BIOCHEMISTRY:
http://www.biochem.duke.edu/

BIOCHEM 658 (SBB 658) Structural Biochemistry I – [Structure of Macromolecules] Principles of modern structural biology. Protein-nucleic acid recognition, enzymatic reactions, viruses, immunoglobulins, signal transduction, and structure-based drug design described in terms of the atomic properties of biological macromolecules. Discussion of methods of structure determination with particular emphasis on macromolecular X-ray crystallography NMR methods, homology modeling, and bioinformatics. Students use molecular graphics tutorials and Internet databases to view and analyze structures. Prerequisites: organic chemistry and introductory biochemistry. *Minicourse, 1st half-semester. MWF 3:20-4:10 pm; Beese; 2 Units*

BIOCHEM 659 (CELLBIO, IMMUNOL, SBB, UPGEN 659) Structural Biochemistry II – [Molecular Biology I] Continuation of BIOCHEM 658. Structure/function analysis of proteins as enzymes, kinetics of binding, catalysis and allostery, protein folding, stability and design protein-protein interactions. Prerequisite: Biochemistry 658, organic chemistry, physical chemistry, and introductory biochemistry. This is an introductory course to learn how to use quantitative methods to understand biological structure and function. *Minicourse, 2nd half-semester. MWF 3:20-4:10 pm; Zhou; 2 Units*

BIOCHEM 681 (SBB 681) Biophysical Methods – This course provides an overview of nine prominent methods used in biochemistry, cell biology and structural biology. They are: optical spectroscopy, fluorescence, light microscopy, ligand binding, kinetics, mass spectrometry, magnetic resonance, electrophysiology and cryoelectron microscopy. The goal is to provide students with sufficient background knowledge to allow them to read and understand papers in the primary literature that employ one or more of these methods. Each method is taught by an instructor who employs the method in their own research. Grade is based on problem sets, quizzes and a final presentation to the class of a paper that uses a method of the student's choice. *TuTh, 10:05-11:20 am; Oas; 3 Units*

BIOCHEM 745S Biochemistry Seminar – This course is a requirement of all first-, second-, and third-year biochemistry graduate students to learn how to clearly and concisely present the background, data, conclusions, and future prospects of your research in both oral and written formats. First-year students will present their rotation projects. Second and third-year students will annually present their research. All students will provide feedback so each presenter can improve presentation content and style. *W 4:30-5:30 pm; Brennan; 1 Unit*

BIOCHEM 790S Seminar (Topics) - This is a discussion-based course that includes introductory lectures and the critical reading of select topics in Biochemistry literature. Topics and instructors are announced each semester. *MW 10:05-11:20 am; Kuehn; 2 Units*

BIOLOGY
https://biology.duke.edu/courses/2020-fall

BIOSTATISTICS:
http://biostat.duke.edu

BIOSTAT 701. Introduction to Statistical Theory and Methods I. This course provides a formal introduction to the basic theory and methods of probability and statistics. It covers topics in probability theory with an emphasis on those needed in statistics, including probability and sample spaces, independence, conditional probability, random variables, parametric families of distributions, and sampling distributions. Core concepts are mastered through mathematical exploration and linkage with the applied concepts studied in BIOSTAT 704. Prerequisite(s): 2 semesters of calculus or its equivalent (multivariate calculus preferred). Familiarity with linear algebras is helpful. Corequisite(s): BIOSTAT 702, BIOSTAT 703. *Instructor: Janice McCarthy. Meets: MW 10:05am-11:20am, Hock 10089. Credits: 3.*

BIOSTAT 702. Applied Biostatistical Methods I. This course provides an introduction to study design, descriptive

statistics, and analysis of statistical models with one or two predictor variables. Topics include principles of study design, basic study designs, descriptive statistics, sampling, contingency tables, one- and two-way analysis of variance, simple linear regression, and analysis of covariance. Both parametric and non-parametric techniques are explored. Core concepts are mastered through team-based case studies and analysis of authentic research problems encountered by program faculty and demonstrated in practicum experiences in concert with BIOSTAT 703. Computational exercises will use the R and SAS packages. Prerequisite(s): 2 semesters of calculus or its equivalent (multivariate calculus preferred). Familiarity with linear algebras is helpful. Corequisites(s): BIOSTAT 701, BIOSTAT 703, BIOSTAT 721. *Instructor: Tina Davenport. Meets: MW 8:30am-9:45am, Hock 10089. Credits: 3.*

BIOSTAT 703. Introduction to the Practice of Biostatistics I. This course provides an introduction to biology at a level suitable for practicing biostatisticians and directed practice in techniques of statistical collaboration and communication. With an emphasis on the connection between biomedical content and statistical approach, this course helps unify the statistical concepts and applications learned in BIOSTAT 701 and BIOSTAT 702. In addition to didactic sessions on biomedical issues, students are introduced to different areas of biostatistical practice at Duke University Medical Center. Biomedical topics are organized around the fundamental mechanisms of disease from both evolutionary and mechanistic perspectives, illustrated using examples from infectious disease, cancer and chronic/degenerative disease. In addition, students learn how to read and interpret research and clinical trial papers. Core concepts and skills are mastered through individual reading and class discussion of selected biomedical papers, team-based case studies and practical sessions introducing the art of collaborative statistics. Corequisite(s): BIOSTAT 701, BIOSTAT 702. *Instructors: Jesse Troy and Josh Granek. Meets: TTh 10:05am-11:20am, Hock 10089. Credits: 3.*

BIOSTAT 703L. Introduction to the Practice of Biostatistics I Lab. The lab is an extension of the course. The lab is run like a journal club. The lab instructs students how to dissect a research article from a statistical and scientific perspective. The lab provides students the opportunity to present on material covered in the co-requisite course and to practice the communication skills that are a core tenant of the program. Corequisite(s): BIOSTAT 703 or permission of the director of graduate studies. *Instructors: Jesse Troy and Josh Granek. Meets: Section 1- T 11:45am-1:00pm, Hock 11025. Section 2- F 10:05am-11:20am, Hock 11025. Credit: 0.*

BIOSTAT 707. Statistical Methods for Learning and Discovery. This course surveys a number of techniques for high dimensional data analysis useful for data mining, machine learning and genomic applications, among others. Topics include principal and independent component analysis, multidimensional scaling, tree-based classifiers, clustering techniques, support vector machines and networks, and techniques for model validation. Core concepts are mastered through the analysis and interpretation of several actual high dimensional genomics datasets. Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722/821 or their equivalents, or permission of the director of graduate studies. *Instructor: Jessilyn Dunn. Meets: TTh 8:30am-9:45am, Hock 10089. Credits: 3.*

BIOSTAT 710. Statistical Genetics and Genetic Epidemiology. Topics from current and classical methods for assessing familiality and heritability, linkage analysis of Mendelian and complex traits, family-based and population-based association studies, genetic heterogeneity, epistasis, and gene-environmental interactions. Computational methods and applications in current research areas. The course will include a simple overview of genetic data, terminology, and essential population genetic results. Topics will include sampling designs in human genetics, gene frequency estimation, segregation analysis, linkage analysis, tests of association, and detection of errors in genetic data. Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722/821 or their equivalents, or permission of the director of graduate studies. *Instructor: Andrew Allen. Meets: MW 11:45am-1:00pm, Hock 10089. Credits: 3.*

BIOSTAT 713. Survival Analysis. Introduction to concepts and techniques used in the analysis of time to event data, including censoring, hazard rates, estimation of survival curves, regression techniques, applications to clinical trials.

Interval censoring, informative censoring, competing risks, multiple events and multiple endpoints, time dependent covariates; nonparametric and semi- parametric methods. Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722/821 or their equivalents, or permission of the director of graduate studies. *Instructor: Yuan Wu. Meets: MW 3:05pm-4:20pm, Hock 10089. Credits: 3.*

BIOSTAT 719. Generalized Linear Models. The class introduces the concept of exponential family of distributions and link function, and their use in generalizing the standard linear regression to accommodate various outcome types. Theoretical framework will be presented but detailed practical analyses will be performed as well, including logistic regression and Poisson regression with extensions. Majority of the course will deal with the independent observations framework. However, there will be substantial discussion of longitudinal/clustered data where correlations within clusters are expected. To deal with such data the Generalized Estimating Equations and the Generalized Linear Mixed models will be introduced. An introduction to a Bayesian analysis approach will be presented, time permitting. Prerequisite(s): BIOSTAT 701, 702, 704, 705, and 721 or 722/821 or their equivalents, or permission of the director of graduate studies. *Instructor: Hwanhee Hong. Meets: TTh 11:45am-1:00pm, Hock 10089. Credits: 3.*

BIOSTAT 721. Introduction to Statistical Programming I (R). This class is an introduction to programming in R, targeted at statistics majors with minimal programming knowledge, which will give them the skills to grasp how statistical software works, tweak it to suit their needs, recombine existing pieces of code, and when needed create their own programs. Students will learn the core of ideas of programming (functions, objects, data structures, input and output, debugging, and logical design) through writing code to assist in numerical and graphical statistical analyses. Students will learn how to write maintainable code, and to test code for correctness. They will then learn how to set up stochastic simulations and how to work with and filter large data sets. Since code is also an important form of communication among scientists, students will learn how to comment and organize code to achieve reproducibility. Programming techniques and their application will be closely connected with the methods and examples presented in the co-requisite course. The primary programming package used in this course will be R. Prerequisite(s): None; familiarity with linear algebras is helpful. Corequisite(s): BIOSTAT 702. *Instructor: Brooke Alhanti. Meets: TTh 8:30am-9:45am, Hock 214. Credits: 3.*

BIOSTAT 801. Biostatistics Career Preparation and Development I. The purpose of this course is to give the student a holistic view of career choices and development and the tools they will need to succeed as professionals in the world of work. The fall semester will focus on resume development, creating a professional presence, networking techniques, what American employers expect in the workplace, creating and maintaining a professional digital presence and learning how to conduct and succeed at informational interviews. Practicums in this semester include an informational interviewing and networking practicum with invited guests. Students participate in a professional “etiquette dinner” and a “dress for success” module as well an employer panel. Corequisite(s): BIOSTAT 701 through BIOSTAT 703. *Instructor: Ellen Baker. Meets: W 1:25pm-2:40pm, Hock 10089. Credit: 1.*

BIOSTAT 802. Biostatistics Career Preparation and Development II. The purpose of this course is to further develop the student’s job seeking ability and the practical aspects of job/internship search or interviewing for a PhD program. The goal is to learn these skills once and use them for a lifetime. Modules that will be covered include: Communication skills both written and oral, interviewing with videotaped practice and review, negotiating techniques, potential career choices in the Biostatistics marketplace, and working on a team. This semester includes writing and interviewing practicum, and a panel of relevant industry speakers. Students will leave this course with the knowledge to manage their careers now and in the future. Prerequisite: BIOSTAT 801. *Instructor: Ellen Baker. Meets: Th 1:25pm-2:40pm, Hock 10089. Credit: 1.*

BIOSTAT 823. Statistical Program for Big Data. This course describes the challenges faced by analysts with the

increasing importance of large data sets, and the strategies that have been developed in response to these challenges. The core topics are how to manage data and how to make computation scalable. The data management module covers guidelines for working with open data, and the concepts and practical skills for working with in-memory, relational and NoSQL databases. The scalable computing module focuses on asynchronous, concurrent, parallel and distributed computing, as well as the construction of effective workflows following DevOps practices. Applications to the analysis of structured, semi-structured and unstructured data, especially from biomedical contexts, will be interleaved into the course. The course examples are primarily in Python and fluency in Python is assumed. Prerequisite(s): BIOSTAT 821 or permission of the Director of Graduate Studies. *Instructor: Cliburn Chan. Meets: MW 4:40pm-5:55pm, Hock 10089. Credits: 3.*

BIOSTAT 900: Current Problems in Biostatistics. Advanced seminar on topics at the research frontiers in biostatistics. Readings of current biostatistical research and presentations by faculty and advanced students of current research in their area of specialization. Instructor: Sean O'Brien. Credit: 1.

BIOSTAT 906. Statistical Inference. Introduce decision theory and optimality criteria, sufficiency, methods for point estimation, confidence interval and hypothesis testing methods and theory. Prerequisite: Biostatistics 704 or equivalent. Instructor consent required. Prerequisite: Permission of the Director of Graduate Studies. *Instructor: Jichun Xie. Meets: MW 10:05am-11:20am, Hock 11025. Credits: 3.*

BIOSTAT 907: Phase II Clinical Trials. Introduction to diverse statistical design and analytical methods for randomized phase II clinical trials. Topics: Minimax, optimal, and admissible clinical trials Inference methods for phase II clinical trials; clinical trials with a survival endpoint; clinical trials with heterogeneous patient populations; and randomized phase II clinical trials. Instructor consent required. *Instructor: Sin-Ho Jung. Meets: TTh 11:45am-1:00pm, Hock 11110. Credits: 3.*

BIOSTAT 908: Independent Study (Research Rotations). Faculty directed statistical methodology research. Instructor consent required. *Instructor: Sean O'Brien. Credit: 1.*

BIOSTAT 911. Modern Inferential Techniques and Theory. The theory for M- and Z- estimators and applications. Semiparametric models, geometry of efficient score functions and efficient influence functions, construction of semiparametric efficient estimators. Introduction to the bootstrap: consistency, inconsistency and remedy, correction for bias, and double bootstrap. U statistics and rank and permutation tests. Prerequisite: STA 711 and BIOSTAT 906 or Permission of the Director of Graduate Studies. *Instructor: Zhiguo Li. Meets: TTh 10:05am-11:20am, Hock 11025. Credits: 3.*

BIOTRAIN:

BIOTRAIN 701: Foundations in Professionalism for Biomedical Scientists. This course equips 1st year School of Medicine (SoM) biomedical PhD students with professionalism skills, including but not limited to stress management, effective communication, and mentor-mentee relationships. The course is team-taught by National Research Mentoring Curriculum-trained faculty members and Leadership and Management in Action Program-trained PhD students from diverse SoM PhD programs. Content includes interactive lectures that provide fundamental knowledge of key professional skills, and small group active learning sessions ("Gateway Groups") during which students discuss and practice professionalism skills and receive feedback from faculty mentors, peer mentors, and peers. Instructors: Sullivan, Thole, Telzrow. TH 8:30AM-9:30AM.

BIOTRAIN 720: Grant Writing for Biomedical Scientists. Introduction to scientific grant writing for second- (or third-) year PhD students. This course contains lecture-based and active learning sessions. Content includes lectures combined

with class discussions on grant agencies, format and structure of grant applications, concepts in peer review, best practices in articulating study design and data outcomes, rigor and reproducibility in a research plan, and crafting biological significance and training statements. Students write an NIH-style proposal and actively participate in topical study sections to receive oral and written critiques of their proposals and to provide constructive feedback of others' proposals. Open only to second- or third-year students in biomedical PhD programs. Instructor: Sullivan and staff. *MWF 8:45AM - 9:45AM*.

BIOTRAIN 898: Gateway to Internship and Experiential Learning. This internship preparation course will serve as a companion course to BIOTRAIN 899 Internship and Experiential Learning to begin the process of allowing Biomedical PhD students to explore specializations and career paths outside academia and prepare them to make more informed career path decisions. The course will encourage students to plan a practical path for pursuing a career outside of academia, address benefits and challenges of participating in an internship during the PhD, and provide tools and skills to navigate the process of finding and successfully completing an internship as part of the PhD course of study. *TH 8:30AM-10:00AM*

CELL AND MOLECULAR BIOLOGY:
http://medschool.duke.edu/cmb

CMB 710 A-F - Cell & Molecular Biology Modules
Modules in the CMB 710 series (A – F) are required for all CMB students. Modules are offered sequentially during the Fall semester. These are the core offerings of the Cell & Molecular Biology Program. Topics reflect the expertise of the corresponding faculty and emphasize either in-depth critical discussion of the primary literature or quantitative/mathematical approaches to addressing biological questions. Each module lasts for 2 weeks, with 3 meetings per week. Students entering through CMB are required to take 6 modules in fall semester of their first year with a minimum of 4 modules in the CMB 710 series. The other two may be from the UPGEN 778 series. A total of 12 modules are required for CMB, with a total of 8 from CMB710. To help you prepare for each module, the instructors have included a summary with any required reading that should be completed prior to the start of each module, and prerequisites.
Note: The Drop/Add deadline for Fall 2022, applies to **all modules**. CHECK for any prerequisites. *MWF 10:20 – 11:40 am;* Di Talia (Course Director); *1 Unit each*

CMB 733.01 (NEUROBIO, PHARM) – Experimental Design and Biostatistics for Basic Biomedical Scientists – See PHARM 333.01

CMB 733.02 (NEUROBIO, PHARM) – Experimental Design and Biostatistics for Basic Biomedical Scientists – See PHARM 333.02

CMB 733.03 (NEUROBIO, PHARM) – Experimental Design and Biostatistics for Basic Biomedical Scientists Statistics – See PHARM 333.03

CMB 764 Cell and Molecular Biology Colloquium – [Student Seminar] required of all CMB students. Each Monday at noon, presentations by upper-year students: one student talks about ongoing dissertation research and another introduces a research paper relevant to that week's seminar. Students attend the Thursday seminar and can have lunch with the speaker. Credit is based on attendance. *M 11:45-1:00 pm;* Boyce; *2 Units*

CMB 797 Modern Techniques in Molecular Biology - This course introduces the fundamental laboratory techniques used in basic research. It is divided into two sections. One section covers techniques used for protein purification, analysis, and the study of protein-protein interactions. The second covers nucleic acid based techniques, including a review of basic nucleic acid chemistry, enzymatic modification, qualitative and quantitative PCR, nucleic acid sequencing, cloning strategies, vectors, and measurement of transcript expression including microarray techniques. This course is built around a team-based learning model. Course reading material and recorded lectures are provided to students to review

before class and class time is spent reinforcing the material through problem sets and group discussion. *8:45-9:45 am; Madan Kwatra; 3 Units*

CELL BIOLOGY:
http://www.cellbio.duke.edu

CHEMISTRY: For a complete listing, please go to: http://www.chem.duke.edu/graduates/courses.php

COMPUTATIONAL BIOLOGY & BIOINFORMATICS:
https://medschool.duke.edu/education/biomedical-phd-programs/computational-biology-and-bioinformatics-program
CBB 510S Computational Biology & Bioinformatics Seminar - A weekly series of seminars on selected topics of current interest in computational biology & bioinformatics. Required of all 1st and 2nd year CBB students. *Mon 12p-1p; Instructor: Hauser; 1 unit*

CBB 511 Journal Club - A weekly series of discussions led by students that focus on current topics in computational biology. Topics of discussion may come from recent or seminal publications in computational biology or from research interests currently being pursued by students. *Th 3:30p-4:30p; Instructor: Hauser; 1 unit*

CBB 520 Genome Tools and Technologies - The course introduces the laboratory and computational methodologies for genetic and protein sequencing, mapping and expression measurement. Prerequisites: Students are expected to have some background course work in genetics, molecular biology, biochemistry, and a modern programming language. *TuTh 10:05a-11:20a; Instructor: Dietrich; 3 units*

CBB 526 Data Science - Data science is 'the science of planning for, acquisition, management, analysis of, and inference from data'. This course systematically covers the concepts, ideas, tools, and example applications of data science in an end-to-end manner. We emphasize data-driven thinking, data processing and analytics, and extracting actionable values from data. We focus on the interactions between data and applications, data modeling, and data processing, data analytics, and the essential algorithms and tools. Prerequisites: A statistics course (Statistics 111 or higher), data structures and algorithms (Computer Science 201), and relational databases (Computer Science216 or 316). *TuTh 1:25p-2:40p; Instructor: Songdechakraiwut; 3 units*

CBB 574 Modeling and Engineering Gene Circuits - This course discusses modeling and engineering gene circuits, such as prokaryotic gene expression, cell signaling dynamics, cell-cell communication, pattern formation, stochastic dynamics in cellular networks and its control by feedback or feedforward regulation, and cellular information processing. The theme is the application of modeling to explore "design principles" of cellular networks, and strategies to engineer such networks. Students need to define an appropriate modeling project. At the end of the course, they're required to write up their results and interpretation in a research-paper style report and give an oral presentation. Prerequisites: Biomedical Engineering 260L or consent of instructor. *MW 1:25p-2:40p; Instructor: You; 3 units*

CBB 591 Independent Study - Faculty directed experimental or theoretical research. *Instructor: Hauser; 1-9 units*

CBB 700 Internship - Student gains practical experience by taking an internship in industry, and writes a report about this experience. Requires prior consent from the student's advisor and from the director of graduate studies. May be repeated with consent of the advisor and the director of graduate studies. *Instructor: Hauser; 1 unit*
CBB 914 Graphical Models for Biological Data - Introduction to probabilistic graphical models and structured prediction, with applications in genetics and genomics. Hidden Markov Models, transducers, conditional random fields, stochastic context-free grammars, Bayesian hierarchical models, and approaches to integrative modeling. Algorithms for exact and approximate inference. Applications in DNA/RNA analysis, phylogenetics, sequence alignment, allelic phasing and imputation, genome/epigenome annotation, and gene regulation. Prerequisite: probability and statistics (BIOSTAT 701 or STA 611 or equivalent), and some programming experience with python, R, or similar language. *TuTh 1:25p-2:40p; Instructor: Majoros; 3 units*

CBB 658 Biochem 658 Structural Biochemistry I--See BIOCHEM 658
CBB 659 Biochem 659 Structural Biochemistry II--See BIOCHEM 659

COGNITIVE NEUROSCIENCE:

751. Neuroscience Bootcamp. Neuroscience Bootcamp is a one week immersive lecture, discussion and laboratory course for graduate students in the Neurobiology Graduate Program and the Cognitive Neuroscience Admitting Program, and graduate students in allied programs at the discretion of the instructors. The Duke Neuroscience Bootcamp is designed to (1) provide a common knowledge base of neuroscience fundamentals; (2) demystify the tools of the discipline—providing hands-on experience with techniques that are commonly used to explore cellular/molecular, circuits and cognitive neuroscience; and (3) introduce new students to a wide variety of Duke faculty and helpful resources for ensuring a successful graduate career. Instructor: Glickfeld, Grandl, Egner. 2 units. C-L: Neurobiology 751; Online Only

DEVELOPMENTAL & STEM CELL BIOLOGY:
https://sites.duke.edu/dscb/

DSCB 700 Classic Papers in Development - The goal of this Fall seminar course is to deepen understanding of the class findings and advances in the field of Development, Stem Cell, and Regenerative Biology and to provide a historical view of how these findings affect our approaches in the field today. The course will consist of both first and second year DSCB students and 20 faculty members who will select papers and facilitate group discussions. ***MWF - 12-1:30 pm***; Lechler; 1 Unit

DSCB 730 Hands on Development Mini Course - This class is required for **first year DSCB students only**, will expose students to basic principles and techniques in development and stem cell biology. This year the class will be held virtually and students will meet with individual faculty to learn about different model systems. MWF (8/17 - 8/28 afternoon only); Lechler, 1 Unit

IMMUNOLOGY:
https://immunobiology.duke.edu/

IMMUNOL 544 Principles of Immunology - This is a graduate level course that is open to both graduate students and advanced undergraduates. It is an introduction to the molecular and cellular basis of the immune response. Topics include anatomy of the lymphoid system, lymphocyte biology, antigen-antibody interactions, humoral and cellular effector mechanisms, and control of immune responses. The last third of the course focuses on special topics and application such as transplantation, autoimmunity, immunodeficiency, and tumor immunity. On selected days, the class is broken down into small discussion groups of approximately 15 students to discuss material introduced in the lectures or to work on problem sets. Graduate students in the Department of Immunology lead these sections. *MWF 1:45-2:35 pm; Miao; 3 Units.*

IMMUNOL 601 Immunology of Human Disease - This advanced course will cover the immune aspect of various human diseases including autoimmune diseases, allergy, tumor, inflammation and infectious diseases. Required course for all students specializing in immunology. Prior course requirement: IMM544. *Tues 10:15-11:30 am; He; 1 Unit.*

IMMUNOL 701D Pillars of Immunology – This course will cover discoveries of historical importance in the field of immunology through student presentations and discussions of classical papers. Intended for students seeking a PhD in Immunology. *F 10:15-11:30 am; Krangel; 1 Unit.*

IMMUNOL 731S Immunology Seminar--Work in progress seminar in which students and postdoctoral trainees give 30 min to 1 hour presentations of their research. Considered a showcase of current research in the Department of Immunology. All students enrolled in IMM programs are required to give a presentation once per year. Informal questions and discussion are encouraged throughout presentation. First and second year Immunology graduate students

should register for Immunology 731S which is graded credit. Third through sixth year Immunology students, along with non-Immunology majors should register for Immunology 732S which is non- graded credit. Attendance is essential for both spring and fall terms. *M 4:20-5:10 pm; Shinohara; 1 Unit.*

IMMUNOL 732S Immunology Seminar--Work in progress seminar in which students and postdoctoral trainees give 30min to 1 hour presentations of their research. Considered a showcase of current research in the Department of Immunology. All students enrolled in IMM programs are required to give a presentation once per year. Informal questions and discussion are encouraged throughout presentation. First and second year Immunology graduate students should register for Immunology 731S for graded credit. Third through sixth year Immunology students, along with non-Immunology majors should register for Immunology 732S which is non-graded credit. Attendance is essential for both spring and fall terms. *M 4:20-5:10 pm; Shinohara; 1 Unit.*

IMMUNOL 735 Topics in Immunology - Focus on current immunology research, emphasizing emerging research areas and new directions in established areas. Students present recent papers in selected subjects. Required course for all students specializing in immunology. *Th 8:45-10 am; Ciofani; Credit/no credit grading only; 1 Unit.*

IMMUNOL 791A Research in Immunology – This course is the first of two for first year students enrolled in the Immunology Graduate Program designed to introduce bench work in immunology and to expose students to a variety of techniques to increase their proficiency. One to two research rotations will be conducted in training faculty laboratories for periods of 6 weeks. Rotations should be approved by the DGS. The second course is IMMUNOL791B offered in the spring. Both courses must be taken in order for the four total credits and grades to post. 2 Units

Second Half Semester:
IMMUNOL 659 / BIOCHEM 659 Structural Biochemistry II - See BIOCHEM 659

INTEGRATED TOXICOLOGY AND ENVIRONMENTAL HEALTH (CERTIFICATE):
http://sites.nicholas.duke.edu/envhealth/

ENVIRON 501 Environmental Toxicology – (required) Study of environmental contaminants from a broad perspective encompassing biochemical, ecological, and toxicological principles and methodologies. Discussion of sources, environmental transport and transformation phenomena, accumulation in biota and ecosystems. Impacts at various levels of organization, particularly biochemical and physiological effects. Prerequisites: organic chemistry and vertebrate physiology or consent of instructor.
TuTh 10:05-11:20 am GH 1105; 3 units; Instructors: Jayasundara, Meyer

ENVIRON 540 Chemical Fate of Organic Compounds – This course will review the basics of environmental organic chemistry with a focus on contaminant chemistry. During this course we will discuss quantitative processes used in predicting the fate and distribution of organic chemicals in the environment with regards to equilibrium/thermodynamics and some kinetic considerations. Topics will include equilibrium partitioning among air, water, sediments and biological tissues, including bioaccumulation and biomagnification. The processes influencing the transport and ultimate fate of organic contaminants in rivers and lakes will be discussed in addition to processes influencing global transport. Prerequisites: university-level general chemistry and organic chemistry within last four years.
Lectures ASYNCHRONOUS ONLINE; Discussions M 3:30-4:45 pm or W 3:30-4:45 pm GH 1105 or ONLINE; 3 units; Instructor: Stapleton

ENVIRON 847S Seminar in Toxicology – (required) Cross-listed with PHARM 847S-01. A weekly research seminar throughout the year is required of participants in the Toxicology Program, but open to students in related fields as well. Students, faculty and invited national speakers present their latest research findings concerning neurotoxicology, molecular biology, teratology, environmental toxicology, public policy of environmental regulation and related fields.
F 12:00-1:15 pm GH 1112 or ONLINE; 1 Unit; Instructor: Meyer.

PHARM 533 Essentials of Pharmacology and Toxicology - (required) See PHARM 533

PHARM 733 Experimental Design and Biostatistics for Basic Biomedical Scientists - (required) See PHARM 733

MEDICAL PHYSICS
http://medicalphysics.duke.edu

MEDPHY 500 Radiation Physics - A course covering the basics of ionizing and non-ionizing radiation, atomic and nuclear structure, basic nuclear and atomic physics, radioactive decay, interaction of radiation with matter, and radiation detection and dosimetry. *MW 10:15 am -11:30 am; Turkington; 1032 Hock Plaza; 3 Units.*

MEDPHY 505 Anatomy and Physiology for Medical Physicists - A course focused on medical terminology, biochemistry pertaining to MP, basic Anatomy and physiology, elementary tumor and cancer biology, and overview of disease in general. Upon completion, the student should: (a) understand anatomic structures, their relationships, their cross-sectional and planar projections, and how they are modified by attenuation and artifacts in the final images; (b) understand the physiology underlying radionuclide images, (c) understand how (a) – (b) are modified by disease, (d) identify anatomical entities in medical images (different modalities), and (e).identify basic disease features in medical images (e.g., Pneumothorax in chest radiographs, microcalcoifications in mammograms). *MW 8:30 am – 9:45 am; Reiman; 1032 Hock Plaza; 3 units*

MEDPHY 530 Modern Medical Diagnostic Imaging System - A course describing basics of imaging science, x-ray imaging modalities including basic principles, detectors, scattered radiation, planar imaging, CT, fluoroscopic imaging, nuclear medicine imaging, US and MRI, and computers in imaging.*TUTH 10:15 am - 11:30 pm; Solomon; 1032 Hock Plaza; 3 Units.*

MEDPHY 722 Advanced Photon Beam Radiation Therapy. This course will cover the physics and clinical application of advanced external beam photon therapies with special emphasis on IMRT. Prerequisite: MP 220*. TUTH 8:30 am - 9:45 am, Q. Wu.; 1032 Hock Plaza*, *3 Units*

MEDPHY 725 Physics and Clinical Applications of Brachytherapy. The course is designed to combine traditional lectures and clinical physics practicum on the topic of LDR (low dose rate) and HDR (high dose rate) brachytherapy. Prerequisite: Medical Physics 520. *MTH 3:30 pm - 4:30 pm; Craciunescu, Meltsner*; *clinics, 2 Units.*

MEDPHY 726 Practicum on Monte Carlo method in Medical Physics - This course focuses on the fundamentals of Monte-Carlo simulations and provides hands-on experience with clinical Monte-Carlo codes used in medical dosimetry. The course will introduce software such as MCNP, EGS, FLUKA, GEANT and Penelope and companion data analysis software ROOT, PAW and CERNLIB. Students will study at least one major code and will perform two or more projects based on a clinically relevant task. Prerequisites: Calculus, modern physics, and programming. Knowledge of C, C++, or Fortran would be a plus. TU *1:45 pm –4:45 pm, Gunasingha, 1032 Hock Plaza, 1-3 Units.*

728. Clinical Practicum and Shadowing (RT). The course gives hands on experience in practical aspects of medical physics as applied to radiation therapy. Special emphasis is given to the operation of various therapy units and dose measuring devices, techniques of measuring the characteristics of radiation beams, commissioning and quality assurance checks for radiation producing devices in the clinic. The course includes shadowing a clinician, technologist, or physicist, while performing their routine clinical tasks. *TH 5:15 pm - 8:15 pm, Z. Wang, clinics, 3 Units.*

MEDPHY 751-1 Medical Physics Basic Research Topics - This seminar provides an overview of research projects conducted by medical physics faculty through a series of invited talks. The aim of the seminar is to help first year students identify their research interests and career/training orientation*. TU 12:00 pm –1:15 pm; Darnell; 1032 Hock Plaza, 1 Unit.*

MEDPHY 751-3 Professional Development Skills for Medical Physicists - This seminar provides important skills for students' professional development through a series of presentations on relevant topics that include public speaking, effective scientific and professional communication, interviewing skills, entrepreneurship, etc. Designed for second year Medical Physics students. *TH 12:00 pm – 1:15 pm; Wilson; 1032 Hock Plaza, 1 Unit.*

MEDPHY 734 Advanced Topics of Non-ionizing-based Imaging Modalities. This course covers advanced topics in non-ionizing Imaging modalities such as Ultrasound and MR imaging, including speckle statistics, Doppler imaging, advanced MR pulse sequences, MR angiography, flow and diffusion etc. Instruction will consist of didactic lectures accompanied by hands-on laboratory exercises (practicum). *TUTH 1:45 pm – 3:00 pm; Robertson; 1032 Hock Plaza, 3 Units*

MEDPHY 763 Advanced Radiation Biology in Medical Physics. This course will teach students about cutting-edge topics in the field of radiobiology that have relevance to medical physicists. The teaching will be through the format of a Journal Club. Journal Club Format. We will provide an outline for how to perform a manuscript review, prior to any student presentations. At the beginning of the semester, groups of students will select papers that they wish to present to the class. Each student assigned to a particular paper will prepare a written review and discuss their assessments with the class during one of the scheduled class dates. Class and group participation is required. Detailed report on selected subject. Students will select a topic from either the reviewed manuscripts or an approved subject of their own choosing (must contain both biology and physics components). The student will write a detailed report on this subject. We will provide a format for the report. Grading will be based upon quality of manuscript review presentations and the detailed final written report. *MW 12:00 pm – 1:00 pm; Dewhirst, Palmer; 1032 Hock Plaza, 3 Units*

MOLECULAR CANCER BIOLOGY

https://pharmacology.duke.edu/training/graduate/molecular-cancer-bio

MOLCAN 780 (PHARM 780) Advances in Cancer Research - [Student Seminar] A presentation and discussion course in which program faculty and graduate students review the recent progress in areas of cancer research being investigated at Duke University. Provides an important avenue for evaluation and feedback for graduate student research and is required each year for all students pursuing their Ph.D. degree in molecular cancer biology. *Th 3:05-4:20pm; Wingler/Zhao; LSRC C144, 2 Units*

MOLCAN 818 (PHARM 818) Molecular Mechanisms of Oncogenesis - This course is a lecture presentation and discussion course on the molecular mechanisms underlying cancer development in which students complete periodic tests, present a paper, and work in a group to write and defend a grant proposal. The objective of the course is to provide an opportunity for in-depth discussions of molecular mechanisms underlying the development of human cancers. The course is intended for second-year students who have already taken the course of Cell Signaling. *TuTh 10:05-11:20 am; Wood; LSRC C335, 3 Units*

MOLECULAR GENETICS & MICROBIOLOGY

http://mgm.duke.edu

MGM 701 Foundations of MGM – This core course is open to MGM first year students with exposure to research interests in the department. MGM faculty will provide an overview of their research along with important historical context. Credit grading only. *Tu (every other Tuesday) 4:00-5:30pm; Scaglione; TBD; 1 unit*

MGM 720 Computational Tools in Next Generation Genomic Analysis – This course is an intensive, one semester course in computer skills necessary to carry out analysis of next generation genomic data. The philosophy for this course is that we are training PhD students, and they should have a fairly in-depth understanding of how this analysis is carried out. This course offers that understanding. The course will involve only a small amount of lecture, and be primarily a hands-on laboratory with extensive discussion. Permission number from Instructor required for registration. Class size is limited to 6 students. *TuTh 1:25-2:40pm and lab of 3:05-4:20pm; Dietrich; 415 Jones, 3 units*

MGM 778 (CMB, UPGEN 778) - Genetic Approaches to the Solution of Biological Problems – See UPGEN 778

MGM 790S - Topics in Molecular Genetics and Microbiology - Required course for all graduate students receiving their degree through MGM through third year of PhD program. Instructor: Scaglione and staff. 1 unit. *F (every other Friday) 4:00pm-5:30pm*

MGM 793 Research for Graduate Students - Laboratory investigation for Graduate students. Various labs within the department of molecular genetics and microbiology. Credits to be arranged. Instructor consent is required. Instructor: Scaglione. 2 units.

NEUROBIOLOGY

http://www.neuro.duke.edu

NEUROBIO 719-01 Concepts in Neuroscience I: Cellular and Molecular Neurobiology - The goal of this course is for students to gain in depth knowledge of cellular and molecular neurobiology and to learn to critically evaluate the associated primary scientific literature. This is a required core course for Neurobiology program graduate students. The course is also frequently taken by other graduate students with research interests in neuroscience including (but not limited to) those in Cognitive Neuroscience, Cell Biology, Developmental Biology, Pharmacology, Genetics, Biology, Psychology, and Biomedical Engineering.
Sep 4 – Dec 4; MWF 10:15am - 11:30am; Grandl/West; Bryan Research, room 301; 5 Units.

NEUROBIO 726S.001 Neurobiology Journal Club (Seminar): First and second year Neurobiology graduate students attend the weekly Neurobiology Invited Seminar Series. Once a month, students will meet to hold a student-run journal club to discuss the work of a speaker from an outside institution.
Weekly Tu 12:00 pm – 2:00 pm; Monthly Fri 4:00pm-5:00pm; West; Bryan Research, rooms 101 and 301; 1 Unit.

NEUROBIO 733.01 (CMB, PHARM 733.01) Experimental Design and Biostatistics for Basic Biomedical Scientists - See PHARM 733.01

NEUROBIO 751 Neurobiology Boot Camp: Neurobiology Bootcamp is a week-long immersive lecture, discussion and laboratory course for graduate students in the Neurobiology Graduate Program and graduate students in allied programs at the discretion of the instructors. The Duke Neurobiology Bootcamp is designed to (1) provide a common knowledge base of neuroscience fundamentals; (2) demystify the tools of the discipline - providing hands-on experience with techniques that are commonly used to explore cellular/molecular, circuits and cognitive neuroscience.
Aug 26 – Aug 30, MTWThF; 9:00am – 8:00pm; Glickfeld/Grandl; Bryan Research, room 301; 2 Units.

NEUROBIO 790 Student Seminar – Preparation and presentation of seminars to students and faculty on topics of broad interest in neurobiology. Required of all first – and second-year students. *W 12:00 – 2:30 pm; Jeremy Kay/Richard Mooney/Dmitry Velmeshev; 1 unit*

NEUROBIO 793 Research in Neurobiology (Independent Study)- This course acquaints students with research in neuroscience and allows them to become proficient in a variety of techniques. It is an independent study in one of the laboratories of the training faculty. Students are expected to do three rotations in three semesters. *(Laboratory Rotations) (up to 12 Units)*

NEUROSCIENCE

http://www.dibs.duke.edu/education/graduate

PATHOLOGY

https://patholgy.duke.edu/education/phd-graduate-program/curriculum

PATHOL 725 Introduction to Systemic Histology The purpose of this course is to teach students how to identify a variety of normal tissues and cell types in standard histologic sections. Structure/function relationships will be emphasized, using an organ system approach. The scheduled class time includes both lecture and laboratory using "virtual microscopy", where scanned glass slides are viewed on the screen of your laptop/tablet computer. The course is open to graduate students and advanced undergraduates and is recommended for students whose research requires examination of tissue sections. *MWF 1:25-2:40 pm, Hale; 3 Units*

PATHOL 735S Animal Models in Translational Research The goal of this course is to give students a working knowledge of the use of animal models in research, types of models and how to choose for translational relevance. Topics include the regulations governing the use of animals in research, principles of in vivo experimental design, as well as best practices for data collection, interpretation and reporting during animal study conduct. Students will be exposed to the principal elements that impart variability and bias in the generation of animal study data, and will learn best practices for the conduct of high-quality animal studies that lead to reproducible data. *MW 11:45am-1:00pm, Landon, 3 Units, location TBD*

PATHOL 787 Basic Biology of Cells as a Function of Age: Implication for Disease The objective of this course is to review the fundamentals of cell biology as a function of age and their contribution to pathologies associated with age-related diseases. This course will cover a wide range of principles, including concepts and theories of aging, impact of aging on cell regulation and signaling, metabolism and epigenetics, relevant in vitro and in vivo experimental models, and potential anti-aging therapies. The course format will involve a combination of lectures and journal club style sessions, in which students will have the opportunity to hone their analytical and critical thinking skills while evaluating current literature. *MW 9:30am-11:00am, Malek, 3 Units, location TBD*

PATHOL 855 Graduate Seminar, Pathology Graduate Students only, This is a year-long course where each graduate student gives a presentation on his/her research in a formal setting to their peers and Pathology Graduate faculty. All Pathology graduate students are required to register for this course each semester throughout their training. Typically, 1st and 2nd year graduate students get 30 min time slots but more senior students are given 1 hr. time slots. Different aspects of presentations by the students (e.g. introduction, significance, quality and rigor of data, validity of conclusions, quality of slides, delivery style, etc.) are anonymously assessed by everyone in the audience, using critique sheets that are provided to the graduate student's mentor for review with students. As a result of the strong emphasis on the importance of oral presentation of research, and peer review, remarkable improvements in the quality and contents of student presentations have been observed each year. *Th 4:00pm-5:00pm, Abraham, 3 Units, MSRB1 001*

PHARMACOLOGY
https://pharmacology.duke.edu/training/graduate/pharmacology

PHARM 533 Essentials of Pharmacology & Toxicology - Drug absorption, distribution, excretion and metabolism. Structure and activity relationships; drug and hormone receptors and target cell responses. Consent of instructor required. *Prerequisite: introductory biology; Chemistry 151L; Mathematics 31 and 32. Instructor: Slotkin and staff, MWF 3:05-4:20 pm; LSRC C144; 4 Units*. ***NOTE:*** **CMB Students in Pharmacology are currently required to take PHR 533 Essentials in Pharmacology & Toxicology. This is also a core course for the Environmental Health Certificate.**

PHARM 733.01 (CMB, NEUROBIO, BME, MOLCAN 733.01) Experimental Design and Biostatistics for Basic Biomedical Scientists - The use and importance of statistical methods in laboratory science, with an emphasis on the nuts and bolts of experimental design, hypothesis testing, and statistical inference. Central tendency and dispersion, Gaussian and non-Gaussian distributions, parametric and nonparametric tests, uni- and multivariate designs, ANOVA and regression procedures. Student presentations in addition to formal lectures. Consent of instructor required. *T 8:30-10:15 am; LSRC C144; Slotkin (Runs concurrently with Section 733.02 & 733.03) 2 Units.*

PHARM 733.02 (CMB, NEUROBIO, BME, MOLCAN 733.02) Experimental Design and Biostatistics for Basic Biomedical Scientists - The use and importance of statistical methods in laboratory science, with an emphasis on the nuts and bolts of experimental design, hypothesis testing, and statistical inference. Central tendency and dispersion, Gaussian and non-Gaussian distributions, parametric and nonparametric tests, uni- and multivariate designs, ANOVA and regression procedures. Student presentations in addition to formal lectures. Consent of instructor required. *W 8:30-10:15 am; LSRC C144; Slotkin (Runs concurrently with Section 733.01 & 733.03) 2 Units.*

PHARM 733.03 (CMB, NEUROBIO, BME, MOLCAN 733.03) Experimental Design and Biostatistics for Basic Biomedical Scientists - The use and importance of statistical methods in laboratory science, with an emphasis on the nuts and bolts of experimental design, hypothesis testing, and statistical inference. Central tendency and dispersion, Gaussian and non-Gaussian distributions, parametric and nonparametric tests, uni- and multivariate designs, ANOVA and regression procedures. Student presentations in addition to formal lectures. Consent of instructor required. *Th 8:30-10:15 am; LSRC C144; Slotkin (Runs concurrently with Section 733.01 & 733.02) 2 Units.*

PHARM 780 (MOLCAN 780) Advances in Cancer Research – See MOLCAN 780

PHARM 818 (MOLCAN 818) Molecular Mechanisms of Oncogenesis - See MOLCAN 818

POPULATION HEALTH SCIENCES

https://populationhealth.duke.edu/education

PHS 701 Applied Analytic Methods for Population Health Sciences I
Students will get an introduction to study design, descriptive statistics, and analysis of statistical models with one or two predictor variables. Topics include: principles of study design, basic study designs, descriptive statistics, sampling, contingency tables, one- and two-way analysis of variance, simple linear regression, and analysis of covariance. Both parametric and nonparametric techniques are also explored. Core concepts are taught through team-based case studies and analysis of research datasets taken from the population health sciences literature and demonstrated in concert with PHS 703 (Introduction to SAS Programming for Population Health Sciences). Computational exercises will primarily use the SAS Statistical Computing Platform. *MW 10:05AM - 11:20AM; Hammill; 2nd Floor Imperial Building, Classroom A; 3 Units*

PHS 703 Introduction to Statistical Programming for Population Health Sciences I, concurrent with PHS 701
Students will be introduced to statistical software packages (e.g., SAS Software System, R Statistical Computing Platform) to provide an introduction to the core ideas of programming, including data preparation, input/output, debugging, and strategies for program design. Students will learn to write code to perform descriptive, statistical, and graphical analyses, and write maintainable code, to test for correctness, and to apply basic principles of reproducibility. Programming techniques and their applications will be closely connected with the methods and examples presented in the co-requisite applied analytic methods course PHS 701. This course assumes minimal programming knowledge. *8:30-10:00 AM; Dean; 2nd Floor Imperial Building, Classroom A; 1 unit*

PHS 705 Topics in Population Health Sciences I
Students will gain foundational knowledge in the US healthcare system, population health sciences, and health and healthcare including an introduction to major diseases and disorders. Topics include: overall structure of the US healthcare system, insurance, Medicare, Medicaid, VA system, the ACA, mental health, health economics, and quality of care. *TU TH 10:05-11:20 AM, Dupre, 2nd Floor Imperial Building, Classroom A; 3 Units*

PHS 707 Population Health Sciences Research Methods and Study Design I
This is the first in a two-course sequence that gives students a strong foundation in population health research methods. The course introduces critical concepts in research methods, including varying types of validity, reliability, and causal inference. Topics include: sampling and interpretation of probability and nonprobability sampling; an introduction to measurement theory; threats to internal validity; experimental designs; and quasi-experimental designs. *TU TH 8:30-9:45 AM; King; 2nd Floor Imperial Building, Classroom A; 3 Units*

PHS 709 Professional Development I
1 hour
This multi-semester course gives students a holistic view of their career choices and how to develop the tools they'll need to succeed professionally. Fall semester focuses on creating a strong professional presence, proper networking techniques, American employer expectations, creating and maintaining a professional digital presence, and learning how to conduct and succeed at informational interviews. Students will attend interviewing and networking events with Duke staff and faculty as well as external guests. *W 8:30-9:45 AM, Skinner; 2nd Floor Imperial Building, Classroom A; 1 Unit*

PHS 811 Pragmatic Health Policy Research
3 hours
This course covers the foundational principles of health policy and policy science, and continues on to consider practical examples of research being used to change policy at various levels.
This course bridges the divide between analysis/methods courses (generating evidence) and policy courses (understanding specific policy areas, process and stakeholders) to help students build foundational knowledge and focused skills in framing/communicating timely, policy-relevant evidence, applicable to many population health-related career paths.
Students will increase knowledge and mastery of theoretical and substantive foundations of pragmatic policy analysis, specific policy areas and issues (e.g. SNAP, Medicaid, opioid use disorder, infant mortality, etc). *M 3:00-6:00 PM, Sandoe, 2nd Floor Imperial Building, Classroom A; 3 Units; Open to both Master's and PhD students*

PHS 813 Improving Population Health through Implementation Science
3 Hours
Implementation science addresses the translation of evidence-based practices, programs and policies into real world settings. This course will include didactic lectures, with case studies, applied group work, and a culminating real-world, hands-on implementation, dissemination, de-implementation, or QI science project. W *3:00-6:00 PM, Zullig, 2nd Floor Imperial Building, Classroom B; 3 units; Open to both Master's and PhD students*

PHS 815 Fundamentals of qualitative research implementation
3 Hours
This course prepares learners for serving as a research assistant on qualitative research studies. Learners will gain competency in 1) conducting qualitative research studies, with an emphasis on study coordination and interviewing skills, and 2) managing data and conducting applied thematic analysis.
Learners will have competency in 1) coordinating qualitative studies (e.g., screening, recruitment, regulatory, scheduling), 2) conducting qualitative interviews (e.g., demonstrable skills in leading in-depth interviews and focus groups), 3) managing study data, and 4) conducting qualitative analysis (e.g., demonstrable skills in analysis steps, use of software). *T TH, 8:30-10:00 AM, Bosworth, 2nd Floor Imperial Building, Classroom B; 3 Units; Open to both Master's and PhD students*

PHS 702 Applied Analytic Methods for Population Health Sciences II
3 Hours
This course is a continuation of PHS 701. Topics include: analysis of multivariable statistical models with continuous, dichotomous and survival outcomes. Topics include mixed effects models, generalized linear models (GLM), basic models for survival analysis and regression models for censored survival data, clustered data. Students will explore parametric and nonparametric and perform computational exercises using the SAS System and R Statistical Computing Platform. *MW 10:05-11:20 AM; Maciejewski; 2nd Floor Imperial Building, Classroom A; 3 Units*

PHS 704 Introduction to Statistical Programming for Population Health Sciences II
1.5 hours, concurrent with PHS 702
Students will build on programming learned in PHS 703 using the SAS Software System and R Statistical Computing Platform. Students will perform descriptive, statistical, and graphical analyses, and write maintainable code, test code for correctness, and apply basic principles of reproducibility. Programming and assignments will be closely connected with the methods and examples presented in the co-requisite applied analytic methods course PHS 702. *MW 8:30-10:00 AM; Dean; 2ND Floor Imperial Building, Classroom A; 1 Unit*

PHS 706 Topics in Population Health Sciences II

This course is a continuation of topics introduced in PHS 705 including: definition and measurement of population health; an overview of determinants of health including medical care, socioeconomic status, the physical environment and individual behavior, and their interactions; an overview of health services research, dissemination and implementation science, epidemiology, and measurement sciences. *TU TH 10:05-11:20 AM; Wang ; 2nd Floor Imperial Building, Classroom A; 3 Units*

PHS 708 Population Health Sciences Research Methods and Study Design II
This is the second in a two-course sequence that gives students a strong foundation in population health research methods. Topics include: qualitative and mixed methods, and advanced designs relevant to population health. The course applies foundational design information to methods unique to population health, including pragmatic trials, administrative claims data, and electronic medical record data. The course culminates in the development of a strong research question for a literature review, using the methods learned to critique research on a topic of the student's choosing. *TU TH 8:30-9:45 AM; Curtis; 2nd Floor Imperial Building, Classroom A; 3 Units*

PHS 710 Professional Development II
This course is a continuation of PHS 709 and teaches project and team management. This course will give the student a holistic view of career choices and development and the tools they will need to succeed as professionals in the world of work. *W 8:30-9:45 AM; Skinner; 2nd Floor Imperial Building, Classroom A; 1 Unit*

UNIVERSITY PROGRAM IN GENETICS AND GENOMICS
http://upg.duke.edu

UPGEN 659 / BIOCHEM 659 Structural Biochemistry II - See BIOCHEM 659

UPGEN 658/ BIOHEM 658 Structural Biochemistry 1-See BIOCHEM 658

UPGEN 701 Advanced Topics in Genetics and Genomics - This course is open only to first year UPGG graduate class. Weekly discussion of current literature in genetics (Fall semester) and genomics (Spring Semester). This is course is meant to fill two objectives. The first objective is to ground each of the members of the UPGG first year class, regardless of their interest, in the two areas of focus of the program - namely, genetics and genomics. The second objective is to facilitate interactions among the diverse student body by bringing the class together once a week for discussion. *T 4:00p-5:30; 2 Units.*

UPGEN 711 (BIOLOGY 701) - Succeeding in Graduate School in the Biological 0Sciences- Weekly lecture and Q&A on choosing a thesis advisor, the grant proposal and scientific manuscript peer review processes, and other topics related to succeeding in graduate school. Also counts for RCR credit. Minicourse, 1st half-semester. *W 12:00p-1:00PM; Noor; Online; 0.5 Units*

UPGEN 716 Genetics Student Research - Presentations by genetics students on their current research. Required course for all graduate students specializing in genetics. Credit grading only. *Wednesday 4:30p-6:00 pm; Zachary Hartman; 1 Unit*

UPGEN 750 Genetics Colloquium - Lectures, and seminars on selected topics of current interest in genetics. Required of all students specializing in genetics. *Tu 12:30-1:30; Ashley-Koch; Online; 1 Unit*

UPGEN 778A-F Genetic Approaches to the Solution of Biological Problems (MGM 778) UPGEN 778A-F are six mini-courses offered sequentially during the fall semester and together cover 24 topics. These courses are part of the core offerings of the University Program in Genetics and Genomics and allow maximum flexibility for a student-designed curriculum. Multiple topics are available during each mini-course and students choose one. The topics address everything from fundamentals of genetics to modern molecular genetic and genomic strategies for the analysis of a

variety of biological systems. Each mini-course consists of six classes. *MWF 2:00-3:30 pm; Ashley-Koch; Full list of topics available at* UPGG Courses; 1 *Unit per module.*