Physiology and Biophysics (HBY)

Chair: Peter R. Brink, Basic Science Tower T-6 Room 140, (631) 444-2287
Graduate Program Director (Ph.D.): Suzanne Scarlata, Basic Science Tower T-6 Room 145A, (631) 444-3071
Graduate Program Director (M.S.): Irene Solomon, Basic Science Tower T-5 Room 167, (631) 444-2932
Graduate Program Administrator: Melanie Bonnette, Basic Science Tower T-6 Room 140, (631) 444-2299

Degree awarded: Ph.D. in Physiology and Biophysics and M.S. in Physiology and Biophysics

The Department of Physiology and Biophysics offers graduate studies leading to the Ph.D. degree. The Department's faculty has a broad spectrum of research interests, with a major emphasis on understanding the mechanisms of regulation of cellular and organ function in mammalian systems.

The overall goals of the new Master of Science degree program in Physiology and Biophysics are to prepare students for a research staff scientist career in industry (without a focus on R&D), a teaching career at the undergraduate college level, or further graduate study leading to the Ph.D degree in the Biomedical Sciences. For students interested in attending medical school, the M.S. degree program can complement and enhance your background in the physiological sciences, including biomedical research. To accomplish these goals, the program of study provides training in cellular and systems-level physiology, membrane biophysics, experimental design, data analysis, and commonly used laboratory techniques in integrative physiology. Elective courses in Biomedical Engineering, Molecular and Cellular Biology, Neuroscience, Pharmacological Sciences, and Physiology and Biophysics, are then selected to complement and expand on the above core training, and meet the individual needs of each student. For more information, please contact Dr. Solomon at *Irene.Solomon@stonybrook.edu*

Research Interests

There are five main research areas in the Department:

1. Regulation of cell function and metabolism

2. Intercellular and intracellular signaling mechanisms

3. Biophysical studies of membranes

4. Cellular and systems electrophysiology and neurobiology

5. Cardiac pre-conditioning and arrhythmia prevention

The Department strives to offer a broad spectrum of experimental approaches and a wide range of research interests, including membrane biophysics, systems biology, cardiac physiology, membrane transport, and the molecular physiology of cell signaling systems. The Department also offers expertise in a wide range of experimental methods including patch clamping, protein chemistry, optical spectroscopy, recombinant DNA and siRNA technology, and state-of-the-art cell imaging.

Some Department faculty members are associated with the Health Sciences Center Diabetes and Metabolism Center and others participate in a University-wide program in Molecular and Cellular Biology, Structural Biology, Biophysics, and Biosystems. Most faculty have collaborative arrangements with other basic science and clinical departments. Through joint faculty appointments, students have access to the unique facilities of Brookhaven National Laboratory and Cold Spring Harbor Laboratory, renowned research institutions, which are located near Stony Brook.

Institute of Molecular Cardiology

Housed within the Department of Physiology and Biophysics is the Institute of Molecular Cardiology. Since heart disease is still the number one cause of death in the United States, the Institute of Molecular Cardiology was established to bring a multidisciplinary group of basic scientists and clinical investigators together to focus on clinically relevant problems. Biophysicists, molecular biologists, cell biologists, engineers, and cardiovascular surgeons together compose the group that currently investigates ischemic preconditioning, atrial and ventricular arrhythmias, cardiac contractility, and the development of stem-cell-based therapies.

Research Facilities

In addition to the wide range of instrumentation and technical centers available on campus, the Department of Physiology and Biophysics is well equipped with major research instrumentation for physiological, metabolic, and biochemical studies. The Department houses a Molecular Biology Core that has scintillation counters, ultracentrifuges, amino acid analyzers, protein sequencers, and a wide variety of chromatographic, electrophoretic, and spectrophotometric equipment. Also available are a peptide synthesizer and a laboratory for chemical synthesis of low-molecular-weight compounds. NMR instrumentation is available through collaboration with other departments. Tissue culture services, including monoclonal antibody production, are also available. Specialized equipment used in studies of membrane physiology and biophysics (e.g., membrane electrophysiology and patch-clamp studies on ion channels) are in routine use in several faculty laboratories. The Department also houses an imaging center containing two confocal microscopes with image acquisition and processing systems.

Molecular Biology Core

The molecular biology core was established to provide students and faculty ready access to DNA/RNA recombinant technology. Departmental facilities include a 37-degree environmental room, a DNA synthesizer, and an automatic DNA sequencer, large orbital shakers, an array of incubators, DNA sequencing gel set ups (IBI), electrophoretic apparatus and power supplies, an IBI gel reader and a software package that permits the reading of DNA sequencing gels, a selection of restriction enzymes, and a number of cDNA expression libraries.

Molecular Modeling

Computational molecular modeling and visualization are valuable tools for the study of signal transduction systems and protein structure/function. Some current applications of faculty affiliated with our Biophysics Program include examining the physical factors involved in protein/membrane, protein/protein,

protein/DNA interactions, studying the specificity of ligand and substrate binding to enzymes, and building models of proteins using domain structures from homologous proteins. Several Departmental members have access to the University's Supercomputing Centers.

Computing Facilities

Access to the campus-wide wireless network is available. All computers are connected via Ethernet to a local area network.

The Graduate Program in Physiology and Biophysics

Goals of the Program

The diverse nature of the Department's research provides a unique environment for graduate study. The overall goal of our program is to prepare students to investigate complex physiological and biophysical problems that often bridge traditional academic boundaries. This requires sound training in a broad range of biological disciplines, plus experience in using the latest techniques in physiology, biochemistry, molecular biology, physics, applied mathematics, and computing.

To accomplish this goal, we recruit a relatively small number of students with diverse undergraduate training in the physical and biological sciences. Individual courses of study are then designed that reflect the background and goals of each student.

Overview of Curriculum

During the first year, all students take courses in cellular and organ systems physiology, biochemistry, and experimental design and data analysis methods. During the second-year, students select from a variety of advanced courses that suit their scientific interests, goals, and background. Most students complete their coursework at the end of the fall semester of their second year. Students rotate through at least three faculty laboratories to gain research experience in their first year. Students also participate, under faculty supervision, in the teaching of physiology or biophysics. Upon completion of the qualifying examination and the selection of a faculty advisor for their research, the students then devote essentially all of their time to dissertation research.

There are three research concentrations available to graduate students: Cellular and Molecular Physiology, Biophysics, and Systems Physiology.

Cellular and Molecular Physiology

The goal of the Cellular and Molecular Physiology concentration is to train students to investigate significant problems in human physiology using modern techniques of molecular and cellular biology. Students who choose this option generally have undergraduate degrees in biochemistry or biology, and will take advanced graduate classes in cellular and molecular biology and molecular genetics during their second year.

To increase the training and research opportunities available to our students, this program is affiliated with an interdepartmental program in Molecular and Cellular Biology (MCB). The MCB Program consists of approximately 100 faculty from 11 departments, as well as investigators at Cold Spring Harbor Laboratory and Brookhaven National Laboratory. It offers several core courses taken by all graduate students in the biological sciences.

Biophysics

The goal of the Biophysics Studies concentration is to train students with strong backgrounds in physics and/or chemistry in modern biophysics. The program is an interdepartmental effort, consisting of faculty from Cold Spring Harbor Laboratory and Brookhaven National Laboratory. Students who choose this option generally take advanced courses in biophysical chemistry, computational biophysics, electrophysiology, or advanced biochemistry. Biophysics students carry out rotations and dissertation research in the lab of any faculty member affiliated with the Biophysics Program.

Systems Physiology

The primary goal of the systems physiology concentration is to provide an educational framework that focuses on preparing students to attack complex integrative problems using interdisciplinary approaches and to work effectively as part of a multidisciplinary team. Areas of specialization in the Department include systems neurophysiology, cardiovascular and microvascular physiology, and vision research. The systems physiology concentration is a central element in the BioSystems Group, which is an interdepartmental consortium of faculty members drawn from six departments, including Physiology and Biophysics, Biomedical Engineering, Neurobiology and Behavior, Pharmacological Sciences, Medicine, and Applied Mathematics and Statistics, as well as members from Brookhaven National Laboratory and Cold Spring Harbor Laboratory.

The campus-wide nature of the BioSystems Group provides educational and research opportunities of exceptional depth and diversity, and the ability to accommodate students with a broad spectrum of interests and backgrounds. This diversity is reflected in the areas of specialization within the graduate programs. These include the general areas of systems physiology, cellular/molecular physiology, biophysics, biomedical engineering, neuroscience, pharmacology, computational biology, and signal processing.

Requirements and Procedures

Advisory Committee

After admission and until the student qualifies for candidacy, the student's education is directed by the Departmental graduate committee. The committee will assess the student's background and preparation and will develop with each student an individual program of courses, laboratory experiences, and independent study. The committee is also responsible for monitoring student performance and assessing progress after the end of the first year.

Laboratory Experience

During the first year, students rotate through at least three laboratories affiliated with the Department. The duration of these rotations may vary, but should not exceed six months. At the end of each rotation, students will submit a written report of the aims and results, as well as the difficulties with the project.

Teaching Experience

Students are required to serve as teaching assistants for one semester in a course offered by the Department. This will fulfill the Teaching Practicum required for doctoral degrees awarded by the State University of New York.

Seminars and Journal Club

The Department hosts an extensive series of seminars on topics of direct and indirect relevance to research interests of the faculty. Seminars are given by faculty and visiting scientists. Students are required to attend all departmental seminars. Students are also required to participate in the student journal club, in which a student

critically presents a journal article to members of the Department.

Course of Study

Graduate students are required to take the following courses: HBY 530 Cellular Physiology and Biophysics, HBY 501 Human Physiology or HBY 531 Medical Physiology, MCB 517 Biomembranes, MCB 520 Graduate Biochemistry, HBY 561 Statistical Analysis of Physiological Data, HBY 562 Model-based Analysis of Physiological Data, HBY 695 Teaching Practicum, HBY 591 Research in Physiology and Biophysics, HBY 570 Journal Club, HBY 690 Seminar in Physiology and Biophysics, and HBY 699 or HBY 700 Thesis Research in Physiology and Biophysics, GRD 500 Scientific Integrity.

Students must also take at least four elective courses equaling 12 credits.

1. Biophysics: HBY 553 Signal Transduction and other courses with approval.

2. Cellular, Molecular, and Systems Physiology: HBM 503, Molecular Genetics Molecular and HBH 533 Physiological Basis of Drug Action, HBP 533 Immunology, HBY 564 Experimental Techniques in Systems Physiology, HBY 565 Mathematical Models of Physiologic and Biophysical Systems, and other courses with approval.

Students are also required to demonstrate competency in statistics and computer programming, either by formal undergraduate or graduate courses, or by passing an exam after self study.

Qualifying for Candidacy

The major purpose of the Qualifying Examination is to establish how well the student is able to formulate scientific questions independently. To accomplish this, the student will be required to write, within a prescribed period of time, a formal research proposal with format and scope similar to an NIH Postdoctoral Fellowship Application under the guidance of a faculty committee.

The qualifying exam will be administered to all second-year students in the spring semester. At that time, the student will choose a topic that may complement but not be directly in the area of the student's own major research interest. The student will then meet with the Preliminary Examination Committee, twice over the course of six to eight weeks. The student will then distribute copies of the proposal to the faculty and present a seminar to the entire Department describing the proposal. Following the seminar, the student will meet with the faculty to defend the proposal. The Preliminary Examination Committee will then vote on whether the student passes, fails or must amend portions of his/her exam.

Doctoral Program Committee

After completing three rotations, the student will select a faculty committee to provide guidance throughout the dissertation research. The committee will meet at least once a year to assess the progress of the work toward a dissertation. The committee will advise the student when it is appropriate to assemble the committee for the dissertation defense.

Thesis Research Proposal

In consultation with the student's advisor and Doctoral Program Committee, the student is required to submit a written thesis proposal to the Doctoral Program Committee as soon as the direction and scope of the dissertation research project is established. The student is also required to present a seminar describing his proposal to the entire Department and to defend the proposal in a closed meeting with the Doctoral Program Committee. The approved thesis proposal should be submitted one to two years after advancement to candidacy.

Dissertation Defense

A Dissertation Defense Committee is appointed by the Dean of the Graduate School, and is to include at least four faculty members, of whom at least one must be from outside the program. The thesis advisor may be in attendance, but is without vote.

Doctoral Thesis

The thesis will be written in the form of one or more scientific publications in accordance with the guidelines of the Graduate School. The student then presents his/her thesis work to Departmental members in an open seminar, after which the student meets privately with the Dissertation Defense Committee for an oral examination. The Dissertation Defense Committee evaluates both the oral exam and the completed thesis.

Time Limits

All requirements must be completed within seven years.

Admission

For admission to the Ph.D. program in Physiology and Biophysics or the M.S. program, the following, in addition to the minimum Graduate School requirements, are normally required:

A. A four-year undergraduate degree including the following courses: one year of calculus, one year of general biology with laboratory, one year of physics using calculus, and one year of chemistry. Training in the following areas is strongly recommended: organic chemistry, biochemistry, and physical chemistry. Courses in genetics, cell biology, and biostatistics will also be useful. In exceptional circumstances, permission may be granted to correct deficiencies in undergraduate training during the first year of graduate study.

B. Three letters of reference are required.

C. The Graduate Record Examination (GRE) General Test is required. Instructions on reporting scores to this campus is on the Graduate School Web site. So that the scores will be available for a timely admission decision, the test should be taken no later than January. The deadline for receipt of the online applications for admission in the fall is January 15. The TOEFL examination is also necessary for foreign students. Acceptance by both the Department of Physiology and Biophysics and the Graduate School is required.

D. A GPA of 3.0 or higher is required.

Faculty

Professors

Brink, Peter R., *Chair,* Ph.D., 1976, University of Illinois: Physiology and biophysics of junctional and excitable membranes.

Cohen, Ira S., M.D., Ph.D., 1974, New York University: Electrophysiology of the heart; synaptic physiology.

Dilger, James P.,[5] Ph.D., 1980, Stony Brook University: Neuromuscular junction; ion channels in nerve membranes.

Johnson, Roger A., Ph.D., 1968, University of Southern California: Mechanism of hormone action; inter- and intracellular regulation of membrane-bound hormone-sensitive enzymes.

Krukenkamp, Irvin B.,[3] M.D., University of Maryland, 1978: Surgical and pharmacologic precondition and atrial arrhythmias.

Mathias, Richard T., Ph.D., 1975, University of California, Los Angeles: Electrophysiology of cardiac muscle; volume regulation in the lens.

McLaughlin, Stuart, Ph.D., 1968, University of British Columbia, Canada: Biophysics of membranes.

Mendell, Lorne,[1] Ph.D., 1965, Massachusetts Institute of Technology: Physiology and modifiability of synapses in the spinal cord.

Miller, W. Todd, Ph.D., 1988, Rockefeller University: Protein structure and function; molecular mechanisms of signal transduction.

Moore, Leon C., Ph.D., 1976, University of Southern California: Renal physiology.

Scarlata, Suzanne, *Ph.D. Program Director*, Ph.D., 1984, University of Illinois: Biophysics of signaling proteins.

Smith, Steven O.,[14] Ph.D., 1985, University of California, Berkeley: Molecular mechanisms of signal transduction.

Associate Professors

Chon, Ki H.,[18] Ph.D., 1993, USC: Biomedical signal processing; identification and modeling of physiological systems and medical instrumentation.

Clausen, Chris, Ph.D., 1979, University of California, Los Angeles: Electrical properties of transporting epithelia.

Konopka, James B.,[17] Ph.D., 1985, UCLA: G protein-coupled receptor signal transduction and yeast morphogenesis.

McKinnon, David,[1] Ph.D., 1987, Australian National University: Control of ion channel expression.

Solomon, Irene C., *M.S. Graduate Program Director,* Ph.D., 1994, University of California, Davis: Neural control of respiratory motor output and fast oscillatory rhythms.

Spector, Ilan, Ph.D., 1967, University of Paris, France: Electrophysiology of nerve and muscle cell lines; ion channels; neurotoxins.

White, Thomas W., Ph.D., 1984, Harvard University: Biology of cell-to-cell communication and gap junction.

Assistant Professors

Bowen, Mark, Ph.D., 1998, University of Illinois, Chicago: Molecular aspects of signal transduction.

Entcheva, Emilia,[18] Ph.D., 1998, Memphis: Cardiac cell function.

Frame, Mary,[18] Ph.D., 1990, University of Missouri: Microcirculation; tissue engineering; nanofabrication.

Nassar, Nicolas, Ph.D., 1992, University Joseph Fourier and EMBL: Protein-protein interactions.

Research Faculty

Cameron, Roger H., *Assistant Professor,* Ph.D., 1990, Stony Brook University: Electron microscopy; pharmacology of plasma cells secretion.

El-Maghrabi, Raafat, *Associate Professor,* Ph.D., 1978, Wake Forest University: Enzyme regulation; hormonal control of metabolism.

Gao, Junyuan, *Assistant Professor,* Ph.D., 1994, Stony Brook University: Sodium potassium pump current in cardiac myocytes.

Kumari, Sindhu, *Assistant Professor*, Ph.D., 1988, Madurai Kamaraj University, India: Biochemical and molecular characterization of gap junction channels and sodium potassium pump.

Pentyala, Srinivas N.,[5] *Assistant Professor*, Ph.D., 1989, Sri Venkateswara University: Molecular mechanics of the action of anesthetics.

Rebecchi, Mario J.,[5] *Associate Professor,* Ph.D., 1984, New York University School of Medicine: Signal transduction in mammalian cells.

Rosati, Barbara, *Assistant Professor*, Ph.D., 2000, Milan, Italy: Transcriptional regulation of ion channel genes in the heart.

Valiunas, Virginijus, *Assistant Professor*, Ph.D., 1992, Kaunas Medical University, Lithuania: Gap junction; intercellular communication and cardiac electrophysiology.

Varadaraj, Kulandaiappan, *Assistant Professor.* Ph.D., 1991, Madri Kamaraj University: Lens membrane proteins and gap junctions.

Wang, Hsien Yu, *Associate Professor,* Ph.D., 1989, Stony Brook University: Signal transduction and development.

Biophysics Program Affiliated Faculty

Grollman, Arthur P., *Distinguished Professor, Department of Pharmacological Sciences*, M.D., 1959, Johns Hopkins University: Chemical carcinogenesis and mutagenesis.

Jacobsen, Chris J., *Professor, Department of Physics*, Ph.D., 1988, Stony Brook University: Soft X-ray microscopy of cellular structure and materials structure.

Joshua-Tor, Leemor, *Assistant Investigator, Cold Spring Harbor Laboratory*, Ph.D., 1991, The Weizmann Institute of Science: Structural biology; X-ray crystallography; molecular recognition; transcription; proteases.

Kirz, Janos, *Professor, Department of Physics*, Ph.D., 1963, University of California, Berkeley: Microscopy and microanalysis of cellular architecture with soft X-rays.

Krainer, Adrian R., *Professor, Cold Spring Harbor Laboratory*, Ph.D., 1986, Harvard University: Mechanisms and regulation of messenger RNA splicing in human cells.

Lennarz, William J., *Professor, Department of Biochemistry*. Ph.D., 1959, University of Illinois: Biosynthesis and function of glycoproteins in development.

London, Erwin, *Professor, Department of Biochemistry*, Ph.D., 1979, Cornell University: Membrane lipid-protein interactions; protein toxin structure and function.

Malbon, C., *Professor, Department of Pharmacology*, Ph.D., 1976, Case Western Reserve University: Elucidating the genetic basis of developmental and metabolic diseases.

Matthews, Gary, *Professor, Department of Neurobiology and Behavior*, Ph.D., 1975, University of Pennsylvania: Cellular biophysics of electrical signals in the retina.

Raleigh, Daniel P., *Professor, Department of Chemistry*, Ph.D., 1988, Massachusetts Institute of Technology: Experimental studies of protein folding and amyloid formation.

Rubin, Clinton, T., *Professor, Department of Orthopaedics*, Ph.D., 1983, Bristol University: Cellular mechanisms responsible for adaptation in bone.

Sampson, Nicole S., *Professor, Department of Chemistry*, Ph.D., 1990, University of California, Berkeley: Enzyme mechanisms and protein structure-function relationships.

Setlow, Richard, *Professor, Department of Biology, and Senior Scientist, Brookhaven National Laboratory*, Ph.D., 1947, Yale University: DNA damage and repair.

Tonge, Peter J., *Professor, Department of Chemistry*, Ph.D., 1986, University of Birmingham, England: Enzyme mechanisms in antitubercular drugs and Alzheimer's disease.

Wong, Stanislaus, *Assistant Professor, Department of Chemistry*, Ph.D., 1999, Harvard University: Fundamental structure correlations in unique nanostructures.

1) Joint appointment, Department of Neurobiology and Behavior

2) Joint appointment, Department of Medicine

3) Joint appointment, Department of Surgery

4) Joint appointment, Department of Pediatrics

5) Joint appointment, Department of Anesthesiology

6) Joint appointment, Cold Spring Harbor Laboratory

7) Joint appointment, Brookhaven National Laboratory

8) Joint appointment, Department of Applied Mathematics and Statistics

9) Joint appointment, Department of Orthopedics

10) Joint appointment, Veterans Administration Hospital

11) Joint appointment, North Shore University Hospital

12) Joint appointment, Department of Urology

13) Joint appointment, SUNY Old Westbury

14) Joint appointment, Department of Biochemistry and Cell Biology

15) Joint appointment, Department of Biology, University of Tulsa, Oklahoma

16) Joint appointment, Department of Pharmacology, College of Physicians and Surgeons, Columbia University

17) Joint appointment, Department of Molecular Genetics and Microbiology

18) Joint appointment, Department of Biomedical Engineering

Degree Requirements

In addition to the minimum Graduate School requirements, the following are required:

A) Completion of HBY 531 or HBY 501, HBY 530, HBY 561 HBY 562, MCB 517, MCB 520, HBY 570, HBY 591, HBY 690, HBY 699, HBY 695, GRD 500

B) Satisfactory completion of the preliminary examination at the end of the second year of study

C) Submission of a thesis research proposal by the end of the third year

D) Participation in the teaching practicum

E) Submission of an approved dissertation and successful oral defense

F) Completion of all requirements within seven years

Courses

HBY 501 Physiology

Introduces normal function of human tissues and organs and their regulation by nervous and endocrine systems. Emphasizes the organization and function of physiological control systems and the maintenance of a constant internal environment.
Prerequisites: Fully matriculated graduate students, with permission of instructor
Fall, 4 credits, ABCF grading

HBY 530 Cellular Physiology and Biophysics

Cellular structure and function. Topics include ion channels excitability, transport, energetics and metabolism, contraction, secretion, and communication within and between cells. Emphasizes quantitative analysis of cellular processes. Crosslisted with BME 545.
Prerequisites: Undergraduate physics, physical chemistry, biology, calculus, or permission of instructor
Fall, 1-3 credits, ABCF grading

HBY 531 Medical Physiology

A graduate-level introduction to the physiology of the organ systems with ultrastructural correlations. Ultrastructural correlations are demonstrated in a laboratory setting using histological preparations in conjunction with electron micrographs illustrating the relevant ultrastructure needed to understand the normal functioning of tissues and organs. The physiology of the major organ systems is addressed in a lecture format with the emphasis on problem solving. Relevant clinical correlations are addressed at the end of each block insofar as they illustrate how symptoms and signs of disease result from disordered physiology. Medical Physiology addresses the structure and function of the cardiovascular, respiratory, renal, gastrointestinal, endocrine, skeletal, reproductive, and integumenary systems.
Prerequisites: Admission to medical or dental school and permission of instructor
Spring, 8 credits, ABCF grading

HBY 553 Signal Transduction

The course will emphasize fundamental concepts in signal transduction (e.g., membrane-protein and protein-protein interactions, amplification of signals), and individual lectures will apply these concepts at each stage of cell signalling from the cell surface to the nucleus, where signal transduction leads to specific gene expression. Crosslisted with HBY 553 or HBH 553.
Prerequisite: Admission to graduate Health Sciences Center program
Spring, odd years, 3 credits, ABCF grading

HBY 554 Principles of Neuroscience

The aim of this course is to highlight and create an understanding as to how the human nervous system operates.
Prerequisite: Undergraduate biochemistry, biology, and chemistry. Permission of instructor.
Fall, 2 credits, ABCF grading

HBY 557 Advanced Physiology

This course is designed to introduce students to integrative approaches in biomedical research. Emphasis will be placed on the primary physiological concepts of control, communication, signal processing, metabolism and replication.
Prerequisites: Systems physiology, biochemistry, and permission of instructor
Spring, 3 credits, ABCF grading

HBY 561 Statistical Analysis of Physiological Data

Statistical methods useful in analyzing common types of physiological data. Topics include probability, data distributions, hypothesis testing with parametric and non-parametric methods, ANOVA, regression and correlation, and power analysis. Emphasis is on experimental design and appropriate, efficient use of statistical software.
Fall, 1 credit, ABCF grading

HBY 562 Model-based Analysis of Physiological Data

The analysis of common biochemical and physiological data by non-linear regression of data models and biophysical models of physiological and biochemical processes. Examples include binding kinetics, compartmental mass transfer, and spectral analysis.
Prerequisite: HBY 561; permission of instructor
Fall, 1 credit, ABCF grading

HBY 564 Experimental Techniques in Systems Physiology

A series of lectures and laboratory exercises designed to introduce students to *in vivo* experimental techniques used in systems physiology. Emphasis will be placed on the ethical use of rodents in biomedical research and the measurement of physiological variables. Data acquisition and analysis procedures used in cardiovascular, respiratory, neural, and renal physiology will also be covered.
Spring, 2 credits, ABCF grading

HBY 565 Mathematical Models of Physiological and Biophysical Systems

An introduction to mathematical modeling of cell and tissue function. Topics include the derivation and numerical solution of models of cell homeostasis, membrane transport and excitability, and cell signaling and metabolism. Grading is based on problems, student presentations, and completion of a modeling project.
Spring, 3 credits, ABCF grading

HBY 570 Student Journal Club

Graduate student presentation on a selected topic with faculty consultation.
Prerequisite: Limited to students of the Physiology and Biophysics program
1 credit, ABCF grading
May be repeated for credit

HBY 590 Special Topics in Physiology and Biophysics

Student seminars on topics to be arranged through consultation with faculty members.
Prerequisite: Permission of instructor
Spring, 1 credit, S/U grading
May be repeated for credit

HBY 591 Physiology and Biophysics Research

Original investigation under the supervision of a staff member.
Prerequisite: Permission of instructor
1-12 credits, ABCF grading
May be repeated for credit

HBY 690 Seminar in Physiology and Biophysics

Seminars and discussions on major topics in physiology and biophysics by students, staff, and visiting scientists.
Prerequisite: Permission of instructor
0-1 credit, S/U grading
May be repeated for credit

HBY 695 Practicum in Teaching in Physiology and Biophysics

Practical experience and instruction in the teaching of physiology and biophysics carried out under faculty orientation and supervision.
1 credit, ABCF grading
May be repeated for credit

HBY 699 Dissertation Research On Campus

Original (thesis) research undertaken with the supervision of a member of the staff.
Prerequisite: Advancement to candidacy (G5); permission of thesis advisor; major portion of research must take place on SB campus, at Cold Spring Harbor, or at Brookhaven National Lab; admission to graduate Health Sciences Center program
1-9 credits, ABCF grading
May be repeated for credit

HBY 700 Dissertation Research Off Campus–Domestic

Prerequisite: Must be advanced to candidacy (G5); major portion of research will take place off campus, but in the U.S. and/or U.S. provinces (Brookhaven National Lab and Cold Spring Harbor Lab are considered on campus); all international students must

enroll in one of the graduate student insurance plans and should be advised by an international advisor; admission to graduate Health Sciences Center program
1-9 credits, S/U grading
May be repeated for credit

HBY 701 Dissertation Research Off Campus—International
Prerequisite: Must be advanced to candidacy (G5); major portion of research will take place outside of the U.S. and/or U.S. provinces; domestic students have the option of the health plan and may also enroll in MEDEX; international students who are in their home country are not covered by the mandatory health plan and must contact the Insurance Office for the insurance charge to be removed; international students who are not in their home country are charged for the mandatory health insurance (if they are to be covered by another insurance plan, they must file a waiver by the second week of classes; the charge will be removed only if the other plan is deemed comparable); all international students must receive clearance from an international advisor; admission to graduate Health Sciences Center program
1-9 credits, S/U grading
May be repeated for credit

HBY 800 Full-Time Summer Research
Full-time laboratory research projects supervised by staff members.
Prerequisite: Permission of instructor; full-time graduate status
Summer, 0 credit, S/U grading
May be repeated