CELLULAR AND MOLECULAR PHYSIOLOGY

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C&MP 5500a / BENG 5200a / MCDB 5500a / PHAR 5500a / PTB 5500a, Physiological Systems W. Mark Saltzman and Stuart Campbell

The course develops a foundation in human physiology by examining the homeostasis of vital parameters within the body, and the biophysical properties of cells, tissues, and organs. Basic concepts in cell and membrane physiology are synthesized through exploring the function of skeletal, smooth, and cardiac muscle. The physical basis of blood flow, mechanisms of vascular exchange, cardiac performance, and regulation of overall circulatory function are discussed. Respiratory physiology explores the mechanics of ventilation, gas diffusion, and acid-base balance. Renal physiology examines the formation and composition of urine and the regulation of electrolyte, fluid, and acid-base balance. Organs of the digestive system are discussed from the perspective of substrate metabolism and energy balance. Hormonal regulation is applied to metabolic control and to calcium, water, and electrolyte balance. The biology of nerve cells is addressed with emphasis on synaptic transmission and simple neuronal circuits within the central nervous system. The special senses are considered in the framework of sensory transduction. Weekly discussion sections provide a forum for

in-depth exploration of topics. Graduate students evaluate research findings through literature review and weekly meetings with the instructor.

C&MP 5503b / IBIO 5503b / PATH 5503b / PHAR 5503b / PTB 5503b, Responsible Conduct of Research, Refresher Course Staff

The NIH requires that students receive training in the responsible conduct of research every four years. This course meets that requirement for fourth-year students. The course has two components: (1) one large-group session is held for all fourth-year students through the BBS; the main topics are scientific misconduct and authorship; (2) two Immunobiology faculty facilitate discussions based on RCR topics, gathered in advance from the students; anonymous or hypothetical stories are selected by the faculty and discussed in a workshop environment in which students are then asked to analyze each case and suggest courses of actions.

C&MP 5511a and C&MP 5512b / PATH 5620a and PATH 5622b / PHAR 5511a and PHAR 5512b / PTB 5620a and PTB 5622b, Laboratory Rotations Staff

TMMPP laboratory rotations, fall term.

C&MP 5560b / BENG 5270b / MCDB 5600b / PHAR 5600b, Cellular and Molecular Physiology: Molecular Machines in Human Disease Emile Boulpaep

The course focuses on understanding the processes that transfer molecules across membranes at the cellular, molecular, biophysical, and physiological levels. Students learn about the different classes of molecular machines that mediate membrane transport, generate electrical currents, or perform mechanical displacement. Emphasis is placed on the relationship between the molecular structures of membrane proteins and their individual functions. The interactions among transport proteins in determining the physiological behaviors of cells and tissues are also stressed. Molecular motors are introduced and their mechanical relationship to cell function is explored. Students read papers from the scientific literature that establish the connections between mutations in genes encoding membrane proteins and a wide variety of human genetic diseases.

C&MP 5580b, Mitochondrial Bioenergetics and Intermediary Metabolism Rachel Perry

A comprehensive introduction to the fundamentals of mitochondrial physiology and pathophysiology. Topics include glucose, lipid, amino acid, and cholesterol metabolism; mitochondrial bioenergetics; flux modeling; inherited and acquired metabolic disorders; and common methods used to characterize metabolism. Our goal is for students not only to be able to explain the key pathways involved in maintenance of glucose and lipid homeostasis, but also to be able to select and critically evaluate techniques commonly used in metabolism, design experiments, and interpret others' results. The class is conducted in a semi-flipped manner: portions of lectures are recorded and posted in advance, and most meetings are a mix of lecture and an activity (discussion, exercise, or quiz). Open to all Yale graduate students and to undergraduates who have taken at least one term of biochemistry. Undergraduates must contact Dr. Perry in advance about their interest in the course.

C&MP 5610a and C&MP 5611b / PTB 5610a and PTB 5611b, Medical Research Scholars Program: Mentored Clinical Experience Yelizaveta Konnikova, Richard Pierce, and Changwan Ryu

The purpose of the Mentored Clinical Experience (MCE), an MRSP-specific course (one year requirement for students in the Program in Translational Biomedicine [PTB]), (requirement for second-year translational biomedicine students in the PTB), is to permit students to gain a deep understanding of and appreciation for the interface between basic biomedical research and its application to clinical practice. The MCE is intended to integrate basic and translational research with direct exposure to clinical medicine and patients afflicted with the diseases or conditions under discussion. The course provides a foundation and a critically important forum for class discussion because each module stimulates students to explore a disease process in depth over four ninety-minute sessions led by expert clinician-scientists. The structure incorporates four perspectives to introduce the students to a particular disease or condition and then encourages them to probe areas that are not understood or fully resolved so they can appreciate the value and challenge inherent in using basic science to enhance clinical medicine. Students are provided biomedical resource material for background to the sessions as well as articles or other publicly available information that offers insight to the perspective from the non-scientific world. During this course students meet with patients who have experienced the disease and/or visit and explore facilities associated with diagnosis and treatment of the disease process. Students are expected to prepare for sessions, to participate actively, and to be scrupulously respectful of patients and patient facilities. Prior to one of the sessions students receive guidance as to what they will observe and how to approach the experience; and at the end of the session, the students discuss their thoughts and impressions. All students receive HIPAA training and appropriate training in infection control and decorum relating to patient contact prior to the course.

C&MP 5629a and C&MP 5630b / PATH 5679a and PATH 5680b / PHAR 5501a and PHAR 5502b / PTB 5629a and PTB 5630b, Seminar in Molecular Medicine, Pharmacology, and Physiology Yansheng Liu, Emanuela Bruscia, Arnaud Augert, Caleigh Mandel-Brehm, Hongying Shen, Susumu Tomita, and Christopher Bunick

Readings and discussion on a diverse range of current topics in molecular medicine, pharmacology, and physiology. The class emphasizes analysis of primary research literature and development of presentation and writing skills. Contemporary articles are assigned on a related topic every week, and a student leads discussions with input from faculty who are experts in the topic area. The overall goal is to cover a specific topic of medical relevance (e.g., cancer, neurodegeneration) from the perspective of three primary disciplines (i.e., physiology: normal function; pathology: abnormal function; and pharmacology: intervention). Required of and open only to Ph.D. and M.D./Ph.D. students in the Molecular Medicine, Pharmacology, and Physiology track.

C&MP 5650b / PATH 5660b / PHAR 5580b / PTB 5650b, The Responsible Conduct of Research Barbara Ehrlich

Organized to foster discussion, the course is taught by faculty in the Pharmacology, Pathology, and Physiology departments and two or three senior graduate students. Each session is based on case studies from primary literature, reviews, and two texts: Francis Macrina's *Scientific Integrity* and Kathy Barker's *At the Bench*. Each week, students are required to submit a reaction paper discussing the reading assignment.

Students take turns leading the class discussion; a final short paper on a hot topic in bioethics is required.

C&MP 5700b, Physiology in Medicine David Zenisek
This discussion-based course makes use of medical case studies and scientific literature to illustrate key physiological concepts at the whole-body, system, organ, cellular, and molecular levels. Students are expected to actively participate in small-group discussions to deepen their understanding of human physiology and pathophysiology and how it relates to laboratory findings. Prerequisite: C&MP 5500.

C&MP 5710b / MB&B 7100b, Electron Cryo-Microscopy for Protein Structure Determination Yong Xiong, Steven Tang, and Ailong Ke
Understanding cellular function requires structural and biochemical studies at an ever-increasing level of complexity. The course is an introduction to the concepts and applications of high-resolution electron cryo-microscopy. This rapidly emerging new technique is the only method that allows biological macromolecules to be studied at all levels of resolution from cellular organization to near atomic detail. ½ Course cr

C&MP 7110b / MB&B 7110b, Practical Cryo-EM Workshop Yong Xiong and Franziska Bleichert
This laboratory course provides hands-on training in the practical aspects of macromolecular structure determination by cryo-electron microscopy (cryo-EM). Topics include cryo-EM data collection, image preparation and correction, single-particle picking and 2D classification, 3D classification, refinement and post-processing, model building, refinement and evaluation. The course includes training in the use of computer programs used to perform these calculations. Prerequisite: MB&B 710/C&MP 710. ½ Course cr