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1001 GRADUATE BIOCHEMISTRY

COURSE LEADER: Dr. David Silver

CREDITS/CLASS MEETINGS: 5 semester hours, 4 sixty-minute classes per week, 58 lectures, 4 review sessions.

PREREQUISITE BACKGROUND: One semester of undergraduate biochemistry and a course in organic chemistry are required. Undergraduate physical chemistry is also helpful preparation. Students who are uncertain about the adequacy of their undergraduate training for this course should discuss the issue with their advisory committee and then consult the course leader.


SUITABILITY FOR 1ST YEAR STUDENTS: First year graduate and MSTP students may enroll if their advisory committees judge their preparation in chemistry and biochemistry adequate.

COURSE DESCRIPTION: This is a one-semester introduction to fundamental topics in biochemistry and physical biochemistry, excluding most of metabolism (which is presented as a separate course during the spring semester). Topics included are: protein structure, folding, and function, nucleic acid structure and protein-DNA interactions, carbohydrates & glycoproteins, lipids & membranes, enzymology, energetics & allostery, posttranslational modification of protein function, transcription, translation, and DNA replication. Most of the material is presented in formal lectures in conjunction with sample problem sets, reading of the literature, discussion sessions and presentation of the protein structure project.

Each student is required to take three non-cumulative examinations that cover each part of the course and to complete a protein structure project. The grade will be based on the exams and protein project.

CREDIT HOURS: 5.0

LEVELS: Sue Golding Graduate Division

SCHEDULE TYPE: Lecture
1003 BIOPHYSICAL CHEMISTRY OF MACROMOLECULES

COURSE LEADERS: Drs. Denis Rousseau and Syun-Ru Yeh

CREDITS/CLASS MEETINGS: 3 semester hours; 27 lectures. The class will meet two times per week for 1.5 hour lectures. The course will have two exams during the term and one final exam as well as homework assignments.

PREREQUISITE BACKGROUND: Open to all students - The course will dovetail with Graduate Biochemistry, building on concepts introduced in that class. Thus, concurrent or prior enrollment in Graduate Biochemistry (or its equivalent) is required. In general, students are recommended to have some background in Physical Chemistry and Biochemistry.

SUGGESTED BACKGROUND READING: Proteins by T.E. Creighton, Selected readings from Biophysical Chemistry by Cantor and Schimmel, Selected readings from Introduction to Protein Science by A. M. Lesk. Selected readings from the primary literature.

SUITABILITY FOR 1ST YEAR STUDENTS: Recommended to have some background in Physical Chemistry and Biochemistry.

COURSE DESCRIPTION: This course is Part 1 of an introductory graduate level course in biophysical chemistry offered every fall semester. Part 2 will be offered in the Spring Semester. The topics will focus on the structures and properties of proteins and nucleic acids, techniques used to study macromolecules and mechanisms of macromolecular function.

CREDIT HOURS: 3.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
1005 MOLECULAR GENETICS

COURSE LEADER: Dr. Nicholas Baker

CREDITS/CLASS MEETINGS: 4 semester hours; corresponding to approximately 40 lectures.

PREREQUISITE BACKGROUND: 1 or more undergraduate Biology courses that include Mendelian genetics and molecular genetics. Students are expected to have a basic understanding of both areas from their prior courses. Students lacking this background should arrange to study basic undergraduate genetics independently, with a tutor, or at another institution prior to enrolling.


SUITABILITY FOR 1ST YEAR STUDENTS: This course is designed primarily for first-year students, and serves as a foundation for several other graduate courses. Students who don't have the required background should consult with the course leader and their advisory committee.

COURSE DESCRIPTION: Molecular Genetics pervades all areas of modern biology. In recent decades, genetic techniques have provided the main tools available for the study of biological processes in vivo. The course focuses upon the gene and understanding function in vivo through the creation or isolation of mutations. The purpose of the course is to provide grounding in these principles and techniques for students in all areas of research, including cell biology, developmental biology, protein structure and function, evolution, neuroscience, pharmacology and human disease. The lectures are organized into an introductory module that covers major genetic principles and techniques that are common to all organisms, followed by a series of modules designed to acquaint the students with the most important genetic model organisms and the advantages these organisms provide for understanding biological processes.

The major goals of this course are to convey:

The basic principles of classical genetic analysis; How to identify the gene responsible for a phenotype or disease; How to study the functions of a known gene; How genetics is currently used to investigate fundamental biological processes in the common model organisms, including bacteria, yeast, C. elegans, Drosophila, mice, and humans; How genetics contributes to human diseases and their study.

Topics within the course include:

The nature of the gene and the mechanisms of inheritance; The isolation and analysis of mutations in haploid and diploid organisms including humans; Inference of wild type gene function from mutant phenotypes; Principles of molecular genetics; High throughput molecular methods including microarrays and gene sequencing; RNAi and morpholino-based inhibition of gene function; Manipulating and studying cloned genes, including reverse genetics, gene knock-out, and transgenic techniques, in a variety of organisms; Genome-wide association studies of human disease; Genetics of cancer.

CREDIT HOURS: 4.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
1007 MEMBRANE POTENTIAL & TRANSPORT

COURSE LEADER: Dr. Alan Finkelstein

CREDITS/CLASS MEETINGS: 2 semester hours; 20 lectures

PREREQUISITE BACKGROUND: Physical Chemistry and Calculus are required; a good background in physics is desirable.

SUGGESTED BACKGROUND READING: Any standard Physical Chemistry text.

SUITABILITY FOR 1ST YEAR STUDENTS: Yes, if they have taken the courses above.

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.

CREDIT HOURS: 2.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPES: Lecture
1032 QUANTITATIVE IMAGING OF CELLS

COURSE LEADERS: Drs. Ben Ovryn and Erik Snapp

CREDITS/CLASS MEETINGS: 3 semester hours; Lectures: 1.5 hrs, twice a week plus laboratories: 1.5 hrs, once per week.

RECOMMENDED BACKGROUND: Undergraduate courses in Biochemistry, Cell Biology, Physics, Algebra, Statistics, and Trigonometry.


SUITABILITY FOR 1ST YEAR STUDENTS: All graduate and MSTP students may enroll.

ENROLLMENT: Enrollment for the course is limited to approximately 15 students due to restricted lab space. Preference will be given to 2nd year and above graduate and MSTP students with a quantitative imaging component to their projects.

NOTE: This is a closed registration and you must get approval from the course leaders in order to register for the course.

COURSE DESCRIPTION: This course presents an in-depth analysis of the principles and applications of light microscopy as applied to imaging cellular structures and molecules. Topics will include: the essentials of light microscopy; fluorophores; live cell imaging; deconvolution; confocal microscopy; photomanipulation; fluorescence correlation spectroscopy, multi-photon intravital imaging; evanescent wave imaging; fluorescence energy transfer and fluorescence lifetime imaging; FACS and evolving microscopies. Formal lectures will be supplemented with laboratory demonstrations that use state-of-the-art microscopes. Grading will be based upon a combination of laboratory exercises, problem sets, midterm, and a final exam.

CREDIT HOURS: 3.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture and Laboratory
1107 MECHANISMS OF DISEASE

COURSE LEADER: Dr. Bridget Shafit-Zagardo

CREDITS/CLASS MEETINGS: 3 semester hours; approximately 27 lectures will be given by Einstein faculty.

PREREQUISITE BACKGROUND: Knowledge of Immunology and Biochemistry is helpful.

SUITABILITY FOR 1ST YEAR STUDENTS: Yes.

COURSE DESCRIPTION: This multidisciplinary course will investigate the pathobiology of human diseases and relevant animal models. Topics will include cellular pathology and the mechanisms of cell injury and repair. The course will emphasize the immunologic, molecular, genetic, and biochemical mechanisms that result in the gross and microscopic changes taking place within affected tissues. Types of injury to be explored in depth will include: biochemical/genetic (mechanisms of neurodegeneration, lysosomal disease, expansion of trinucleotide repeats, chromosomal abnormalities), cancer, infectious, inflammatory, immunologic injury (Tuberculosis, Acquired Immunodeficiency Syndrome, Multiple Sclerosis), and environmental (DNA damage).

The course requirements will be assigned readings and open discussion, an oral presentation and a final exam.

CREDIT HOURS: 3.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
1111 VIROLOGY

COURSE LEADERS: Drs. Vinayaka Prasad, Ganjam Kalpana and Kartik Chandran

CREDITS/CLASS MEETINGS: 3 semester hours; approximately 30 lectures.

PREREQUISITE BACKGROUND: Biochemistry, Gene Expression and Molecular Genetics courses are recommended, but not mandatory.

SUGGESTED BACKGROUND READING:

SUITABILITY FOR 1ST YEAR STUDENTS: The course is suitable for first year students as well as for M.D./Ph.D. students beginning the Ph.D. phase. Information covered in course requires a reasonable level of background in contemporary molecular biology, biochemistry and cell biology.

COURSE DESCRIPTION: The study of animal and plant viruses has yielded key insights into the biology of cells and organisms and has helped lay the foundation of modern molecular biology. In this era of new and emerging viral infections (e.g., avian flu, SARS, Ebola, West Nile), a sophisticated and broad-based understanding of how animal viruses multiply and cause disease is needed. The primary goal of this course is to foster such an understanding.

The course includes, in addition to didactic lectures by faculty, a critical learning component, where students discuss research papers with active group discussion. Topics to be covered include virus structure, mechanisms of virus entry and replication, regulation of viral and host gene expression, virus assembly, egress, host responses to viral infections, and viral pathogenesis. The course will also demonstrate how these basic virological principles offer opportunities for diagnosis, prevention, and therapeutic intervention of prevalent and emerging viral diseases. A unique aspect of this course is that it provides training in writing scientific papers through a 'paper-writing exam' on new, unpublished data by a virologist.

The course is roughly based on the contents of the ASM book, 'Principles of Virology' listed above. The course leaders caution that the class lectures are to be considered most up-to-date as new developments in the field are rapidly superseding the materials in the textbook. Additional reading materials will be drawn primarily from current literature.

CREDIT HOURS: 3.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
1128 DEVELOPMENTAL NEUROSCIENCE

COURSE LEADERS: Drs. Mark Mehler and Zaven Kaprielian

CREDITS(CLASS MEETINGS): 5 semester hours/three 1.5 hour meetings per week for a total of approximately 37 classes.

PREREQUISITE BACKGROUND: Undergraduate courses in Developmental Biology, Molecular Genetics and Neuroscience are recommended but not required.


SUITABILITY FOR 1ST YEAR STUDENTS: Recommended for 1st year students.

COURSE DESCRIPTION: This course will cover the cellular and molecular principles underlying the construction of a functioning nervous system. The course will begin with overviews of neurogenesis, neural patterning and axon guidance, and an introduction to neuroembryology. Subsequent classes will focus on neural induction, patterning of the neuraxis, stem cell biology, growth factors/cytokines and relevant signaling mechanisms, neurogenesis and gliogenesis, forebrain development, neuronal cell death, axon guidance mechanisms, synapse assembly and neural circuit formation. Throughout the course, insights gained from both vertebrate and invertebrate model systems will be discussed.

Grading will be based on participation in course director-facilitated Student Synopsis and Discussion classes and Student Study Sections, as well as on a written Grant Proposal. There are eight Student Synopsis and Discussion classes interspersed with faculty lectures. During these classes, students are expected to summarize the main points of the preceding two or three lectures, as well as present and discuss key papers in these areas. Each student in the class will be required to write an original grant proposal on a topic in Developmental Neuroscience. There will be two Student Study Sections during the semester. At these study sections, students will critique their classmates’ grant proposals. After each study section, students will have the opportunity to revise their grant proposal based on the recommendations of their peers. The final revision of the grant proposal will be turned in on the last day of class in lieu of a final exam and will be graded by the course directors.

CREDIT HOURS: 5.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
1129 MOLECULAR AND CELLULAR NEUROSCIENCE

COURSE LEADER: Dr. Kamran Khodakhah

CREDITS/CLASS MEETINGS: 5 semester hours in the form of three 2 hour meetings per week for a total of approximately 45 presentations. A few lectures will be devoted to invited speakers from outside the Medical School, and presentations by the students.


SUITABILITY FOR 1ST YEAR STUDENTS: This course is a pre-requisite for the Systems Neuroscience course. Therefore, students interested in Neuroscience are highly encouraged to take this (and ideally the Developmental Neuroscience course) in their first year.

COURSE DESCRIPTION: The course offers a multidisciplinary approach to the study of the nervous system from first principles. The class format consists of a combination of formal and informal lectures and student presentations with a major emphasis on interactive class discussion. The course requires active student participation during the class and offers review sessions if needed. Please note that this is a very demanding course and students must plan to devote significant amount of time it.

CREDIT HOURS: 5.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
1216 PROTEIN FOLDING: DISEASE TO DESIGN

COURSE LEADERS: Drs. Robert Callender, Jonathan Lai, Marion Schmidt

CREDITS/CLASS MEETINGS: 2 semester hours. Fridays, 2 hour lectures for 11 weeks

PREREQUISITE BACKGROUND: Graduate Biochemistry is required

COURSE DESCRIPTION: This course will focus on current research in understanding the relationship between the biophysical nature of proteins, the cellular mechanisms to maintain protein homeostasis and protein misfolding diseases, and will provide up-to-date insights in current approaches of protein engineering. The course is most appropriate for students who have already completed Graduate Biochemistry. The course takes a very broad and comprehensive view. It will first cover protein folding from a reductionist view with emphasis on current quantitative approaches. Subsequently, the individual pathways, which constitute the cellular proteostasis network, their crosstalk and their regulation will be introduced. With all this in hand, the origin, pathogenesis and treatment approaches of protein misfolding diseases will be presented. Finally, the theory and application of protein design will be discussed. Students will be expected to read original research articles and to be prepared to periodically present these articles to the class. Several guest lectures from researchers currently working in both protein folding and the role of protein folding in human disease are planned.

TENTATIVE COURSE OUTLINE:

- Introduction to the energetics of protein structure
- Protein Folding: Descriptions of the folding pathway
  - Folding of small model systems: helix and sheet
  - The Folding pathway of specific proteins
- Protein structure modeling
- Protein quality control in the cell
  - The proteostasis network and regulation
- Human disease based on misfolding
  - Non-amyloidogenic diseases
  - Amyloidogenic and neurodegenerative diseases.

- Protein Engineering
  - Hierarchical Design
  - Design of novel proteins
  - Protein-protein interactions

CREDIT HOURS: 2.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPES: Lecture
1221 TOPICS IN DEVELOPMENTAL BIOLOGY AND DISEASE

COURSE LEADERS: Drs. Andreas Jenny and Florence Marlow

CREDITS/CLASS MEETINGS: 3 semester hours; approximately 27 class meetings, 1-1 1/2 hours each. This year's course will highlight fundamental concepts in classical and modern developmental biology and how developmental systems further our understanding of disease. In addition to formal presentations, faculty will facilitate presentations and discussions by students for some of the sessions. Evaluation will be based on presentations and class participation in discussions.

PREREQUISITE BACKGROUND: A background in Molecular Genetics and Gene Expression or similar courses will be beneficial. However, students without this background can be considered on an individual basis, and should consult the course leaders for advice.


SUITABILITY FOR 1ST YEAR STUDENTS: Yes, with suitable undergraduate preparation, or if they have taken courses similar to those described above in the prerequisite section.

COURSE DESCRIPTION: The field of developmental biology combines classical embryology, cell biology, modern molecular biology and genetics in the context of the whole organism. Developmental biology discoveries have made significant contributions toward our understanding of basic cellular processes including signal transduction, cell proliferation, differentiation, and morphogenesis. The Topics in Developmental Biology and Disease course will highlight fundamental principles of classical and modern developmental biology in the context of developmental problems that are being pursued at Einstein. The topics will include stem cells, asymmetric cell division, cellular polarity, morphogenesis and patterning, microRNA contribution to development, and human development/birth defects. Many of the mechanisms underlying embryonic development are also hijacked by cells in disease states. Therefore, developmental biology discoveries are expected to continue to contribute toward understanding birth defects and pathogenic processes, such as cancer. Aspects of mouse, human, Xenopus, zebrafish, and C. elegans development will be compared. Conserved molecular and evolutionary features of development will be common themes. In addition, how developmental principles have been and continue to be applied to further our understanding of disease will be explored.

CREDIT HOURS: 3.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPES: Lecture
**1244 BIOLOGY OF AGING**

**Course Leaders:** Ana Maria Cuervo MD,PhD and Nir Barzilai MD

**CREDITS/CCLASS MEETINGS:** 2 semester hours; 12 formal classes (2h classes/ 2 times a week) plus a “hot topic” talk and 2 journal clubs

**PREREQUISITE BACKGROUND:** Undergraduate courses in Biochemistry, Cell Biology, Genetics and Statistics.

**SUITABILITY FOR 1ST YEAR STUDENTS:** All graduate and MSTP students may enroll

**COURSE TEXT:** Hand book of the Biology of Aging (Masoro EJ and Austad SN), 2006; Molecular Biology of Aging (Guarente L, Partridge L, Wallace, D), 2008*; Course notes and additional materials to be assigned.

**COURSE DESCRIPTION:** Why do we get old? Is aging a disease or a physiological stage in life? As the percentage of aging population grows, under what has been termed as “global aging”, the need to understand the peculiarities of the aging process increases and has become a priority for public health. The common goal of aging researchers is being able to extend the healthy active years of life. Research in Biology of Aging is in exponential expansion because this field has benefit in recent years from the advances in many other areas of research going from genetics to cell biology, biochemistry of proteins, systems biology, etc. Furthermore, classical studies of genetics of longevity in laboratory species are now escalating to humans, thus making possible a better understanding of both physiological aging and age-related diseases.

This course presents an in-depth analysis of the biology of aging, building up from changes occurring at the molecular and cellular level and analyzing the consequences at the organism level. In addition, the influence of these age-related changes in what are commonly considered a disease of aging, such as neurodegeneration, diabetes, etc, will also be discussed. **Topics will include:** theories of aging, experimental models used to study of aging and longevity, impact of oxidative stress in cell and organ function, the metabolic syndrome of aging, functional changes in the immune, musculoskeletal and central nervous systems, genetic instability and genetics of aging and longevity.

The goal of this course is to motivate an interest among our graduates for problems in biology of aging and to prepare them for the growing demand for future generations of aging researchers.

**COURSE FORMAT:** Every class will be taught by experts of our faculty working on the topic in question. An external expert will be brought every year to cover aspects of biology of aging that are not currently part of the expertise of our faculty. Two journal-club format classes will evaluate research papers in two different areas of research every year. Grading will be based upon a combination of participation in class discussions and a final exam.

**CREDIT HOURS:** 3.0

**LEVELS:** Sue Golding Graduate Division

**SCHEDULE TYPES:** Lecture
1257 PILLARS OF BIOLOGY: CLASSIC PROBLEMS AND MODERN CONCEPTS

STUDENT COURSE LEADERS: Michael Goldberg, Wendy McKimpson, Arthur Ruiz

FACULTY COURSE LEADER: Dr. Moshe Sadofsky

MEETINGS PER WEEK: 2 semester hours, once per week (Tuesday 4-6 PM)

RECOMMENDED BACKGROUND: Undergraduate courses in biochemistry, cell biology, and genetics.

SUITABILITY FOR 1ST YEAR STUDENTS: First year students may seek permission from the course leaders. This 2 credit course is not intended to satisfy the requirement that students take one or more advanced courses beyond the core curriculum.

ENROLLMENT: Enrollment of the course is limited to approximately 15 students.

NOTE: This is a closed registration and approval from the faculty course leader is required in order to register for the course. (Pick up course registration form in the Graduate Office).

EVALUATION: Students enrolled for credit will be evaluated by review of presentations, and according to their attendance and participation in discussion.

COURSE DESCRIPTION: The aim of the course is to acquaint students with scientific literature and progress in selected focused areas of biological research. The class will focus on landmark papers in the following areas of interest: biochemistry/biophysics, biomedicine, cancer, cell biology, developmental biology, evolutionary biology, genetics, immunology, microbiology, molecular biology, neuroscience, and systems/computational biology. Presentations will be made by students and senior student facilitators with a primary focus on discussing milestone papers and their implications. Invited faculty will participate by providing their reflections and perspective on the history and scientific context of the papers presented. Through in-depth analysis of the literature on specific topics, the student is expected to gain a broadened knowledge, an increased appreciation of the process through which scientific understanding develops, and an improved ability to critically read and analyze the original literature.

COURSE STRUCTURE: Classes will consist of discussing seminal, classic papers and their broad implications in the life sciences. One of the aims of this course is to help foster an appreciation for the seminal discoveries of different fields. Potential papers for discussion will be provided by course leaders, covering various fields in biology. Final paper choices will be decided by class vote.

Students are required to participate in all discussions and give 1-2 presentations on assigned dates. The class will be run such that during the first hour an enrolled student will present a landmark paper, covering historical context, relevant background and paper content/conclusions. During the second hour, a lecture will be given by a senior student facilitator, highlighting the impact of the selected paper on the specific field and exploring the notable advances since.
The student-friendly atmosphere of the course is designed to encourage and nurture broad curiosity in biological research, provide students with a unique perspective into the history and advancements made in biology, as well as develop presentation/teaching skills. Students will gain a strong foundation in the life sciences that will complement future coursework and laboratory studies.

Below is a sample list of the type of papers that will be discussed:

**Biochemistry/Biophysics:** JH Matthaei et al “Characteristics and composition of RNA coding units.” *PNAS* 1962 (deciphered the genetic code)

**Cell Biology:** MF Lyon “Gene action in the X Chromosome of the mouse (Mus musculus L).” *Nature* 1961 (1st description of X inactivation)


**Genetics:** King and Wilson “Evolution at two levels in humans and chimpanzees” *Science* 1975 (1st demonstration that chimps and humans were 99% identical)

**Immunology:** JFP Miller and GF Mitchell “Cell to cell interaction in the immune response. I. Hemolysinforming cells in neonatally thymectomized mice reconstituted with thymus or thoracic duct lymphocytes.” *J. Exp. Med.* 1968 (established the concept of immune cell-cell interactions by showing helper T cell-B cell cooperation)


**Molecular Biology:** S Benzer “Fine structure of a genetic region in bacteriophage.” *PNAS* 1958 (defined the structure of a gene)

**Neuroscience:** AL Hodgkin and AF Huxley “Resting and action potentials in single nerve fibres” *J. Physiol* 1945 (identification of the action potential)

**CREDIT HOURS:** 2.0  
**LEVELS:** Sue Golding Graduate Division  
**SCHEDULE TYPES:** Lecture
1315 SPECIAL TOPICS IN MOLECULAR GENETICS

COURSE LEADER: Dr. Scott W. Emmons

MEETINGS PER WEEK: One Time: Wednesday, 4-6pm

PREREQUISITE BACKGROUND: Molecular Genetics or equivalent

SUITABILITY FOR 1ST YEAR STUDENTS: Appropriate for: second year students. First year students may seek permission of the course leader. Attendance and participation by more senior students, postdocs and faculty is welcomed. This 2 credit course is not intended to satisfy the requirement that students take one or more advanced courses beyond the core curriculum, courses such as Advanced Mammalian Genetics, Developmental Biology, Developmental Neuroscience, and so forth. Registering students will be asked to specify what other advanced course(s) they are taking.

EVALUATION: Students enrolled for credit will be evaluated according to their attendance and participation in discussion. Class size is limited.

COURSE DESCRIPTION: The aim of the course is to acquaint students with scientific literature and progress in selected focused areas of biological research. The topics to be treated will vary from year to year depending on the interests of the teaching faculty. Each year, several topics will be covered in short modules. Lectures may be presented, but a primary focus will be discussion of important background articles and current research papers. Through in-depth analysis of the literature on specific topics, the student is expected to gain a broadened knowledge, increasing appreciation of the process through which scientific understanding develops, and an improved ability to critically read and analyze the original research literature.

TOPICS FOR 2011-2012

Writing, reading and erasing the histone code: why, where and how
Julie Secombe, Department of Genetics
The ability to correctly regulate gene expression is vitally important, both during development and in adulthood. Because transcription occurs not on naked DNA but within the nucleus of a cell where DNA is wrapped around the histone proteins into chromatin, understanding how genes are regulated requires us to understand chromatin. In addition to compacting the DNA to fit within the physical constraints of the nucleus, chromatin also directly affects the expression of genes. Integral to many chromatin-mediated effects are covalent modifications (methylation, acetylation, etc.) that occur on the histone proteins. In recent years, there has been an explosion of new data regarding how these modifications are deposited, interpreted and removed, how this affects transcription, and how this goes wrong in human disease. In this section, we will examine the ‘why, where and how’ of a subset of histone modifications.

Autism spectrum disorders: from genes to function
Brett Abrahamson
Department of Genetics
Defined entirely in terms of behavior, the Autism Spectrum Disorders represent a unique class of clinical conditions involving deficits in language use, impaired social behavior, and a
circumscribed range of interests. In the course of study we will evaluate and discuss key papers covering a range of topics spanning the identification of novel risk loci to mechanistic work aimed at understanding the developmental function of genes now implicated in disease.

**Systems-level analysis of vertebral segmentation**
Ertugrul Ozbudak  
**Department of Genetics**
During embryonic development, the precursors of vertebrae are laid down as sequential somite segments. Fgf, Wnt, Notch and Retinoic Acid signaling pathways interact with each other and act upstream of a developmental clock, which is called segmentation oscillator, to govern somite segmentation. During this course we will discuss the mechanistic details of this fascinating rhythmic process by critically evaluating publications in the field.

**CREDIT HOURS:** 2.0  
**LEVELS:** Sue Golding Graduate Division  
**SCHEDULE TYPES:** Lecture
1325 CLINICAL RESEARCH 101: FUNDAMENTALS OF CLINICAL RESEARCH METHODS

COURSE LEADER: Dr. Paul Marantz (and invited speakers)

CREDITS/CLASS MEETINGS: 2 credits; 1 ninety-minute class per week, 11 lectures, final exam and presentation. Each registered participant will be required to sign in for each lecture. Students must attend at least 9 of the 11 lectures and pass the Final Exam to receive a passing grade.

SUITABILITY FOR 1st YEAR STUDENTS: 1st or 2nd year graduate (PhD) or MSTP students interested in clinical/translational research, especially those considering the new PhD concentration in Clinical Investigation (PCI), are encouraged to register.

The course is most appropriate for students who either:

1. Have not yet chosen a thesis research laboratory and are considering the PCI track, or
2. More senior students, who may not need the course to fulfill requirements, but are interested in potentially pursuing clinical research as a career move after the PhD.

COURSE DESCRIPTION: This course provides an introduction to Clinical Research. The student will learn how clinical research studies are designed, how to analyze and interpret statistical comparisons, and will develop skills in critically reading the clinical research literature. The course consists of 11 lectures and includes the following topics. Study Design I: The research question; observational studies; Study Design II: clinical trials and meta-analysis; Biostatistics I: descriptive and analytic statistics - univariate techniques; Biostatistics II: analytic statistics - multivariate techniques; Biostatistics III: survival analysis; outcomes research: assessing quality of medical care; Evaluation of diagnostic testing; Clinical prediction rules; Cost-effectiveness and decision analysis; Emerging challenges in research: genetic approaches to complex disease; Research ethics; Opportunities in clinical research. The course will culminate with a Final Exam.

PLEASE NOTE: Students must first register for the course and then fill out an additional registration form in the Clinical Research Training office.

CREDIT HOURS: 2.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
1326 EPIDEMIOLOGY II FOR CLINICAL INVESTIGATORS

COURSE LEADER: Dr. Gloria Ho

CREDITS/CLASS MEETINGS: 3 credits; 12 week course meets 1x week for 3.5 hours


SUITABILITY FOR 1st YEAR STUDENTS: Advanced course

PREREQUISITE BACKGROUND: Must have completed Clinical Research Summer Intensive (Course # 1307), and co-enrolled or have taken Biostatistics II or permission from instructor.

COURSE DESCRIPTION: This course focuses on the analytical issues of epidemiological studies: biases, confounding, interaction, statistical methods used in case-control and longitudinal studies, and sample size/statistical power. The homework will reinforce these concepts. Students must have completed the Summer Intensive and are expected to know the basic design issues of retrospective and prospective studies as well as clinical trials.

NOTE: Class size limited to 15

CREDIT HOURS: 3.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
1327 BIOSTATISTICS II FOR CLINICAL INVESTIGATORS

COURSE LEADERS: Drs. Hillel Cohen and Aileen McGinn

CREDITS/CLASS MEETINGS: 3 credits; 1x per week/3.5 hours (2-hour sessions/Stata Lab immediately follows for 1.5 hours).

PREREQUISITE BACKGROUND: Must have completed Clinical Research Summer Intensive (Course #1307), and co-enrolled or have taken Epidemiology II, or permission from instructor


SUITABILITY FOR 1st YEAR STUDENTS: Advance course

COURSE DESCRIPTION: This course builds on knowledge of univariate and bivariate analyses learned in the "Summer Intensive" course and introduces concepts related to multivariate model building for multiple linear regression. Topics include regression diagnostics, assessing interaction, statistical adjustment for confounding and approaches for selecting appropriate model variables.

The Stata Lab builds on the data analysis techniques and interpretation covered in the "summer Intensive" course. This course will focus on multiple linear regression model building, interpretation and diagnostics tests, in close alignment with the Biostatistics II curriculum. Didactic sessions presume readings are done prior to class.

NOTE: Class size limited to 15

CREDIT HOURS: 3.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
1350 INTRODUCTION TO SYSTEMS BIOLOGY: THEORY AND CASE STUDIES

COURSE LEADERS: Dr. Aviv Bergman

CREDITS/CLASS MEETINGS: 3 semester hours; 1 times a week for 1 1/2 hours.

SUITABILITY FOR 1ST YEAR STUDENTS: This course is opened to first year students. It is preferred that the students who take this class have a theoretical background in math, physics, engineering or the computational sciences.

COURSE DESCRIPTION: By means of biological case studies we will cover a broad range of relevant techniques from mathematical, statistical, and computational sciences. In this course we will introduce computational and simulation platforms that the students will build upon as the course progresses. By the end of the course we expect all students to have attained a substantial programming proficiency. The main aim of this course is to provide the students with the means to move beyond quantitative techniques for descriptive purposes alone, towards making biologically relevant predictive models.

Perl (4 Classes)
1.-2.5. Introduction to PERL, structured program theorem, control structures, variables, functions.
2.5-3. Introduction to Relational databases
4. Dynamic programming technique and its application to pairwise sequence alignments (sampling with dynamic programming, scoring with mutation tables and gap penalty functions)

Matlab (6 Classes)
1. Matlab syntax and data structure, and data to visualization
2. Intro Linear Algebra, theory and practice
3. Intro Probability, Markov Processes, theory and practice
4. Intro ODE, theory and practice.
5. Fourier Transform and Image Processing
6. Programing Stochastic simulations

R (6 Classes)
1. Intro to R; syntax, variable types, data structures
2. Data; cleaning it, shaping it, looking at it
3. Model fitting & comparison (i) ANOVA, Linear models, nonlinear
4. Model fitting & Comparison (ii) ODEs; mixed effects models
5. Stochastic Simulations, Monte Carlo methods
6. Short guide to efficient, transparent programming in R; and advanced graphical methods

CREDIT HOURS: 3.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
1352 COMPUTATIONAL GENOMICS AND EPIGENOMICS

COURSE LEADERS: Dr. John Greally

CREDITS/CLASS MEETINGS: 2 semester hours; once per week for 2 hours.

PREREQUISITE BACKGROUND: Introduction to Biostatistics (BIOS 1014) and Gene Expression (BIOS 1006).

SUITABILITY FOR 1ST YEAR STUDENTS: Not suitable unless prior formal coursework in computational biology

COURSE DESCRIPTION: This course has two objectives. Each lecture will have two components, the first a 30 minute biological or technical overview, the second a 1 hour lecture defining theoretical and practical issues in computational and statistical analysis. The goals are (1) to give students an understanding of the properties of the genome, how it is regulated, and how mutations and epigenetic abnormalities cause disease, (2) to explain the technologies available to study the genome and epigenome today and (3) to provide students with the analytical tools to study the genome themselves.

Lectures will be created as podcasts, online links will be provided for web-based analytical tools, and programs will be available for download. Examinations will be problem-based, requiring that datasets be analysed and interpreted.

COURSE FORMAT: 12 lectures; 2 take home exams (20% each); final exam (60%)

CREDIT HOURS: 2.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture
GRADUATE PROGRAMS IN THE BIOMEDICAL SCIENCES
http://www.einstein.yu.edu/phd

4003 CRYOELECTRON MICROSCOPY OF MACROMOLECULAR ASSEMBLIES

4008 MAGNETIC RESONANCE SPECTROSCOPY AND PROTEIN STRUCTURE

COURSES AT THE NEW YORK STRUCTURAL BIOLOGY CENTER

Einstein COURSE COORDINATORS: Dr. Hernando Sosa (Cryo-em course), Dr. Mark Girvin and Dr. Linda Jelicks (Magnetic Resonance spectroscopy course)

PRESENT COURSES OFFERED:

1. 4003 Cryoelectron Microscopy of Macromolecular Assemblies (Fall)
2. 4006 NMR Spectroscopy of Macromolecules (Spring)
3. 4008 Magnetic Resonance Spectroscopy and Protein Structure (Fall)

NOTE: These courses will be held outside the Einstein campus. Meetings will be at the New York Structural Biology Center (NYSBC, Convent Avenue and 133rd Street, New York). Transportation from Einstein to the NYSBC and vice-versa is the responsibility of the students. Lectures and discussions will also be broadcast over the web, but class participation is important and attendance is mandatory.

CREDITS/CLASS MEETINGS: 3 semester hours; 2 – 3 times weekly including one discussion or practical session for about 14 weeks.

REGISTRATION REQUIREMENTS/BACKGROUND: These are advanced courses. You must get approval from one of the Einstein course coordinators in order to register.

COURSE DESCRIPTIONS AT:

Cryoelectron Microscopy of Macromolecular Assemblies
http://cryoem.nysbc.org/CemGraduateCourse.html

Einstein is a member of NYSBC.

CREDIT HOURS: 3 credits for the lecture/discussions
1 credit for the practical discussions

LEVELS: Sue Golding Graduate Division

SCHEDULE TYPES: Lecture/Practical
5005 PHYSIOLOGY: FROM MOLECULES TO MAN

COURSE LEADER: Dr. Myles Akabas

COURSE DESCRIPTION: Physiology is the study of the homeostatic mechanisms by which cells, organs and whole animals maintain their normal state. It attempts to understand the sensory systems, information integration processes and effector systems that are involved in the regulation of physiological processes, such as blood pressure and volume, and how the systems respond to stresses to restore normal physiological levels. Starting with basic membrane transport processes the course proceeds to epithelial and muscle physiology, it then covers organ level physiology of the heart, lungs and kidneys with the goal of understanding the physiologic processes that regulate cardiac output, blood pressure, volume, osmolarity and composition of body fluids. The course will attempt to describe the molecular basis for the organ level physiology. The goals of this course are to provide the students with an understanding of basic renal, cardiovascular and pulmonary physiology and an appreciation of the current limits of our understanding and the major questions that are the focus of current research.

The course generally meets three times per week although on a somewhat irregular schedule to avoid conflicts with medical school courses that the MSTP students must take. As a result the class runs from Labor Day through the end of January. Evaluation is based on class participation and four take-home, essay exams. The course is required for all first year MSTP students and open to PhD students.

CONTACT INFORMATION: x-3360, Ullmann 209

CREDIT HOURS: 4.0
LEVELS: Sue Golding Graduate Division
SCHEDULE TYPE: Lecture