

BASIC MEDICAL SCIENCE (BMSC-GA)

BMSC-GA 1358 Introduction to Programming (2 Credits)

Typically offered occasionally

This introductory hands-on course is designed to help students with little or no computing background to start writing programs to facilitate research and analysis work. Fundamental concepts in programming will be covered, using Python as the implementation language.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 1997 Grant Writing (1 Credit)

Typically offered occasionally

Course Enrollment limited to PhD students enrolled at the Sackler Institute. This course will introduce every aspect of grant writing, including selecting funding mechanisms, writing individual grant sections and understanding administrative policies. The course format will alternate between large didactic lectures on specific portions of the grant application or application process and small group meetings. The small groups will be one senior faculty per six students and each student will be responsible for writing the current grant section assignment and critiquing the work of the other students.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 1999 Scientific Methods: Survival Techniques (0 Credits)

Typically offered occasionally

Although tremendous scientific progress has been made during the past two centuries, the way we train our young investigators to do research has basically remained unchanged: we practice apprenticeship. While our students are provided courses on select subjects, formal instruction on how to do research is not offered. As this can be frustrating and inefficient for the students, Dr. Tung-Tien Sun has organized a course to assist students in learning how to get laboratory techniques to work reproducibly and predictably; read a paper actively rather than passively; select a good project; keep current with the scientific literature and the relevance of such a task; write a scientific paper; become an effective seminar speaker. This course consists of five sessions, each two hours long (one hour lecture plus one hour discussion), covering several topics that a graduate student must master in order to survive and to excel in doing research. The course covers the following topics: experimental design, literature analysis, scientific writing, oral presentation, and computer skills.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 2000 Scientific Integrity & the Responsible Conduct Research (1 Credit)

Typically offered all terms

This is a 10-week course, which meets each spring semester for approximately 1.5 hours per week. Students are required to complete readings and attend small group discussions (consisting of 10 students each). Each discussion group is led by a senior graduate student or postdoctoral fellow who presents different case studies on the lecture topic presented that week. Written materials and other resources may be given out each week. To demonstrate the trainees' comprehension and retention of information presented during the course, a written examination must be passed.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 2001 Topics in Molecular Biology (3 Credits)

Typically offered occasionally

This course provides a broad overview of gene expression, nuclear organization and nucleic acid metabolism. Part I consists of five weekly group discussions covering fundamental methodologies applicable to many areas of cell and molecular biology and introduces students to the art of reading of the primary scientific literature. Part II features nine weeks of intensive lectures and weekly discussion groups organized into timely themes such as control of gene transcription, chromatin structure and epigenetics, telomere biology, DNA replication and recombination, synthesis and folding of functional proteins, and RNA processing. The course emphasizes fundamental molecular processes that underlie almost all aspects of current research in molecular, cellular and developmental biology.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 2002 Foundations of Cell and Molecular Biology II (6 Credits)

Typically offered occasionally

Intensive, two-semester course. Provides a broad overview of nucleic acid and protein metabolism and function. The spring semester covers various aspects of cell biology, signal transduction, and genetics. Topics include biogenesis of cellular membranes; vesicular transport; the cytoskeleton; cell differentiation and development; concepts in receptor signaling; and genetics of model organisms. Each semester is comprised of two or three modules that differ somewhat in organization, including the number of required lectures. Each module places significant emphasis on student-led discussions. The reading of primary research articles is heavily stressed. Grades are assigned on the basis of examination, essay, and discussion scores.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 2004 Molecular Mechanisms in Biology (4 Credits)

Typically offered occasionally

The goal of this course is to provide students with an in-depth understanding of the structures of proteins and nucleic acids, the modes of interaction that underlie protein-protein and protein-nucleic acid recognition, and how knowledge of macromolecular structure leads to an understanding of biological processes. Topics include enzyme structure and mechanism, membrane proteins, ligand-receptor recognition, protein-protein interactions in signal transduction, molecular machines, and protein-nucleic acid recognition. The class meets three times per week? two lectures and one discussion session.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 2005 Intro to Cell Neurosci (6 Credits)

Typically offered occasionally

Introduction to the anatomy, cell biology, molecular structure, and physiology of neurons and glial cells. Equips students with the skills necessary to read the contemporary neuroscience literature as well as provides a grounding in the fundamental concepts of cellular neurobiology. Emphasis is on basic cellular and molecular mechanisms used by neurons to receive, integrate, and transmit information. Subjects covered include the fine structural anatomy and electrophysiological properties of neurons and glia, the role of ion channels in intracellular and intercellular communication, mechanisms of synaptic transmission and integration, biochemistry and physiology of neurotransmitters, and regulation of neuronal function by gene expression.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 2010 Medical & Molecular Parasitology (4 Credits)*Typically offered occasionally*

The course will provide an in-depth analysis of the cellular, immunological, molecular and genetic mechanisms in parasite biology and parasite-host interactions. Topics will include mechanisms of host cell invasion, host innate and adaptive immune response, parasite genome structure and expression, antigenic variability, immune evasion, vaccine design, epidemiology, genetics, genomics and vector-parasite interactions. The course will cover a variety of parasites and their insect vectors. Protozoan (Plasmodium, Leishmania, Trypanosoma, Toxoplasma, Entamoeba, Trichomonas) and metazoan (Schistosoma, Trichinella) parasites which cause disease in humans will be studied.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2016 Protein Modifications in Cell Signalling (4 Credits)***Typically offered occasionally*

This course focuses on the role of post-translational modifications of proteins in governing human health and disease and explores cutting edge molecular tools, including mass spectrometry, used for identifying unique post-translational modifications of proteins. There are one formal lecture and one paper discussion section per week.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2017 Advanced Tissues & Organs: Special Topics (2 Credits)***Typically offered occasionally*

The focus of this course is autoimmunity and the GU & Endocrine systems; open to both first and second year students, including non-Pathobiology students.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2202 Medical Microbiology (2 Credits)***Typically offered occasionally*

This course is roughly divided into two sections: virology and bacteriology/ mycology. The virology section covers viral structure, classification, and replication; viral pathogenesis; antiviral drugs; viral oncogenesis; host-parasite interactions; and methods of prevention. The bacteriology/mycology section covers bacterial structure, function, and classification; microbial adaptation (genetics, genetics of pathogenesis, and antibiotic resistance); mechanisms of microbial pathogenesis; antibiotic design and targets; host-parasite interactions; epidemiology of infectious disease; and methods of prevention.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2210 Molecular Virology (4 Credits)***Typically offered occasionally*

This course is an introduction to the molecular biology and pathogenesis of animal viruses. Twenty lectures cover fundamental aspects of the viral life cycle (viral entry into cells, replication, transformation, control of translation) host response (innate and acquired immune response) and explore the biology of a number of medically important RNA and DNA viruses, including some emerging pathogens. Selected readings assigned by the lecturers are discussed in separate sections

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2213 Genetics and Genomics: From Peas to People (4 Credits)***Typically offered occasionally*

Transmission genetics in diploid organisms. Principles and methods of genetic analysis in diploid organisms?including Drosophila, worms, zebrafish, plants, mice, and humans?are emphasized. Classes include lectures, problem solving, and discussion of primary literature. Topics include linkage, gene interactions, mapping, mutagenesis, clonal analysis, sex determination, transgenic studies, use of mosaics, imprinting, and methods of study in human genetics.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2306 Intro to Immunology (4 Credits)***Typically offered occasionally*

This comprehensive core course, designed for research-oriented students, provides a broad but intensive examination of the immune response, with a special emphasis on the experimental approaches that led to our current understanding of immunological principles. Students are assigned weekly reading in the form of textbook chapters and a primary research paper. Students and faculty discuss the textbook information during one session each week, and regular quizzes on this information provide feedback to all students on their preparation and progress. Critical analysis of the original research articles in a discussion format is held on Fridays. The research papers form the starting point for a dialogue between students and faculty that probes intellectual and practical questions in immunology research, venturing beyond the material presented in the papers into related issues and current research.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2308 Advanced Immunology (4 Credits)***Typically offered occasionally*

Students are assigned two to three ?papers of the week,? which are sent by e-mail a week in advance of the seminar. Students are selected to present the papers to fellow classmates and faculty. The papers are discussed for their significance (questions addressed and their relevance), techniques utilized, analysis of data, and perspectives.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2318 Basic Mechanisms of Molecular Oncology and Tumor Immunology (4 Credits)***Typically offered occasionally*

Studies the molecular basis of cancer. Topics include somatic mutations and DNA repair mechanisms; viral systems relevant to cellular transformation and human cancer; the pathogenesis of cancer as a consequence of alterations in oncogenes; growth factor genes and tumor suppressor genes, with emphasis on the function of their normal counterparts; tumor progression; mechanisms of metastasis; and tumor immunology.

Grading: GSAS Graded**Repeatable for additional credit:** No

BMSC-GA 2401 Principles in Pharmacol (3 Credits)*Typically offered occasionally*

This course is a combination of lectures, workshops, and seminars. The lectures and workshops are part of the Medical Pharmacology course for medical students. Topics include pharmacokinetics, pharmacodynamics, drug metabolism, drug receptors, and drugs affecting the nervous system. The seminars, for graduate students only, are designed to introduce the students to the use of molecular pharmacology in drug development.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2404 Molecular Signalling (4 Credits)***Typically offered occasionally*

This course, divided into two parts, focuses on modern drug design and discovery. In the first part, lectures relating to modern drug design discuss structure/function analysis, rational drug design, combinatorial chemistry, automation, target discovery, and gene-based therapies. In the second part, lectures relating to drug discovery as it applies to biology and medicine discuss peptides as inhibitors of amyloidosis, receptors and AIDS, angiogenic inhibitors, anti-obesity peptides, vaccine development for malaria, inflammation, anticancer drugs, and factors that control neuronal survival/death. Each student is expected to write a research paper related to one of these topics. One session is devoted to business considerations in drug development, including interactions between academia and industry. At the end of the course, each student writes a plan for developing a new drug that is related to topics in the course or that utilizes methodology discussed in the course. This plan includes a short introduction, a description of the experimental design, and a discussion of the expected outcomes.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2406 Molecular Pharmacology of Receptors (3 Credits)***Typically offered occasionally*

This course gives an overview of the principles in pharmacology, modern approaches to studying pharmacology, and molecular aspects of receptors and signal transduction. The course is divided into three parts. The first part, introduction to molecular pharmacology, focuses on some of the basic concepts in signaling, drug-receptor interactions, and pharmacokinetics. The second part, modern approaches to pharmacological research, emphasizes methods such as crystallography, mass spectrometry, and genetic studies with *Drosophila* and *C. elegans* as pharmacological tools. The third part, applications of pharmacology research, focuses on the structure and function of tyrosine kinase receptors, receptor phosphatases, G protein receptors, insulin receptors, steroid/thyroid hormone nuclear receptor gene family, glycoproteins and proteoglycans of the nervous system, recycling and internalization of receptors, exocytosis and receptors for neurotransmitters, and proteolytic processing of receptors and ligands. Classes include lectures as well as weekly discussions on selected papers.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2511 Tutorial in Biochemistry & Molecular Biophysics (1.5 Credits)***Typically offered occasionally*

This course is for students in their 3rd or 4th year and consists of a series of one-on-one discussions with their faculty tutor to expand the student's knowledge in a useful but somewhat orthogonal direction to their graduate research.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2604 Bioinformatics (3 Credits)***Typically offered occasionally*

This practical course in bioinformatics emphasizes the use of computers as a tool in molecular biology research. The course devotes approximately equal time to applications available on the Web and to those available at the School of Medicine's Research Computing Resource. Rather than teach specific commands, discussions emphasize underlying principles that enable scientists to make better use of computer programs. Includes an introduction to the VMS operating system, the basics of computer communications (telnet, e-mail, Usenet, and the WWW), using sequence databases, similarity searching, multiple alignment, DNA sequencing, and phylogenetics.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2606 Tutorial in Developmental Genetics (1.5 Credits)***Typically offered occasionally*

This course is for advanced students to conduct one-on-one discussions with their faculty tutor to help expand the student's knowledge.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 2607 Advanced Topics in Microbial Pathogenesis (3 Credits)***Typically offered occasionally*

The objective of this course is to familiarize students with an integrative approach to host-parasite interactions. Microbial diseases are the result of a very complex interaction between the parasite and the host. Recent developments in the genetics and physiology of pathogens as well as in the immune response of the host make microbial pathogenesis a very exciting field of research. This course provides an integrative view of different pathogens.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2609 Developmental and Stem Cell Systems II (2-6 Credits)***Typically offered occasionally*

Fundamental questions, concepts, and methodologies of modern inquiry into the genetic and epigenetic mechanisms of development are explored through lectures, readings in the primary literature, and laboratory work.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2610 Developmental and Stem Cell Systems I (2-6 Credits)***Typically offered occasionally*

This course is an introduction to Developmental Genetics and Stem Cell Biology. Fundamental questions, concepts and methodologies of modern inquiry into the genetic and cellular mechanisms of development and stem cell biology will be explored through coordinated lectures, labs, and discussion of primary literature.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 2611 Cell and Molecular Biology Journal Discussion Club (1.5 Credits)***Typically offered occasionally*

Neuroscience graduate students are required to take a sequence of tutorials during the spring semester of their first year in the program.

Grading: GSAS Graded**Repeatable for additional credit:** Yes

BMSC-GA 2616 Tutorial: (3 Credits)*Typically offered occasionally*

This course is an introduction to the range of eukaryotic organisms that causes disease in humans. The course covers the helminths and the protozoan parasites and studies insects as both agents and vectors of human disease. For each pathogen, students learn its life history, epidemiology, clinical features of the disease it causes, and pathogenesis. The course also covers the basic principles of laboratory diagnosis and treatment. In the laboratory sessions, students look at prepared slides, make wet mounts of live parasites, and learn to prepare thick and thin blood films for diagnosis of malaria. At the end of the course, the students work on group projects that address questions such as: (1) Do helminth infections protect against the development of autoimmune diseases? (2) Will there ever be a malaria vaccine? This course is an introduction to the range of eukaryotic organisms that causes disease in humans. The course covers the helminths and the protozoan parasites and studies insects as both agents and vectors of human disease. For each pathogen, students learn its life history, epidemiology, clinical features of the disease it causes, and pathogenesis. The course also covers the basic principles of laboratory diagnosis and treatment. In the laboratory sessions, students look at prepared slides, make wet mounts of live parasites, and learn to prepare thick and thin blood films for diagnosis of malaria. At the end of the course, the students work on group projects that address questions such as: (1) Do helminth infections protect against the development of autoimmune diseases? (2) Will there ever be a malaria vaccine? 3. Do parasites always evolve towards less virulence?

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 3007 Research Cell Biology (0.5-12 Credits)***Typically offered occasionally*

This course is for students to conduct independent research toward their dissertation in Cell Biology.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 3025 Thinking Strategically about your Scientific Career (Individual Development Plan) (1 Credit)***Typically offered all terms*

This course is intended to assist PhD students in navigating their graduate careers and postgraduate career searches. Participants will have the opportunity to evaluate their own values and interests as they relate to their PhD experience and professional careers.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No**BMSC-GA 3201 Rsch in Microbiology (0.5-12 Credits)***Typically offered occasionally*

This course is for students to conduct independent research toward their dissertation in Microbiology

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 3211 Seminar in Microbiology (1.5 Credits)***Typically offered occasionally*

In this course, students present their thesis research to peers and faculty in the Microbiology program for discussion and feedback.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 3301 Research in Pathology (0.5-12 Credits)***Typically offered occasionally*

This course is for students to conduct independent research toward their dissertation in Molecular Oncology & Tumor Immunology.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 3311 Seminar in Pathology (1.5 Credits)***Typically offered occasionally*

In this course, students present their thesis research to peers and faculty in the Molecular Oncology & Tumor Immunology program for discussion and feedback.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 3401 Research in Pharmacology (0.5-12 Credits)***Typically offered occasionally*

This course is for students to conduct independent research toward their dissertation in Molecular Pharmacology.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 3403 Rsch in Develop Genetics (0.5-12 Credits)***Typically offered occasionally*

This course is for students to conduct independent research toward their dissertation in Developmental Genetics.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 3404 Seminar in Developmental Genetics (1.5 Credits)***Typically offered occasionally*

In this course, students present their thesis research to peers and faculty in the Developmental Genetics program for discussion and feedback.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 3501 Research in Physiology & Neuroscience (0.5-12 Credits)***Typically offered occasionally*

This course is for students to conduct independent research toward their dissertation in Neuroscience & Physiology.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 3713 Research in Biochemistry & Molecular Biophysics (0.5-12 Credits)***Typically offered Fall and Spring*

This course is for students to conduct independent research toward their dissertation in Biochemistry & Molecular Biophysics.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 3715 Seminar in Biochemistry & Molecular Biophysics (2 Credits)***Typically offered occasionally*

In this course, students present their thesis research to peers and faculty in the Biochemistry & Molecular Biophysics program for discussion and feedback.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4012 Reading Course in Biochemistry (1-4 Credits)***Typically offered occasionally*

Advanced instruction on a limited topic.

Grading: GSAS Graded**Repeatable for additional credit:** Yes

BMSC-GA 4013 Readings in Microbiology (1-4 Credits)*Typically offered occasionally*

Advanced instruction on a limited topic.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 4111 Reading Course in Pharmacology (1-4 Credits)***Typically offered occasionally*

Advanced instruction on a limited topic.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 4112 Reading Course in Molecular Oncology (1-4 Credits)***Typically offered occasionally*

Advanced instruction on a limited topic.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 4115 Reading Course in Immunology (1-4 Credits)***Typically offered occasionally*

Advanced instruction on a limited topic.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 4116 Reading Course in Cell Biology (1-4 Credits)***Typically offered occasionally*

Advanced instruction on a limited topic.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4401 Reading Course in Developmental Genetics (1-4 Credits)***Typically offered occasionally*

Advanced instruction on a limited topic.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 4402 Reading Course in Structural Biology (1-4 Credits)***Typically offered occasionally*

Advanced instruction on a limited topic.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 4403 Techniques in Structural Biology and Molecular Biophysics (4 Credits)***Typically offered occasionally*

This course teaches students the underlying theory and techniques used in X-ray crystallography, electron microscopy, NMR spectroscopy, mass spectrometry, and computer modeling. The information in this course enables students to pursue their dissertation research in structural biology. Topics include X-ray diffraction, phasing, and refinement; cryoelectron microscopy, image processing, and tomography; multidimensional NMR spectroscopy; MALDI-TOF and Q-TOF mass spectrometry; and ab initio and homology modeling of proteins.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4404 Fund Concepts Magnetic Resonance Imaging (Mri) (3 Credits)***Typically offered occasionally*

Magnetic resonance imaging is a fast-growing interdisciplinary field. In this course, students learn how the knowledge they gain from their education in physics, chemistry, mathematics, and computer science can be utilized to further understand the biomedical sciences.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4405 Independent Study in Structural Biology (1-6 Credits)***Typically offered occasionally*

Advanced instruction on a limited topic.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No**BMSC-GA 4406 Intro to Tissues and Organ Systems (4 Credits)***Typically offered occasionally*

This survey course and its accompanying laboratory are the cornerstone for the newly developed graduate training program in pathobiology. The specific goal of this course is to provide an overview of the basic development and physiology of mammalian tissues and organs and introduce the tools, techniques, and strategies important in the study of in vivo model systems for human disease.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4407 Intro to Histopathology Laboratory (2 Credits)***Typically offered occasionally*

This introductory laboratory course must be taken in conjunction with the lecture course Tissues and Organ Systems. The specific goal of this laboThis introductory laboratory course must be taken in conjunction with the lecture course Tissues and Organ Systems. The specific goal of this laboratory course is to introduce students to the tools, techniques, and strategies necessary for the study of in vivo model systems for human disease.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4408 Cryoelectron Microscopy of Macromolecular Assemblies (4 Credits)***Typically offered occasionally*

This comprehensive course covers the theory and practice of solving molecular structures by electron microscopy. The course starts with optics, sample preparation, and a basic mathematical description of diffraction before moving into a detailed exploration of the three main methods of structure determination: electron crystallography, single particle analysis, and electron tomography. The course ends with a discussion of map interpretation and molecular fitting. This is predominantly a lecture course involving one 2-hour lecture per week accompanied by a discussion session and an occasional practical session using the facilities at the New York Structural Biology Center.

Lectures are given by expert electron microscopists from around New York City, and students from various campuses are encouraged to attend.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4409 Adv Magnetic Resonance Imaging (3 Credits)***Typically offered occasionally*

This course continues from Fundamentals of MRI, taught in the fall, and successful completion of the fall course is a prerequisite. The course introduces and utilizes mathematical concepts such as the Fourier transform, k-space, and the Bloch equations to describe the physical and mathematical principles governing data acquisition and image reconstruction. Topics covered include diffusion, perfusion, functional brain imaging, cardiac MRI, spectroscopic imaging, clinical MRI, rf engineering, contrast agents, and molecular imaging. This course includes weekly lectures, discussion sessions revolving around assigned research articles, and practical labs pertinent to material covered in the lectures.

Grading: GSAS Graded**Repeatable for additional credit:** No

BMSC-GA 4410 Advanced Tissues & Organs: Cardiovascular and Pulmonary Systems (2 Credits)*Typically offered occasionally*

This course combines a practical lab component with lectures and discussions. The first half of the course focuses on three complex organ systems: the cardiovascular, endocrine, and nervous systems. The goals are to understand the individual systems as well as their interactions with other systems and resulting impact on the function or dysfunction of the organism as a whole. The goal of the second half of the course is to provide a strong foundation in basic immunology and the host response to infectious, inflammatory, and autoimmune stimuli. The laboratory sessions provide a more robust, three-dimensional understanding of normal organ function as well as better conceptualization of the underlying cellular processes leading to disease.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4411 Pathobiology of Disease (2 Credits)***Typically offered occasionally*

This course focuses on the molecular, cellular, and organismal basis of disease pathogenesis and how modern experimental approaches have led to new therapies. Students take the course in the spring semester of both their first and second years. Each year, the course discusses two complex disease entities. The course is based on student presentations and the critical evaluation of selected papers from the contemporary literature. There is also a writing component to the course: Students write their own abstracts to existing papers that approach disease pathophysiology in whole animal models. This exercise helps students learn how to distill core data from in vivo experiments, and to appreciate the inherent advantages and limitations of in vivo approaches.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4413 Mammalian Stem Cells in Disease and Regeneration (2 Credits)***Typically offered occasionally*

This course will cover a broad range of topics relevant to stem cell biology. This fast-moving field brings together many aspects of basic and applied biology and medicine including development, regeneration/repair, and cancer. The course will cover these topics in four parts: concepts and themes (including adult, embryonic, germline stem cells, general molecular themes), stem cell biology relevant to specific organ systems, stem cells and cancer, and therapeutics and ethics. The lecture/discussion format will give students both a broad background and the opportunity to apply critical thinking skills to recent data in the field

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No**BMSC-GA 4414 Disorders of The Nervous System (4 Credits)***Typically offered occasionally*

This course will address disorders of the nervous system, using examples selected from several of the the major classes of CNS disorders.

The first lectures will address developmental disorders, followed by disorders of sensory systems. Subsequently there will be a series of topics that address neurological and psychiatric diseases with complex or heterogeneous etiology, such as schizophrenia and epilepsy. Neurodegenerative disorders and brain injury will(also be addressed. Finally, examples of cancer and infectious diseases that target the CNS will be presented. For each topic, a clinical overview will be provided, followed by research about underlying mechanisms, based on clinical research or animal models. The course will follow the textbook "Diseases of the Nervous System" (S. Gilman, Ed.). The course instructors are research scientists who have expertise in neuroscience and translational research. The major(goals of the course will be to introduce clinical topics to graduate students in a context that complements basic neuroscience courses, and provides opportunities to expand their perspectives from basic science to clinically-related endpoints.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4415 Rdgs in Translational Neuroscience (1.5 Credits)***Typically offered occasionally*

This course will be a weekly discussion series that addresses current translational neuroscience research. Each session will last 1-1.5 hours. Every month there will be one didactic lecture by the course instructor that will address how to read scientific articles, how to write articles, construct abstracts, optimize poster and oral presentations of research articles. The topics for the presentThis course will be a weekly discussion series that addresses current translational neuroscience research. Each session will last 1-1.5 hours. Every month there will be one didactic lecture by the course instructor that will address how to read scientific articles, how to write articles, construct abstracts, optimize poster and oral presentations of research articles. The topics for the presentation will be decided with the help of the course instructor. The presentation will begin with an overview of the topic, and then continue with a critical presentation of the article. Students will be graded on their presentation, and participation in discussions of other presentations.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 4416 Seminar in Biomedical Imaging (1.5 Credits)***Typically offered occasionally*

In this course, students present their thesis research to peers and faculty in the Biomedical Imaging & Technology program for discussion and feedback.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4417 Research in Biomedical Imaging (0.5-12 Credits)***Typically offered occasionally*

This course is for students to conduct independent research toward their dissertation in Biomedical Imaging & Technology.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4418 Tutorial in Biomedical Imaging (1-6 Credits)***Typically offered occasionally*

This course is an independent study for the biomedical imaging students to study a current topic/technique in the field.

Grading: GSAS Graded**Repeatable for additional credit:** Yes

BMSC-GA 4419 Drug Development in a New Era (3 Credits)*Typically offered occasionally*

This course covers drug and device development, delivering essential knowledge for translational researchers and basic scientists. Core tenants involve integrating resources within the global economy and public health domain, providing an overview of this innovative, multidisciplinary process.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4420 Neuroanatomy (3 Credits)***Typically offered occasionally*

The course covers the gross and histological structure of the brain and the anatomical localization and connectivity of the major functional systems that comprise the human central and peripheral nervous systems. Class time will be divided among lectures, laboratories, and conferences.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4422 Translating Cancer Discovery into Clinical Practice (4 Credits)***Typically offered occasionally*

This course is designed to educate students about the importance of translational research in oncology. Specifically, it focuses on the growing cross talk between basic science research and clinical oncology for development of novel approaches in managing cancer patients (both from diagnostic and therapeutic standpoints).

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4425 Stem Cell Biology Seminar (1.5 Credits)***Typically offered occasionally*

In this course, students present their thesis research to peers and faculty in the Stem Cell Biology program for discussion and feedback.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4426 Medical Imaging (3 Credits)***Typically offered occasionally*

This course introduces the physics, instrumentation, and signal processing methods used in x-ray (projection radiography), x-ray computed tomography, ultrasound imaging, optical imaging, and magnetic resonance imaging. The course builds on fundamental signal processing, basic electricity and magnetism, and multivariable calculus.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4427 Practical Magnetic Resonance Imaging I (6 Credits)***Typically offered occasionally*

This course is a practical introduction to the basic components of signal excitation and detection in magnetic resonance imaging (MRI). Prerequisites are basic knowledge of C++, BMSC-GA 4404 or permission from the course instructor for students not enrolled in the Vilcek training program in Biomedical Imaging & Technology.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4428 Pract Magnetic Resonance Imaging II (6 Credits)***Typically offered occasionally*

This course is a practical introduction to image reconstruction, processing, and analysis in magnetic resonance imaging (MRI). The course is divided into three modules. During laboratory sessions and homework, students will use Matlab to implement and test image reconstruction methods, perform image segmentation and coregistration.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4429 Tutorial in Stem Cell Biology (1.5 Credits)***Typically offered occasionally*

This course is for advanced students to conduct one-on-one discussions with their faculty tutor to help expand the student's knowledge.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4430 Research in Stem Cell Biology (0.5-12 Credits)***Typically offered occasionally*

This course is for students to conduct independent research toward their dissertation in Stem Cell Biology.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4433 Assembly & Function of Circuits in the CNS (3 Credits)***Typically offered occasionally*

This course covers the fundamental principles underlying nervous system development, from neural induction through activity-dependent fine tuning of neuronal properties and synaptic connections at later phases of development. We will address modern techniques to study neurodevelopment extensively. Primary research articles constitute the bulk of the required reading materials.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4435 Computational Biomedicine Seminar (1.5 Credits)***Typically offered occasionally*

In this course, students present their thesis research to peers and faculty in the Computational Biomedicine program for discussion and feedback.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4436 Research in Computational Biomedicine (0.5-12 Credits)***Typically offered occasionally*

This course is for students to conduct independent research toward their dissertation in Computational Biomedicine.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4437 Proteomics Informatics (3 Credits)***Typically offered occasionally*

This course provides an introduction to proteomics and mass spectrometry workflows, experimental design, and data analysis with a focus on algorithms for extracting information from experimental data. The following subjects will be covered: (1) Protein identification; (2) Protein characterization; (3) Protein quantitation.

Grading: GSAS Graded**Repeatable for additional credit:** No

BMSC-GA 4439 Machine Learning (3 Credits)*Typically offered occasionally*

This course will highlight what problems machine learning can solve relating to classification and regression. Extensive focus will be given to the main ways to classify: unsupervised and supervised. Also, the course will devote time to comparing machine learning vs. statistics. Prerequisites: Calculus, Linear Algebra, Algorithms and Data Structures, and Statistics.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4441 Seminar in Immunology (1.5 Credits)***Typically offered occasionally*

In this course, students present their thesis research to peers and faculty in the Immunology & Inflammation program for discussion and feedback.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4442 Research in Immunology (0.5-12 Credits)***Typically offered occasionally*

This course is for students to conduct independent research toward their dissertation in Immunology & Inflammation.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4446 Optical Microscopy (4 Credits)***Typically offered occasionally*

The course will cover the basics of light and fluorescence microscopy, along with up to date developments and advanced methods. This course will give an introduction to the physical nature of light, experimental design of microscope, image analysis, with a focus on modern microscopy techniques and single-molecule microscopy methods.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4449 Methods in Quantitative Biology (3 Credits)***Typically offered Fall and Spring*

This course provides an overview of foundational knowledge and essential methods relevant for all areas of biomedical informatics. Students will explore recurring themes and application domains most frequently used in the field. The majority of the coursework will be programming assignments and readings.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4450 Consulting in Biomedical Informatics (3 Credits)***Typically offered occasionally*

This is an elective course for graduate students enrolled in the Systems and Computational Biomedicine program. Students will participate in BPIC consultations, prepare reports, present consultations to faculty mentors and their peers. The students will meet weekly to discuss former consultations as case studies, ongoing consultation and strategies for effective informatics consulting.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4451 Data Analysis and Biostatistics with R (2 Credits)***Typically offered Spring*

This course provides students an introduction to R programming and biostatistics so that they can appropriately analyze data generated in the lab. The course covers fundamental topics in biostatistics including estimation, hypothesis testing, correlation, regression, and experimental design. Students will use the R Studio programming environment to implement the methods taught. Classes will be a mix of lectures and lab, providing students the opportunity to work individually on their laptop and code throughout the lecture.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No**BMSC-GA 4452 Applied Sequencing Informatics (3 Credits)***Typically offered occasionally*

This course provides practical training in informatics methods for analysis of next-generation DNA sequencing (NGS) data. Students will review the development of DNA sequencing laboratory technologies and informatics tools, current methods, and promising new developments. Current best-practice bioinformatics methods will be discussed, with an emphasis on data structures and algorithms, for the most commonly used NGS technologies and applications including variant detection, ChIP-seq, RNA-seq, de novo assembly, and targeted sequencing. A number of different computational frameworks and toolkits will be used including SAMTools, BedTools, BWA, TopHat/Cufflinks, GATK, QIIME, and Galaxy.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4453 Integrative Genomic Data Analysis (2 Credits)***Typically offered occasionally*

This course provides practical training in informatics methods for analysis of next-generation DNA sequencing (NGS) data. Students will review the development of DNA sequencing laboratory technologies and informatics tools, current methods, and promising new developments. Current best-practice bioinformatics methods will be discussed, with an emphasis on data structures and algorithms, for the most commonly used NGS technologies and applications including variant detection, ChIP-seq, RNA-seq, de novo assembly, and targeted sequencing. A number of different computational frameworks and toolkits will be used including SAMTools, BedTools, BWA, TopHat/Cufflinks, GATK, QIIME, and Galaxy.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4455 Introduction to Health Informatics (3 Credits)***Typically offered Fall and Spring*

An introduction to biomedical informatics, the interdisciplinary science of information management in medicine with a focus on its relevance to clinical research in medicine and public health. Innovative methods to capture, store, and retrieve clinical and population level data and information systems which can support research interventions will be reviewed.

Grading: GSAS Graded**Repeatable for additional credit:** No

BMSC-GA 4456 Advanced Topics in Bioinformatics (4 Credits)*Typically offered occasionally*

This course serves as an introduction to Biomedical Informatics, an interdisciplinary science of biological information management. The course focuses on the relevant mathematical, statistical, and computer science methodology that build the foundation of the field. Overview of application areas of Bioinformatics in current biomedical research will also be presented.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4457 Genome Integrity (3 Credits)***Typically offered occasionally*

This course provides students with a broad base in fundamental principles of genome integrity while at the same time providing connections between genome integrity, organismal fitness, and human disease.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4458 Cell Biology Seminars (1.5 Credits)***Typically offered occasionally*

Training in current topics relevant to Genome Integrity will be provided by a weekly journal club in conjunction with the New York Academy of Sciences Genome Integrity Discussion Group (NYAS GIDG). The topics for the Journal Club papers will be coordinated with the NYAS GIDG meeting talks. The NYAS convenes various meetings, seminars, and interdisciplinary conferences annually in New York City. The Sackler Institute provides annual NYAS memberships to all Sackler Graduate Students. The GIDG at the NYAS has been in place since 2002. It meets 5 times a year with 4 talks by invited faculty from the greater New York area (Oct, Dec, Feb, and April meetings) and a keynote address by a leader in the field (June meeting). Many faculty, students, and postdocs from NYU and the greater New York area regularly attend these meetings. The NYAS GIDG covers a broad range of topics including the DNA damage response, DNA replication, transcription, chromatin modification, recombination, cell cycle control, telomeres, chromosome segregation, epigenetic states, as well as the emergence of new technologies relevant to research in genome integrity. Prior to each meeting students will be assigned four papers (one for each talk) and then will meet with a participating genome integrity training grant (TG) faculty member each week for the four weeks prior to the meeting to discuss the papers in a journal club format. Eight TG faculty will participate each year hosting one Journal Club during the Fall and one during the Spring semester. Attendance at the NYAS GIDG meetings will then reinforce and enrich student understanding of the Journal Club topics.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4459 Drug Development and Pharmacology (4 Credits)***Typically offered occasionally*

This course is a combination of lectures and discussions of primary literature. The lectures that constitute the first part of the course are designed to provide a firm foundation in the basic concepts in pharmacology and drug development. Topics include: pharmacokinetics, drug metabolism, drug receptors and drug development, testing and approval. The lectures in the second part of the course are designed to introduce the students to the use of molecular pharmacology in drug development. Lectures encompass cardiovascular disease, G-protein receptors; the development of drugs that block kinases for the treatment of cancer; lipid metabolism; and pharmacological strategies for the treatment of addictive disorders. The third part of the course will cover diabetes. Topics include feeding behavior/satiety, obesity, diabetes and its complications. The final part of the course concerns metabolism and cancer. Topics include metabolism of cancer cells, chemotherapy and personalized medicine. There will be one formal lecture and one paper discussion section per week. The examination is at the conclusion of the course and will require students to defend specific aims (grant format) on any related topic discussed in the course in a group oral presentation. Attendance, active participation and discussion leadership throughout the course will also contribute to the final grade.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4460 Cell Biology Works-in-Progress (1.5 Credits)***Typically offered occasionally*

Genome Integrity students will be required to present their research annually from their 2nd year on. As a forum for student presentations, we will take advantage of our already existing multi-group meeting (The NYU Genome Integrity Group). This group, which comprises over one third (10/29) of the faculty mentors in the proposed training grant, meet monthly for faculty, postdocs and students to present their research. This meeting will be expanded to twice-monthly to provide a forum for graduate students in the Genome Integrity Training Program to present their research. As the number of students in the program increases we will develop a Works in Progress Course for student presentations that will meet weekly.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4461 Molecular Mechanisms of Neurodegeneration (4 Credits)***Typically offered occasionally*

This elective course for graduate students focuses on molecular and cellular mechanisms of neurodegeneration. For the Spring 2015 semester, topics will include, genetics, endoplasmic reticulum stress, endosomal dysfunction, parenchymal and vascular amyloid as well as cerebrovascular dysfunction, axonal degeneration, mitochondria and oxidative stress, viral infections, neuromuscular synapses, microglia and therapeutic approaches. It is anticipated that these topics may change from year to year based on advances in the field and availability of experts. The objective is to provide students who are interested in neurodegeneration with a foundation relevant to their dissertation project, and that these lectures and journal clubs may introduce them to novel concepts, hypotheses and controversies that may have implications for their own research.

Grading: GSAS Graded**Repeatable for additional credit:** No

BMSC-GA 4462 Systems and Motor Neuroscience (3 Credits)*Typically offered occasionally*

A core required course for the Neuroscience & Physiology Training Program.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4463 Readings in Neuroscience (0.5-5 Credits)***Typically offered occasionally*

This course will serve as an advanced elective course in the Neuroscience & Physiology graduate training program.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 4465 Seminars in Pathobiology and Translational Medicine (WIP) (1.5 Credits)***Typically offered occasionally*

Seminars in Pathobiology and Translational Medicine (also known as works-in-progress or WIP) are designed specifically for the Pathobiology training program but they are open to all Sackler graduate students.

These seminars are overseen by the Pathobiology Program Director and Graduate Advisors. Pathobiology students begin to attend WIP in their second year after they join the program. In years 3-4-5, students are required to present their research projects, including the description of the underlying hypothesis, critical review of the background literature, and presentation of latest results. Each trainee presents at least once per year in an oral presentation format. Once a month in place of the research presentation, students participate in the Translational Science and Medicine Journal Club where a research article is jointly presented by one Pathology resident/fellow and one graduate student. Clinical subjects are addressed in the context of basic science/mechanism-based research. Dr. Sandra DeMaria helps oversee the content of this course.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 4466 Research in Pathobiology (0.5-12 Credits)***Typically offered occasionally*

This course will be for those students in the Pathobiology Training Program or an open program student doing research in a Pathobiology faculty member's lab.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4467 Host Pathogen Interactions (4 Credits)***Typically offered occasionally*

The course is a basic introduction to different pathogens of viral, bacterial, and parasitic origin and host immune responses. It also analyzes the immunological, cellular, molecular, and genetic mechanisms in pathogen biology and pathogen-host interactions.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4468 Fundamentals of Microbiology and Microbial Pathogenesis (4 Credits)***Typically offered occasionally*

For students interested in medical microbiology and related disciplines, this course will cover fundamental aspects of bacteriology and parasitology by means of interactive lectures, discussions, lab sessions and student presentations of research papers.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4469 Positron Emission Tomography (3 Credits)***Typically offered occasionally*

An introduction to the fundamentals of positron emission tomography (PET) focusing initially on physics and instrumentation, then addressing how PET data are collected and formed into an image, the synthesis and production of PET radionuclides, the design of imaging studies for PET tracer validation, the principles of PET tracer kinetic modeling, the clinical applications.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4473 Rigor & Reproducibility (1 Credit)***Typically offered occasionally*

This course will provide students with a set of skills to support their graduate work and future research careers through its focus on literature searching, research data management, data visualization, team science, citation management, Git/GitHub, publication metrics, and publication models.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No**BMSC-GA 4476 Cell Biology (3 Credits)***Typically offered occasionally*

The course emphasizes basic cell biology and translational applications. Topics include: cell and molecular interactions governing potency, differentiation and plasticity among cellular hierarchies, mechanisms of cell adhesion, migration, communication and dynamic cytoskeletal reorganization in the construction of tissues, regulation of cell proliferation and death, and subcellular protein trafficking and signaling.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4478 Ethics (Refresher) (0 Credits)***Typically offered all terms*

This course refreshes student's knowledge of the ethical considerations involved in biomedical research, an NIH requirement every 4 years.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No**BMSC-GA 4479 Immunology Journal Club (1.5 Credits)***Typically offered occasionally*

This course will teach students how to present a paper, how to critically evaluate a paper, and what are some of the key current findings in the field of Immunology.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4480 Activity Dependent Neuronal Signalling (3 Credits)***Typically offered occasionally*

This course will serve as an advanced elective course in the Neuroscience & Physiology graduate training program.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4481 Advanced Practical Training (1-6 Credits)***Typically offered occasionally*

Students in the doctoral program in biomedical informatics gain experience with practical uses of advanced mathematical tools, through a relevant internship activity in a corporate, laboratory, or similar environment. This opportunity may be available to MS students; decisions are made on a case-by-case basis.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No

BMSC-GA 4482 Introduction to Research (2 Credits)*Typically offered occasionally*

This course is an entry level course required of all first year Sackler PhD students, where students will learn to think broadly and critically both in research methodology and in reading scientific literature.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4483 Clinical Decision Support (3 Credits)**

Clinical decision support refers to using information technology to support medical decision-making. In this course, students will learn the fundamentals of clinical decision support, with the end result being the design of their own clinical decision support tool.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4484 A Deep Dive into Scientific Writing and Presenting (1 Credit)**

The goal of this course is to improve students' ability to communicate their research, both written and orally even when the audience is not familiar with their area of expertise.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4485 Advanced Topics in Cellular and Molecular Neurobiology (4 Credits)**

This course will cover fundamental principles of molecular and cellular biology as they relate to nervous system function including topics such as control of gene regulation, protein synthesis, mechanisms that generate neuron architecture, intracellular and intercellular signaling, and molecular genetics.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4486 Programming for Data Analysis (2 Credits)**

This course is designed to empower students to learn R programming language to conduct data science. A range of topics will be studied including handling and querying databases, exploratory/confirmatory analysis and visualization in R, with an emphasis on biomedical data rather than textbook illustrated datasets.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**BMSC-GA 4487 Introduction to SAS for Data Management and Analysis (1 Credit)**

This course is a hands-on introduction to data management, manipulation and basic data analyses using SAS. Topics will include importing data from other formats into SAS, creating new variables and manipulating existing ones, merging data sets, converting character and numeric information, generating descriptive statistics, creating listings and summary reports, performing data cleaning, displaying data graphically, using macro variables and writing basic macros.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No**BMSC-GA 4488 Research in Epidemiology (0.5-12 Credits)**

This course is for students to conduct independent research toward their dissertation in Epidemiology.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4489 Research in Biostatistics (0.5-12 Credits)**

This course is for students to conduct independent research toward their dissertation in Biostatistics.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4491 Epidemiology seminar and journal club (1 Credit)**

In this course, students present their thesis research or journal articles to peers and faculty in the Epidemiology program for discussion and feedback.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4492 Biostatistics seminar and journal club (1 Credit)**

In this course, students present their thesis research or journal articles to peers and faculty in the Biostatistics program for discussion and feedback.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**BMSC-GA 4493 Deep Learning in Medicine (3 Credits)**

Students will learn the most common deep learning methods emerging in medicine. Students will be able to differentiate various deep learning methods and choose the most appropriate ones for specific research methods.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4494 Advanced Regression Modeling (3 Credits)**

Students will gain knowledge on the inference and application of generalized linear models, classification and regression tree (CART), support vector machine (SVM), linear mixed models, and generalized estimating equations.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4495 Methods and Applications for Systems and Synthetic Biology (2 Credits)**

The goal of the course is to familiarize the students with current technologies and their application with a focus on high throughput biology.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4496 Advanced Epidemiology Methods II (4 Credits)**

This course exposes doctoral students to emerging causal inference concepts and advanced methods in epidemiologic research. Students will be able to consider and apply how these strategies complement and advance traditional and first-line strategies.

Grading: GSAS Graded**Repeatable for additional credit:** No**BMSC-GA 4497 Principles and Applications of Flow Cytometry (1 Credit)**

This course will cover the principles of flow cytometry, a widely used technology for biomedical research.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No**BMSC-GA 4498 Advanced Integrative Omics (3-6 Credits)**

Students will be trained to work collaboratively towards a common interdisciplinary research goal through the analysis of a complex multimodal 'omics data set to answer novel scientific questions.

Grading: GSAS Graded**Repeatable for additional credit:** No

BMSC-GA 4499 Evaluation Methods for Predictive Risk Models (3 Credits)

The course gives data scientists the multidisciplinary skills to evaluate systems and apply findings that improve organizational and system outcomes. Combining tools from business, health economics and process improvement science, students learn how a program evaluation approach applies to assessing the impact of multidisciplinary models on the wider health economy.

Grading: GSAS Graded

Repeatable for additional credit: Yes

BMSC-GA 4500 Approaches in Microbiome Research (3 Credits)

Students will learn contemporary microbiome research trends and analysis methods. They will experience the workflow of data analysis using the most popular platforms and understand their relative strengths and weaknesses. Students will learn to communicate microbiome research results correctly and effectively.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 4501 Molecular Epidemiology at the Interface of Biology and Population Health (2 Credits)

Epidemiology forms the cornerstone of public health, and shapes policy decisions and preventive healthcare practices. This course provides an introduction to the interdisciplinary science of molecular epidemiology using advanced laboratory methods in combination with analytical epidemiology to better address population health research challenges, from the molecular to the societal level.

Grading: GSAS Graded

Repeatable for additional credit: Yes

BMSC-GA 4502 Critical Thinking in Epidemiology (2 Credits)

Students will learn to critically evaluate, integrate and synthesize bodies of literature pertaining to current questions in epidemiology. Through in-depth analyses of current topics, we will focus on methodological issues in published studies that may pose limitations to our ability to answer the question of interest.

Grading: GSAS Graded

Repeatable for additional credit: Yes

BMSC-GA 4503 Peer Review in the Life Sciences (4 Credits)

As scientists, we communicate our research findings by publishing papers in scientific journals with peer review playing an integral part of the process. Yet, peer review is rarely formally taught leading to variable standards. This course will provide training in the peer review of manuscripts in the life sciences.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 4505 Advanced Methods in Observational Data Analysis (3 Credits)

This course aims to provide students with the knowledge and skills necessary for understanding indications and interpretation of statistical approaches used in observational health research.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4506 Health Communication: Applied Methods for Recruiting and Retaining Participants in Clinical Trials (3 Credits)

This course explores how to design materials to help engage patients in research studies and help public health practitioners and clinicians communicate complex information so patients can actively participate in their medical decisions.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4507 Systematic Reviews and Meta-Analyses (3 Credits)

This course trains students to conduct a systematic literature review, considered the highest level of evidence for answering clinical questions. It comprises didactic classroom sessions and lectures and the hands-on conducting of a systematic review of a topic.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4508 Introduction to Economic Evaluation in Health and Medicine (3 Credits)

This course aims to introduce concepts and techniques used in the economic evaluation of healthcare interventions, develop a specific research question, apply best model-building practices, and conduct analysis and interpret results.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4509 Introduction to Dissemination and Implementation in Science (3 Credits)

This course provides a comprehensive introduction to dissemination and implementation research. Students will learn to conceptualize and analyze research problems, and apply theory to improve implementation outcomes with increasing independence.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4510 Healthcare Delivery Science (3 Credits)

This course provides a comprehensive introduction to healthcare delivery in the US and the principles of care redesign to enable students to develop core competencies in healthcare delivery science.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4511 Principles of Population Health Science (3 Credits)

This course will introduce students to the study of relationships between many health determinants or health outcomes in large populations. Students will acquire a basic understanding of the socioeconomic, behavioral, cultural, and health care-related determinants of population health. This course is meant to complement other courses in population health sciences.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 4512 Population Health Seminar (1 Credit)

In this course, students present their thesis research to peers and faculty in the Population Health program for discussion and feedback.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4513 Fundamental Discoveries in Biology (6 Credits)

This class will allow first- and second-year doctoral students to learn the fundamentals of great scientific discoveries (how they were conceived, tested, and interpreted) in a format that promotes critical thinking, writing, and oral presentation skills.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 4514 Research in Population Health (0.5-12 Credits)

This course is for students to conduct independent research toward their dissertation in Population Health.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4515 Ion Channels and Transporters (1.5 Credits)

This course will highlight ion channels and transporters in mammalian cells and their roles in cell function. Although not the primary focus, the course also covers transporters of metabolites and macromolecules, and emerging roles of ion channels and transporters in immune cells.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4516 Community Outreach (3 Credits)

The course will provide a valuable experience for trainees to introduce science to young people from different backgrounds, encouraging them to pursue an education in STEM. The experience will help increase awareness and motivate our students to reach out to those who need academic resources and role models.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4517 Analytic Techniques for Healthcare Delivery Science (3 Credits)

This course introduces quantitative and qualitative analytical techniques most often used in healthcare delivery science (HDS). It will deliver a clear understanding of the role these methods can play in HDS research, an understanding of various approaches to the collection and analysis of data, and their application to research questions of varying kinds/stages in a project.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4518 Translating Epidemiologic Research for Population Health Impact (2 Credits)

The course aims to build competencies in applying public health research methods and evidence to “real-world” policy and practice efforts. It will delve into the divide that often exists between public health research and the execution of policy and practice and will prepare students to better conduct and communicate research to begin overcoming these divides.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 4520 Workshop on the Creative Scientific Process (1 Credit)

Students will learn how analogies provide an intuition for a problem, how new questions can be identified by searching for contradictions, how a hypothesis can be a liability for making new discoveries, and how ideas can be imported and exported across research fields.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4521 Individual Development Plan for MD/PhD students (0 Credits)

This course assists MD/PhD candidates in navigating their combined research and clinical careers. Participants will have the opportunity to evaluate their skills, values, and interests as they relate to their MD and PhD experience and professional careers.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4522 Biotechnology Industry: Structure & Strategy (3 Credits)

This course uses the case method to allow students to play the role of senior management at a life sciences enterprise, presenting them with the opportunity to analyze situations, identify issues, develop and evaluate options, make decisions, and plan implementation. Content will primarily include running a biotechnology company, not starting one.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4523 Qualitative Research Methods for Population Health (2 Credits)

This course provides an overview of qualitative research methods and presents an awareness of the possibilities that qualitative research offers. The methods are one of the tools that can be used to address health equity with an emphasis on qualitative research design, methods of data gathering, coding, and analysis.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 4524 Life Course Epidemiology (2 Credits)

This course provides an overview of the life course approach, a framework for epidemiologists to understand the cause and development of various health outcomes across the life span, and demonstrates how it is applied in various domains of epidemiological research.

Grading: GSAS Graded

Repeatable for additional credit: No

BMSC-GA 4525 Introduction to Biomedical Entrepreneurship: Foundations of Biomedical Startups (3 Credits)

This course will teach students how to turn novel ideas into marketable drugs, devices, and digital health solutions. A special focus is on the commercialization of academic discoveries and inventions and the entrepreneurial journey of scientist-entrepreneurs.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No

BMSC-GA 4526 Health Disparities and Health Equity in Community Health (3 Credits)

Health disparities are systematic, plausibly avoidable health differences that adversely affect economically and socially disadvantaged groups. Health equity reflects a commitment to social justice in health. This course will introduce concepts, research methods, and practical applications to advance health equity, with a particular focus on community-based and safety-net healthcare settings.

Grading: GSAS Pass/Fail

Repeatable for additional credit: No