian Duistermas, PhD, x6822, MC 156-29, briand@caltech.edu
Moriel Zelikowsky, PhD, x6822, MC 156-29, moriel@caltech.edu

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

# Bi23 BIOLOGY TUTORIALS
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# SECTIONS 4-6

## Physical Principles of Biological Instrumentation (3 units) 4-14

Physical phenomena spanning vast energy, length, and time scales lurk inside instruments that scientists routinely use to understand the functioning of biological systems. We will discuss fundamental principles and practical details of an eclectic collection of useful tools including: light imaging and single molecule detection; electron microscopy and tomography; X-ray crystallography and neutron scattering; nuclear magnetic resonance and magnetic resonance imaging; peptide and DNA synthesis and DNA chips; gel and capillary electrophoresis; DNA sequencing; polymerase chain reaction; protein docking and molecular dynamics; and brain imaging and neural recording. The class will be taught in a manner that encourages participation. Students will enjoy the use of a tablet-based collaborative learning app and partake in mini-activities, exercises and demonstrations. The class will be three units a week, all in-class time. There will be a reading selection that interested students can peruse further outside of class time.

***Organizational Meeting on Wednesday, January 8th, at 4 PM in Sherman Fairchild Library 328***

Tutors: James Maloney, MS, x2468, MC 139-74, maloney@caltech.edu
Julius Su, PhD, x2843, MC 139-74, jsu@caltech.edu

## The Vaccine: Past, Present, and Future (3 units) 5-14

According to NPR-Reuters "21% of people believe autism is linked to vaccines. 7% believe in a link between vaccines and diabetes. More than 35% of households with children had concerns about the safety or value of vaccines." As scientists, we're often asked to confront the "controversy" for colleagues, friends and family, and this course is intended to present an evidence-based guide to understanding why vaccines are perhaps the most important public health intervention of the past century. This course will cover the field of human preventive and therapeutic vaccines, on a case-by-case basis. The curriculum will be divided into vaccine targets. The first two classes will focus on fundamentals of vaccines, initial developments and antecedents, their mode of action and an overview of all the targets for vaccines. Then, two successful vaccines will be discussed each week. The last two classes will focus on current challenges and new methods of vaccination. Each week, two students will present assigned articles on that week's vaccines. One of the classes will feature the students divided in two groups and debating controversial aspects of vaccination. Course grading will be based on class participation and presentation. Overall, the course will aim to provide an overview of vaccines, their successes and challenges.

***Organizational Meeting on Wednesday, January 8th at 4 PM in Braun 370***

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

## Protein Disorder: Function with Structure? (3 units) 6-14

The predominant paradigm of protein science has long been that well-defined three-dimensional structure determines function. In recent years, however, a broad swath of proteins has been identified that appear to lack such a structure and are instead intrinsically disordered. Furthermore, this disorder is suggested to convey novel functions. In this course, we will examine the characteristics of disordered proteins and their wide-ranging roles in cellular signaling, transcriptional regulation, and pathogenesis.

***Organizational Meeting on Wednesday, January 8th, at 4 PM in 256 Crellin***

Tutor: Tim Miles, BS, x6009, MC 164-30, tmiles@caltech.edu

Faculty Responsible for Bi23: Dr. Alice S. Huang, x3446, MC 156-2