

## ***Contemporary PBSB: Cells, systems, and quantitative methods V5.0***

Course content and organization are designed to prepare students for twenty-first century research in the function, analysis, modeling, and understanding of living systems at each of several scales, from the molecular through the cellular to the organ system and organism. Multiscale and translational examples develop conceptual skills necessary to design meaningful experiments, derive insight from journal reports, work within the group structure now essential for contemporary research, and communicate new developments and related findings to today's peers and future students. Structural and developmental concepts are covered as they illuminate function.

Each module consists of multiple weeks. Typical weeks for many modules include two in-depth lecture-conferences that combine careful presentation of core material with student participation, and conclude with either a computational analysis and/or model, or an illuminating article from the literature. Other modules introduce new instructional modalities and perspectives designed to instill skills essential for researchers, while providing insights into scales or approaches central to contemporary research.

Days and times: Mondays and Wednesdays 1 to 3 PM; Fridays 3 to 5 PM *except as noted*  
Room: LC-504, 1300 York Avenue

### ***Quarters I and II: PBSB.9000.01-Contemporary PBSB 1-3***

15 weeks: August 29, 2016 – December 9, 2016.

This is the first term of a one-year modular course required of all first-year students in the PBSB Program. The entire course or individual modules are open to students of other programs with the permission of the course director; class limit 20 students.

### ***CPBSB 1: Membranes and cells (MAC)***

Four weeks: August 29, 2016 – September 23, 2016; Daniel Gardner

This module introduces rigorous, essential fundamentals of membranes, cells, and membrane proteins. It also uses the relation between experimentally-derived data and mathematical and computational models and analyses as an introduction to how biophysicists think. Such a view is fundamental to understanding contemporary PBSB research, no matter the level, techniques, or system.

Week 1: Membranes and compartments

Tuesday, Aug. 30 @1 PM: Cell membranes, structure and function – Andersen

Wednesday, August 31: Compartments and electrolytes – Andersen

Friday, Sept. 2: Journal Club – Gardner

Week 2: Membrane potentials and action potentials

Tuesday, Sept. 6 @1 PM: Membrane potentials and action potentials – Gardner

Wednesday, Sept. 7: Hodgkin-Huxley models and beyond – Gardner

Friday, Sept. 9: Channels, transporters, and pumps – Palmer

Weeks 3 and 4: Membrane protein structure and function

Monday, Sept. 12: Protein structure/function and modification – Boudker

Wednesday, Sept. 14: Introduction to analysis of living systems (osmotic balance computer lab) – Krogh-Madsen

Friday, Sept. 16: Channeling transporters, transporting channels – Accardi

Monday, Sept. 19: Computer lab Hodgkin-Huxley modeling – Gardner, Victor

Wednesday, Sept. 21: Neuromuscular transmission – Dittman

Friday, Sept. 23: Module evaluation/exam

### **CPBSB 2: Protein function signaling and synthesis (PFSAS)**

Five weeks: September 26, 2016 – October 28, 2016; Olga Boudker

Module 2 combines lectures on aspects of cellular signaling coupled to guided independent work by students, teamed in pairs. Individual research papers will be assigned to student pairs in advance, during the week of Sept. 19.

#### Week 5:

Monday, Sept. 26: Signaling at membranes – Dittman  
Wednesday, Sept 28: Thinking about science: the grant proposal/review process – Boudker  
Friday, Sept. 30: Protein viewing and modeling I (lab) – Khelashvili

#### Week 6:

Monday, Oct. 3: Thermodynamics and signaling – Boudker  
Wednesday, Oct. 5: Two-on-one student meetings with advising faculty  
Friday, Oct. 7: Protein viewing and modeling II (lab) –Khelashvili

#### Week 7:

Monday, Oct. 10: Ion channel signaling - TBD  
Wednesday, Oct. 12: Student oral presentations of project Aims I  
Friday, Oct. 14: Student oral presentations of project Aims II

#### Week 8:

Monday, Oct. 17: Transcription – Skrabanek  
Wednesday, Oct. 19: Protein multiple sequence alignments (lab) – Skrabanek  
Friday, Oct. 21: Departmental Retreat; no class

#### Week 9:

Monday, Oct 24: GPCR signaling - TBD  
Wednesday, Oct 26: Regulatory network modeling – Khelashvili  
Friday, Oct 28: Mock NIH study section (Extended class)

Final proposals due Friday, Nov 4

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### **CPBSB 3: Control and communication in bodies and brains (CCBB)**

Six weeks: October 31, 2016 – December 9, 2016; Bernice Grafstein  
(note Thanksgiving break November 24 – 25)

CPBSB3 will give a working introduction to the concepts underlying the nervous system, and the ongoing study of it, with examples drawn from molecular, cellular, and systems levels. At the same time, it again uses student research and presentations, along with student critiques, as a principal modality, thus developing skills essential to contemporary research.

#### Week 10: Neurons and brain networks I

Monday, Oct 31: Organization of the nervous system I: basic structure, development, sensory coding – Grafstein  
Wednesday, Nov 2: CNS synapses & plasticity – Gardner  
Friday, Nov 4: Neuronal system dynamics: negative feedback – Aksay

#### Week 11: Neurons and brain networks II

Monday, Nov 7: Neuronal system dynamics: positive feedback – Aksay  
Wednesday, Nov 9: Organization of the nervous system II: Vision – retina to V1 – Grafstein  
Friday, Nov 11: Student pair-presentations: Sensory organ transduction – Grafstein

Week 12: Neural and chemical pathways

Monday, Nov 14: Vision - Nirenberg

Wednesday, Nov 16: Mast cells as a communication medium - Silver

Friday, Nov 18: Organization of the nervous system III: Central visual pathways - Gardner

Week 13: Standing up

Monday, Nov 21: Organization of the nervous system IV: spinal cord; reflex activity - Grafstein

Wednesday, Nov 23: Thanksgiving break, no class

Friday, Nov 25: Thanksgiving break, no class

Week 14: Using the brain

Monday, Nov 28: Organization of the nervous system V: cerebral cortex; sensory-motor coordination - Grafstein

Wednesday, Nov 30: Memory & learning - Prusky

Friday, Dec 2: Computational lab: vision - Victor, Gardner

Week 15: Rewiring the nervous system

Monday, Dec 5: Organization of the nervous system VI: structural plasticity - Grafstein

Wednesday, Dec 7: Student presentations: Nervous system topics I (7 students) - Grafstein

Friday, Dec 9: Student presentations: Nervous system topics II (7 students) - Grafstein