COURSE CATALOG
Spring 2020 Block III
### Spring 2020 Course Descriptions

#### Block III

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLRM 5821</td>
<td>Advanced Epidemiologic Research</td>
</tr>
<tr>
<td>BIOS 7409</td>
<td>Approaches to Study Neural Circuits in Behaving Animals</td>
</tr>
<tr>
<td>BIOS 7404</td>
<td>Cell Biology of Neuronal Function</td>
</tr>
<tr>
<td>BIOS 7411</td>
<td>Data Analysis in Neuroscience</td>
</tr>
<tr>
<td>CLRM 5861</td>
<td>Design &amp; Analysis of Longitudinal Data Studies</td>
</tr>
<tr>
<td>BIOS 7002</td>
<td>Human Metabolism: Regulation and Disease</td>
</tr>
<tr>
<td>BIOS 7408</td>
<td>Introduction to Developmental Neuroscience</td>
</tr>
<tr>
<td>BIOS 7032</td>
<td>Long Term Trends in Biomedical Sciences and Ethical Issues</td>
</tr>
<tr>
<td>BIOS 7013</td>
<td>Mechanisms of Disease</td>
</tr>
<tr>
<td>BIOS 7014</td>
<td>Molecular Approaches to Drug Action and Design</td>
</tr>
<tr>
<td>BIOS 5007</td>
<td>MSTP Mechanisms of Disease</td>
</tr>
<tr>
<td>BIOS 5012</td>
<td>Renal, Respiratory and Acid-Base Physiology</td>
</tr>
<tr>
<td>BIOS 8008</td>
<td>Special Topics in Molecular Genetics</td>
</tr>
<tr>
<td>BIOS 7029</td>
<td>Stem Cells, Development and Disease</td>
</tr>
<tr>
<td>BIOS 7027</td>
<td>Systems Biology Seminar</td>
</tr>
<tr>
<td>BIOS 7410</td>
<td>Techniques in Human Neuroscience</td>
</tr>
<tr>
<td>BIOS 7412</td>
<td>The Cellular, Molecular and Genetic Basis of Neurological and Psychiatric Disorders</td>
</tr>
<tr>
<td>BIOS 7015</td>
<td>Viruses</td>
</tr>
</tbody>
</table>

*Subject to change*
CLRM 5821 – Advanced Epidemiologic Research

COURSE DESCRIPTION: This course will introduce advanced methods in epidemiology with the primary goal of expanding knowledge of evolving methodological issues for epidemiological studies and causality inference. Topics include efficient study designs (e.g. nested case-controls, case-cohort, case-crossover) in epidemiological studies, causal diagrams and causal inference, propensity score and instrumental variable analysis to address confounding and bias. At the end of the course students will have a better understanding of various epidemiological methods used in clinical and epidemiological studies.


PREREQUISITES: Clinical Research Intensive; Epidemiological Research Methods

STUDENT PREPARATION: No specific background preparation needed. All students are expected to have a working knowledge of basic computers and college mathematics.

SUITABLE FOR 1ST YEAR STUDENTS: No. This is an advanced course.

STUDENT ASSESSMENTS: Case Studies, In-Class Discussion, Written Critiques and Final Exam.

CREDIT HOURS: 2.0
BIOS 7409 – Approaches to Study Neural Circuits in Behaving Animals

COURSE DESCRIPTION: This course will introduce students to techniques for in vivo recording of neural activity and approaches to define connectivity and expression profiling of neurons. Emphasis on techniques, instrumentation, and data analysis (demos for analysis). We will introduce the basics of measurement and instrumentation for in vivo physiology, in vivo calcium imaging, and introduce methods for manipulation, anatomy, and expression profiling of neurons. A key motivation in going over the techniques will be to compare methods for recording and manipulation (i.e. physiology versus imaging, optogenetics versus chemogenetics) in terms both of the mechanisms at the level of individual neurons and how that manipulation will impact resulting data and interpretation of behavioral/activity outcomes. Course meetings will be lectures to go over the basic information as well as hands on demonstrations with equipment and example data analysis. Students will be evaluated based class participation and on a final presentation (around 15 minutes) of recent advances in the application or analysis of one of the techniques discussed in class.

This course will provide detail about instrumentation, data output, and data analysis specific to in vivo neural recording techniques. The objective is to spend time on methodologies that are touched upon but not fleshed out in detail in the PONI and PONII courses. The is no other course at Einstein that teaches these techniques, which illustrate general principles of brain function.

Course Objectives:
- understand principles of measurement and analysis
- understand the advantages and limitation of specific approaches for neural recordings
- get hands-on experience handling data sets from in vivo recording experiments
- understand the advantages and limitations of methods for manipulating neurons
- become versed in visualizing and interpreting data from neural recording and neural manipulation experiments

PREREQUISITES: Principles of Neuroscience I and II.

REQUIRED MATERIALS: If students would like to follow along with data analysis demonstrations, a computer and free software (TBA) will be required. Demos will also be shown on a screen.

STUDENT PREPARATION: Strong background in neurobiology

SUITEABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS: Students will be assessed based on in-class participation and a final presentation (75% participation; 25% final presentation).
Participation will be assessed by daily or weekly reflections on Canvas, that will include short summaries of the main points covered in that week, and assessment of lab notebook.

**Attendance and Participation**

No more than one unexcused absence will be allowed. All absences (excused or otherwise) must be “made-up” by completing the requisite work completed in class.

**CREDIT HOURS**: 2.0
BIOS 7404 – Cell Biology of Neuronal Function

COURSE DESCRIPTION: We will consider the neuronal specific adaptations of organelles and pathways that regulate proteostasis. In-depth review of mechanisms underlying protein synthesis, recycling and degradation in neurons; mechanisms of polarized trafficking underlying protein localization at specific locations during neuronal differentiation and in mature neurons; neuronal homeostatic adaptations to activity-dependent changes in the intact circuitry; molecular basis of activity-dependent synapse remodeling under physiopathological conditions.

PREREQUISITES: No; undergraduate level Cell Biology preferred but not required.

REQUIRED MATERIALS: No specific material, including textbook, required; the Course will be structured to include lectures, discussion of current literature and attendance to seminars by invited speakers on topics related to course topics.

SUITABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS: 75% class participation; 25% paper presentation

CREDIT HOURS: 1.5
BIOS 7411 – Data Analysis in Neuroscience

COURSE DESCRIPTION: Targeted to the needs of Neuroscience graduate students, this course compliments and expands on existing mathematical-based instruction with practical, “plain English” explanations in order to provide the skill requisite to applying and interpreting statistical concepts appropriately. Actual data sets (provided by neuroscience faculty, open data sources and the students) and hands-on data visualization and analyses in each session provide real-world examples of the typical and unique challenges faced in experimental neuroscience.

Course Objectives:
1) Practical experience, through the use of actual data-sets (detailed below), in choosing appropriate data analysis tools and statistical models for typical data encountered in neuroscience studies.
2) Choosing the Correct Statistical Tests: Mastery of the implications, pros and cons, assumptions and limitations of various statistical models. Effective and transparent data visualization and illustration.
3) Application of statistical principles to pre-registration and experimental design (including power analysis).
4) Learning to correctly report statistical data – learning to interpret and understand statistical data reporting and identify errors and false assumptions in published and presented data.
5) Avoiding common pitfalls.
6) Application of these basic principles to complicated data sets for the greatest transparency and rigor.

PREREQUISITES: None.

REQUIRED MATERIALS: Computer (either platform) – contact the course director if this is an issue. JMP (SAS) will be provided by the department.

STUDENT PREPARATION: Undergraduate statistics recommended

SUITABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS: Weekly HW assignments – 20% of grade; 2 take home exams 80% of grade (one mid, one final)
Feedback given for each assignment and in class. Problem sets with feedback in class. Other formative assessments include – daily or weekly reflections on Canvass, short summaries of the main points covered in that week. Assignments may include webinar type instructional videos for how to use the software (although in class instruction is provided).

Attendance and Participation
No more than one unexcused absence per session. All absences (excused or otherwise) must be “made-up” by completing the requisite work. No more than 3 excused absences per session.
The data sets and resulting analysis should have been completed during each class session, with appropriate guidance to a reasonable standard. Students will be required to upload these to Canvas.

**Objective Assessments:**
- Summative assessments = 2 exams.
- Formative assessments - weekly HW and in class exercises in software use, data analysis and data management.

**Subjective assessments:**
Will be assessed before and after the class.
- Familiarity with, and confidence in judging and evaluating the suitable models available for statistical analysis.
- Familiarity with and confidence in evaluating statistical data reported in seminal and relevant publications.
- Completes the worksheets, analysis in class correctly and demonstrates sufficient familiarity with software features.
- Reflections will be requested weekly.

It should be noted here that despite the fact that many students have a decent rote understanding of the mathematical formulae and assumptions underlying basic statistics, they do not recognize these in the real world and express a profound (and accurate) lack of confidence about the application of these basic principles in their daily work.

**CREDIT HOURS: 1.5**
CLRM 5861 – Design & Analysis of Longitudinal Data Studies

COURSE DESCRIPTION: This course consists of a total of 14 lectures/labs which will be taught in two 7-week modules. The first module will cover logistic regression and the second module will cover survival analysis. Each module has a required textbook and will have weekly reading and graded homework assignments and a take-home exam.

OBJECTIVES: To learn the basics and applications of logistic regression in assessing associations between exposure/explanatory variables and a dichotomous outcome variable.

To learn fundamental methods in analyzing time to event data using survival analysis, especially Cox proportional hazards modeling.

Use STATA software to conduct both logistic regression and survival analysis and to be able to interpret the statistical output related to these modeling techniques.


PREREQUISITES: N/A

STUDENT PREPARATION: N/A

SUITABLE FOR 1ST YEAR STUDENTS: No

STUDENT ASSESSMENTS: A final grade of pass/fail for Biostatistics III will be assigned based on both modules: Class Participation 10%; Homework 30%; Module one exam 30% and Module two exam 30%

CREDIT HOURS: 2.0
BIOS 7002 – Human Metabolism: Regulation and Disease

COURSE DESCRIPTION: The course combines lecture, self-study and weekly small group student-led discussions of contemporary literature relevant to the lecture topics.

The course is both an extension of Biochemistry taught during Block 1 as well as an opportunity for students to develop a more cohesive view of the nature and regulation of human metabolism. The course will cover key areas in metabolism and will highlight relationships to clinically relevant topics and the integration and regulation of carbohydrate, lipid, amino acid and nucleic acid metabolism.

PREREQUISITES: A passing grade in, or exemption from, course 7001, *Biochemistry*, is required.

The student should be conversant in the basic concepts of biochemistry that are presented in the Biochemistry course prerequisite. These include, but are not limited to a familiarity with the fundamental biochemical species of amino acids, lipids, oligosaccharides and nucleic acids, biochemical energetics, the fundamental energy-producing biochemical pathways, enzymatic catalysis and enzyme regulation.


SUITABLE FOR 1ST YEAR STUDENTS: Yes.

STUDENT ASSESSMENT:
- Exam 1 covering sections 1 and 2: 40%
- Exam 2 covering sections 3 and 4: 40%
- Discussion 1: 5%
- Discussion 2: 5%
- Discussion 3: 5%
- Discussion 4: 5%

Students are expected to attend all lecture, discussion and exam sessions. If an absence is anticipated, the student must contact the Course Director before the session.

Attendance at the Review Sessions given throughout the course and before each exam is optional but highly recommended.

CREDIT HOURS: 4.0
BIOS 7408 – Introduction to Developmental Neuroscience

COURSE DESCRIPTION: The goals of Developmental Neuroscience course are the study of
1. Central nervous system development with a focus on mammalian cerebral cortex development.
2. Neural stem cell mediated neuronal and glial cell type elaborations during development and adult brain.
3. Cellular and molecular processes regulating the elaboration of these neuronal and glial cell types.
4. Roles of non-neural cells, microglia during development and in the maintenance of homeostasis in adult central nervous system.

This course provides an up to date overview of the embryonic and early postnatal development of the nervous system focusing on recent advances in the fields of genetics and epigenetics. It will also review important biological processes such as cell competition, cell fitness, different forms of cell death, as it relates to homeostasis of the developing nervous system. This will be complemented with an overview of recent advances in the fields of iPSC and organoids as in vitro models of disease pathogenesis and tissue regeneration.

Course Objectives:
1. Understanding molecular processes giving rise to the three dimensional structure and cellular diversity of CNS.
2. Utilization of this knowledge in devising new regenerative strategies including the utilization of iPSCs and organoids to understand and treat neurodegenerative diseases.

PREREQUISITES: None.

REQUIRED MATERIALS: Required readings PRIOR to each class session.

STUDENT PREPARATION: Students are encouraged to have a basic understanding of molecular genetics and cell biology.

SUITABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS:
- Class Participation: 50%
- Essay format final exam: 50%

Participation will be assessed by weekly reflections on Canvas, that will include short summaries of the main points covered in that week.

*Students cannot miss more than 1 class and those who are at risk of failing will be notified as necessary.

CREDIT HOURS: 2.0
BIOS 7032 – Long Term Trends in Biomedical Sciences and Ethical Issues

COURSE DESCRIPTION: It is a time of transformative technologies in all areas of science and engineering. The class will review the abilities of emerging technologies and issues raised by their application, including the possibility of species extinction. This can really only be understood in an interdisciplinary sense since cross fertilization has clearly led to these technologies and also informs future progress in handling them. The course will focus on biomedical research and medical applications. Many are clearly transformative and bring with them important ethical implications. Some are downright dangerous.

There are several goals of the course. They are all prompted by the observation that the present moment in time is clearly very different than the past, even the near past. We can document exponential growth in many areas of human experience, and this growth is particularly cogent in the biomedical sciences (and science in general). Very little in our evolutionary history prepares us to cope with such a fast pace of change. This course is aimed at students pursuing a career in biomedical research.

Students will be broadly exposed to new technologies which are likely to be transformative. Ethical issues, which students will obviously face in their future careers, are discussed in the hopes of preparing them for future challenges.

Course Objectives: The goals are:

- To explore the current era, what some have called the Anthropocene, a new chapter of earth’s geological history.
- To prepare students to anticipate a research environment where both fundamental knowledge and approaches (techniques) change at a fast pace. Moreover, it seems clear that science research in the future will be increasingly of an interdisciplinary nature.
- Preparing future biological researchers for the clear and disturbing ethical challenges that lie ahead. The issues, brought about by new discoveries and technologies, are here-to-fore little explored.
- To develop some sense of ownership and responsibility for the fruits of a student’s (and beyond) research. It is not sufficient to just bring about new knowledge, but also ponder how this new knowledge might be used.

PREREQUISITES: None.

REQUIRED MATERIALS: Required Reading: (other sources will be suggested as the course progresses)

- The future of genome editing. Prof. George Church. https://www.youtube.com/watch?v=WswvF8mRug
GRADUATE PROGRAMS IN THE BIOMEDICAL SCIENCES


STUDENT PREPARATION: Students should have knowledge of basic Biology, Chemistry, Physics.

SUITABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS: There will be no exams for this course. Students will be assigned to review specific materials and report to the class their findings, possibly with a powerpoint presentation. A short paper will be assigned to count as the final. Students will be graded also on class participation.

CREDIT HOURS: 1.0
BIOS 7013 – Mechanisms of Disease

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, chromosomal abnormalities), aging, cancer infectious, inflammatory, immunologic injury (Tuberculosis, Acquired Immunodeficiency Syndrome, Multiple Sclerosis), and environmental (DNA damage). Minimum 12 students.

PREREQUISITES: Knowledge of Immunology and Biochemistry is helpful.

REQUIRED MATERIALS: The course requirements will be assigned readings and open discussion, 2 oral presentations.

STUDENT PREPARATION: Background Knowledge of Immunology and Biochemistry is helpful.

SUITABLE FOR 1ST YEAR STUDENTS: Yes.

UNIQUE TRAINING OFFERED IN THIS COURSE: This course will offer a broad perspective of pathologic mechanisms and aspects of disease. There is little overlap with existing courses.

STUDENT ASSESSMENTS: Grading will be based on class participation and oral presentations. Attendance is mandatory for all lectures.

CREDIT HOURS: 3.0
BIOS 7014 – Molecular Approaches to Drug Action and Design

COURSE DESCRIPTION: As a society, where would we be without drugs? Antibiotics, chemotherapeutics and small molecules for the treatment of infections, cancer, diabetes, blood pressure, pain and a multitude of other conditions has allowed us to live longer, healthier and more productive lives. This course will provide an essential foundation of pharmacology for students interested in understanding how some of the most impactful drugs were discovered or designed and their mechanisms of action via state-of-the-art lectures and in depth discussion. Modules will cover the principles of modern pharmacology (e.g. pharmacokinetics, pharmacodynamics, pharmacogenomics), methodologies of drug discovery/design and therapeutics for the treatment of cancer, metabolic diseases and infections. The course will also introduce newer concepts in drug development, including drugs to target aging, neurodegenerative diseases, and the role of the microbiome. Throughout, emphasis will be placed on the biology and chemistry of interactions between agents and their cellular targets, including specific enzymes, and their cellular processes. When available, their impact on physiologic systems will also be discussed, including preclinical data that spurred these drugs toward clinical trials, to evidence for their eventual successes (or failures) in humans.

Course Objectives:

- Develop a fundamental understanding of pharmacology concepts and their application to guiding drug development
- Become familiar with how various types of drugs, from small molecules to antibodies, are designed, developed and tested for potential clinical use
- Become familiar with major classes of drugs, including their mode of action, used to treat common chronic conditions, including cancers, type 2 diabetes, infections and metabolic disease
- Gain a holistic understanding of the challenges and opportunities in successfully developing and bringing a drug candidate to market

PREREQUISITES: Should have the equivalent of graduate school biochemistry. Specifically, students should have some familiarity with thermodynamics, enzyme kinetics, protein structure and function, receptor ligand interactions.

REQUIRED MATERIALS: None

SUITABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS: Student performance will be heavily dependent on class participation (30%), as well as two take-home exams (25% each), and two student group presentations (10% each). Student participation will be based on regular attendance and discussion during faculty lectures and student projects. Students will also be expected to demonstrate mastery of concepts learned during lectures on both take home exams and group projects/presentations.

CREDIT HOURS: 3.0
BIOS 5007 – MSTP Mechanisms of Disease

COURSE DESCRIPTION: This course is directed to first year MSTP students and aims to provide an understanding of the general common molecular mechanism that are responsible for cellular and tissue damage and/or malfunction in most pathological processes. The course makes use of 3 different teaching approaches: lectures to present basic concepts, team based-learning using discussions on selected scientific papers and the preparation small presentation on specific topics by the students to discuss in the classroom.

Topics covered include:

A. Mechanisms of cellular damage and death:
   i. Cell/Tissue Adaptations. Response to stress;
   ii. Cell Injury: molecular targets;
   iii. Mechanisms of Cell injury;

B. Tissue regeneration and repair:
   i. Cell growth: Regulation of cell cycle;
   ii. Tissue regeneration: Transit and adult stem cells in differentiated tissues.
   iii. Wound healing

C. Inflammation:
   i. Acute inflammation;
   ii. Chronic inflammation;
   iii. Leukocytes and tissue resident cells: migration and activation;
   iv. Endothelium;
   v. Soluble mediators;
   vi. Sepsis

D. Immunopathology:
   i. Hypersensitivity;
   ii. Autoimmune disease: Mechanisms of immune tolerance, Mechanisms of autoimmunity and Autoimmune and inflammatory pathologies.

E. Aging and age-associated disorders:
   i. Theories of aging;
   ii. Experimental models;
   iv. Age-related pathologies: Neurodegeneration, Cancer, Diabetes, Bone and Joint pathology.
   Other pathologies;
   v. Anti-aging therapies.

F. Hemodynamic and vascular diseases:
   i. Hemodynamics and hemostasis: blood flow and coagulation;
   ii. Edema;
   iii. Hemorrhage;
iv. Thrombosis and embolism;
v. Atherosclerosis.
H. Cellular transformation and cancer:
i. Genome instability;
ii. Sustained proliferation;
iii. Evasion of growth suppression;
iv. Resistance to cell death;
v. Replicative immortality;
vi. Cancer stem cells;
vii. Tumor microenvironment;
viii. Angiogenesis;
ix. Invasion and metastasis;
x. Inflammation;
xi. Metabolic reprogramming;
xii. Immune Evasion;
xiii. Therapies: Current and future;
xiv. Epidemiology: risk factors/causes.

Course Objectives:
- Understand the basic molecular and cellular mechanisms that underlie pathology in cells and tissues, and recognize how this knowledge can be applied to design therapeutic approaches
- Acquire the ability to critically evaluate published data and report it to other scientists
- Develop skills to perform a comprehensive review of current knowledge on a specific topic and to communicate it to and discuss it critically with an audience

PREREQUISITES: None.

REQUIRED MATERIALS: None required. Recommended: Robbins and Cotran, Pathological Basis of Disease)

SUITABLE FOR 1ST YEAR STUDENTS: This course is for first-year MSTP students only

STUDENT ASSESSMENTS: Participation in Class: 20%; JC presentation and discussion: 40%; Focused topic presentation and discussion: 40%)

CREDIT HOURS: 1.0
BIOS 5012 – Renal, Respiratory and Acid-Base Physiology

COURSE DESCRIPTION: This course will cover the basic principles of renal, respiratory and acid-base physiology from the whole animal to the cellular and molecular levels. It will focus on functional mechanisms and homeostatic regulatory processes that maintain the volume and composition of body fluids. Homeostatic mechanisms will be discussed in relationship to human pathophysiological conditions. The course is required for all first year MSTP students.

PREREQUISITES: Membrane Physiology & Transport in Block 1 is a prerequisite to this course. Students should have a year of undergraduate chemistry and biology and preferably physics.

REQUIRED MATERIALS: Readings from textbooks, journal and review articles will be provided.

STUDENT PREPARATION: Students should be familiar with fundamental membrane and epithelial transport processes, membrane potentials, fluid mechanics and hemodynamics. Students should know about the G-protein coupled receptor second messenger signaling pathways regulating intracellular cAMP, cGMP, protein kinase C and IP3.

SUITABLE FOR 1ST YEAR STUDENTS: Yes. Required for 1st year MSTP students.

UNIQUE TRAINING OFFERED IN THIS COURSE: The course has no overlap with any other graduate division course. It will provide the students with an understanding of the kidney and lung function and how their function is homeostatically regulated to maintain the volume, composition and acid-base balance of body fluids.

STUDENT ASSESSMENTS: Students will be assessed on in class paper presentations, class participation and a take home essay and short answer exam.

CREDIT HOURS: 2.0
BIOS 8008 – Special Topics in Molecular Genetics

COURSE DESCRIPTION: The aim of the course is to discuss recent literature and progress in selected focused areas of biological research, for example to explore newly emerging areas that are not yet covered in other courses. Each year, several topics will be covered in short modules. Although there may be some lectures, the primary focus will be class discussion and presentation.

Course Objectives:
Students will learn about and discuss 2-3 emerging areas of current interest. Through in-depth analysis, the student is expected to gain a deeper knowledge of current research, appreciation of the process through which scientific understanding develops, and ability to critically read and analyze the original research literature.

TOPICS FOR SPRING 2020 SEMESTER:
Neuronal synapse development: a cell biology puzzle (Peri Kurshan)
We will try to understand how synapses—the site of information transfer between neurons—develop along axons and dendrites. This process represents a complex feat of cell biology that is still not well understood. We will discuss how genetic model organisms have contributed to our understanding of synapse development and examine new evidence and concepts about the biophysical properties of synaptic proteins that suggest the involvement of phase-separation in synapse formation.

Molecular methods for complex diseases (Frank Soldner). We will discuss how recent advances and novel functional genetics approaches enable systematic dissection of the contributions of risk factors to complex diseases. Epidemiology and population genetics suggest that complex diseases result from the interaction between multiple genetic and non-genetic risk factors eg lifestyle, environmental and aging. Three major recent innovations have fundamentally changed our ability to functionally study complex diseases: (i) Reprogramming of somatic cells into human induced pluripotent stem cells (hiPSCs) to generate patient-derived disease-relevant cells, (ii) the development of genome engineering technologies such as the CRISPR/Cas9 system to modify the genome in human cells, and (iii) the availability of tissue-type and disease-specific genome-scale genetic and epigenetic information. These offer new prospects for understanding the pathogenesis of complex diseases.

PREREQUISITES: Molecular Genetics course or equivalent advisable.

SUITABLE FOR 1ST YEAR STUDENTS: Yes with appropriate background.

STUDENT ASSESSMENTS: Grading will be by class presentation and participation.

CREDIT HOURS: 1.0
BIOS 7029 – Stem Cells, Development and Disease

COURSE DESCRIPTION: The course focuses on the fundamentals of developmental biology, stem cells and regenerative medicine. The pathways and processes central to embryogenesis are often reused during tissue regeneration. Moreover, many diseases have their origins in mis-regulation of developmental pathways. A fundamental knowledge of development can thus strengthen your understanding of regenerative biology, aging, and disease. In this course, we will focus on the major principles and appropriate experimental approaches utilized in researching questions in development and stem cell biology.

The course is comprised of lectures, team-based learning discussions and writing sessions. For all aspects of the course, students are highly encouraged to raise their own questions about material presented and to voice their agreement (or dissent!) with thoughts raised during discussions. Course leaders and instructors will make sure that everyone has a chance to participate in the discourse.

Course Objectives: The goal of this course is for students to get an overview of the state-of-the-art of research in developmental biology and stem cells. Students will learn to critically evaluate literature and seminars, to understand relevant experimental approaches, and to develop logical thinking and good experimental design skills for studying development and stem cell biology.

PREREQUISITES: None

REQUIRED MATERIALS: None; ‘Developmental Biology’ by Gilbert et al. or similar standard textbooks can be helpful. Instructors will point out relevant literature for further reading. Material to be studied in advance will be posted with sufficient notice on Canvas.

SUITABLE FOR 1ST YEAR STUDENTS: Yes.

STUDENT ASSESSMENTS: Grading is primarily based on participation. Course leaders and instructors evaluate participation of student [preparedness, quality of questions and answers] during lecture-based classes and journal club presentations. In case of paper discussions, a student will act as facilitator and will introduce the topic and randomly select students to present figures or answer questions emerging from the ongoing discussion. All students are expected to be part of the paper discussion. The facilitator will summarize conclusions and future directions or details that should be further addressed. Discussion leaders of JCs will receive extra credit.

Additionally, there is a group writing exercise that will comprise 12.5% of the final grade. The class will be divided into groups of 3-4 students each. Each group will write a one-page grant proposal on a development or stem cell topic, and then present it to the class. Grades will be assigned based on the logic and experimental approach of the proposal and presentation.

Attendance and participation in ALL classes is required. Absences must be excused prior to class meeting. More than two absences per term will result in a failing grade for the course.

CREDIT HOURS: 2.5
BIOS 7027 – Systems Biology Seminar

COURSE DESCRIPTION: It has long been recognized that scientific breakthroughs and groundbreaking research in the coming century requires multidisciplinary approaches to many areas of research. By means of critical reading of classical and contemporary articles the course will cover a broad range of relevant techniques from mathematical, statistical and computational sciences, and their relations to the specific scientific questions in each of the articles discussed. The course will cover 26 articles on biological questions that have been addressed both theoretically and experimentally. These articles will cover a broad range of biological topics from molecular biology, evolutionary biology, geonomics and neuroscience.

(In order for this course to be given a (minimum of 6 students) must be registered.)


REQUIRED MATERIALS: N/A

SUITABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS: Student presentation throughout the course

CREDIT HOURS: 2.0
BIOS 7410 – Techniques in Human Neuroscience

COURSE DESCRIPTION: This course will provide a survey of current methodologies used in the study of human neuroscience and behavior. These include functional magnetic resonance imaging (fMRI), diffusion tensor imaging (DTI), functional near-infrared spectroscopy (fNIRS), event-related brain potentials, mobile brain/body imaging (MOBI), and clinical assessments. Lectures will focus on the tools and techniques used to understand brain systems that enable memory, attention, language, scene perception, and executive functions, and the development of these processes across the lifespan.

Course Objectives:
- Learn the range of methodologies used to investigate the brain basis of human cognition.
- Identify strengths and limitations in the study of complex brain functions.

PREREQUISITES: None.


SUITABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS: Grades will be based on attendance (10%) class participation (30%) and presentation of a paper that includes the strengths and weaknesses of the technique for answering questions about human behavior (60%). Participation will be assessed by daily or weekly reflections on Canvas, that will include short summaries of the main points covered in that week.

Attendance and Participation
No more than one unexcused absence will be allowed. All absences (excused or otherwise) must be “made-up” by completing the requisite work completed in class.

CREDIT HOURS: 1.25
BIOS 7412 – The Cellular, Molecular and Genetic Basis of Neurological and Psychiatric Disorders

COURSE DESCRIPTION: This block will be subdivided into four, weekly sessions devoted to neurological and psychiatric disorders, as follows:

- Psychiatric disorders (schizophrenia, bipolar disorder, addiction)
- Speech and hearing disorders; auditory processing
- Neurodegenerative disorders (e.g., Alzheimer Disease, Parkinson Disease, Huntington Disease)
- Neurological disorders (e.g., epilepsy, stroke)

The lectures will combine a clinical description of the disorders with the modern approaches being used to understanding their molecular and genetic basis, for the purpose of developing novel therapies. The methods that will be discussed include genome wide association studies (GWAS), copy number variant (CNV) analysis, whole genome and exome sequencing, induced pluripotent stem cell disease-modeling, CRISPR-editing, high throughput drug screening using human neuronal cells, regenerative medicine, and gene therapy/antisense oligonucleotides.

The course provides an overview of a broad range of neurological, neurodevelopmental and psychiatric disorders, along with descriptions of modern research tools designed to help understand their underlying basis. The course has a unique translational perspective. There is not other course at Einstein dedicated to teaching about brain disorders.

Course Objectives: Acquaint Ph.D. students with the clinical features of various neurological and psychiatric disorders, which are among the most disabling disorders in the world, and show how the tools of modern basic science research are being used to develop novel therapies.

PREREQUISITES: None.

REQUIRED MATERIALS: Suggested reading: Each lecture will be accompanied by one article; either a review or a relevant research paper related to that particular lecture.

STUDENT PREPARATION: Basic undergraduate courses in neuroscience and genetics

SUITABLE FOR 1ST YEAR STUDENTS: Yes

STUDENT ASSESSMENTS: 40% of the final grade will be based on attendance and class participation. At the end of each class, the students are expected to upload a short (250 word) paragraph to canvas on what they have learned in class.

CREDIT HOURS: 1.25
BIOS 7015 – Viruses

COURSE DESCRIPTION: The study of viruses helped lay the foundation of modern molecular biology, and continues to provide new insights into the biology of cells and organisms. Moreover, we live in an increasingly interconnected and crowded world in which “new” viruses can emerge and spread throughout the globe seemingly overnight, and are being discovered at an ever-accelerating pace through cutting-edge genome sequence-based technologies. At the same time, “old” viruses such as HIV-1 remain a global threat and viruses we thought we had defeated, such as measles, are resurgent. Therefore, a sophisticated and broad-based understanding of animal viruses is needed more than ever. In this course, we will study how viruses are put together, how they multiply in their hosts and cause disease, how we find new viruses and characterize them, and how we exploit them as tools for basic research and therapy.

'Viruses' will be kicked off with a lecture by a noted virologist. This will be followed by didactic lectures featuring Einstein’s own virology faculty complemented by invited outside speakers. All speakers are international experts in different areas of the study of viruses. The course is organized into 6 units and the lectures will cover virus structure, mechanisms of virus entry and replication, regulation of viral and host gene expression, virus assembly, virus egress, host responses to viral infections, and viral pathogenesis and evolution. ‘Viruses’ will demonstrate how these basic principles offer opportunities for diagnosis, prevention, and treatment of prevalent and emerging viral diseases, and for the development of new applications that utilize viruses as tools.

PREREQUISITES: Biochemistry, Gene Expression and Molecular Genetics courses are recommended, but not mandatory. Information covered in the course requires a reasonable level of background in contemporary molecular biology, biochemistry and cell Biology.

REQUIRED MATERIALS:
- A computer to access email and internet.

SUITABLE FOR 1ST YEAR STUDENTS: Yes.

STUDENT ASSESSMENTS: There will be two exams: a mid-term and a final exam. In addition, classroom participation will carry 20% of the total marks.

CREDIT HOURS: 3.0