

MCDB QBio Track courses and requisites

Prerequisites:

See standard MCDB track

Core courses:

The 3 standard pairs (either this or that)

MCDB 330 (Emonet): **Modeling Biology Systems I**

General and Special electives:

Two lab courses (MCDB 201 Lab or above), one MCDB course 350 or above and any 2 of the following:

- **MCDB 361(Emonet, Clark, Howard): Modeling Biology Systems II:** Advanced topics in computational biology. Quantitative modeling and analysis of essential processes: growth and form: mechanics of cell shape and motion; stochasticity and the origin and function of noise in gene expression and signal transduction; reaction-diffusion; networks and their evolution; modeling neurons and neural networks. Assumes knowledge of the mathematical and programming basics covered in the MCDB 261.
- **BENG 467/ENAS 567 (Levchenko), Systems Biology of Signaling:** Approaches from systems biology to the fundamental processes underlying both the sensory capability of individual cells and cell-to-cell communication in health and disease.
- **MB&B452a (Gerstein) Bioinformatics, mining and simulation:** Techniques in data mining and simulation applied to bioinformatics, the computational analysis of gene sequences, macromolecular structures, and functional genomics data on a large scale. Sequence alignment, comparative genomics and phylogenetics, biological databases, geometric analysis of protein structure, molecular-dynamics simulation, biological networks, microarray normalization, and machine-learning approaches to data integration.
- **MB&B302b (de la Cruz, theory MBB) Principles of Biophysics:** An introduction to the theoretical basis of biophysical concepts and approaches with selected examples and applications.
- **MB&B 435 (Yong Xiong) Mathematical Methods in Biophysics:** Applied mathematical methods relevant to analysis and interpretation of biophysical and biochemical data. Statistics and error analysis, differential equations, linear algebra, and Fourier transforms. Analysis of real data from research groups in MB&B.
- **MB&B 523 Biological physics:** An introduction to the physics of several important biological phenomena, including molecular motors, protein folding, bacterial locomotion, and allostery. The material and approach are positioned at the interface of the physical and biological sciences.

- **PHYS 402 Advanced Classical Physics:** Advanced physics as the field developed from the time of Newton to the age of Einstein. Topics include mechanics, electricity and magnetism, statistical physics, and thermodynamics. The development of classical physics into a "mature" scientific discipline, an idea that was subsequently shaken to the core by the revolutionary discoveries of quantum physics and relativity.
- **MATH 246 Ordinary Differential Equations:** First-order equations, second-order equations, linear systems with constant coefficients. Numerical solution methods. Geometric and algebraic properties of differential equations.
- **MATH 251 Stochastic Processes.** Introduction to the study of random processes, including Markov chains, Markov random fields, martingales, random walks, Brownian motion, and diffusions. Techniques in probability, such as coupling and large deviations. Applications chosen from image reconstruction, Bayesian statistics, finance, probabilistic analysis of algorithms, and genetics and evolution.
- **CPSC 475 Computational Vision and Biological Perception.** An overview of computational vision with a biological emphasis. Suitable as an introduction to biological perception for computer science and engineering students, as well as an introduction to computational vision for mathematics, psychology, and physiology students.
- **CPSC 440 Numerical Computation.** Algorithms for numerical problems in the physical, biological, and social sciences: solution of linear and nonlinear systems of equations, interpolation and approximation of functions, numerical differentiation and integration, optimization.
- **MCDB 320 Neurobiology.** The excitability of the nerve cell membrane as a starting point for the study of molecular, cellular, and systems-level mechanisms underlying the generation and control of behavior.
- **CENG 320 Immunoengineering.** Introduction to immunoengineering, a field combining immunology with the physical sciences and engineering. Focus on biophysical principles and biomaterial applications for understanding and engineering immunity.

Consult with track adviser if you want approval for a substitution.