

# GENETICS (GEN)

Genetics and genomics are central to all aspects of the life sciences. Genetics is the branch of biology that deals with heredity, variation of genes among individuals in a population, and the expression and regulation of genes. Genomics focuses on determining the structure and function of genomes and includes the mapping of genes, high-throughput DNA sequencing, and investigating the molecular mechanisms by which genetic and environmental factors contribute to phenotypes. Every day, scientists are using the tools of genetics and genomics to make exciting discoveries in fields such as molecular medicine, cancer research, biodiversity, and sustainability.

Within the Genetics (GEN) major, students may choose the Genomics option (Genetics:Genomics). Genetics provides a solid foundation in biology, biochemistry, microbiology, chemistry, physics, math, and cell biology. Students also take advanced courses in molecular genetics, bioinformatics, molecular evolution, and genomics. Genetics students receive additional training in wet lab techniques. The Genetics:Genomics option provides additional training in genomics, evolutionary genetics, and computer programming for bioinformatics.

There are many opportunities for interested students to gain research experience through formal or informal research projects in faculty members' laboratories. The genetics faculty conduct research on diverse topics such as evolution, gene structure and function, host-microbe interactions, genome sequencing and analysis, heredity, and diversity in populations. Faculty research areas encompass microbial, plant, and animal genetics. Genetics faculty are committed to mentoring undergraduate students in independent research experiences in their laboratories, which provide students with exposure to and training in cutting-edge research technologies.

Students with degrees in genetics or genomics are well prepared to apply to graduate schools (e.g., for training as genetic counselors or researchers) or professional schools, or to pursue careers in biotechnology companies, forensics labs, hospitals, university research laboratories, or government agencies. Two additional courses are needed for application to professional programs (e.g., medical or dental school). Graduates may also be employed in fields such as management, sales, marketing, regulatory affairs, technical writing, or science journalism. With supplementary courses in education, graduates with a bachelor's degree in genetics or genomics can teach at the elementary, middle, or high school level.

## Pre-Professional Health Programs

Students interested in postgraduate careers in the health care professions should visit the [Pre-Professional Health Programs Advising](#) website or visit the office in person. Requirements for specific types of professional schools (e.g., medical, dental, physician assistant, pharmacy, etc.) are available from [Pre-Health Advising](#). Students interested in veterinary medicine should consult the [Pre-Veterinary Medicine Program](#). Many of the prerequisite courses required by professional schools are also requirements of the genetics major, but students should consult with their faculty adviser to create a plan of study that best prepares them for pursuing a career in one of these health professions.

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

## Programs

- [Genetics Major \(B.S.\)](#)
- [Genetics Major Genomics Option \(B.S.\)](#)
- [Genetics Minor](#)

## Courses

### Genetics (GEN)

#### GEN 401 - Professional Perspectives in Genetics

**Credits:** 1

Introduction to the fields of genetics and genomics and to the genetics faculty and their research. Careers and professional opportunities for genetic majors presented by invited speakers. Emphasis on skills needed for academic success and strategies for achieving professional goals.

**Grade Mode:** Credit/Fail Grading

#### GEN 604 - Principles of Genetics

**Credits:** 0 or 4

Chemical structure of genetic material, gene recombination, mutation, and chromosome mapping. Gene expression and regulation; recombinant DNA; evolutionary, quantitative, and population genetics. College math or statistics suggested.

**Prerequisite(s):** (BIOL 411 with a minimum grade of D- or BIOL #411H with a minimum grade of D-) and (BIOL 412 with a minimum grade of D- or BIOL 412H with a minimum grade of D-) and CHEM 403 with a minimum grade of D- and (CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D-).

**Equivalent(s):** BIOL 604

**Grade Mode:** Letter Grading

#### GEN 606 - Genetics Lab

**Credits:** 4

Hands-on experience with some of the important model organisms used for research in genetics (fruit flies, bacteria, yeast, nematodes, and plants). Investigation of fundamental genetic concepts in the laboratory, experience with transmission and molecular genetic techniques, introduction to bioinformatics, analysis and interpretation of data.

**Prerequisite(s):** GEN 604 with a minimum grade of D-.

**Grade Mode:** Letter Grading

**Special Fee:** Yes

#### GEN 704 - 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. Lab.

**Attributes:** Writing Intensive Course

**Prerequisite(s):** BMS 503 with a minimum grade of D- and BMS 504 with a minimum grade of D- and GEN 604 with a minimum grade of D-.

**Grade Mode:** Letter Grading

**Special Fee:** Yes

**GEN 705 - Population Genetics****Credits:** 3

Exploration of the forces (mutations, 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.

**Prerequisite(s):** GEN 604 with a minimum grade of D- and BIOL 528 with a minimum grade of D-.

**Equivalent(s):** PBIO 705, ZOOL 665, ZOOL 705

**Mutual Exclusion:** No credit for students who have taken NR 664.

**Grade Mode:** Letter Grading

**GEN 706 - 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.

**Prerequisite(s):** GEN 604 with a minimum grade of D-.

**Equivalent(s):** ANSC 706, BCHM 706

**Grade Mode:** Letter Grading

**GEN 711 - Genomics and Bioinformatics****Credits:** 0 or 4

Methods, applications, and implications of genomics—the analysis of whole genomes. Medical, ethical and legal implications of genomic data. Computer lab provides exposure and experience in a range of bioinformatics approaches used in genome analysis. Computer Lab.

**Prerequisite(s):** GEN 604 with a minimum grade of D-.

**Equivalent(s):** GEN 711W

**Grade Mode:** Letter Grading

**GEN 711W - 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, as well as medical, ethical and legal implications. The lab provides exposure and experience on a range of bioinformatics approaches—the computer applications used in genome analysis. Lab.

**Attributes:** Writing Intensive Course

**Prerequisite(s):** GEN 604 with a minimum grade of D-.

**Equivalent(s):** BCHM 711, BCHM 715, GEN 711, MICR 711, MICR 715

**Grade Mode:** Letter Grading

**GEN 712 - 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. Computer Lab.

**Prerequisite(s):** GEN 604 with a minimum grade of D- and GEN 711 with a minimum grade of D-.

**Grade Mode:** Letter Grading

**GEN 713 - 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.

**Attributes:** Writing Intensive Course

**Prerequisite(s):** GEN 604 with a minimum grade of D- and BMS 503 with a minimum grade of D- and BMS 504 with a minimum grade of D-.

**Equivalent(s):** MICR 713

**Grade Mode:** Letter Grading

**GEN 714 - Personal Genomics****Credits:** 4

Analysis and implications of personal genomic data is the focus of this course. Students understand and appreciate all aspects of the availability of personal genomic information and tools including scientific, medical, social, ethical and legal issues. Students have the opportunity to analyze their own individual genome to one of the publicly available genomes to learn about all various aspects of this emerging field. The course will be an entirely online format.

**Prerequisite(s):** GEN 604 with a minimum grade of D-.

**Grade Mode:** Letter Grading

**GEN 715 - 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. Some knowledge of statistics recommended. Computer Lab.

**Prerequisite(s):** GEN 604 with a minimum grade of D-.

**Equivalent(s):** ZOOL 715

**Grade Mode:** Letter Grading

**GEN 717 - Molecular Microbiology****Credits:** 5

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

**Attributes:** Writing Intensive Course

**Prerequisite(s):** BMS 503 with a minimum grade of D- and BMS 504 with a minimum grade of D- and GEN 604 with a minimum grade of D-.

**Equivalent(s):** MICR 717

**Grade Mode:** Letter Grading

**Special Fee:** Yes

**GEN 721 - 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.

**Prerequisite(s):** GEN 604 with a minimum grade of D-.

**Grade Mode:** Letter Grading

**GEN 725 - 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.

**Co-requisite:** GEN 705**Prerequisite(s):** GEN 604 with a minimum grade of D- and BIOL 528 with a minimum grade of D-.**Grade Mode:** Letter Grading**GEN 771 - 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.

**Prerequisite(s):** GEN 604 with a minimum grade of D-.**Grade Mode:** Letter Grading**GEN 772 - 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. Lab.

**Attributes:** Writing Intensive Course**Prerequisite(s):** GEN 604 with a minimum grade of D-.**Equivalent(s):** PBIO 772**Grade Mode:** Letter Grading**GEN 774 - 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 production of pharmaceuticals; controversies associated with this technology. Lab.

**Prerequisite(s):** GEN 604 with a minimum grade of D-.**Equivalent(s):** PBIO 774, PBIO 775**Grade Mode:** Letter Grading**Special Fee:** Yes**GEN #790 - Undergraduate Teaching Experience****Credits:** 1-4

Provide academic support to graduate teaching assistants or faculty in preparing, presenting, and executing Genetics lectures or labs.

**Repeat Rule:** May be repeated for a maximum of 4 credits.**Equivalent(s):** MICR 790**Grade Mode:** Letter Grading**GEN 795 - Investigations in Genetics****Credits:** 1-4

Advanced research or scholarly projects developed and conducted under the supervision of a faculty member. Provides the opportunity to apply advanced knowledge and techniques of the major to a specific problem or question.

**Repeat Rule:** May be repeated for a maximum of 4 credits.**Equivalent(s):** GEN 795W**Grade Mode:** Letter Grading**GEN 795W - Investigations in Genetics****Credits:** 1-4

Advanced research or scholarly projects developed and conducted under the supervision of a faculty member. Provides the opportunity to apply advanced knowledge and techniques of the major to a specific problem or question.

**Attributes:** Writing Intensive Course**Repeat Rule:** May be repeated for a maximum of 4 credits.**Equivalent(s):** GEN 795**Grade Mode:** Letter Grading**GEN 799 - Senior Thesis****Credits:** 1-4

Independent research project under the direction of a faculty sponsor for seniors in genetics. Final product is a written thesis. One or two semesters.

**Attributes:** Writing Intensive Course**Repeat Rule:** May be repeated for a maximum of 8 credits.**Grade Mode:** Letter Grading**GEN 799H - Honors Senior Thesis****Credits:** 1-4

Independent research project under the direction of a faculty sponsor for seniors in genetics and in the Honors Program. Final product is a written thesis. One or two semesters.

**Attributes:** Honors course; Writing Intensive Course**Repeat Rule:** May be repeated for a maximum of 8 credits.**Grade Mode:** Letter Grading**Faculty**[Genetics affiliated faculty.](#)