GDBBS Course Guide

Emory University

A comprehensive listing of graduate level courses affiliated with the Graduate Division of Biological and Biomedical Sciences in the Laney Graduate School at Emory, including courses outside of the GDBBS that our students have found useful

Last updated December 11, 2018
Graduate Division of Biological and Biomedical Sciences Courses (GDBBS)

IBS 555
Basic Biomedical and Biological Sciences I
The IBS 555/556 sequence is intended to catalyze students’ efforts to build the strong foundation required to effectively conduct primary research in the biomedical and biological sciences. Emphases include: (a) comprehending major concepts and vocabulary of modern biomedical sciences, (b) developing skills to critically read scientific literature and evaluate data, and (c) understanding core methodologies used to address fundamental questions about macromolecules and complex processes in cells and organisms. Disciplines considered include: Biochemistry, Structural Biology, Cell Biology, Development, Genetics, Molecular Biology, and Cell Physiology. The connections between these disciplines will be stressed. One goal is to integrate concepts with the experimental foundations on which they are based; thus approximately 10-20% of the lecture content will focus on methodologies. Class sessions (1 h 45 min) will be held four days a week. The format for most classes will be lectures by faculty, with student questions and discussion encouraged. Examination questions will derive from both class content and assigned readings.

IBS 556
Basic Biomedical and Biological Sciences II
The IBS 555/556 sequence is intended to catalyze students’ efforts to build the strong foundation required to effectively conduct primary research in the biomedical and biological sciences. Emphases include: (a) comprehending major concepts and vocabulary of modern biomedical sciences, (b) developing skills to critically read scientific literature and evaluate data, and (c) understanding core methodologies used to address fundamental questions about macromolecules and complex processes in cells and organisms. Disciplines considered include: Biochemistry, Structural Biology, Cell Biology, Development, Genetics, Molecular Biology, and Cell Physiology. The connections between these disciplines will be stressed. One goal is to integrate concepts with the experimental foundations on which they are based; thus approximately 10-20% of the lecture content will focus on methodologies. Class sessions (1 h 45 min) will be held four days a week. The format for most classes will be lectures by faculty, with student questions and discussion encouraged. Examination questions will derive from both class content and assigned readings.

GDBBS General Courses

IBS 500R
Current Topics in Bioscience: Electronics for Neuroscience Research
Goal: To provide students having zero background in electronics the essential skills to undertake do-it-yourself (DIY) electronics project of relevance to neuroscientists. In the end students will complete a capstone project that requires programming a microcontroller and build an associated electronic device for use in their experiments. Cost of devices will generally be less than $100 (sometimes much less).
Grading: Weekly quizzes and quality of final capstone project
IBS 504
Introduction to Prokaryotic Molecular Genetics
Original literature on various topics is read and discussed. Topics include DNA; structure and synthesis; mutation; recombination; complementation; genetic analysis; phage; transduction; F plasmid and conjugation; plasmids; transposition; restriction and modification; gene cloning; regulation.

IBS 525
Human Anatomy
The structure of the human body is examined using cadaver dissections. Laboratory work is supplemented by lectures which emphasize principles of organization and clinical relevance of major structural systems in different body regions.

IBS 526
Neuroanatomy and Systems Neuroscience
The organization and function of the nervous system are surveyed in a series of lectures, laboratories, problem-solving sessions, and presentations of illustrative clinical material. Emphasis is placed on cellular and molecular aspects of neurobiology and the organization of sensory, motor and cognitive systems.

IBS 538
Statistical Design and Analysis of Experiments
This course is designed to teach students a wide variety of statistical methods commonly used in the experimental biological sciences. Students successfully completing this course should be able to: understand and implement good experimental design in conducting scientific research, choose and carry out appropriate statistical analyses for a variety of data types, provide sound interpretation of statistical analyses, and critically read and interpret the statistical content of scientific journal articles in the biological and biomedical sciences.

IBS 541
Molecular Biology and Evolutionary Genetics
Technological innovation in molecular biology has allowed us to generate an enormous amount of DNA sequence data from various groups of organisms. In 2001, the nucleotide sequence of the entire human genome has been characterized; the genomic sequencing of many additional organisms will be completed in the future. The challenging task for biologists now is how to extract information from these data. Since these sequence differences are the products of accumulation of mutations in different organisms, the problem is basically reduced to studying the mechanisms of evolution of genes, proteins and genomes of different organisms. In this class, we will learn a wide range of topics, including population genetics, molecular evolution, human genome projects, bioinformatics and functional genomics.
IBS 542
Concepts of Immunology
The purpose of this course is to supply a fundamental and comprehensive presentation of the essential concepts in Immunology. It is designed to prepare students for advanced study and research in Immunology. In addition to descriptions of immunological concepts and terminology, emphasis will be placed on experimental approach. Students should begin to become aware of "state of the art" technology and current direction of Immunological research.

IBS 548
Biology of the Eye
A course designed for juniors, seniors, and graduate students who may be interested in a basic understanding of the eye. This course will review basic principles and state-of-the art information on ocular anatomy, embryology, biochemistry, physiology, genetics, immunology, microbiology, pharmacology, and pathology. This course will provide a fascinating insight into the overall function of the eye.

IBS 570
Essentials of Animal Experimentation
The course is focused on essential information all graduate students should have before beginning animal studies. The course includes discussion of ethics, laws and regulations, environmental variables and quality control, genetical consideration, experimental design and investigative techniques, biological characteristics of laboratory animals, biosafety, and responsible study of animals.

IBS 574
Computational Biology and Bioinformatics
The purpose of this class is to introduce and provide hands on training in current and relevant computational/bioinformatics resources, approaches, and programs applicable to a wide range of biological and biomedical research. A particular emphasis will be placed on genomic scale analysis of DNA, proteins, and gene expression.

IBS 599R
Thesis Research: Master’s Level
A. For undergraduate students pursuing a joint BS/MS degree in Biology
B. For students terminating their graduate studies at the MS level:

IBS 690
Laboratory Animal Pathology and Problem-based Learning
The Comparative Pathology (fall semester) lecture is designed to provide a general overview of pathological lesions of nonhuman primates (NHPs) with emphasis on gross and histopathology. The lectures will focus on classic pathologic conditions, common conditions observed in research settings and NHP- animal models for human diseases.
**IBS 691**  
Biology Management & Medicine of Rabbits and Rodents  
The course covers research uses, animal care programs and methods, reproduction and disease diagnosis, treatment and prevention for rats, mice, hamsters, guinea pigs, gerbils, other unusual or exotic rodents used in research, and rabbits, including unique strains, stocks, and mutants.

**IBS 692**  
Biology, Management & Medicine of Nonhuman Primates & Exotic Species  
The course covers taxonomy, behavior, laboratory management, research uses, and diagnosis, treatment and prevention of disease in nonhuman primates, mink, ferrets, armadillos, amphibia, reptiles, birds, marsupials, fish, marine mammals and invertebrates used in scientific research.

**IBS 699R**  
Advanced Graduate Research  
Structured for advanced graduate students who have not yet reached candidacy and are developing a research project for satisfying their Ph.D. degree requirements. Offers the opportunity for each student to work in the research laboratory area which identifies with their focused interests and allows them the space, materials and instruction to develop a project leading toward the Ph.D. degree. Tailored to the individual student.

**IBS 760r**  
Advanced Topics in Bioscience  
Cross-listed Offerings with other schools or departments.
Biochemistry, Cell and Developmental Biology Courses (BCDB)

BCDB 501
BCDB Foundations I
BCDB Foundations is a required course for first year BCDB Graduate Students. The course is composed of a series of Minicourses which are taught by teams of faculty to cover Biochemistry, Cell Biology and Developmental Biology in depth. The Minicourse format will also be used to encourage innovative approaches to teaching material, with particular emphasis on small group interactions between faculty and students.

BCDB 502
BCDB Foundations II
BCDB Foundations is a required course for first year BCDB Graduate Students. The course is composed of a series of Minicourses which are taught by teams of faculty to cover Biochemistry, Cell Biology and Developmental Biology in depth. The Minicourse format will also be used to encourage innovative approaches to teaching material, with particular emphasis on small group interactions between faculty and students.

BCDB 570R
Introductory Graduate Seminar
The seminar consists of presentation and critical evaluation of scientific material which can be obtained from a variety of sources including contemporary scientific literature. The course is designed to teach students how to analyze and interpret data, and importantly, to prepare and deliver oral presentations. After a student advances to candidacy, he or she may elect to take this course on a satisfactory/unsatisfactory basis. Advanced students will, in general, present material relevant to his/her thesis project.

BCDB 597R
Laboratory Rotations
During the first year in the program each student will have the opportunity to do experimental work in two or, optionally, three faculty laboratories. These laboratory "rotations" provide students with an early opportunity for research experience. Students are required to do one rotation in each semester of the first year, and may do an additional rotation the following summer. The rotations are designed to expose the student to different research approaches. These laboratory experiences will help familiarize the student with some of the many techniques used to examine research problems in cell biology or biophysics. As such the rotations can help define each student's own research interests. This is an important antecedent to determining an area for a thesis project and the selection of a research advisor, although the choice of advisor is certainly not limited only to those faculty with whom the student rotated. The laboratory research rotations also provide the faculty with an opportunity to observe and evaluate the performance of first-year students in a research setting. Students entering the program in Advanced Standing, or who have prior laboratory experience, may do fewer rotations at the discretion of the Program Director and Executive Committee. The initial
rotation will not begin until four weeks after a student enters the Program to allow the student some time to investigate various rotation opportunities.

**BCDB 790R**
Advanced Graduate Seminar
This seminar will be for advanced students in the program. It will be a forum for them to orally present their research to an audience wider than those working solely in their specific area. In this way it will serve as a vehicle for students to learn to present clear and interesting talks and deal with and offer criticism.

**BCDB 797R**
Directed Study
Tailored to the individual student's needs. Allows the advanced students to go into specific laboratories and learn advanced techniques.

**BCDB 799R**
Dissertation Research
Structured for advanced graduate students who have completed all coursework and who have designed and had approved a research project for satisfying the Ph.D. degree requirements. Offers the opportunity for each student to work in the research laboratory area which identifies with their focused interests and allows them the space, materials and instruction to complete approved projects for the Ph.D. degree. Tailored to the individual student.

**IBS 522R**
Hypothesis Design & Scientific Writing
This is a course whose principal function will be to teach writing skills for graduate students in the biomedical sciences. Good writing is an important skill regardless of your future plans or direction. While briefly describing other funding bodies and grant funding mechanisms, this course will use the NIH predoctoral NRSA application as its primary example. It will not fully prepare you to submit such a grant; it is intended to acquaint the student and give some practice in what is involved in the preparation of a biomedical research grant application.

**Cancer Biology Courses (CB)**

**CB 570R**
Introductory Graduate Seminar
The seminar consists of presentation and critical evaluation of scientific material which can be obtained from a variety of sources including contemporary scientific literature. The course is designed to teach students how to analyze and interpret data, and importantly, to prepare and deliver oral presentations. After a student advances to candidacy, he or she may elect to take this course on a satisfactory/ unsatisfactory basis. Advanced students will, in general, present material relevant to his/her thesis project.
CB 597R
Laboratory Rotations
During the first year in the program each student will have the opportunity to do experimental work in two or, optionally, three faculty laboratories. These laboratory "rotations" provide students with an early opportunity for research experience. Students are required to do one rotation in each semester of the first year, and may do an additional rotation the following summer. The rotations are designed to expose the student to different research approaches. These laboratory experiences will help familiarize the student with some of the many techniques used to examine research problems in cell biology or biophysics. As such the rotations can help define each student's own research interests. This is an important antecedent to determining an area for a thesis project and the selection of a research advisor, although the choice of advisor is certainly not limited only to those faculty with whom the student rotated. The laboratory research rotations also provide the faculty with an opportunity to observe and evaluate the performance of first-year students in a research setting. Students entering the program in Advanced Standing, or who have prior laboratory experience, may do fewer rotations at the discretion of the Program Director and Executive Committee. The initial rotation will not begin until four weeks after a student enters the Program to allow the student some time to investigate various rotation opportunities.

CB 790R
Advanced Graduate Seminar
The seminar consists of presentation and critical evaluation of scientific material which can be obtained from a variety of sources including contemporary scientific literature. The course is designed to teach students how to analyze and interpret data, and importantly, to prepare and deliver oral presentations. After a student advances to candidacy, he or she may elect to take this course on a satisfactory/unsatisfactory basis. Advanced students will, in general, present material relevant to his/her thesis project.

CB 799R
Dissertation Research
Structured for advanced graduate students who have completed all coursework and who have designed and had approved a research project for satisfying the Ph.D. degree requirements. Offers the opportunity for each student to work in the research laboratory area which identifies with their focused interests and allows them the space, materials and instruction to complete approved projects for the Ph.D. degree. Tailored to the individual student.

IBS 522R
Hypothesis Design & Scientific Writing
This is a course whose principal function will be to teach writing skills for graduate students in the biomedical sciences. Good writing is an important skill regardless of your future plans or direction. This course will focus on NIH funded grants, e.g., R01 and NRSA applications. It will not fully prepare you to submit such a grant; it is intended to acquaint the student and give some practice in what is involved in the preparation of a biomedical research grant application.
**IBS 523**
Cancer Biology I
This course is directed at students in both basic science (graduate students) and clinical training (residents, M.D./Ph.D. students) interested in a comprehensive course on fundamental aspects of human cancer. A second component of the course will focus on the development of the concept of translational research by bringing basic science concepts to realistic clinical applications through discussion of current literature and seminars by clinical and basic science faculty actively engaged in translational research. The course will consist of lectures by teaching faculty in the Department of Radiation Oncology and the Winship Cancer Center, literature discussion periods and translational research seminars. Some of the topics to be covered include the following: fundamental properties of neoplastic cells; multistage carcinogenesis; metastasis; cell cycle; apoptosis; genomic instability in cancer cells; signal transduction pathways; oncogenes and tumor suppressor genes; tumor immunology; chemotherapy; and fundamentals of radiation biology.

**IBS 524**
Cancer Biology II
This course is directed at students in both basic science (graduate students) and clinical training (residents, M.D./Ph.D. students) interested in a comprehensive course on fundamental aspects of human cancer. A second component of the course will focus on the development of the concept of translational research by bringing basic science concepts to realistic clinical applications through discussion of current literature and seminars by clinical and basic science faculty actively engaged in translational research. The course will consist of lectures by teaching faculty in the Department of Radiation Oncology and the Winship Cancer Center, literature discussion periods and translational research seminars. Some of the topics to be covered include the following: fundamental properties of neoplastic cells; multistage carcinogenesis; metastasis; cell cycle; apoptosis; genomic instability in cancer cells; signal transduction pathways; oncogenes and tumor suppressor genes; tumor immunology; chemotherapy; and fundamentals of radiation biology.

**IBS 562**
Cancer Clinical Colloquium
The course is designed to provide cancer biology students with an overview of the human side of cancer. The format will be small group discussions with experts in the field of cancer diagnostics, screening, epidemiology, and treatment, as well as representatives patients and and family members of patients with cancer, The goal is to have an open dynamic discussion as to the real human impact of translation discoveries from the research laboratories of clinical practice. The expectation of ongoing class participation is significant for success in the course, Weekly writing assignments in a short blog format will be an important part of the student’s overall evaluation.
**IBS 761**  
*Cancer Pharmacology*  
This course is designed to provide students with an overview of the fundamentals of pharmacology as applied to cancer therapy. The course will address molecular mechanisms of action to chemotherapeutic, anti-hormonal, and new experimental drugs. The mechanisms by which malignant cells become resistant to anticancer agents and ways to potentially overcome drug resistance. Topics covered will range from traditional chemotherapy drugs to novel concepts in cancer pharmacology.

**Genetics and Molecular Biology Courses (GMB)**

**GMB 570R**  
*Introductory Graduate Seminar*  
The seminar consists of presentation and critical evaluation of scientific material which can be obtained from a variety of sources including contemporary scientific literature. The course is designed to teach students how to analyze and interpret data, and importantly, to prepare and deliver oral presentations. After a student advances to candidacy, he or she may elect to take this course on a satisfactory/unsatisfactory basis. Advanced students will, in general, present material relevant to his/her thesis project.

**GMB 597R**  
*Laboratory Rotations*  
During the first year in the program each student will have the opportunity to do experimental work in two or, optionally, three faculty laboratories. These laboratory "rotations" provide students with an early opportunity for research experience. Students are required to do one rotation in each semester of the first year, and may do an additional rotation the following summer. The rotations are designed to expose the student to different research approaches. These laboratory experiences will help familiarize the student with some of the many techniques used to examine research problems in cell biology or biophysics. As such the rotations can help define each student's own research interests. This is an important antecedent to determining an area for a thesis project and the selection of a research advisor, although the choice of advisor is certainly not limited only to those faculty with whom the student rotated. The laboratory research rotations also provide the faculty with an opportunity to observe and evaluate the performance of first-year students in a research setting. Students entering the program in Advanced Standing, or who have prior laboratory experience, may do fewer rotations at the discretion of the Program Director and Executive Committee. The initial rotation will not begin until four weeks after a student enters the Program to allow the student some time to investigate various rotation opportunities.

**GMB 706**  
*Ethical Conduct in Research*  
The students are asked to examine a set of case studies and lead the discussions with respect to the grey/ethical concerns that are raised. The students are expected to learn to identify situations and events that can lead to ethical issues, and are exposed to methods of conflict
resolution, and procedures for avoiding ethical violations, and reporting them if they are observed.

The topics that are discussed are data management, mentoring, authorship, peer review, collaboration, human subjects, use of animals in research, scholarly misconduct, conflict of interest, and public scholarship.

GMB 790R
Advanced Graduate Seminar
This seminar will be for advanced students in the program. It will be a forum for them to orally present their research to an audience wider than those working solely in their specific area. In this way it will serve as a vehicle for students to learn to present clear and interesting talks and deal with and offer criticism.

GMB 797R
Directed Study
Tailored to the individual student’s needs. Allows the advanced students to go into specific laboratories and learn advanced techniques.

GMB 799R
Dissertation Research
Structured for advanced graduate students who have completed all coursework and who have designed and had approved a research project for satisfying the Ph.D. degree requirements. Offers the opportunity for each student to work in the research laboratory area which identifies with their focused interests and allows them the space, materials and instruction to complete approved projects for the Ph.D. degree. Tailored to the individual student.

IBS 515
Current Topics in Molecular Genetics
Special Topics in RNA Biology
This advanced literature-based class will explore cross-disciplinary themes in RNA biology across a variety of model systems. The contribution of RNA in mediating diverse paradigms of gene regulation will be emphasized. Student led in depth literature review and class discussions will be paired with seminars featuring exemplary speakers as we focus on the design, logic, and interpretation of scientific experiments.

IBS 522R
Hypothesis Design & Scientific Writing
This is a course whose principal function will be to teach writing skills for graduate students in the biomedical sciences. Good writing is an important skill regardless of your future plans or direction. This course will focus on NIH funded grants, e.g., R01 and NRSA applications. It will not fully prepare you to submit such a grant; it is intended to acquaint the student and give some practice in what is involved in the preparation of a biomedical research grant application.
IBS 546R
Presenting Genetics
The emphasis of this course is to teach students how to organize and present genetics and molecular biology topics to their peers or to students, rather than to necessarily teach them the science that is discussed.

IBS 547
Genetics Seminar: Molecular Biology & Genetics of the Visual System
This course will be in journal club format. Presentations will be given by each student (about three per session). Presentations should last 30 minutes and there will be 10 minutes of discussion after each presentation. It is for all graduate students with an interest in the visual system and who have a molecular biological background or interest.

IBS 560
Model Genetic Systems
This course covers several eukaryotic species which are currently the subject of major research in molecular genetics (yeast, C. elegans, Drosophila, mouse, zebrafish and possibly chlamydomonas or dictyostelium). The unique advantages of each system are emphasized, including historic reasons for choosing the organism as a genetic model as well as why it is currently used. Lectures will be given by faculty that utilize these organisms in their laboratories. Students are assigned readings from the literature. Three or four exams are given during the semester.

IBS 561
Eukaryotic Chromosome Organization & Function
This course will focus on the features of chromosomes that are fundamental to gene function and to their behavior in meiosis and mitosis.

IBS 714R
Genomics and Human Genetics
The course will revolve around a new publication "Annual Review of Genomics and Human Genetics." Each year the topics change but will represent a broad gamut within this general area. Each week one chapter will be assigned and it will be expected that each student has read the assigned chapter in detail.

IBS 736
Genetic Epidemiology
Course includes: scope of genetic epidemiology, basic concepts of genetics, application of genetic concepts to epidemiology, epidemiologic aspects of genetic traits, genetic approaches to familial aggregation, methods of gene discovery for complex traits.
**IBS 746**  
**Graduate Human Genetics**  
This fast-paced and rigorous course will:  
(1) provide students with an overview of concepts and methodologies in contemporary human genetics, and (2) empower students to be critical readers of the primary literature.  
The syllabus is structured to include a combination of faculty lectures, daily to weekly in-class discussions of primary research papers, and a brief grant-composition and presentation exercise at the end of the semester.

**Immunology and Molecular Pathogenesis Courses (IMP)**

**IBS 513**  
**Virology**  
The course is designed to provide a strong background in basic concepts involving viral replication, pathogenesis and immunity. The first section of the course focuses on concepts that are applicable to viruses in general, including virus structure, host cell entry, RNA virus transcription and replication, DNA virus transcription and replication, retroviruses and retroviral integration, processing and translational of viral mRNAs, virus assembly and exit, acute and chronic infections, viral pathogenesis, viral immunity, and immune evasion strategies. The second portion of the course concentrates on specific virus families with emphasis on human pathogens. The third section of the course covers special topics in virology including adaptive and innate immunity to viruses and immune evasion by viruses, viruses and cancer, viral vectors and vaccines, chronic and persistent infections caused by viruses, and emerging viruses.

**IBS 522R**  
**Hypothesis Design & Scientific Writing**  
This is a course whose principal function will be to teach writing skills for graduate students in the biomedical sciences. Good writing is an important skill regardless of your future plans or direction. This course will focus on NIH funded grants, e.g., R01 and NRSA applications. It will not fully prepare you to submit such a grant; it is intended to acquaint the student and give some practice in what is involved in the preparation of a biomedical research grant application.

**IBS 545R**  
**Introduction to Research**  
This course is structured for first year graduate students. They are assigned laboratory rotations and are taught research interests, methods and procedures for genetics, immunology and virology. Emphasis is placed by the faculty on the research and laboratory techniques applicable to respective research areas.

**IBS 745**  
**Infection and Immunity**  
Non-specific and specific host defenses clash with the pathogenic mechanisms of microbes, and the end result may be health or disease. The students will read selected papers and reviews that illustrate the definition of significant problems and the laboratory approach to their
solution. In class they will discuss general principles and selected examples drawn from specific infections.

**IBS 747R**  
Current Topics in Immunology  
Journal club type presentation by students on selected topics in immunology. Faculty instructors choose topics. It is a 5 credit hours advanced level course offered twice a year, spring and fall. Usually two classes/week and each class is 1:30 hours long. Four faculty instructors participate and each faculty conducts 6 classes. Evaluation is based on presentation, participation in the discussion and sometimes comprehensive writing on one of the topics.

**IBS 777R**  
Annual Reviews of Immunology  
This course reviews the most recent information in the field of Immunology. Several review articles are studied in depth in class with group participation. Individual assignments require the class participants to review and report on work by specific authors. Content of class changes each semester.

**IMP 570R**  
Introductory Graduate Seminar  
The seminar consists of presentation and critical evaluation of scientific material which can be obtained from a variety of sources including contemporary scientific literature. The course is designed to teach students how to analyze and interpret data, and importantly, to prepare and deliver oral presentations. After a student advances to candidacy, he or she may elect to take this course on a satisfactory/ unsatisfactory basis. Advanced students will, in general, present material relevant to his/her thesis project.

**IMP 597R**  
Laboratory Rotations  
During the first year in the program each student will have the opportunity to do experimental work in two or, optionally, three faculty laboratories. These laboratory "rotations" provide students with an early opportunity for research experience. Students are required to do one rotation in each semester of the first year, and may do an additional rotation the following summer. The rotations are designed to expose the student to different research approaches. These laboratory experiences will help familiarize the student with some of the many techniques used to examine research problems in cell biology or biophysics. As such the rotations can help define each student's own research interests. This is an important antecedent to determining an area for a thesis project and the selection of a research advisor, although the choice of advisor is certainly not limited only to those faculty with whom the student rotated. The laboratory research rotations also provide the faculty with an opportunity to observe and evaluate the performance of first-year students in a research setting. Students entering the program in Advanced Standing, or who have prior laboratory experience, may do fewer rotations at the discretion of the Program Director and Executive Committee. The initial
rotation will not begin until four weeks after a student enters the Program to allow the student some time to investigate various rotation opportunities.

**IMP 790R**
Advanced Graduate Seminar
This seminar will be for advanced students in the program. It will be a forum for them to orally present their research to an audience wider than those working solely in their specific area. In this way it will serve as a vehicle for students to learn to present clear and interesting talks and deal with and offer criticism.

**IMP 792R**
Colloquium Immunology
This course instructs first and second year MMG and IMP students in the organization and presentation of research endeavors. Students are trained in computer programs for figure and slide preparation and use of photo documentation systems. Presentations of journal articles and personal research in progress are evaluated by both attending students and the faculty organizers. Students are also instructed in the art of moderating or convening scientific meeting sessions.

**IMP 797R**
Directed Study
Tailored to the individual student's needs. Allows the advanced students to go into specific laboratories and learn advanced techniques.

**IMP 799R**
Dissertation Research
Structured for advanced graduate students who have completed all coursework and who have designed and had approved a research project for satisfying the Ph.D. degree requirements. Offers the opportunity for each student to work in the research laboratory area which identifies with their focused interests and allows them the space, materials and instruction to complete approved projects for the Ph.D. degree. Tailored to the individual student.

**Microbiology and Molecular Genetics (MMG)**

**IBS 513**
Virology
The course is designed to provide a strong background in basic concepts involving viral replication, pathogenesis and immunity. The first section of the course focuses on concepts that are applicable to viruses in general, including virus structure, host cell entry, RNA virus transcription and replication, DNA virus transcription and replication, retroviruses and retroviral integration, processing and translational of viral mRNAs, virus assembly and exit, acute and chronic infections, viral pathogenesis, viral immunity, and immune evasion strategies. The second portion of the course concentrates on specific virus families with emphasis on human pathogens. The third section of the course covers special topics in virology including adaptive
and innate immunity to viruses and immune evasion by viruses, viruses and cancer, viral vectors
and vaccines, chronic and persistent infections caused by viruses, and emerging viruses.

**IBS 522R**
Hypothesis Design & Scientific Writing
This is a course whose principal function will be to teach writing skills for graduate students in
the biomedical sciences. Good writing is an important skill regardless of your future plans or
direction. While briefly describing other funding bodies and grant funding mechanisms, this
course will use the NIH predoctoral NRSA application as its primary example. It will not fully
prepare you to submit such a grant; it is intended to acquaint the student and give some
practice in what is involved in the preparation of a biomedical research grant application.

**IBS 545R**
Introduction to Research
This course is structured for first year graduate students. They are assigned laboratory
rotations and are taught research interests, methods and procedures for genetics, immunology
and virology. Emphasis is placed by the faculty on the research and laboratory techniques
applicable to respective research areas.

**IBS 568**
Principles of Anti-infectives
To provide fundamental knowledge on anti-infectives used to treat
microbial infections or anti-infectives employed in host defense, mechanisms of microbial
resistance, and epidemiology and evolution of resistance. At the conclusion of the course the
student will better understand how anti-infectives that are important in human health function
and how microbes can circumvent their action.

**IBS 725**
Prokaryotic Gene Expression
Original literature readings on gene regulation in prokaryotic systems. Topics include repression
and activation of transcription in phage lambda, as well as more complex systems, such as
bacterial differentiation.

**IBS 727**
Genetics of Bacterial Pathogenicity
This course examines molecular genetic and molecular biological approaches to the study of an
important medical problem: the way in which bacteria cause disease. During class discussion,
students develop the ability to call upon these approaches to answer health-related questions
by critically examining the original literature.

**IBS 742**
Regulation of Cell Growth
The course will focus on the regulation of cell growth in bacteria only. Topics to be covered will
include the control of synthesis of macromolecules, regulation of gene expression, growth
under extreme conditions and cell-cell interactions. The aim will be to provide the students with an understanding of how the activities that occur in growing cells are coordinated, and how they change in response to environmental conditions. The course will cover both the genetic and biochemical approaches to these problems.

**MMG 570R**
**Introductory Graduate Seminar**
The seminar consists of presentation and critical evaluation of scientific material which can be obtained from a variety of sources including contemporary scientific literature. The course is designed to teach students how to analyze and interpret data, and importantly, to prepare and deliver oral presentations. After a student advances to candidacy, he or she may elect to take this course on a satisfactory/unsatisfactory basis. Advanced students will, in general, present material relevant to his/her thesis project.

**MMG 597R**
**Laboratory Rotations**
During the first year in the program each student will have the opportunity to do experimental work in two or, optionally, three faculty laboratories. These laboratory "rotations" provide students with an early opportunity for research experience. Students are required to do one rotation in each semester of the first year, and may do an additional rotation the following summer. The rotations are designed to expose the student to different research approaches. These laboratory experiences will help familiarize the student with some of the many techniques used to examine research problems in cell biology or biophysics. As such the rotations can help define each student's own research interests. This is an important antecedent to determining an area for a thesis project and the selection of a research advisor, although the choice of advisor is certainly not limited only to those faculty with whom the student rotated. The laboratory research rotations also provide the faculty with an opportunity to observe and evaluate the performance of first-year students in a research setting. Students entering the program in Advanced Standing, or who have prior laboratory experience, may do fewer rotations at the discretion of the Program Director and Executive Committee. The initial rotation will not begin until four weeks after a student enters the Program to allow the student some time to investigate various rotation opportunities.

**MMG 790R**
**Advanced Graduate Seminar**
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**MMG 792R**
**Colloquium Microbiology/Immunology**
This course instructs first and second year MMG and IMP students in the organization and presentation of research endeavors. Students are trained in computer programs for figure and
slide preparation and use of photo documentation systems. Presentations of journal articles and personal research in progress are evaluated by both attending students and the faculty organizers. Students are also instructed in the art of moderating or convening scientific meeting sessions.

**MMG 797R**
Directed Study
Tailored to the individual student's needs. Allows the advanced students to go into specific laboratories and learn advanced techniques.

**MMG 799R**
Dissertation Research
Structured for advanced graduate students who have completed all coursework and who have designed and had approved a research project for satisfying the Ph.D. degree requirements. Offers the opportunity for each student to work in the research laboratory area which identifies with their focused interests and allows them the space, materials and instruction to complete approved projects for the Ph.D. degree. Tailored to the individual student.

**Molecular and Systems Pharmacology (MSP)**

**IBS 531**
Introduction to Molecular & Systems Pharmacology I
This is the first course of a two semester sequence that broadly covers the basis of human and experimental disease and modern therapeutics. IBS531 covers fundamental principles of pharmacodynamics and pharmacokinetics, molecular pharmacology, and the physiology and pharmacology of the autonomic nervous system, the endocrine and metabolic control systems, and the cardiovascular circuit.

**IBS 532**
Introduction to Molecular and Systems Pharmacology II
This course provides a comprehensive overview of mechanisms of drug action and therapeutic applications of pharmacologic agents.

**IBS 537**
Grant Writing for Molecular & Systems Pharmacology
Pharmacogenomics, combinatorial chemistry and high-throughput screening have become essential elements of modern drug discovery strategies. This course is intended to provide students with experience in critical thinking as applied to the preparation of research grant applications. The course will include lectures but largely consist of iterative student presentations. Assignment of grades will be based on a research paper prepared by each student.
IBS 701
Cell Surface Receptors
The course consists primarily of lectures and discussions and covers an examination of receptor theory and an overview of our current knowledge of hormone and neurotransmitter receptors. Topics to be discussed include bioassays, radioligand binding assays, efficacy and intrinsic activity, reversible and irreversible antagonists, occupancy-response relationships and coupling efficiency, receptor subclassification, receptor cloning and structure, and mechanisms of supersensitivity and desensitization; specifically as they relate to receptors for biogenic amines, peptides and steroids. A final written essay type examination, an oral presentation, and class participation determine the final grade.

IBS 704
Human Ion Channelopathies (How Good Channels Go Bad)
This course will examine the molecular mechanisms of ion channel regulation in a physiological context with a particular emphasis on channelopathies, diseases caused by ion channel dysfunction. We will discuss examples of ion channels that are regulated by calcium influx and intracellular Ca stores, phosphorylation, voltage, G-proteins, cyclic nucleotides, and neurotransmitters. Channelopathies to be explored will include epilepsy, cardiac rhythm disorders, myotonia, diabetes, hereditary retinal degeneration, pain insensitivity, polycystic kidney disease, Dent’s disease (nephrolithiasis with renal failure), malignant osteopetrosis, central core disease, severe immunodeficiency of early infancy, migraine, and various ataxias. The course will emphasize the molecular and biophysical mechanisms underlying how channels function. Structure at the atomic level will be an important component of the course. The course will rely heavily on readings of primary research literature. It would be useful for the student to have some familiarity with electrophysiological techniques and the biochemistry and pharmacology of signal transduction and cell surface receptors.

IBS 717
Neuropharmacology
The course will provide a comprehensive coverage of selected aspects of drug actions on the central nervous system from the subcellular level to the intact organism. The focus will be on the neurochemical bases of drug action, with behavioral and physiological correlates. Acetylcholine, monoamine, amino acid, and neuropeptide systems will be covered along with major classes of drugs that interact with these systems, such antianxiety drugs, antidepressant drugs, antipsychotic drugs, hallucinogens, opioids, and stimulants. Basic principles and contemporary research techniques will be emphasized in faculty lectures, student presentations, and critical reviews of relevant literature.

IBS 740
Molecular Toxicology
The goal of this course is to strengthen the students’ understanding of the interaction between environmental chemicals and specific organ systems of the human body, focusing on appreciation of the explicit cellular and molecular mechanisms that underlie the toxicity. This knowledge will be supplemented through outside readings and class discussions using a
modified problem based learning (PBL) format. These interactions will serve to support the students’ understanding of the material and provide them with a real world perspective of molecular toxicology.

**IBS 761**  
Cancer Pharmacology  
This course is designed to provide students with an overview of the fundamentals of pharmacology as applied to cancer therapy. The course will address molecular mechanisms of action to chemotherapeutic, anti-hormonal, and new experimental drugs. The mechanisms by which malignant cells become resistant to anticancer agents and ways to potentially overcome drug resistance. Topics covered will range from traditional chemotherapy drugs to novel concepts in cancer pharmacology.

**MSP 501**  
Ethical Conduct of Research in the Pharmacological Sciences  
A series of hour-long discussions on different ethical topics related to the Pharmacological Sciences. The faculty facilitator gives a short overview of the topic, and then leads discussion of a series of case studies on the topic. Four classes are held per semester, students receive one credit total for two semesters of participation. This course is required for all first and second year MSP students. Students sign up for the course in the fall semester and receive their grade at the end of the spring semester.

**MSP 570R**  
Introductory Graduate Seminar  
The seminar consists of presentation and critical evaluation of scientific material which can be obtained from a variety of sources including contemporary scientific literature. The course is designed to teach students how to analyze and interpret data, and importantly, to prepare and deliver oral presentations. After a student advances to candidacy, he or she may elect to take this course on a satisfactory/unsatisfactory basis. Advanced students will, in general, present material relevant to his/her thesis project.

**MSP 597R**  
Laboratory Rotations  
During the first year in the program each student will have the opportunity to do experimental work in two or, optionally, three faculty laboratories. These laboratory "rotations" provide students with an early opportunity for research experience. Students are required to do one rotation in each semester of the first year, and may do an additional rotation the following summer. The rotations are designed to expose the student to different research approaches. These laboratory experiences will help familiarize the student with some of the many techniques used to examine research problems in cell biology or biophysics. As such the rotations can help define each student’s own research interests. This is an important antecedent to determining an area for a thesis project and the selection of a research advisor, although the choice of advisor is certainly not limited only to those faculty with whom the student rotated. The laboratory research rotations also provide the faculty with an opportunity
to observe and evaluate the performance of first-year students in a research setting. Students entering the program in Advanced Standing, or who have prior laboratory experience, may do fewer rotations at the discretion of the Program Director and Executive Committee. The initial rotation will not begin until four weeks after a student enters the Program to allow the student some time to investigate various rotation opportunities.

**MSP 717**
Principles of Therapeutic Discovery
Concepts, methods and case-studies about the process of drug and therapeutic discovery.

**MSP 790R**
Advanced Graduate Seminar
This seminar will be for advanced students in the program. It will be a forum for them to orally present their research to an audience wider than those working solely in their specific area. In this way it will serve as a vehicle for students to learn to present clear and interesting talks and deal with and offer criticism.

**MSP 797R**
Directed Study
Tailored to the individual student's needs. Allows the advanced students to go into specific laboratories and learn advanced techniques.

**MSP 799R**
Dissertation Research
Structured for advanced graduate students who have completed all coursework and who have designed and had approved a research project for satisfying the Ph.D. degree requirements. Offers the opportunity for each student to work in the research laboratory area which identifies with their focused interests and allows them the space, materials and instruction to complete approved projects for the Ph.D. degree. Tailored to the individual student.

**Neuroscience Courses (NS)**

**IBS 506R**
Basic Mechanisms of Neurological Diseases
This course convenes 3 hours a week for 1 semester. One and a half hours are devoted to discussing the clinical features of the disease. As often as possible, actual patients or videotapes of patients are presented. During the second hour and a half session each week an important area of current research into mechanisms of the disease is discussed. Students are assigned selected reviews and research papers before each class meeting.
IBS 530R  
Frontiers in Neuroscience  
This seminar exposes neuroscience students to the most recent and cutting edge topics in neuroscience. Students will interact with speakers and engage in post-seminar questions and answer sessions. Seminars will change from year to year.

IBS 534  
Computational Neuroscience  
This course will explore the function of single neurons and biological neural networks with computer simulations. It will consist of short (30 - 45 min) lectures followed by computer exercises.

IBS 535  
Behavioral Neuroendocrinology  
The goal of this course is to develop an understanding of biological mechanisms underlying the control of behavioral processes. For this, we will focus on the effects of hormones on behavior (and vice versa) throughout the effect of these chemical messengers on specific brain regions that regulate particular behaviors. Students will be evaluated based on presentation/review of articles and participation in the class.

IBS 543R  
Grant Writing & Professional Development  
This is a course whose principal function will be to teach writing skills for graduate students in the biomedical sciences, specifically Neuroscience. Good writing is an important skill regardless of your future plans or direction. This course will focus on NIH funded grants, e.g., R01 and NRSA applications. It will not fully prepare you to submit such a grant; it is intended to acquaint the student and give some practice in what is involved in the preparation of a biomedical research grant application.

IBS 703R  
Current Topics in Social Behavioral Neuroscience  
The purpose of the course is to provide in-depth experience in the evaluation of current or emerging cutting edge science. The faculty will rely heavily on current research papers and emphasis will be placed on how and why certain lines of experimental investigation developed. Two or three areas of research will be chosen by the course coordinator and these will be developed in detail.

IBS 717  
Neuropharmacology  
The course will provide a comprehensive coverage of selected aspects of drug actions on the central nervous system from the subcellular level to the intact organism. The focus will be on the neurochemical bases of drug action, with behavioral and physiological correlates. Acetylcholine, monoamine, amino acid, and neuropeptide systems will be covered along with major classes of drugs that interact with these systems, such antianxiety drugs, antidepressant
drugs, antipsychotic drugs, hallucinogens, opioids, and stimulants. Basic principles and contemporary research techniques will be emphasized in faculty lectures, student presentations, and critical reviews of relevant literature.

**IBS 750**  
Molecular Neurobiology  
This course will cover a broad range of topics of neuroscience with a focus on important molecular biology approaches to address critical questions regarding neuronal architecture and cellular signaling as well as molecular mechanisms that underlie important neurological disorders. Over the course, students will learn how to utilize complex neurobiology problems and how to critically analyze scientific data.

**NS 551**  
Techniques in Experimental Neuroscience  
This semester long 2-credit hours course is aimed at introducing first-year neuroscience graduate students to the various experimental techniques applied in neuroscience research in the laboratory. The goal is to expose students to these techniques by providing a lecture by a faculty member that is an expert in the particular techniques, followed by a student-led discussion of a recent publication employing the technique. The course will be built around topics that cover the breadth of neuroscience research and are based on the strength of the research in the neuroscience community at Emory University.

**NS 570R**  
Neuroscience: Professional Development, Communication and Ethics  
The seminar consists of presentation and critical evaluation of scientific material which can be obtained from a variety of sources including contemporary scientific literature. The course is designed to teach students how to analyze and interpret data, and importantly, to prepare and deliver oral presentations. After a student advances to candidacy, he or she may elect to take this course on a satisfactory/unsatisfactory basis. Advanced students will, in general, present material relevant to his/her thesis project.

**NS 597R**  
Laboratory Rotations  
During the first year in the program each student will have the opportunity to do experimental work in two or, option ally, three faculty laboratories. These laboratory "rotations" provide students with an early opportunity for research experience. Students are required to do one rotation in each semester of the first year, and may do an additional rotation the following summer. The rotations are designed to expose the student to different research approaches. These laboratory experiences will help familiarize the student with some of the many techniques used to examine research problems in cell biology or biophysics. As such the rotations can help define each student's own research interests. This is an important antecedent to determining an area for a thesis project and the selection of a research advisor, although the choice of advisor is certainly not limited only to those faculty with whom the student rotated. The laboratory research rotations also provide the faculty with an opportunity
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**NS 790R**  
Advanced Graduate Seminar  
This seminar will be for advanced students in the program. It will be a forum for them to orally present their research to an audience wider than those working solely in their specific area. In this way it will serve as a vehicle for students to learn to present clear and interesting talks and deal with and offer criticism.

**NS 797R**  
Directed Study  
Tailored to the individual student's needs. Allows the advanced students to go into specific laboratories and learn advanced techniques.

**NS 799R**  
Dissertation Research  
Structured for advanced graduate students who have completed all coursework and who have designed and had approved a research project for satisfying the Ph.D. degree requirements. Offers the opportunity for each student to work in the research laboratory area which identifies with their focused interests and allows them the space, materials and instruction to complete approved projects for the Ph.D. degree. Tailored to the individual student.

**Population Biology, Ecology, and Evolution Courses (PBEE)**

**IBS 591**  
Population Biology and Evolution of Disease  
This course includes lectures on a number of subjects the most prominent of which are: (i) the epidemiology of infectious diseases, (ii) the constitutive and inducible (immune) defenses of mammals, (iii) the within-host dynamics of bacterial and viral infections, (iv) the mechanisms of pathogenesis and the evolution of virulence, and (v) the prevention and treatment of infectious diseases by vaccination and antimicrobial agents. The emphasis of these lectures and the course at large are population and evolutionary processes and the use of mathematical models to study and explore these processes. Approximately half the course will be critical readings and discussions of bad as well as good original and review articles on the population biology and evolution of infectious disease.

**IBS 592**  
Quantitative Methods in Population Biology, Ecology and Evolution  
This course is unique in that it familiarizes students through hands on experience with the methods used in the mathematical modeling of population and evolutionary processes,
including dynamical systems theory, matrix methods in population analysis, statistical estimation, and traditional population genetics theory. Students will define, fit, and explore mathematical models through implementation in the R programming language.

**IBS 593**
Population and Quantitative Genetics
This fast-paced, graduate level class explores the theory and applications of single locus population genetics, quantitative genetics and coalescent theory to understanding the patterns and processes acting on genetic variation in natural populations. This is a required core course for Population Biology, Ecology and Evolution (PBEE) graduate students. The specific topics covered include:

- Genetic Variation in Natural Populations
- Genetic Drift
- The Neutral Theory of Molecular Evolution
- Natural Selection
- Two-Locus Dynamics
- Nonrandom Mating
- Quantitative Genetics
- Coalescent Theory

A goal of this course is to combine theory with data in order to critically evaluate the primary scientific literature. Furthermore, students should attain proficiency applying mathematical models in order to better understand the role of different evolutionary processes acting on genetic variation in natural populations. This class also contains a short writing module and an examination of the role of strong inference in Population Biology. Student performance is evaluated through a combination of weekly homework assignments, formal written examinations, and by the student’s participation in class discussions which will focus on a critical reading of both the text and selected primary literature.

**IBS 594**
Evolutionary Biology
This fast-paced, graduate level class explores the history and current status of the major research areas in evolutionary biology through lectures and readings of primary literature. This a required core course for Population Biology, Ecology and Evolution (PBEE) graduate students. The specific topics covered include:

- The History of Evolutionary Thought
- Phylogenetics
- Natural Selection and Adaptation
- Population Structure
- Molecular Evolution
- Sexual Selection
- Evolution of Sex and Sex Chromosomes
- Speciation
- Evolutionary Game Theory
- Kin Selection and Eusociality
• Evolution of Novelty
• Evolution of Developmental Programs
• Evolution of Aging
• Evolution of Virulence
• Macroevolution
• Human Evolution

Student performance is evaluated through a combination of homework assignments, formal written examinations, and by the student’s participation in class discussions which will focus on a critical reading of both the text and selected primary literature.

**IBS 595**
Ecology
This course covers the basic processes generating patterns of species abundance and geographic distribution. Topics include the modeling of population dynamics in age-structured populations, projection matrices and life-history dynamics and evolution, metapopulation structure and colonization dynamics, host-parasite, predator-prey, and competition systems. Break-out sections take place each week in which a paper related to the topic of the week is discussed with the students and organized by the faculty.

**IBS 796R**
Advanced Topics in PBEE
This course is specifically designed to bring graduate students and faculty together each spring to review a contemporary “hot-topic” in population and evolutionary biology. Each spring, a topic is chosen by students and faculty and then students and faculty pair for presentations of papers on the chosen topic. Students are expected to enroll in at least two Advanced Topics courses during their training in PBEE.

**IBS 796R**
Advanced Topics in PBEE
This course is specifically designed to bring graduate students and faculty together each spring to review a contemporary “hot-topic” in population and evolutionary biology. Each fall, a topic is chosen by students and faculty and then students and faculty pair for presentations of papers on the chosen topic. Students are expected to enroll in at least two Advanced Topics courses during their training in PBEE.

**PBEE 577**
PBEE Practice of Science
This course is targeted at second year graduate students in the biological sciences. Topics will include setting and meeting writing goals, providing feedback to colleagues and mentees, the peer review process, grant structure, presentation styles and writing recommendation letters. For graduate students in the PBEE program, emphasis will be placed on meeting writing goals associated with the PBEE qualifying exam.
PBEE 597r
Laboratory Rotations
During the first year in the program each student will have the opportunity to do experimental work in two or, optionally, three faculty laboratories. These laboratory "rotations" provide students with an early opportunity for research experience. Students are required to do one rotation in each semester of the first year, and may do an additional rotation the following summer. The rotations are designed to expose the student to different research approaches. These laboratory experiences will help familiarize the student with some of the many techniques used to examine research problems in cell biology or biophysics. As such the rotations can help define each student’s own research interests. This is an important antecedent to determining an area for a thesis project and the selection of a research advisor, although the choice of advisor is certainly not limited only to those faculty with whom the student rotated. The laboratory research rotations also provide the faculty with an opportunity to observe and evaluate the performance of first-year students in a research setting. Students entering the program in Advanced Standing, or who have prior laboratory experience, may do fewer rotations at the discretion of the Program Director and Executive Committee. The initial rotation will not begin until four weeks after a student enters the Program to allow the student some time to investigate various rotation opportunities.

PBEE 790R
Advanced Graduate Seminar
The seminar consists of presentations and critical evaluation of scientific material which can be obtained from a variety of sources including contemporary scientific literature. The course is designed to teach students how to analyze and interpret data, and importantly, to prepare and deliver oral presentations. Both faculty and students will make presentations. For students, this course provides a forum for them to orally present their research to an audience wider than those working solely in their specific area. In this way it will serve as a vehicle for students to learn to present clear and interesting talks and deal with and offer criticism.

PBEE 797R
Directed Study
Tailored to the individual student’s needs. Allows the advanced students to go into specific laboratories and learn advanced techniques.

PBEE 799R
Dissertation Research
Structured for advanced graduate students who have completed all coursework and who have designed and had approved a research project for satisfying the Ph.D. degree requirements. Offers the opportunity for each student to work in the research laboratory area which identifies with their focused interests and allows them the space, materials and instruction to complete approved projects for the Ph.D. degree. Tailored to the individual student.
**Common Electives Outside of GDBBS** (taken in the past by GDBBS students)

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</tbody>
</table>

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