GENETICS MAJOR (B.S.)

https://colsa.unh.edu/molecular-cellular-biomedical-sciences/program/bs/genetics-major

Description

The **Genetics program (GEN)** explores the world of genetics and genomics in plants, animals, and microbes. Genetics majors are interested in understanding how DNA, along with the environment, specifies simple traits like hair color to more complex traits like high blood pressure, diabetes, and mental illness. The Genetics faculty strongly value hands-on learning and many GEN students conduct undergraduate research under the supervision of our faculty. GEN graduates are prepared for successful careers in the biotechnology fields or for entry into a variety of graduate school, genetic counseling, or health professional programs.

The Genetics program offers course work and laboratories in:

- molecular genetics
- bioinformatics
- human genetics
- comparative genomics
- plant genetics
- microbial genetics and evolution
- population and evolutionary genetics

Students in the Genetics program may participate in a variety of experiential learning activities including:

- independent research experiences in laboratories of UNH faculty
- work at the Hubbard Center for Genome Studies or Research Computing Center
- internships at biotechnology companies in the Greater Boston area
- internships with genetics counselors at area medical centers

GEN graduates have been successful in attaining careers as:

- research scientists and laboratory technicians in
  - biotechnology and pharmaceutical companies
  - academic research programs
  - forensics
  - biomedical research centers & medical schools
  - government agencies
- genetic counselors
- educators
- technical support associates

GEN graduates are prepared for further education in:

- professional health programs
  - genetic counseling
  - medical school
  - dental school
  - allied health programs (physician assistant, pharmacist, nursing or pathologist's assistant programs)
  - veterinary school
- graduate programs such as
  - Genetics and Genomics
  - Integrative Biology
  - Neurogenomics
  - Molecular Biology
  - Microbiology
  - Environmental Sciences
  - Public Health
  - Computer Science

Requirements

Degree Requirements

Minimum Credit Requirement: 128 credits

Minimum Residency Requirement: 32 credits must be taken at UNH

Minimum GPA: 2.0 required for conferral*

Core Curriculum Required: Discovery & Writing Program Requirements

Foreign Language Requirement: No

All Major, Option and Elective Requirements as indicated.
**Major GPA requirements as indicated.*

Major Requirements

Students majoring in genetics take seven Foundation courses, six Bioscience Core courses, four Genetics Core courses and four Major Elective courses. One capstone experience, supervised and approved within the major, is required of all seniors. In addition, all other University requirements must be completed, including those for the University Discovery Program and Writing Program.

A minimum grade of C- minus or better is required in Statistics and all Bioscience Core, Genetics Core, and Major Elective courses.

Required Courses

Code	Title	Credits
Foundation Courses		
CHEM 403	General Chemistry I [1]	4
CHEM 404	General Chemistry II	4
CHEM 545 & CHEM 546	Organic Chemistry and Organic Chemistry Laboratory [2]	5
MATH 424B	Calculus for Life Sciences [3]	4
BIOL 528	Applied Biostatistics I	4
PHYS 401	Introduction to Physics I	4
PHYS 402	Introduction to Physics II	4

1 Fulfills Physical Science Discovery requirement
2 Students applying to health profession schools need a full year of Organic Chemistry, a full year of Introductory Biology, as well as a full year of English. CHEM 651/CHEM 653 and CHEM 652/CHEM 654 should be taken in place of CHEM 545/CHEM 546; ENGL 502 or ENGL 503 in suggested in addition to ENGL 401. See Pre-Professional Health Program Advising.
3 Fulfills Quantitative Reasoning Discovery requirement

Code	Title	Credits
Bioscience Core Courses		
BIOL 411	Introductory Biology: Molecular and Cellular [4]	4
BIOL 412	Introductory Biology: Evolution, Biodiversity and Ecology	4

GEN 604	Principles of Genetics	4
BMS 503 & BMS 504	General Microbiology and General Microbiology Laboratory	5
BMCB 605	Principles of Cell Biology	4
BMCB 658 & BMCB 659	General Biochemistry and General Biochemistry Lab	5

[4] Fulfills Biological Science Discovery requirement, Discovery Inquiry requirement, and Discovery laboratory requirement

Code	Title	Credits
Genetics Core Courses		
GEN 606	Genetics Lab	4
GEN 711	Genomics and Bioinformatics	4
GEN 704	Microbial Genetics and Genomics [5]	5
or GEN 771	Molecular Genetics	
MCBS 401	Professional Perspectives in Molecular, Cellular, and Biomedical Sciences	1

Electives

Four (4) unique major electives are required from the below categories.

Code	Title	Credits
Laboratory-Based Electives		
Select one from the following:		
GEN 704	Microbial Genetics and Genomics [5]	5
GEN 705 & GEN 725	Population Genetics and Population Genetics Lab [5]	5
GEN 717	Molecular Microbiology	5
GEN 795	Investigations in Genetics (4-credit minimum) [6]	1-4
GEN 795W	Investigations in Genetics (4-credit minimum) [6]	1-4
GEN 799	Senior Thesis (4-credit minimum) [6]	1-4
GEN 799H	Honors Senior Thesis (4-credit minimum) [6]	1-4
BMCB 753	Cell Culture	5
BMCB 754	Molecular Biology Research Methods	5
INCO 790	Advanced Research Experience (4-credit minimum) [6]	1-4

Code	Title	Credits
Population/Evolutionary Genetics Electives		
Select one from the following:		
GEN 705 & GEN 725	Population Genetics and Population Genetics Lab [5]	5
GEN 715	Molecular Evolution	4
GEN 772	Evolutionary Genetics of Plants	4

[5] Where listed, this course may fulfill another category (Genetics Core, Laboratory-Based Major Elective, or Population/Evolutionary Genetics Major Elective), IF students take one additional Bioscience Major Elective.

[6] Must be a research project with a genetics focus.

Code	Title	Credits
Bioscience Electives		
Select two from the following:		
GEN 704	Microbial Genetics and Genomics [5]	5
GEN 705 & GEN 725	Population Genetics and Population Genetics Lab [5]	5
GEN 706	Human Genetics	4
GEN 712	Programming for Bioinformatics	5
GEN 713	Microbial Ecology and Evolution	4
GEN 715	Molecular Evolution	4
GEN 717	Molecular Microbiology	5
GEN 721	Comparative Genomics	4
GEN 771	Molecular Genetics	4
GEN 772	Evolutionary Genetics of Plants	4
GEN 795	Investigations in Genetics (4-credit minimum) [6]	1-4
GEN 795W	Investigations in Genetics (4-credit minimum) [6]	1-4
GEN 799	Senior Thesis (4-credit minimum) [6]	1-4
GEN 799H	Honors Senior Thesis (4-credit minimum) [6]	1-4
ANSC 602	Animal Rights and Societal Issues	4
ANSC 612	Genetics of Animals	4
ANSC 701	Physiology of Reproduction	4
BIOL 704	Plant-Microbe Interactions	3
BIOL 706	Data Science with R for the Life Sciences	4
BIOL 711	Experimental Design & Analysis	4
BMCB 750	Physical Biochemistry	3
BMCB 753	Cell Culture	5
BMCB 754	Molecular Biology Research Methods	5
BMCB 760	Pharmacology	4
BMCB 763	Biochemistry of Cancer	4
BMCB 794	Protein Structure and Function	4
BMS 650	Molecular Diagnostics	4
BMS 702	Endocrinology	4
BMS 705	Immunology	3
BMS 706	Virology	3
BMS 718	Mammalian Physiology	4
BMS 719	Host-Microbe Interactions	4
BMS 735	Molecular and Cellular Parasitology	4
BMS 740	Human Microbiome	4
INCO 790	Advanced Research Experience (4-credit minimum)	1-4
NR 706	Soil Ecology	4
ZOOL 625 & ZOOL 626W	Principles of Animal Physiology and Animal Physiology Laboratory	5
ZOOL 690	Evolution	4
ZOOL 736	Genes and Behavior	4
ZOOL 777W	Neuroethology	4

Capstone

The capstone explores areas of interest based on the integration of prior learning. The capstone requirement may be satisfied through a course, created work or product, or some form of experiential learning (e.g., honors thesis, mentored research project, or other special student activity). Students may take more than one capstone course. Capstone completion is never displayed on Degree Works; your advisor will certify capstone completion at the time of graduation. Students must have 90 credits or more when completing their capstone requirement. Contact your advisor for questions about capstones.

Code	Title	Credits
Approved Capstone Courses		
GEN 704	Microbial Genetics and Genomics	5
GEN 705 & GEN 725	Population Genetics and Population Genetics Lab	5
GEN 715	Molecular Evolution	4
GEN 717	Molecular Microbiology	5
GEN 790	Undergraduate Teaching Experience (4 credit minimum; classroom presentation required)	1-4
GEN 795	Investigations in Genetics (4-credit minimum) [6]	1-4
GEN 795W	Investigations in Genetics (4-credit minimum) [6]	1-4
GEN 799	Senior Thesis (4-credit minimum) [6]	1-4
GEN 799H	Honors Senior Thesis (4-credit minimum) [6]	1-4
INCO 790	Advanced Research Experience (4-credit minimum) [6]	1-4

[6] Must be a research project with a genetics focus.

Degree Plan

Sample Degree Plan

This sample degree plan serves as a general guide; students collaborate with their academic advisor to develop a personalized degree plan to meet their academic goals and program requirements.

First Year		
Fall		**Credits**
BIOL 411	Introductory Biology: Molecular and Cellular	4
MCBS 401	Professional Perspectives in Molecular, Cellular, and Biomedical Sciences	1
ENGL 401	First-Year Writing	4
CHEM 403	General Chemistry I	4
Discovery course		4
	Credits	**17**
Spring		
BIOL 412	Introductory Biology: Evolution, Biodiversity and Ecology	4
MATH 424B	Calculus for Life Sciences	4
CHEM 404	General Chemistry II	4
Discovery course		4
	Credits	**16**
Second Year		
Fall		
GEN 604	Principles of Genetics	4
BMCB 605	Principles of Cell Biology	4
BIOL 528	Applied Biostatistics I	4
Discovery course		4
	Credits	**16**
Spring		
GEN 606	Genetics Lab	4
BMS 503 & BMS 504	General Microbiology and General Microbiology Laboratory	5
CHEM 545 & CHEM 546	Organic Chemistry and Organic Chemistry Laboratory	5
Discovery course		4
	Credits	**18**
Third Year		
Fall		
BMCB 658 & BMCB 659	General Biochemistry and General Biochemistry Lab	5
PHYS 401	Introduction to Physics I	4
Discovery course		4
Elective (any course)		4
	Credits	**17**
Spring		
GEN 711	Genomics and Bioinformatics	4
PHYS 402	Introduction to Physics II	4
Major Elective (Population or Evolutionary Genetics)		4
Discovery course		4
	Credits	**16**
Fourth Year		
Fall		
Genetics Core course		4
Major Elective (Laboratory based)		4-5
Major Elective (Bioscience/possible Capstone)		4-5
Elective (any course)		4
	Credits	**16-18**
Spring		
Major Elective (Bioscience)		4
Elective (any course)		4
Elective (any course)		4
	Credits	**12**
	Total Credits	**128-130**

Student Learning Outcomes

Program Learning Outcomes

Core Knowledge in Genetics

- Students will be able to describe DNA, its role, structure, how DNA is packaged in the chromosomes in terms of histones, nucleosomes, and chromatin, including its discovery, how has modern genomics influenced, and differences between prokaryotes and eukaryotes.
- Students will be able to describe the central dogma of molecular biology, including specific details related to replication, transcription, and translation.
- Students will be able to define and describe evolution, how drift, gene flow, mutation, natural selection, recombination, within a population genetic framework, may result in evolution.
- Students will be able to describe the differences between mitosis and meiosis and how errors in these processes may effect phenotype, cause disease, etc.
- Students will be able to evaluate how genes and the environment can interact to produce a phenotype, including allelic differences and changes in gene regulation.
- Students will be able to describe the concept of deep time, and how comparing genes and genomes allows us to understand evolution and relatedness between species.
- Students will be able to use pedigrees to determine mode of inheritance of a trait.
- Students will be able to describe ethical issues related to modern genomics and implications for health care and insurance, interpersonal relationships, family planning, etc.
- Students will be able to describe high-throughput sequencing, and how it has changed the practice of modern genetics.

Quantitative Literacy, Inquiry & Analysis

- Students will be able to apply the scientific method to examine experimental evidence and draw informed conclusions.
- Students will be able to use graphs to represent scientific data.
- Students will be able to apply statistical methods to interpret scientific data.

Critical Thinking & Problem Solving

- Students will be able to use data to troubleshoot an unexpected outcome .
- Students will be able to apply core knowledge to critically interpret scientific data.

Written Communication

- Students will demonstrate written skills to communicate scientific knowledge and experimental data.

Oral Communication

- Students will be able to demonstrate oral presentation skills to communicate scientific knowledge and experimental data.