Albert Einstein College of Medicine

Graduate Programs in the Biomedical Sciences

COURSE CATALOG

Spring 2024 Block II

Spring 2024 Courses
Block II

Subject to change

BIOS 7024 – Chemical Biology

COURSE LEADER:
Jonathan R. Lai, PhD

COURSE SCHEDULE:
November 28, 2023 – March 5, 2024
Tuesdays, Thursdays, 1:10-2:10
Fridays, 2:00-3:00

COURSE DESCRIPTION:
This class will examine fundamental principles and current techniques for the use of chemical methods to manipulate and study biological processes. Topics include synthesis and screening of chemical and protein libraries, methods for modification of proteins, display technologies, enzymology, and ProTAC/LysoTAC design. This course will build on concepts presented in Biochemistry (which focuses on fundamental aspects of protein and nucleic acid structure and mechanism) and complement Human Metabolism and Gene Expression.

COURSE OBJECTIVES:
The goal of this course is to provide students with a foundational framework of concepts in Chemical Biology that can be applied to drug discovery or basic research on biological systems. Upon completion of this course, successful students will:

1. Critically assess Chemical Biology primary literature and communicate methods and conclusions to their peers.
2. Demonstrate knowledge of fundamental principles of Chemical Biology and how those may be applied to biological systems.
3. Demonstrate the ability to select Chemical Biology methods to solve problems in a biological system.

PREREQUISITES:
Biochemistry (Block I).

REQUIRED MATERIALS:
Laptop.

SUITABLE FOR 1ST YEAR STUDENTS:
Yes.

STUDENT ASSESSMENTS:
Two presentations (20% each): Students will be assigned into teams and will be responsible for reading assigned literature, providing critical analysis, and then presenting to the rest of the class. Evaluations will be performed by the Course Director in conjunction with contributing lecturers and be based on clarity, accuracy, composition of slides, and critical dialogue.

Discussant on two presentations (5% each): Students will listen to other student presentations and provide commentary or ask questions. Participation is expected.

Two in-class examinations (25% each): Students will be expected to demonstrate knowledge of the assigned topics, and to critically analyze methodologies and formulate experimental strategies to apply them to biological problems.

CREDIT HOURS: 3.0

BIOS 7018 – Computational Biology of Proteins

COURSE LEADER:
Andras Fiser, PhD

COURSE SCHEDULE:
November 28, 2023 – March 5, 2024
Tuesdays, Thursdays, 10:30-11:40

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.).

We also devote about one third of the lectures to provide an introductory Python programming course with practical applications in bioinformatics.

COURSE OBJECTIVES:
- To learn fundamentals of bioinformatics algorithms and most frequent applications in protein science research.
- To learn python programming.

PREREQUISITES:
None.

SUGGESTED MATERIALS:
Not required, but suggested:
- Computational Biochemistry and Biophysics, Marcel Dekker, New York, NY, ISBN 978-0824704551.
- 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.

SUITABLE FOR 1ST YEAR STUDENTS:
Yes.

STUDENT ASSESSMENTS:
25% Midterm exam
25% Python programming exam
25% Final exam
25% Attendance

A pass requires 75%.

CREDIT HOURS: 2.5

BIOS 8009 – Fundamentals of Course Design and Teaching

COURSE LEADER:
Michael Risley, PhD

COURSE SCHEDULE:
January 4 – May 9, 2024
Thursdays, 4:00- 6:00

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.

This 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 concepts in adult learning, course, lesson and syllabus design, lecture hall strategies, active learning strategies, formative and summative assessment techniques.

The course will also introduce the application of artificial intelligence in research and scientific education-an explosive and rapidly evolving field that will heavily influence teaching and learning.

COURSE OBJECTIVES:

- Describe the traits most common to highly successful teachers and courses.
- Identify the varied characteristics of adult students as a basis for designing learning environments and activities.
- Differentiate significant (deep) from superficial learning.
- Define cognitive hierarchies and backward design as fundamental principles for course and lesson planning.
- Design lessons, courses and syllabi consistent with defined learning objectives, learning hierarchies and diversity in learning styles.
- Describe the importance of active learning theory and varied instructional modalities to achieve active learning in diverse settings, ranging from the lecture hall to scientific paper analysis and discussion.
- Design formative and summative assessments of student learning, teaching and course effectiveness.
- Design a Teaching Portfolio component for the curriculum vitae.

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.

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

SUITABLE FOR 1ST YEAR STUDENTS:
No.

STUDENT ASSESSMENTS:
This is a pass/fail course. The course seeks to promote student discussion and engagement in varied active learning activities with peer learners, which may include postdocs and faculty. Therefore, to enhance the learning environment there will only be occasional quizzes. Course objectives will be achieved through a mix of instructor-directed and student-directed discussions, selected readings from texts and education research literature, and active learning strategies which engage students in group-based discussions, course planning and teaching.

Successful completion of the course requires:

- Attendance/quizzes (**no more than 3 absences and/or failed assignments/quizzes**). **All assigned readings are expected to be read prior to class and will be occasionally quizzed.**
- Active weekly participation in class and group discussions/assignments.
- Satisfactory completion of group exercises in course design.
- Satisfactory peer evaluation of contributions and performance within the learning group.

CREDIT HOURS: 2.0

BIOS 7007 – Gene Expression: Beyond the Double Helix

COURSE LEADER:
David Shechter, PhD | Matthew Gamble, PhD

COURSE SCHEDULE:
November 27, 2023 – March 4, 2024
Mondays, Wednesdays, Thursdays, 2:20- 4:00

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. Students will learn how to critically think about interpreting and designing experiments. 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.

COURSE OBJECTIVES:
Biological Information, i.e. DNA, RNA, Chromatin, Translation, other information stores.

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

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

REQUIRED MATERIALS: Computer.

SUITABLE FOR 1ST YEAR STUDENTS: Yes.

STUDENT ASSESSMENTS:
There will be three take-home, open-book exams. These exams will be distributed throughout the course block, covering content from lectures, discussion sections, and readings. Critical thinking and experimental design and interpretation are key parts of the grading. Grades and constructive feedback will be returned. The exams will count for 80% of the final grade. Discussion section participation (attendance and oral contributions) will count for 20% of the final grade. As an experiment this year to better space out the work, the questions for Exam I will be handed out piecemeal after each relevant lecture and answers to each question will be due one week after it is assigned.

CREDIT HOURS: 5.0

BIOS 7022 – Immunology

COURSE LEADER:
Teresa DiLorenzo, PhD | Grégoire Lauvau, PhD

COURSE SCHEDULE:
November 28, 2023 – March 5, 2024
Tuesdays, Thursdays, 1:10-2:10
Fridays, 1:10-2:40

COURSE DESCRIPTION:
The course will consider both innate and adaptive immunity and include the structure and function of key receptors including innate Pattern Recognition Receptors, Major Histocompatibility Complex, Immunoglobulins and T Cell Receptors. The mechanisms of innate immune responses, antibody formation and molecular aspects of cellular immunity, including T and B cell interactions and memory lymphocyte formation, will be emphasized, and connections to modern biomedical science will be highlighted. These will include presentations and discussions on autoimmunity, immunity against microbial pathogens, transplantation, and tumor immunology. The course will rely on multiple materials, including formal lectures (by sixteen Einstein faculty), seminal paper discussions, immunological methods and mouse model lectures, assigned reading (selected textbook chapters and cutting-edge review articles), didactic videos, and data-driven learning sessions ("hands-on" data analysis and interpretation).

COURSE OBJECTIVES:
The goal of the course is to provide students with a broad overview of basic immunology, while also delving deeply into cellular and molecular details in areas of central importance to the field. 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.

PREREQUISITES:
Although there are no formal prerequisites, students who are completely new to immunology are especially advised to do some preparation in advance to become familiar with the basics.

REQUIRED MATERIALS:
Textbook: Janeway's Immunobiology 10th edition, Murphy, Weaver, and Berg, ISBN-13: 978-0393884906, ISBN-10: 0393884902
Computer access; internet access.

SUITABLE FOR 1ST YEAR STUDENTS:
Yes.

STUDENT ASSESSMENTS:

First-quarter exam	15 points
Participation	10 points
Midterm exam	30 points

Final exam	45 points
	100 points

Students earning a total of 70 points or greater will receive a passing grade for the course. Lower point totals may also qualify as passing, but this will need to be determined once the grade distribution has been evaluated.

The participation grade will be determined based on attendance and contributions to class discussions, including seminal paper and data sessions.

CREDIT HOURS: 4.0

BIOS 7005 – Molecular Cell Biology

COURSE LEADER:
U. Thomas Meier, PhD | Duncan Wilson, PhD

COURSE SCHEDULE:
November 27, 2023 – March 4, 2024
Mondays, Wednesdays, Fridays, some Thursdays, 9:00-10:20

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, 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 cycle, cell junctions, extracellular matrix, cytoskeleton, small G proteins, and signal transduction.

COURSE OBJECTIVES:
At the end of this course, you will understand the structures and functions of most cell components and how they communicate and interact with each other. It will make scientific literature and seminars more accessible to you. You will develop an overall sense and feel for life on a cellular level.

PREREQUISITES:
Some background in biochemistry, molecular biology, and cell biology is helpful but not required.

REQUIRED MATERIALS:
Albert's "Molecular Biology of the Cell" 7th edition. https://digital.wwnorton.com/mboc7
ISBN-10: 0393884821; ISBN-13: 978-0393884821

Reading the relevant chapter(s) prior to the lecture is required and essential for understanding the lectures. Additional required reading material will be provided by each lecturer consisting of review articles and original research articles.

SUITABLE FOR 1ST YEAR STUDENTS:
Yes

STUDENT ASSESSMENTS:
Based on three in-class exams and, to a minor extent, on three team-based learning sessions (TBLs).
Grading is on a curve, not on a fixed score, which will be discussed after each exam.

CREDIT HOURS: 5.0

BIOS 7011 – NMR for Chemistry and Biochemistry

COURSE LEADER:
David Cowburn, PhD | Sean Cahill, PhD

COURSE SCHEDULE:
November 27, 2023 – March 4, 2024
Mondays, Wednesdays, 10:40-11:50

COURSE DESCRIPTION:
The course will provide a gentle but thorough introduction to basic NMR theory and principles followed by application of NMR to solving various chemical and biochemical problems. Topics will include one-, two-, and 3-dimensional NMR methods applied to: the covalent structure and conformation of small molecules and macromolecules, ligand binding and exchange rates, pKa values, and enzyme mechanisms. Lectures will be combined with hands-on sessions in the NMR lab, where students will be assigned projects to be completed on the NMR spectrometers.
NOTE: there are approximately 7 labs that will require some time outside of the assigned block to complete - prepare to spend 1-2 hours for each lab to run experiments and/or analyze data on your own time.

COURSE OBJECTIVES:
Students will acquire the basic skills for running NMR experiments and interpreting NMR data from a variety of applications in chemistry and structural biology.

PREREQUISITES:
A general familiarity with organic chemistry and biochemistry.

REQUIRED MATERIALS:
Computer or laptop.

SUITABLE FOR 1ST YEAR STUDENTS:
Yes.

STUDENT ASSESSMENTS:
Lab reports and problem sets: 75%
Scores on late reports/problem sets are discounted 10%/day; lowest score will be dropped.

Presentation: 25%
Score based on
- Introduction to paper and problem studied
- NMR methods and details of experiments performed
- Summary and discussion of results

- Conclusions, future directions and timing of talk

Grade required to pass: 65/100; w/ Honors: 93

CREDIT HOURS: 2.5

BIOS 7034 – Principles of Magnetic Resonance Imaging

COURSE LEADER:
Mark Wagshul, PhD | Craig Branch, PhD | Qi (Chris) Peng, PhD

COURSE SCHEDULE:
November 27, 2023 – March 4, 2024
Mondays, Wednesdays, 4:10-5:30

COURSE DESCRIPTION:
The course will cover the basic principles of magnetic resonance imaging, including the fundamentals of magnetic resonance, image formation and applications. Specific topics will include: fundamentals of nuclear magnetic resonance, relaxation and the Bloch equations, spin and gradient echoes, contrast mechanisms, principles of image formation, signal to noise ratio and resolution. Individual modules will give students exposure to MRI pulse sequence design and to clinical imaging, with hands-on experience on a 3T MRI scanner.

COURSE OBJECTIVES:
The overall goal of the course is to provide a basic understanding of how MRI works, including detailed methods of image formation and acquisition. At the end of the course, students should be able to describe the physical processes involved in acquiring and processing MRI data, the difference between various MRI imaging techniques, and clinical applications of these various methods.

PREREQUISITES:
College level physics (basics of magnetism) and mathematics (exponentials functions, algebraic functions, basic calculus concepts, e.g., derivatives and integrals). While not required, basic programming skills will be used in this course (experience with any language will be helpful, although we will be using Matlab) and students with no formal programming coursework are recommended to do online learning in advance. Suggested online modules will be emailed out a few weeks prior to the first lecture.

REQUIRED MATERIALS:
E. Mark Haacke, “Magnetic Resonance Imaging: Physical Principles and Sequence Design” ISBN-10: 0471351288; ISBN-13: 978-0471351283.

SUITABLE FOR 1ST YEAR STUDENTS:
Yes.

STUDENT ASSESSMENTS:
Final take-home exam (50%), Problem sets (25%, 4-5/semester), attendance (10%), participation (15%)

Final project will be in the form of an either 1) written specific aims and study design, using MRI methods to address a fundamental question in clinical or pre-clinical medicine, or 2) critical review of a peer-reviewed MRI methods paper. The student will present and defend their proposal/paper review in an oral presentation (15-20 min) to be delivered during the last week of classes.

Problem sets will be handed out ~ every other week, with 1-2 problems designed to test students on their mastery of the imaging principles covered in class, and their ability to apply these principles to clinical or basic science applications.

Attendance will be graded based on attendance to the lectures (on a sliding scale, with full credit for at least 90% attendance). In the event of occasional, valid reasons for missed classes, students can discuss with the course instructors to make up missed material.

Participation will be expected of all students, in the form of occasional queries during class; while there will be no formal discussion sessions, all of the modules will be taught in an interactive manner, with adequate opportunity for interactive participation from students during class. Reasonable effort on the part of a student to participate in these discussions will be expected.

CREDIT HOURS: 3.0

BIOS 7407 – Principles of Neuroscience II

COURSE LEADER:
José L. Peña, MD, PhD | Ruben Coen-Cagli, PhD | Anita Autry-Dixon, PhD

COURSE SCHEDULE:
November 28, 2023 – March 5, 2024
Tuesdays, Thursdays, Fridays, 2:00-4:00

COURSE DESCRIPTION:
Principles of Neuroscience II is a 13-week course required for students in the Department of Neuroscience. In this course, students will explore how complex neural systems integrate afferent information and direct efferent outflow, and the mechanisms underlying the development of these neural systems. 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, followed by investigation of the developmental mechanisms driving the structure and function of neural networks. Student knowledge in these areas will be built 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.

COURSE OBJECTIVES:
- To learn the role of neural networks in high-order perceptual, motor and behavioral states functions.
- To learn computational approaches explaining brain functions.
- To learn how to write a research grant

PREREQUISITES:
Principles of Neuroscience I (Block I)

REQUIRED MATERIALS:
Online access to Zoom lectures, books and journals available at Einstein's library.

SUITABLE FOR 1ST YEAR STUDENTS:
Yes

STUDENT ASSESSMENTS:
The grade in this course will be based on participation in class (25%), proposed research project, midterm projects critiques (25%), and final proposed research project (50%).

CREDIT HOURS: 6.0

BIOS 7020 – Responsible Conduct of Research

COURSE LEADER:
Victoria H. Freedman, PhD | Anne Bresnick, PhD | Diane Safer, PhD

COURSE SCHEDULE:
November 28, 2023 – March 5, 2024
Tuesdays, 8:30-10:20

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

Topics:

- Overview of RCR
- Research Misconduct
- Protection of Human Subjects
- Welfare of Laboratory Animals
- Conflicts of Interest
- Data Management Practices
- Collaborative Research
- Mentor and Trainee Responsibilities
- Resilience and Self-Efficacy
- Responsible Scientist
- Safe Research Environments
- Authorship and Publication
- Peer Review

COURSE OBJECTIVES:
The Responsible Conduct of Research course is designed to introduce key issues in the responsible conduct of research (RCR), by following the research process from inception to planning, conducting, reporting, and reviewing biomedical research. The course will provide an overview of the rules, regulations, and professional practices that define the responsible conduct of research. In addition, the course aims to provide a practical framework for ethical decision making when faced with difficult situations in the research and training environment.

PREREQUISITES:
None

REQUIRED MATERIALS:
The textbook "ORI Introduction to the Responsible Conduct of Research" by Nicholas H. Steneck (Department of Health & Human Services) features case studies, text-box inserts, discussion questions and electronic and printed resources. The text is available online as a PDF document (http://ori.hhs.gov/documents/rcrintro.pdf). Each session of the course is associated with one or more chapters from the text.

SUITABLE FOR 1ST YEAR STUDENTS:
Yes. Required for 1st year students and PREP scholars.

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: 2.0