Overview of Courses in the Biological Sciences 2020-2022

Most courses are offered on a two-year cycle. Participation in a course requires students to attend all sessions. The most widely used format for courses consists of twelve sessions of two to four hours, comprising a lecture, discussions and review of relevant articles from the literature. Students desiring more information about course content and participation or qualification requirements are encouraged to approach the organizers.

2020-21	Fall	Winter	Spring and Summer
	Comprehensive Neuroscience Freiwald/Hudspeth/Jarvis Maimon/Strickland	**Cell Biology of Nuclear Processes** de Lange	**Bioinformatics** Carroll
	Experiment and Theory in Modern Biology Simon	**Cell Cycle Control** F. Cross/Funabiki	**Comprehensive Neuroscience** Freiwald/Hudspeth/Jarvis Maimon/Strickland
	Quantitative Understanding in Biology Banfelder/Skrabanek	**Cellular and Organismal Metabolism** Birsoy/Cohen	**Introduction to Programming for the Life Sciences** Syberg
	Responsible Conduct of Research Tri-Institutional Faculty	**Comprehensive Neuroscience** Freiwald/Hudspeth/Jarvis Maimon/Strickland	**Mammalian Genetics** Smogorzewska
	Seminars on Modern Biology Rockefeller Faculty	**Math Review for Biologists** Magnasco	**Mathematical Modeling** Magnasco
		Science Diplomacy Ausubel/Holford	**Quantitative Understanding in Biology Short Course** Banfelder/Skrabanek
		Virology Rice/Bieniasz/Hatziioannou	**Social Evolution and Behavior** Kronauer
			Virology (continued) Rice/Bieniasz/Hatziioannou

2021-22	Fall	Winter	Spring and Summer
	Biochemical and Biophysical Methods I Alushin/Darst/Liu/Rout	**Biochemical and Biophysical Methods II** Alushin/Darst/Liu/Rout	**Bioinformatics** Carroll
	Chemical Biology Kapoor	**Cell Biology** Simon/Shaham	**Cell Biology (continued)** Simon/Shaham
	Experiment and Theory in Modern Biology Simon	**Cellular and Organismal Metabolism** Birsoy/Cohen	**Genetics and Evolution** Cross/Kronauer
	Molecular Basis of Cancer Tavazoie	**Development of CNS Circuits** Hatten	**Introduction to Programming for the Life Sciences** Syberg
	Quantitative Understanding in Biology Banfelder/Skrabanek	**Science Diplomacy** Ausubel/Holford	**Microbial Pathogenesis** Marraffini/Rock
	Responsible Conduct of Research Tri-Institutional Faculty		**Quantitative Understanding in Biology Short Course** Banfelder/Skrabanek
	Seminars on Modern Biology Rockefeller Faculty		
	Stem Cells in Tissue Morphogenesis and Cancer Fuchs/Brivanlou		

Fall 2020: September 9– December 18

Hour	Monday	Tuesday		Wednesday	Thursday	Friday
9		Experiment and Theory in Modern Biology				
10	Comprehensive Neuroscience			Seminars on Modern Biology	Comprehensive Neuroscience	Seminars on Modern Biology
11						
12						
1						
2						
3						
4			Responsible Conduct of Research			
5		Quantitative Understanding In Biology			Quantitative Understanding In Biology	
6						

Winter 2020-21: January 5 – March 19

Hour	Monday	Tuesday	Wednesday	Thursday	Friday
9			Math Review for Biologists Lectures		
10	Comprehensive Neuroscience	Virology Lecture 10-12		Comprehensive Neuroscience	
11					
12		Lunch/Discussion 12-2			
1			Cellular and Organismal Metabolism	Cell Cycle Control	
2	Cell Biology of Nuclear Processes				
3		Math Review for Biologists Labs		Science Diplomacy	
4					
5					
6					

Spring 2021: March 22 – June 11

Hour	Monday	Tuesday	Wednesday	Thursday	Friday
9					
10	Comprehensive Neuroscience	Virology Lecture 10-12		Comprehensive Neuroscience	
11					
12		Lunch/Discussion 12-2			
1	Mammalian Genetics				
2			Introduction to Programming for the Life Sciences		
3		Mathematical Modeling			
4					
5			Statistics Short-Course		
6					

Course descriptions are listed alphabetically within subject areas. The course unit value is indicated in parentheses. Participation in seminars, tutorials, journal clubs and minor courses for which no value is indicated cannot be used as part of the curriculum qualification.

Biochemistry, Structural & Chemical Biology & Biophysics

Biochemical and Biophysical Methods I & II (2 for each part)

Gregory Alushin, Seth Darst, Shixin Liu, Michael Rout

This course presents the fundamental principles of biochemistry and biophysics, with an emphasis on methodologies. In addition, case studies are discussed, examining how physical and chemical methods have been used to establish the molecular mechanisms of fundamental biological processes. The course is offered in two consecutive semesters. Part I introduces biological macromolecules and experimental tools for dissecting their three-dimensional structures and assembly principles. Part II covers methods aimed at delineating the conformational fluctuations, chemical turnovers, and kinetic trajectories of biological complexes at molecular, cellular, and evolutionary scales. There will be a two-hour session biweekly. The recommended reading is The Molecules of Life: Physical and Chemical Principles by John Kuriyan et al.; Molecular Biology of the Cell by Bruce Alberts et al.; Physical Biology of the Cell by Rob Phillips et al. The method of evaluation will be a 5-minute oral presentation of a research proposal + 1-page written summary with specific aims for one semester; a 3-page written review of a chosen method for the other semester.

Chemical Biology (1)

Tarun Kapoor

The spirit of this course is to explore the complexities of modern biology using the tools of chemistry. The lectures cover amino acid chemistry, nucleic acid chemistry, posttranslational modifications of proteins, discovery and use of chemical probes to examine cellular mechanisms, membrane chemistry, chemical tools for imaging, and natural product biosynthesis. The method of evaluation is class attendance, active participation in the discussions and exams (midterm and final).

Cell, Molecular & Developmental Biology

Cell Biology (2)

Sanford Simon and Shai Shaham

This is an advanced course covering major topics in modern cell biology, taught by faculty and visitors who are specialists in various disciplines of Cell Biology. A good knowledge of textbook cell biology is a prerequisite for effective participation. The course will be completed with an oral exam. Recommended text for cell biology: *Molecular Biology of the Cell* by Alberts et al., Garland Publishing, Inc. Recommended text for histology: *Basic Histology* by Junquera, Kaniero and Kelly, 2016 edition.

Cell Biology of Nuclear Processes (2)

Titia de Lange

This course is taught by Rockefeller faculty whose expertise covers the following subjects: Robert Roeder (transcription); David Allis (chromatin); Sohail Tavazoie (RNA processing and modification);

Michael Rout (NE and NPCs); Frederick Cross (cell cycle control); Michael O'Donnell (DNA replication); Agata Smogorzewska (DNA repair); Titia de Lange (DNA damage response and telomeres); and Hironori Funabiki (chromosome segregation). The main prerequisite is a basic understanding of molecular biology and biochemistry. The methods of evaluation include: course attendance, participation in discussions and a final, take-home exam.

Cell Cycle Control (1)

Frederick Cross and Hironori Funabiki

This seminar explores the current understanding of eukaryotic cell cycle control. Topics include the construction of a biochemical oscillator and overall structure of cell cycle control; positive and negative control of DNA replication; spindle morphogenesis and function; chromosome cohesion control; surveillance mechanisms (checkpoints) monitoring spindle and DNA integrity; and control of proliferation (start/restriction point control). The seminar relies heavily on studies in model organisms, but the emphasis throughout will be on aspects of cell cycle control conserved among eukaryotes. The method of evaluation is class attendance, homework exercises and active participation in the discussions.

Cellular and Organismal Metabolism (1)

Kivanc Birsoy and Paul Cohen

This course covers fundamental aspects of cellular (biochemical pathways) and organismal metabolism, as well as exciting new applications of these pathways to diseases such as obesity, diabetes, and cancer. Lectures are given by the two course directors, as well as outside experts in the field. The format consists of a weekly, two-hour lecture, followed by discussion. The main prerequisite is an undergraduate biochemistry course. The required reading consists of a biochemistry textbook and discussion papers. Recommended texts are Biochemistry (Lehninger), Navigating Metabolism (Navdeep Chandel). The method of evaluation is classroom attendance, active participation in discussions, and presentations.

Molecular Basis of Cancer (2)

Sohail Tavazoie

This course is designed to teach modern concepts in the regulation of growth control and its significance to cancer. The format consists of a weekly, two-hour lecture followed by informal discussion over lunch. Each lecture is accompanied by a review and a research article to be discussed at lunch. The required textbook is *The Biology of Cancer*, by Robert A. Weinberg, 2nd edition, Taylor and Francis, Inc., 2013. A reference list is distributed at the first session. The method of evaluation is class attendance, active participation in the discussions and a take home final exam.

Stem Cells in Tissue Morphogenesis and Cancer (2)

Elaine Fuchs and Ali Brivanlou

This course aims to present and discuss key concepts in stem cell biology drawing on research from planaria, *Drosophila*, zebrafish, mouse and human. We cover basic principles of stem cells from self-renewal to tissue development, homeostasis, wound-repair and cancer. In addition to the basic lectures, there are 6-7 guest speakers who are world renowned leaders in the field. Although these lectures are open to the public, they are geared towards students enrolled in the course. Following each of these

lectures, speakers lead a discussion with the class. Course credit is awarded based upon participation in lectures and class discussions, as well as a written paper. Students are required to attend lectures and class.

Genetics

Genetics and Evolution (2)

Frederick Cross and Daniel Kronauer

This seminar covers the basic mechanisms of genetics and evolution including the generation of mutations and genetic segregation; linkage and recombination (with emphasis on linkage/segregation in eukaryotes). The course also considers changes in population genotypes when these basic genetic mechanisms are operating in the presence or absence of selective pressure. Changes in population genotypes can have effects ranging from polymorphism at neutral loci to the evolution of distinct species. Such changes are also used in historical analysis to trace migrations, evolution and coevolution in diverse biological contexts. The method of evaluation is class attendance, homework exercises, and active participation in the discussions.

Mammalian Genetics (1)

Agata Smogorzewska

This course covers genetics of bone marrow failure syndromes, cancer susceptibility, infectious diseases, obesity, diabetes, coronary heart disease, and neurodegenerative diseases. Wealso discuss human gene mapping, disease modeling using mouse genetics, modern genetic tools including RNAi screening and genetic engineering using CRISPR, as well as ethical issues in modern human genetics. Performance in the course is evaluated by class participation and a take home final exam.

Bioinformatics, Mathematics and Programming

Bioinformatics (2)

Thomas Carroll

In this course, we are introduced to the analysis of high-throughput sequencing using R and Bioconductor. We learn the fundamentals of data handling in R, review the standard high-throughput sequencing data types and manipulate this data using the Bioconductor R libraries. Following this, we step through the processing and analysis of published RNA-seq, ChIP-seq and ATAC-seq data. The course has no prerequisites. Attendance for all sessions is required. Class meets for a 3 hour session, biweekly. The method of evaluation is two weekly exercises on what is reviewed each week.

Introduction to Programming for the Life Sciences (2)

Seth Syberg

In this course, students learn how to write code in a single programming language. The course focuses primarily on learning to write general purpose programs in the Python programming language. Towards the end, students learn about shell scripting and the R programming language. The method of evaluation is class attendance, active participation in the discussions, programming exercises during class and a weekly programming challenge outside of class. Students who wish to take the course for

credit must complete a final project.

Mathematical Modeling (1)

Marcelo Magnasco

This is an introduction to important topics in mathematical modeling and quantitative biology. A representative selection of subjects includes basic dynamics, fixed points and bifurcations, spiking neuron models, diffusion, chemical kinetics and systems biology, and stochastic simulation. Lectures introduce each topic and lab sessions cover programming methods in Python. The course is intended to be accessible to students who have taken Math Review for Biologists, or who have a similar level of facility with calculus, linear algebra, and basic Python programming. Students are expected to attend a two-hour lecture and discussion session and a two hour coding lab session each week. The method of evaluation is completion of a final project.

Math Review for Biologists (0)

Marcelo Magnasco

This is an intensive skill development course, starting with calculus and linear algebra and leading up to differential equations, Fourier transforms, and related computational methods for model simulation. A concurrent journal club explores the major historical papers as well as contemporary biological modeling papers proposed by the students in full line-by-line detail. The method of evaluation is weekly attendance, active participation in the class discussions and journal clubs.

Quantitative Understanding in Biology (2)

Jason Banfelder and Luce Skrabanek

This course prepares students to apply quantitative techniques to the analysis of experimental data. To emphasize both practical and theoretical skills, the course involves several hands-on workshops, and requires the completion of several projects. Students will be well positioned to meet the emerging requirements of funding agencies for formally planned experiments and fully reproducible and documented data analysis methods. Specific topics include: practical aspects of data formatting and management: graphical, mathematical and verbal communication of quantitative concepts; a review of statistics, with emphasis on the selection of appropriate statistical tests, the use of modern software packages, the interpretation of results, and the design of experiments; the formulation, evaluation and analysis of mathematical models of biological function, with an emphasis on linear and non-linear regression, determination of model parameters, and the critical comparison of alternative models with regard to over-parameterization. Grades are determined based on several take-home problem sets, and a midterm and final exam.

Microbiology & Virology

Microbial Pathogenesis (2)

Luciano Marraffini and Jeremy Rock

Infectious diseases continue to be a leading cause of human morbidity and mortality worldwide as well as an important cause of economic loss and the 'poverty trap' in developing countries. Microbial Pathogenesis focuses on the molecular mechanisms of host-pathogen interactions and pathogenesis of

representative bacterial, fungal and protozoan diseases. Topics include malaria, trypanosomiasis, toxoplasmosis, selected gram-negative and gram-positive bacterial infections, pathogenic mycobacteria, opportunistic mycoses, the evolution of pathogenicity and the impact of the host microbiota during microbial pathogenesis, and the development of antimicrobials and vaccines. The course is taught by Rockefeller and Cornell faculty and selected guest speakers. Each class includes a lecture followed by an in-depth discussion of assigned papers with the lecturer. The discussion can be continued at lunch with the speaker.

Each class includes a lecture, followed by one or two (depending on the number of students) 20-minute presentations by students on a paper suggested by the speaker in which they outline follow-up experiments. Lunch with the speaker follows for a set of interested students. Course requirements include attendance, participation in the discussions, individual presentations and a three-page research proposal at the end of the course.

Virology (2)

Charles Rice, Paul Bieniasz and Theodora Hatziioannou

In this course, Rockefeller faculty and selected visitors give lectures and lead discussions about virology with major emphasis on the cellular and molecular biology of animal viruses. Topics include virus structure, replication, molecular genetics and gene expression, interactions with host cells, immunology, pathogenesis, viral vaccines, antiviral therapy and resistance. A number of model systems are discussed, including cytocidal, steady-state and tumorigenic virus-cell interactions. Session- specific papers will provide background material and topics for discussion at the weekly journal clubs. Course requirements include class attendance, active participation in the discussions, presentations during journal club and a written grant proposal.

Neurosciences

Comprehensive Neuroscience (1 per quarter; 4 for the full-year course)

Winrich Freiwald, A. James Hudspeth, Erich Jarvis, Gaby Maimon and Sidney Strickland

This course serves both as an introduction to neuroscience and as a refresher for those with a modest background in the field. Divided into quarterly segments that can be taken independently, the course covers the entire breadth of neuroscience. The first quarter covers the nature of water and biological membranes, ions and electrical signaling, and synaptic signaling and plasticity. The second segment encompasses neuronal cell biology and neuroanatomy, neurogenesis and neural degenerative diseases. In the third quarter, we explore sensory transduction and neural coding in both arthropods and mammals. The final segment deals with the central processing of sensory information, neural integration and evolution. There are two lectures, a discussion session and a laboratory of computational exercise weekly. Evaluation is based upon attendance, oral presentations, laboratory performance and participation in the discussions.

Development of CNS Circuits (1)

Mary Beth Hatten

This course focuses on the molecular and cellular mechanisms underlying the development of the nervous system. Topics include the evolution of the nervous system, specification of neural cell types, cortical histogenesis, the formation of neural circuits and mechanisms underlying behavior.

The course also considers the molecular genetics of human neuro-developmental disorders.

Social Evolution and Behavior (2)

Daniel Kronauer

This intensive one week course held at The Rockefeller University Center for Field Research in Millbrook, NY includes lectures, workshops, paper discussions, student presentations and field outings. The course explores complex questions from a variety of angles including genetics, behavioral ecology, ethology, neuroscience, as well as evolutionary and theoretical biology. It covers a broad range of biological systems, ranging from single genetic elements, social microbes, insects and vertebrates, to mutualistic interactions between species. Course requirements include active participation in the discussions, student presentations and hands on workshops.

The Biology of Brain Disorders (1)

Gerald Fischbach

This course emphasizes the biological and behavioral underpinnings of common neurological and psychiatric disorders. Subjects include: Disorders of Excitation and Conduction (epilepsy, multiple sclerosis); Perception, Cognition and Memory (autism, schizophrenia, Alzheimers disease); Consciousness (coma, persistent vegetative state); Mood (depression, anxiety); Motivation (addiction); Sensation (pain); Motor Control (Parkinsons disease, ataxia); Trauma (brain/spinal cord injury; stroke). The course meets once a week for 2 hours and consists of introductory remarks, followed by brief student presentations and open discussion based on assigned readings. Each student is asked to write a speculative paper relating a disordered trait to a specific brain circuit.

General

CSHL and MBL (1)

One unit of graduate credit will be granted for courses taken at Cold Spring Harbor Laboratory (CSHL) and the Marine Biological Laboratory at Woods Hole (MBL). In order to qualify for credit, the course must meet for a minimum of 2 weeks (a week being defined as 40+ hours of lecture/lab work) and the Dean's Office must receive written evaluation of the student's performance from the course instructor. A student may only receive credit for one CSHL or MBL course during his/her tenure as a graduate student. Courses at institutions other than CSHL or MBL will be evaluated for credit on a case by case basis.

Science Diplomacy: Thinking Globally about the Biological and Medical Fields (0)

Jesse Ausubel and Mande Holford

The shorthand term 'Science Diplomacy' spans wide-ranging activities connecting science and technology with international affairs. With an emphasis on global health and medicine, this course considers the larger context of dealing with nations in conflict, the role of finance, women and technology in development, innovation in the public and private sectors, and views of Science Diplomacy from outside the United States. This six week course of seminars samples the current landscape of Science Diplomacy issues, programs, and organizations. The goals of the course are to help early career biomedical scientists: (a) think more systematically about the global potential of their work, including ethical, political, and economic implications and (b) become acquainted with the people,

networks, and resources available for scientific cooperation involving nations with whom cooperation may be especially difficult. As a conclusion to the course, clusters of participants are challenged to develop a concept or proposal for a Science Diplomacy activity that connects importantly to their own current research and interests. Ten of the most engaged students are invited to join a field trip in March to Washington, DC to meet with prominent Science Diplomacy practitioners and tour relevant institutions.

Care and Use of Laboratory Animals

Comparative Bioscience Center (CBC) staff
Call x8642 for schedule information.

This seminar introduces the student to federal and state regulations and NIH policy governing the use of laboratory animals in research. Instruction is also offered on preparation of a protocol for approval of animal use, resources available at the CBC, aseptic technique, anesthesia, euthanasia, and common zoonotic diseases. Once a student attends this course, key card access to the facility is approved. Announcements for upcoming hands-on animal training events are posted on the bulletin board outside the CBC first floor elevator.

VII. Policies, Procedures, and Rules

a. Standard of Conduct

Students are expected to be knowledgeable of and comply with the rules and regulations in the Graduate Student Guide, as well as the Human Resources Handbook. The University strives to maintain an atmosphere in which freedom of expression, intellectual inquiry and mutual respect are valued. Students, in accepting admission to the graduate program, agree to act responsibly and respectfully of the Rockefeller University community and all of its individual members. Students whose behavior, whether it is on- or off-campus, is considered detrimental to the University community are subject to disciplinary action. The University is required to deal fairly and decently with each individual.

b. The Rockefeller University Policy for the Prevention of and Response to Sex Discrimination, Sexual Harassment, Sexual Violence, Relationship Violence, and Stalking

(Policy Under Title IX and NY Education Law Art. 129-B)[1]

To the extent that this Policy overlaps with the University's Non-Discrimination, Anti-Harassment, and Anti-Retaliation Policy, this Policy will control in cases involving sex discrimination, sexual harassment, sexual violence, relationship violence, sexual assault, and/or stalking involving a student.[2]

Policy Statement

The Rockefeller University (the "University", "Institution") is committed to maintaining an educational environment that is free from sex discrimination, sexual harassment, sexual violence, relationship

[1] Effective August 14, 2020.
[2] This policy may be applied when the complainant is an employee in certain, limited circumstances.