Spring 2018 Course Descriptions

Block II

7018 Computational Biology of Proteins

COURSE DESCRIPTION: An introductory course to Protein Bioinformatics. We provide a systematic introduction to the major techniques, algorithms and tools used in Bioinformatics (for sequence alignments, classifications, secondary and tertiary structure predictions, modeling, sampling of conformations, energy functions, prediction of various functional and structural features of proteins, docking etc.).

REQUIRED MATERIALS: Not required, but suggested: Computational Biochemistry and Biophysics, Marcel Dekker, New York, NY, ISBN 978-0824704551. M. Watanabe, B. Roux, A. MacKerell, and O. Becker; Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids by R. Durbin, S. R. Eddy, A. Krogh, G. Mitchison ISBN 978-0521629713; Bioinformatics: The Machine Learning Approach, Second Edition by: P. Baldi ISBN 978-0262025065; Protein Structure Prediction: A Practical Approach by MJE Sternberg 978-0199634965; From Protein Structure to Function with Bioinformatics. Ed. Daniel John Rigden, Publisher: Springer; 2009 edition ISBN-13: 978-1402090578.

PREREQUISITES: No

STUDENT PREPARATION: Clear understanding of basic biochemical and biophysical concepts are expected. I.e. Biochemistry course in first Block is advised.

SUITABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS: A midterm and a final exam.

CREDIT HOURS: 2.5

8009 Fundamentals of Course Design and Teaching

COURSE DESCRIPTION: Research and teaching are two major spheres of scholarship and responsibility for most faculty in academic sciences. Training in the science and art of teaching is uncommon, however, particularly in the research intensive environment of a medical school. Although we are often expected to teach and show evidence of good teaching, our training in pedagogy is frequently weak, and research training does not substitute for training to teach.

The proposed course will present fundamental concepts and principles widely used in the design and execution of courses for adult learners (college and postgrad). Topics will include cognitive hierarchies and multiple intelligences in adult learning, course, lesson and syllabus design, lecture hall strategies, active learning strategies, formative and summative assessment techniques.

REQUIRED MATERIALS: Computer access to course management website. Textbooks are suggested in syllabus.

PREREQUISITES: Open to advanced graduate students who have completed their required courses and qualifying exam. This course cannot be used to fulfill a graduate course or graduate program requirement. Also open to postdocs and faculty. The course enrollment will be limited to 45.

STUDENT PREPARATION: No specific academic knowledge requirements.

SUITABLE FOR 1ST YEAR STUDENTS: No

UNIQUE TRAINING OFFERED IN THIS COURSE: There is no overlap with other courses. This is the only course organized specifically to teach pedagogical principles of course design, lesson planning and diverse teaching approaches/skills.

STUDENT ASSESSMENTS: Participants who successfully complete (pass/fail) the course will receive an official institutional certificate of completion to add to their CV. Successful completion of the course will be assessed by attendance, weekly participation in discussions/assignments and satisfactory completion of exercises in course design. Written reflections are required for each objective; a course syllabus and lesson plans are produced and evaluated; a teaching philosophy statement; No more than 3 absences/missed assignments are permitted.

CREDIT HOURS: 2.0

7007 Gene Expression: Beyond the Double Helix

COURSE DESCRIPTION: This course deals with molecular mechanisms of biological information content. Specifically the course will tackle the question of how the information contained within DNA, RNA, and chromatin is stored and used in different biological contexts. The major focus is on the molecular mechanisms of the regulation of gene expression and their impact on cellular functions. Topics include: the genome and DNA, the biochemistry of DNA transcription into RNA, biochemistry of chromatin and the histone code, regulation of transcription and of chromatin structure, its modification and role in epigenetic phenomena; metabolism of the major cellular classes of RNA, emphasizing transcription, processing, stability/degradation, and translation of messenger RNA into protein and control at each of these steps; the role of RNA-mediated catalysis in biology and evolution; the biology and biochemistry of non-coding RNA and the use of RNAi as an experimental and therapeutic tool.

REQUIRED MATERIALS: Computer.

PREREQUISITES: Undergraduate course in molecular biology at the level of Alberts “Molecular Biology of the Cell” and 1st Block Graduate Biochemistry.

STUDENT PREPARATION: Students should be familiar with nucleic acid structure, college-level genetics, graduate biochemistry level protein structure/function.

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: This course uniquely targets molecular mechanisms of the *storage* of biological information in nucleic acids and chromatin and the *utilization* of this biological information through transcription, RNA processing, and translation. Modest overlap with graduate biochemistry and molecular genetics is expected and useful.

STUDENT ASSESSMENTS: Three take-home exams (80% total), and weekly student-led paper discussions and problem sets (20%).

CREDIT HOURS: 5.0

7022 Immunology

COURSE DESCRIPTION: This course will provide students with a broad overview of basic immunology, while also delving deeply into cellular and molecular details in areas of central importance to this field. The course will consider both innate and adaptive immunity and include the structure and function of key receptors including immunoglobulins, T cell receptors and innate pattern recognition receptors. The mechanisms of antibody formation and molecular aspects of cellular immunity, including T and B cell interactions and lymphocyte memory formation, will be emphasized, and connections to modern biomedical science will be highlighted. These will include presentations and discussions on autoimmunity, immunity against major microbial pathogens (viruses, bacteria, parasites), transplantation and tumor immunology. The course will rely on multiple materials, including formal lectures (from >22 Einstein Faculty), Seminal papers discussion and Immunological methods/mouse model lectures (prepared by advanced postdoctoral fellows), Assigned reading (selected textbook chapters, cutting edge review articles and didactic videos), Data driven learning sessions ("Hands-on" data analysis and interpretation) and mandatory attendance to select seminars of the Microbiology and Immunology Department. Successful completion of the course will provide students with strong fundamental knowledge in basic immunology, and assist them in deepening their knowledge of current research and developments in modern immunology.

REQUIRED MATERIALS: Janeway's Immunobiology 9th edition Kenneth P. Murphy, ISBN 978-0-8153-45053-0 Published by Garland Science, Taylor & Francis Group, LLC ; computer access; internet access

PREREQUISITES: None.

STUDENT PREPARATION: Gene expression; protein structure; cell structure and organization

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: Immunology training is provided by this course and no other. The course will also cover methods used extensively in immunology research and applicable to other fields.

STUDENT ASSESSMENTS: Exams (Midterm, Final); Class and Discussion Participation, Basic Concept Homework

CREDIT HOURS: 4.0

7008 Membrane Potentials and Transport

COURSE DESCRIPTION: Thermodynamics is briefly reviewed with special emphasis on the concept of chemical potential and its relation to the Boltzman Distribution. The gradient of chemical potential is then introduced as the driving force in transport phenomena. With these concepts established, the problems of equilibria and transport across membranes are taken up. These include diffusion, Donnan equilibrium, diffusion potentials, membrane potentials, fixed charge membranes, electrical excitability, and the analysis of single-channel records.

REQUIRED MATERIALS: N/A

PREREQUISITES: Basic knowledge of calculus and elementary thermodynamics

STUDENT PREPARATION: None

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: See course description above

STUDENT ASSIGNMENTS: Problem sets, final oral exam

CREDIT HOURS: 2.0

7005 Molecular Cell Biology

COURSE DESCRIPTION: This course will cover basic areas in cell biology with emphasis on selected topics of current interest. The three main areas will be intracellular protein transport, the nucleus, and the cytoskeleton. Topics include: membrane structure and biogenesis, functions of intracellular membranes and the signal hypothesis, protein trafficking and intracellular sorting, glycosylation, exocytosis, endocytosis and membrane fusion, nuclear structure and organization, nuclear transport, mRNA localization, self assembly of cytoskeletal structures, actin, microtubules, intermediate filaments, molecular motors, mitosis, cell junctions, extracellular matrix, cytoskeleton and signal transduction.

REQUIRED MATERIALS: "Lewin's CELLS" 2015, Third edition (ISBN: 978-1-284-02939-0); eds. G. Plopper, D. Sharp, and E. Sikorski; Jones and Bartlett Publishers; Sudbury, MA. http://go.jblearning.com/CELLS3e

Reading the relevant chapter(s) prior to the lecture is required and essential for understanding the lectures. Several copies are on closed reserve in the library. The cheapest source for the book is Amazon and the E-Book is available through the Einstein online library at:

http://zc6sj2ch8l.search.serialssolutions.com/?V=1.0&N=100&tab=BOOKS&L=ZC6SJ2CH8L&S=AC_T_B&C=Lewin%27s+cells

PREREQUISITES: This is a demanding course involving a substantial amount of reading and should only be taken by those first year students with a background in biochemistry and cell biology.

SUITABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS: 3 exams and 3 team based learning sessions

CREDIT HOURS: 5.0

5011 MSTP Cardiac Physiology

COURSE DESCRIPTION: The course will cover the fundamentals of cardiovascular physiology. The initial part of the course will cover the basics of muscle contraction and the differences between cardiac, skeletal and smooth muscle, as well as the autonomic nervous system and hemodynamics. The second part of the course will focus on cardiac function covering electrophysiology, pump function, and neurohumoral control of cardiac contractility, output and blood pressure. The course will be required for all first year MSTP students.

REQUIRED MATERIALS: Assigned textbook chapters, and articles distributed either as paper copies or pdfs.

PREREQUISITES: Students should have a year of biology including organ systems biology and a year of physics covering energy and work plus the electrical concepts of voltage, current, resistance. Students should also know about second messenger systems including cAMP, cGMP, IP3 and DAG. The Block 1 graduate course Membrane Physiology and Transport is a required prerequisite for this course.

STUDENT PREPARATION: Students should be familiar with the basics of electrical excitability and action potentials. They should have knowledge of hormonal second messenger systems and the basics of muscle contraction.

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: N/A

STUDENT ASSESSMENTS: Small group TBL participation, surprise quizzes and an essay final exam.

CREDIT HOURS: 2.0

7020 Responsible Conduct of Research

COURSE DESCRIPTION: This course fulfills an NIH mandated training requirement and is required for all 1st year PhD and MSTP students and pre-and post-doctoral students.

Topics:

- Overview of RCR
- Research Misconduct
- Protection of Human Subjects
- Welfare of Laboratory Animals
- Conflicts of Interest
- Data Management Practices
- Mentor & Trainee Responsibilities
- Collaborative Research
- Authorship & Publication
- Peer Review

REQUIRED MATERIALS: Course readings will be distributed or made available as pdf files.

PREREQUISITES: N/A

STUDENT PREPARATION: N/A

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: N/A

STUDENT ASSESSMENTS: No class session may be missed in order to receive credit. An incomplete grade for the course will require retaking missed sessions the following semester.

CREDIT HOURS: 1.0

7031 Structural Molecular Biology

COURSE DESCRIPTION: Structural Molecular Biology seeks to provide a complete and coherent picture of biological phenomena at the molecular and atomic level. The goals include developing a comprehensive understanding of the molecular shapes and forms embraced by biological macromolecules and extending this knowledge to understand how different molecular architectures and mechanisms are used to perform the reactions and processes that are central to life.

Related processes will be included such as protein folding, protein dynamics, molecular modeling, drug design and computational biology. Central tools used in this research include X-ray diffraction, NMR, electron microscopy, small angle scattering, integrative approaches to larger systems, and simulation and experimental comparison using molecular dynamics. The course will be complimented by specific workshops on the technical aspects. In addition, students with specific interests will be guided to ancillary courses for deep immersion in detailed topics.

REQUIRED MATERIALS: Laptop

PREREQUISITES: Biochemistry

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: The overall objective is that students will be able to assess the literature in this area critically, and to design their own use of the covered methods to answer critical biomedical questions.

STUDENT ASSESSMENTS: Quizzes, Exam, Participation

CREDIT HOURS: 4.0

7403 Systems Neuroscience

COURSE DESCRIPTION:

Scope: The course will explore how complex neural systems integrate afferent information and direct efferent outflow. The overall goal will be to explore higher order functions, such as the structure and function of neural systems underlying sensation and movement, learning and memory at the sensory and motor levels, as well as higher-level cognitive processes including object perception and attention. At every stage we will build on a firm understanding of the underlying physiology and anatomical structure. Principal areas of interest will be on hierarchical neural systems, the plasticity of neural networks, serial and parallel neural processing, cognition and computational modeling.

Format: The course will be divided into four modules: 1) Principles of neural systems, 2) Neural bases of sensation 3) Neural bases of behavior and 4) Higher order functions and cognition. Each module will contain an initial series of didactic lectures introducing key facts and concepts, as well as class participation sessions focused on pre-assigned questions and relevant research papers. Techniques will be illustrated by demonstration.

REQUIRED MATERIALS: Access to internet by tablet, computer.

REQUIRED MATERIALS: N/A

PREREQUISITES: Must have completed and passed the Cellular and Molecular Neuroscience course (special cases should contact course leaders).

STUDENT PREPARATION: Recommended Textbook/Background Reading: Principles of Neural Science (Kandel, Schwartz & Jessell, Eds.), The Cognitive Neurosciences III (Gazzaniga, Ed.), Theoretical Neuroscience (Dayan & Abbott, Eds.).

SUITABLE FOR 1ST YEAR STUDENTS: Yes

UNIQUE TRAINING OFFERED IN THIS COURSE: No significant overlap noted with other courses.

STUDENT ASSESSMENTS: The grade will be based on class participation and a term paper in the form of a grant proposal. The midterm exam will involve critiquing classmates' grant proposals.

CREDIT HOURS: 6.0