

GENETICS (GEN)

Degrees Offered: Ph.D., M.S.

This program is offered in Durham.

The Department of Molecular, Cellular, and Biomedical Sciences offers a Doctor of Philosophy (Ph.D.) degree, a Master of Science (M.S.), and an accelerated master's program (B.S./M.S.) in Genetics, providing outstanding and diverse research opportunities in genetics and genomics. Graduate students (Ph.D. and M.S.) in genetics are typically supported by teaching or research assistantships, as well as by competitive internal and external fellowship programs. For more information about the program, including admission and degree requirements, please contact the Department of Molecular, Cellular, and Biomedical Sciences at mcbs.dept@unh.edu.

Distinctive Features of the Program

As an interdisciplinary program made up of faculty from multiple departments, and from the [Hubbard Center for Genome Studies](#), the Genetics graduate program integrates disciplines ranging from molecular and cellular biology to environmental and evolutionary genetics and genomics. The faculty conduct research on living systems spanning microbes, plants, and animals. Incoming students have the opportunity for laboratory rotations to explore the various areas of genetics and genomics in those cases where a thesis advisor has not been identified or where exposure to a variety of experimental approaches is advantageous.

The Graduate Program in Genetics offers:

- Outstanding research training in many cutting-edge research areas in molecular and evolutionary genetics, genomics, and bioinformatics.
- Weekly seminar series that includes both distinguished invited speakers and graduate student research presentations.
- Opportunities to gain experience teaching and mentoring undergraduate students in the biological sciences.
- Strong track record for graduates attaining successful careers in academia, biomedical research institutes, biotechnology and pharmaceutical companies, and state and federal governmental agencies.

Admission Requirements

An applicant is expected to have completed basic courses in chemistry, biological sciences, mathematics, and physics. Otherwise well-qualified applicants will be permitted to correct deficiencies in undergraduate education by enrollment in the appropriate courses or by independent study during the first year. Applicants must submit a personal statement and three letters of recommendation. If possible, the personal statement should specify the applicant's research interests and names of potential faculty mentors. Applicants from non-English-speaking countries must submit current TOEFL scores in addition to the items listed above.

Accelerated Master's Degree Requirements

This accelerated program leading to a combined Bachelor and Master's degree in Genetics is designed for highly motivated and qualified students seeking additional training to further their career goals as a researcher in the life sciences.

Admission to the combined degree program is highly competitive. Students wishing to pursue this option must have a grade point average

greater than 3.2 at the time of application. A thesis advisor must be identified during the junior year, and the approval of the advisor must be obtained. Prior to the first semester of the senior year, the student must formally apply through the Graduate School and receive early admission to the Genetics Graduate Program. The requirement for the Graduate Record Examination is waived for combined degree applicants.

<https://colsa.unh.edu/molecular-cellular-biomedical-sciences>

Programs

- [Genetics \(Ph.D.\)](#)
- [Genetics \(M.S.\)](#)

Courses

Genetics (GEN)

GEN 804 - Genetics of Prokaryotic Microbes

Credits: 5

Maintenance, exchange, and expression of genetic material in bacteria and their viruses. Historical overview of the role microbial genetics played in development of modern molecular biology. Contemporary perspective on methods used to understand the function of genes and their applications to basic science, biomedical research, and biotechnology. Introductory microbiology and microbiology lab AND one semester genetics recommended. Lab.

Equivalent(s): MICR 804

Grade Mode: Letter Grading

Special Fee: Yes

GEN 805 - Population Genetics

Credits: 3

Exploration of the forces (mutation, selection, random drift, inbreeding, assortative mating) affecting the frequency and distribution of genetic variation in natural populations. Quantifying the structure of populations. Methods of analysis for theoretical and practical applications. One semester of genetics and one semester of statistics recommended.

Equivalent(s): ZOOL 805

Grade Mode: Letter Grading

GEN 806 - Human Genetics

Credits: 4

Genetic basis of human traits and diseases including both traditional methods of diagnosis and contemporary molecular genetic approaches stemming from the human genome project. Case studies exemplify common practices in human genetic counseling and integrate the scientific basis of diagnosis with the special ethical implications of human genetic analysis. One semester of genetics recommended.

Equivalent(s): ANSC 806

Grade Mode: Letter Grading

GEN 811 - Genomics and Bioinformatics

Credits: 0 or 4

Methods, applications, and implications of genomics-the analysis of whole genomes. Microbial, plant and animal genomics are addressed. Medical, ethical and legal implications of genomic data. Computer lab provides exposure and experience in a range of bioinformatics approaches used in genome analysis. One semester of genetics recommended. Computer lab.

Equivalent(s): BCHM 811, MICR 811

Grade Mode: Letter Grading

GEN 812 - Programming for Bioinformatics**Credits:** 5

Development of programming skills that enable life science students to ask fundamental biological questions that require computers to automate repetitive tasks and handle query results efficiently. Topics include: computer values of important parameters of biological sequence data; pattern search and motif discovery scripts; accessing, querying, manipulating, retrieving, parsing, analyzing, and saving data from local and remote databases. One semester of bioinformatics and one semester of genetics recommended. Computer Lab.

Grade Mode: Letter Grading**GEN 813 - Microbial Ecology and Evolution****Credits:** 4

Evolutionary and ecological forces that generate the tremendous diversity of microbial life on Earth with emphasis on viruses, archaea and bacteria. Functional roles of microorganisms, their population dynamics and interactions, and their mechanisms of evolutionary change in a variety of environmental settings, including natural communities and laboratory microcosms. Introductory microbiology and microbiology lab and one semester of genetics recommended.

Equivalent(s): MICR 813**Grade Mode:** Letter Grading**GEN 815 - Molecular Evolution****Credits:** 4

Rates and patterns of evolutionary change in biomolecules. Forces affecting the size and structure of genomes. Molecular mechanisms of organismal evolution. Emphasizes integrating evidence from biochemistry, molecular genetics and organismal studies. Methods for reconstructing phylogeny from molecular sequences. One semester of genetics and one semester of statistics recommended. Computer lab.

Equivalent(s): ZOOL 815**Grade Mode:** Letter Grading**GEN 817 - Molecular Microbiology****Credits:** 5

Fundamental physiological and metabolic processes of archaea bacteria and fungi with a strong emphasis on prokaryotes. Literature-based course with lab. Topics include regulation and coordination of microbial metabolism, bacterial cell cycle, global control of gene expression, signal transduction, and microbial cell differentiation. Introductory microbiology and microbiology lab and one semester of genetics recommended. Lab.

Equivalent(s): MICR 817**Grade Mode:** Letter Grading**Special Fee:** Yes**GEN 821 - Comparative Genomics****Credits:** 4

Explores the central questions and themes in contemporary comparative genomics, including genome biology, phylogenomics, human origins, population genomics, and ecological genomics. Provides the conceptual framework required to evaluate new work in this fast-changing field. One semester of genetics recommended.

Grade Mode: Letter Grading**GEN 825 - Population Genetics Lab****Credits:** 2

Hands-on approach to exploration of evolutionary forces affecting the frequency and distribution of genetic variation in natural populations. Wet lab techniques include DNA extraction, restriction enzyme digestion, PCR, DNA fragment size-selection. Computational skills include high-throughput sequencing data control, identifying allelic variants, and generation of population genetic summary statistics. One semester of genetics and one semester of statistics recommended.

Co-requisite: GEN 805**Grade Mode:** Letter Grading**GEN 871 - Molecular Genetics****Credits:** 4

Structure, organization, replication, dynamics, and expression of genetic information in eukaryotes. Focus on molecular genetic and epigenetic mechanisms of gene expression and its control; molecular genetic control of cell division and differentiation during development. One semester of genetics recommended.

Equivalent(s): BCHM 871**Grade Mode:** Letter Grading**GEN 872 - Evolutionary Genetics of Plants****Credits:** 4

Mechanisms of genetic change in plant evolution, both in nature and under human influence. Topics include neo-Darwinian theory; speciation and hybridization; origins and co-evolution of nuclear and organelle genomes; gene and genome evolution; transposable elements; chromosome rearrangements; polyploidy; genetic modification. Lab introduces methods in information gathering, bioinformatics, genome analysis, plant breeding, and genetic manipulation. One semester of genetics recommended prior to taking this course. Lab.

Equivalent(s): PBIO 872**Grade Mode:** Letter Grading**GEN 874 - Techniques in Plant Genetic Engineering and Biotechnology****Credits:** 4

Theory and hands-on experience with techniques used in plant genetic engineering, including cell and tissue culture, gene cloning, and analysis of foreign gene expression. Discussion of role of plant biotechnology in sustainable agriculture and climate change; modifying plants for better nutrition and stress response, environmental remediation, and for production of pharmaceuticals; controversies associated with this technology. Lab. One semester of genetics recommended.

Equivalent(s): PBIO 874**Grade Mode:** Letter Grading**Special Fee:** Yes

Faculty

See https://colsa.unh.edu/molecular-cellular-biomedical-sciences/program/phd/genetics#collapse_1784.