CURRICULUM IN GENETICS AND MOLECULAR BIOLOGY (GRAD)

Contact Information

Curriculum in Genetics and Molecular Biology
Visit Program Website (http://gmb.unc.edu)

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The Curriculum in Genetics and Molecular Biology is an interdepartmental predoctoral training program leading to a Ph.D. degree in genetics and molecular biology. The goal of this program is to train students to be creative, sophisticated research scientists within the disciplines of genetics and molecular biology. To this end, we emphasize acquisition of a foundation of knowledge, accumulation of the laboratory skills required for implementing research objectives, development of the ability to formulate experimental approaches to solving contemporary problems in the biological sciences, and completion of an original research project. During their first year, students enroll in graduate-level courses and participate in laboratory rotations. Subsequently, students select a faculty research advisor and establish an advisory committee. Research work is done in the laboratory facilities of the individual faculty member and is supported primarily by faculty research grants.

The curriculum faculty have appointments in 14 departments in the School of Medicine, the School of Dentistry, the Eshelman School of Pharmacy, and the College of Arts and Sciences. The faculty represent diverse research interests that use the tools of genetics, molecular biology, and biochemistry to address fundamental questions in the areas of cell cycle regulation, chromosome structure, development and disease models, DNA repair and recombination, genome stability, evolutionary genetics, genomics, human genetics, neurobiology, pathogens and immunity, signal transduction, transcription, gene regulation, and virology. Students are able to choose from a variety of biological systems and questions for their thesis research.

Requirements for Admission for Graduate Work

Applications from students with good academic records and interest in research careers in genetics and molecular biology are favorably considered. Applicants preferably have majored or minored in one of the following disciplines: genetics, biology (zoology or botany), microbiology, chemistry, mathematics, physics, or biophysics. They usually have taken calculus and organic and physical chemistry, although these are not essential. Applicants are accepted to begin their initial studies in the fall. They must apply to the program through a unified application program known as the Biological and Biomedical Sciences Program (BBSP). Students apply for graduate study in the biological or biomedical sciences at UNC–Chapel Hill. Students interested in any of the BBSP research areas apply to BBSP, and those whose application portfolio places them highest on the admission list are asked to visit Chapel Hill for interviews. Students who are ultimately admitted to UNC–Chapel Hill make no formal commitment to a specific Ph.D. program. After completing their first year of study students leave BBSP and join a dissertation laboratory and matriculate into one of 15 participating Ph.D. programs. During their first year BBSP students are part of small, interest-based groups led by several faculty members. These groups meet regularly and provide a research community for students until they join a degree-granting program. The application consists of Graduate Record Examination (GRE) scores, transcripts of records, three letters of recommendation, and a statement of purpose, all submitted through the Web-based application system of The Graduate School. Students are encouraged to apply as early as possible, preferably before December 1. (Applicants seeking a master's degree are not considered for admission.)

Financial Aid

Stipends for predoctoral students are available from an NIH predoctoral training grant and from the University. Tuition, student fees, and graduate student health insurance are also covered by the training grant and the University.

In addition to the dissertation requirements of The Graduate School (four full semesters of credit including at least six hours of doctoral dissertation; a written preliminary examination, an oral examination, and a dissertation), students in the Curriculum in Genetics and Molecular Biology must meet the following requirements:

- complete four didactic courses (GNET 621 and either GNET 631 OR GNET 632 are required; the other two may come from any appropriate combination of full-semester courses or five-week modules, with three modules being equivalent to a full course; at least one module or course must have a quantitative, statistical, or computational focus)
- complete one seminar/journal club course that focuses on critical reading of the literature
- act as a teaching assistant for one semester
- participate in a student seminar series as an attendee until the end of the third year
- present in the student seminar series in the third and subsequent years
- participate in the annual retreat held jointly with the Department of Genetics and the Curriculum in Bioinformatics and Computational Biology
- attend the weekly seminar series sponsored by the curriculum and the Department of Genetics
- publish at least one peer-reviewed research article as first or co-first author

Students are required to rotate through at least three laboratories before choosing a dissertation advisor. It is strongly recommended that students attend national meetings to better understand how their research fits with progress in their field.

Professors

Shawn Ahmed, Telomere Replication and Germline Immortality in *C. elegans*
Albert S. Baldwin, Regulation of Gene Expression, Control of Oncogenesis and Apoptosis
Victoria Bautch, Molecular Genetics of Blood Vessel Formation in Mouse Models
Kerry S. Bloom, Mechanisms of Chromosome Segregation in Yeast, Chromosome and Spindle Dynamics
Patrick Brennwald, Examination of Problems in Membrane Trafficking and Cell Polarity Using Genetics

Kathleen Caron, Genetically Engineered Animal Models in the Study of Human Disease
Frank L. Conlon, Mesodermal Patterning and Heart Development, T-Box Genes
Jeanette Gowen Cook, Integrating DNA Replication Control with Checkpoint Signaling
Gregory P. Copenhaver, Regulation of Meiotic Recombination in Higher Eukaryotes
Blossom Damania, Viral Oncogenes, Signal Transduction, Transcription and Immune Evasion of KSHV/RRV
Jeffery L. Dangl, Plant Disease Resistance and Cell-Death Control, Plant Genomics
Ian Davis, Mechanisms of Transcription Factor Deregulation in Cancer Development
Channing J. Der, Oncogenes, Ras Superfamily Protein, Signal Transduction
Dirk P. Dittmer, Anti-Lymphoma Therapies
Bob Duronio, Genetics of Cell-Cycle Control during *Drosophila* Development
Bob Goldstein, Generation of Cell Diversity in Early Development of *C. elegans*
Jack D. Griffith, HIV, Transcription, Electron Microscopy
Mark Heise, Genetics of Arbovirus Virulence and Immune Evasion
Corbin D. Jones, Population Genetics and Evolution in *Drosophila*
Jonathan Juliano, Malaria Drug Resistance, Diversity and Population Evolution
Joseph Kieber, Molecular Genetic Analysis of Hormone Signaling in *Arabidopsis*
Nobuyo Maeda, Genetics Modeling of Atherosclerosis in Mice
Terry Magnuson, Mammalian Genetics, Epigenetics, Genomics
William F. Marzluff, Regulation of RNA Metabolism in Animal Cells
A. Gregory Matera, Biogenesis of Small Ribonucleoproteins in Health and Disease
Karen L. Mohlke, Human Genetics and Genomics, Diabetes, Complex Diseases
Fernando Pardo-Manuel de Villena, Meiotic Drive, Chromosome Segregation, Non-Mendelian Genetics
Leslie V. Parise, Adhesion Receptors and Signaling in Platelets, Sickle Cells and Cancer
Charles Perou, Genomic and Molecular Classification of Human Tumors to Guide Therapy
Mark Peifer, Cell Adhesion, Signal Transduction and Cancer
Dale Ramsden, V(D)J Recombination, DNA Double Strand Break Repair
Aziz Sancar, Structure and Function of DNA Repair Enzymes, Biological Clock
Jeff Sekelsky, Genetics of Genome Instability in *Drosophila*
Brian Strahl, Histone Modifications and Gene Regulation
Ronald I. Swanstrom, Retroviruses, Molecular Biology of the AIDS Virus
Jenny P. Ting, Discovery of New Genes in Inflammation and Apoptosis, Functional Genomics of Immunologic and Neurologic Diseases
Cyrus Vaziri, Integration of DNA Replication and Repair
Ellen R. Weiss, Regulation of G-Protein-Coupled Receptor Signal Transduction Pathways
Bernard E. Weissman, Tumor Suppressor Genes, Cancer Genetics
Yue Xiong, Cancer Biology, Mammalian Cell Cycle, Tumor Suppressor Genes
Yanping Zhang, Genetics and Mechanisms of Cancer Cell Growth and Division

Associate Professors

Jonathan Berg, Clinical Adult and Cancer Genetics
Scott Bultman, Mouse Models of Human Disease, Chromatin-Modifying Factors, Epigenetics
Amy S. Gladfelter, Cytoskeleton Dynamics, Biophysical Cell Biology, Cytoplasm Organization
Zhongchao Han, Genomic DNA Transfer, Drug-Gene Delivery and Nanomedicine
Samir Kelada, Genetics and Genomics of Environmentally Induced Asthma
William Kim, Exploration of the Role of Hypoxia-Inducible Factor in Tumorigenesis
Amy Maddox, Mechanisms of Cell Shape Change
Paul Maddox, Mitotic Mechanisms and Chromosome Dynamics
C. Ryan Miller, Preclinical Experimental Therapeutics and Biomarker Research in Gliomas
Jason W. Reed, Plant Development, Auxin Signaling, Light Responses
Elizabeth Shank, Chemical Interactions in Microbial Communities
Shehzad Sheikh, Immune Responses to the Microbiome in Crohn's Disease and Ulcerative Colitis
Lisa Tarantino, Genetic Mapping of Complex Behavioral Traits
Scott Williams, Asymmetric Cell Division in Development and Disease, Epithelial Differentiation

Assistant Professors

Anthony Amelio, Camp Signaling, Gene Regulation, Alternative Splicing
J. Mauro Calabrese, Epigenetic Control by Long Noncoding RNAs, Genomics, Stem Cells, Cancer, Human Genetic Disorders
Jill Dowen, Three-Dimensional Genome Architecture and Gene Regulation in Development and Disease
Michael Emanuele, Cell Cycle Regulation by the Ubiquitin System
Hector Franco, Molecular, Cellular and Bioinformatic Dissection of Transcriptional Enhancers in Cancer
Jimena Giudice, Alternative Splicing, Epigenetic and Intracellular Trafficking in Heart and Skeletal Muscle Development and Diseases
Gaorav Gupta, Genome Integrity in Breast Cancer
Nate Hathaway, Mechanisms of Mammalian Genome Regulation, Chemical Biology and Drug Discovery
Kathryn Hoadley, Integrative Genomic Characterization of Cancer and precancer
Folami Ideraabdullah, Genetics, Toxicants, and Nutrition: Gene-Environment Interactions in Epigenetic Gene Regulation
Sarah Linnsteadt, Genetic and Transcriptional Mechanisms of Increased Chronic pain and PTSD
Daniel McKay, Developmental Genomics, Regulation of Gene Expression
Zachary Nimchuk, Plant Developmental Genetics and Stem Cell Regulation
Chad Pecot, Biology of Metastatic Cancer, Sirna Regulation of Gene Expression in Tumors
Douglas Phanstiel, Molecular Mechanisms Underlying Acquisition of Disease States in Cells
Jeremy Purvis, Signal Transduction in Cancer and Stem Cells
Yuliya Pylayeva-Gupta, Immunomodulatory Mechanisms in Pancreatic Cancer and Metastasis
Celia Shiau, Function and Development of Macrophages and Brain Microglia; Inflammation and Innate Immune Activation
Jason Stein, Genome Variation that Affects the Structure and Development of the Brain and Risk for Neuropsychiatric Illness
Ageliki Tsagaratou, Epigenetic and Transcriptional Regulation in T cell Differentiation, Function and Disease
Greg Wang, Epigenetics, Gene Regulation, and Disease, Notably Hematopoietic Malignancies

Hyejung Won, Genetics of Psychiatric Illnesses and Neurobiological Mechanisms.
Anthony Zannas, Bolecular Mechanisms Linking Psychosocial Stress with Disease Risk

GNET

Advanced Undergraduate and Graduate-level Courses

GNET 621. Principles of Genetic Analysis I. 3 Credits.
Prerequisite for undergraduates, BIOL 202. Permission of the instructor for undergraduates. Genetic principles of genetic analysis in prokaryotes and lower eukaryotes.
Grading status: Letter grade
Same as: BIOL 621.

GNET 622. Principles of Genetic Analysis II. 4 Credits.
Principles of genetic analysis in higher eukaryotes; genomics.
Requisites: Prerequisite, BIOL 621.
Grading status: Letter grade
Same as: BIOL 622.

GNET 623. Developmental Genetics Seminar. 1 Credit.
Permission of the instructor. Presentations of current research or relevant papers from the literature on development by students will be followed by open forum discussion of relevant points, and critique of presentation skills. Two hours per week.
Grading status: Letter grade.

GNET 624. Developmental Genetics. 3 Credits.
Permission of the instructor for undergraduates. Genetic and molecular control of plant and animal development. Extensive reading from primary literature.
Grading status: Letter grade
Same as: BIOL 624.

GNET 625. Seminar in Genetics. 2 Credits.
Permission of the instructor for undergraduates. Current and significant problems in genetics. May be repeated for credit.
Repeat rules: May be repeated for credit; may be repeated in the same term for different topics; 12 total credits. 6 total completions.
Grading status: Letter grade
Same as: BIOL 625.

GNET 631. Advanced Molecular Biology I. 3 Credits.
Required preparation for undergraduates, at least one undergraduate course in both biochemistry and genetics. DNA structure, function, and interactions in prokaryotic and eukaryotic systems, including chromosome structure, replication, recombination, repair, and genome fluidity. Three lecture hours a week.
Grading status: Letter grade
Same as: BIOC 631, BIOL 631, MCRO 631.

GNET 632. Advanced Molecular Biology II. 3 Credits.
Required preparation for undergraduates, at least one undergraduate course in both biochemistry and genetics. The purpose of this course is to provide historical, basic, and current information about the flow and regulation of genetic information from DNA to RNA in a variety of biological systems. Three lecture hours a week.
Grading status: Letter grade
Same as: BIOC 632, BIOL 632, MCRO 632.

GNET 635. Clinical and Counseling Aspects of Human Genetics. 3 Credits.
Topics in clinical genetics including pedigree analysis, counseling/ethical issues, genetic testing, screening, and issues in human research. Taught in a small group format. Active student participation is expected.
Requisites: Prerequisite, BIOL 425; permission of the instructor for students lacking the prerequisite.
Grading status: Letter grade
Same as: BIOL 529.

GNET 645. Quantitative Genetics of Complex Traits. 1 Credit.
Students will learn about various topics that form the basis for understanding quantitative genetics of complex traits with biomedical and agricultural relevance. The ultimate goal of quantitative genetics in this postgenomic era is prediction of phenotype from genotype, namely deducing the molecular basis for genetic trait variation.
Requisites: Prerequisite, GNET 621.
Grading status: Letter grade.

GNET 646. Mouse Models of Human Disease. 1 Credit.
This course will focus on the laboratory mouse as a model organism to learn fundamental genetic concepts and understand how state-of-the-art experimental approaches are being used to elucidate gene function and the genetic architecture of biological traits.
Grading status: Letter grade.

GNET 647. Human Genetics and Genomics. 1 Credit.
The course covers principles and modern approaches of human genetics and genomics, including human genetic variation, linkage, genome-wide association analysis, sequencing for variant discovery in monogenic and complex diseases, regulatory variation, the molecular basis of human disease, and functional validation of disease variants.
Grading status: Letter grade.

GNET 655. Issues in Human Genetics. 1 Credit.
This course will provide an overview of methods in human genetics during the critical reading of selected literature and work of speakers that will present in the Friday Seminar Series.
Grading status: Letter grade.

GNET 675. Computational Genetics. 1 Credit.
A course on systems genetics focused on student participation and the development of targeted multidisciplinary responses to genetic questions.
Grading status: Letter grade.

GNET 680. Modeling Human Diseases in Mice. 1 Credit.
Permission of the instructor. This course will provide an overview of the use of the mouse as an experimental model for determining factors, both genetic and environmental, that contribute to human diseases. One seminar hour a week.
Grading status: Letter grade.