

Descriptions for BB4900 Capstone courses

BB 4900-A17. Systems Biology and Molecular Engineering

Emphasis will be on analysis of biological phenomena from a systems-level perspective. Principles and technologies of “omic-level” approaches such as genomics, proteomics and metabolomics will be discussed. Case studies that address modern frontiers of systems will be discussed. Focus will be on learning about emerging technologies of molecular engineering and evaluate their role in understanding the principles of living systems and human diseases. Recommended background: BB 2950, BB2920.

BB 4900- B17. Cell Motility and Nano-Machines

Cell motility is important for all cells, from bacteria to neurons. The motile mechanisms of cells are diverse, but in many cases, the cellular components responsible have been conserved in evolution. Some of the key molecules for motility are 80-90% identical between animal, fungi and plants! Despite this similarity, these molecular machines are responsible for generating differences in cell shape and motility such as those between fungal hyphae, leaf cells, and neurons. How are these molecular machines organized to allow the incredible diversity of forms and behaviors of cells? How is energy converted and forces generated by machines only a few nanometers in size? What cellular assemblies and structures are responsible for muscle contraction, phagocytosis of bacteria, or metastatic behavior? In this class we will explore the recent and classic literature in this field and we will also explore the constantly expanding collection of exciting videos of cells in motion. Suggested background: BB 2550 (Cell Biology).

BB4900-C18. The Human Microbiome

Somewhere on the order of 10-100 trillion microbial symbionts are harbored within each of our bodies! At the genome level, humans are ~99.9% identical to one another, but can be 80-90% different in terms of their microbiome. The Human Microbiome Project, launched by the NIH, seeks to characterize microbial communities and begin to answer questions such as: is there an identifiable core of “normal” bacteria?; how does the microbiome interface with other systems such as the immune system or the central nervous system?; does intrapersonal microbial diversity change over time?; and can we identify correlations between changes in the microbiome and human health? Does the phrase “I have a gut feeling” refer to links between the microbiome and behavior? By reading the primary literature and learning about recent technologic advances in the field, we may begin to answer these and other questions. Students should have a strong foundational knowledge of cell biology, microbiology and genetics.

BB4900-D18. Synthetic Biology

Do we yet have the technology to engineer life? Can we control gene expression to create organisms that function in useful ways? Do we understand the tenets of genetic regulation as well as we *think* we do? These important questions and more

are investigated by the emerging field of Synthetic Biology. In this course, students will explore this exciting new realm of biology through in-depth analysis and discussion of primary literature. Topics to be covered include the design and construction of synthetic gene circuits, synthesis of new genes and genomes, logic gate regulation of gene expression, and the latest applications of synthetic biology to advances in medicine, information processing, and the environment. Students should have a strong foundational knowledge of cell biology, molecular biology, and genetics, as would be obtained from BB2550, BB2920, and BB2950.