Bi23 BIOLOGY TUTORIALS
WINTER TERM 2012

Computational Techniques in Biostat (3 units) 1-12

This course is oriented toward developing interest and confidence in statistics and data analysis techniques with a strong emphasis on simulation and programming. This course requires basic knowledge about probability theory and Matlab experience is recommended (although we will try to have some intro sessions). We will cover Hypothesis Testing including Frequency distributions, Probability density functions; Bayesian techniques: inference making, parameter estimation; Confidence Intervals, p-values, t-test, comparison of sample distributions; Stochastic Processes (Random Walk, MCMC simulation techniques) and Data Analysis: Fitting techniques (Chi-square, maximum likelihood methods), Error analysis (calculation of mean, variances) and Linear discriminator analysis: Fisher discrimination.

Organizational Meeting on Wednesday, January 4th, at 4 PM in Beckman Behavioral Biology 24

Tutor: Nikhil Joshi, Ph.D., x8968 email: nikhil.joshi@caltech.edu

The Biology of Environmental Science (3 units) 2-12

The chemistry and biology of life extends beyond the physical boundaries of an organism. As such, environmental influences may profoundly affect the biochemical processes and ecology of species in unexpected but identifiable ways. This course will examine historical and contemporary topics in environmental science that have and continue to impact various life forms. The biochemical and ecological nature of this impact will be addressed through assigned primary literature and case study readings, short instructor-conducted lectures, and group discussions. Topics may include ozone production/destruction, DDT, plastics, agricultural pollutants, chemical warfare agents, waste management, urban planning, visual and auditory stimuli, and social action.

Organizational Meeting: Wednesday, January 4th, at 4 PM in Broad 156

Tutor: Toni Lee, B.Sc., x6407, M/C 114-96, email: acetonile@gmail.com

DNA Nanotechnology for Biologists (3 units) 3-12

How do DNA nanotechnologists create nanoscale objects like smiley faces? How do they use such objects to study biomolecular interactions? How do they build tiny walkers based on DNA that mimic motor proteins? How do they create network of logic gates based on DNA that simulates a brain? These are some of the questions that will be discussed during the course. We will go over the state-of-the-art research papers in DNA nanotechnology, especially focusing on biology-related studies and applications, and brainstorm some new potentials of DNA nanotechnology in biological studies.

Organizational Meeting on Wednesday, January 4th, at 4 PM in Moore 239

Tutor: Sungwook Woo, M.S., 626-831-8317, MC 136-93, email: woo@dna.caltech.edu

The Neuroethology of Courtship: How the Senses Drive Evolution (3 units) 4-12

Courtship is the primary way that animals choose their mates and thereby influence the genetic make-up of their species. Courtship takes many forms throughout the animal kingdom, but all forms require a close relationship between the senses and the decision to mate. Elements of these courtship displays are indications of individual fitness whereby the best mates have the most apparent signals. The perception of these signals is reliant on the sensory system of the signal receiver. For example, male fireflies emit a series of photic pulses to attract females. To select a mate, neurons in the female firefly visual systems filter the male's signal and produce phasic neural responses to flash onsets, allowing females to select males with a higher frequency of pulses. Once the female has decided to mate with a male, she responds with her own series of photic pulses. However, these signals can be exploited by predatory animals, which use them to attract prey. Here, predatory fireflies mimic female photic pulses to lure prey. This communication drives the evolution of sensory systems within and between species. In this course, we will explore the neurophysiology underlying the five predominant sensory systems as well as how these systems influence and exploit mate choice. The course will be primarily discussion and reading based with a final exam.

Organizational meeting on Wednesday, January 4th, at 4 PM in Beckman Behavioral Biology 3

Tutors: Blythe Towal, Ph.D., x8961, email: towal@caltech.edu & Cindy Harley, Ph.D., x 4901, harley@caltech.edu, Both MC 216-76

Computational Models in Biology and Biochemistry (3 units) 5-12

Computational models of biological systems have become more popular and more elaborate in recent years. They are not only an exciting area of research, but also a powerful tool for experimental biologists. In this course, we will examine various models and discuss their background, use and merit. We will also explore the methods and tools needed to construct such models. Each participant will be expected to prepare a Journal-Club like presentation and complete a small project, either alone or in groups.

Organizational Meeting on Wednesday, January 4th, at 4 PM in Beckman Behavioral Biology 236

Tutor: Melanie Stefan, Ph.D., x3924, MC 216-76, email: mstefan@caltech.edu

Genes, Germ Cells, Stem Cells & Early Mammalian Development (3 units) 6-12

The fertilized egg gives rise to the early preimplanation embryo and at the four-cell stage each blastomere is still totipotent. But soon after this only the inner cell mass cells (ICM) of the blastocyst retain their pluripotency. It is from the ICM cells that pluripotent embryonic stem cells (ES) are derived. Primordial germ cells (PGCs) are the only cells remaining that retain their totipotency throughout the life of the animal. Multipotent stem cells with restricted differentiation are found in other embryonic and adult tissues. Recent work has shown that PGCs or their adult counterpart, germ stem cells (GS) can be adapted to culture to form pluripotent stem cells. In this class we will study early mammalian development as well as the tools that have been developed for the study of embryos and their stem cell derivatives. These methods include: in vitro fertilization, cloning, transgenics, isolation of ES cells and induced pluripotent stem cells (iPS). The epigenetic changes and the genes that are key to pluripotency will be studied in detail. We will examine this area by reading and discussing papers in an informal setting. The students will have an opportunity to present papers to the rest of the class.

Organizational Meeting on Wednesday, January 4th, at 4 PM in Beckman Institute, Room 66 (Fraser Conference Room)

Tutor: Carol Readhead, Ph.D., x2863, MC 147-39, email: readhead@caltech.edu

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