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 Discovery Program and the University Writing Program.

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

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM 403</td>
<td>General Chemistry I ¹</td>
<td>4</td>
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<tr>
<td>CHEM 404</td>
<td>General Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 545 &amp; CHEM 546</td>
<td>Organic Chemistry and Organic Chemistry Laboratory ²</td>
<td>5</td>
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<tr>
<td>MATH 4248</td>
<td>Calculus for Life Sciences ³</td>
<td>4</td>
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<tr>
<td>BIOL 528</td>
<td>Applied Biostatistics I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 401</td>
<td>Introduction to Physics I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 402</td>
<td>Introduction to Physics II</td>
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</table>

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

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<thead>
<tr>
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<tr>
<td>BIOL 411</td>
<td>Introductory Biology Molecular and Cellular ⁴</td>
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<tr>
<td>BIOL 412</td>
<td>Introductory Biology Evolution, Biodiversity and Ecology</td>
<td>4</td>
</tr>
<tr>
<td>GEN 604</td>
<td>Principles of Genetics</td>
<td>4</td>
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⁴ Includes lecture and lab
Four unique major electives are required from the below categories.

### Code Core Courses

**GEN 401** Professional Perspectives in Genetics
- **Credits:** 1

**GEN 606** Genetics Lab
- **Credits:** 4

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

**GEN 704** Genetics of Prokaryotic Microbes
- **Credits:** 5

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

**GEN 741** Techniques in Plant Genetic Engineering and Biotechnology
- **Credits:** 4

**GEN 795** Investigations in Genetics (4-credit minimum)
- **Credits:** 1-4

**GEN 795W** Investigations in Genetics (4-credit minimum)
- **Credits:** 1-4

**GEN 799** Senior Thesis (4-credit minimum)
- **Credits:** 1-4

**GEN 799H** Honors Senior Thesis (4-credit minimum)
- **Credits:** 1-4

**BMCB 750** Cell Culture
- **Credits:** 5

**BMCB 754** Molecular Biology Research Methods
- **Credits:** 5

**BMCB 760** Pharmacology
- **Credits:** 4

**BMS 673** Biochemistry of Cancer
- **Credits:** 4

**BMS 794** Protein Structure and Function
- **Credits:** 4

**BMS 795** Molecular Diagnostics
- **Credits:** 4

**BMS 797** Endocrinology
- **Credits:** 4

**BMS 798** Virology
- **Credits:** 3

**BMS 718** Mammalian Physiology
- **Credits:** 4

**BMS 719** Host-Microbe Interactions
- **Credits:** 4

**BMS 740** Human Microbiome
- **Credits:** 4

**BMS 735** Molecular and Cellular Parasitology
- **Credits:** 4

**BMS 740** Human Microbiome
- **Credits:** 4

**BMS 760** Molecular Genetics
- **Credits:** 4

**BMS 704** Molecular Microbiology
- **Credits:** 4

**BMS 702** Endocrinology
- **Credits:** 4

**BMS 705** Immunology
- **Credits:** 3

**BMS 706** Virology
- **Credits:** 3

**BMS 718** Mammalian Physiology
- **Credits:** 4

**INCO 790** Advanced Research Experience (4-credit minimum)
- **Credits:** 1-4

**NR 706** Soil Ecology
- **Credits:** 4

**ZOO 625** Principles of Animal Physiology
- **Credits:** 5

**ZOO 626W** and Animal Physiology Laboratory
- **Credits:** 4

**ZOO 660** Evolution
- **Credits:** 4

**ZOOT 716** Genes and Behavior
- **Credits:** 4

**ZOOT 777W** Neuroethology
- **Credits:** 4

#### Electives
Four unique major electives are required from the below categories.

**Code Laboratory-Based Electives: Select one**

**GEN 704** Genetics of Prokaryotic Microbes
- **Credits:** 5

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

**GEN 741** Techniques in Plant Genetic Engineering and Biotechnology
- **Credits:** 4

**GEN 795** Investigations in Genetics (4-credit minimum)
- **Credits:** 1-4

**GEN 795W** Investigations in Genetics (4-credit minimum)
- **Credits:** 1-4

**GEN 799** Senior Thesis (4-credit minimum)
- **Credits:** 1-4

**GEN 799H** Honors Senior Thesis (4-credit minimum)
- **Credits:** 1-4

**BMCB 750** Cell Culture
- **Credits:** 5

**BMCB 754** Molecular Biology Research Methods
- **Credits:** 5

**INCO 790** Advanced Research Experience (4-credit minimum)
- **Credits:** 1-4

#### Code Population/Evolutionary Genetics Electives: Select one

**GEN 704** Population Genetics
- **Credits:** 5

**GEN 725** and Population Genetics Lab
- **Credits:** 5

**GEN 715** Molecular Evolution
- **Credits:** 4

**GEN 772** Evolutionary Genetics of Plants
- **Credits:** 4

**ZOO 625** Principles of Animal Physiology
- **Credits:** 5

**ZOO 626W** and Animal Physiology Laboratory
- **Credits:** 4

**ZOO 756** Evolution
- **Credits:** 4

**ZOOT 716** Genes and Behavior
- **Credits:** 4

**ZOOT 777W** Neuroethology
- **Credits:** 4

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.

Must be a research project with a genetics focus.

**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 Approved Capstone Courses**

**GEN 704** Genetics of Prokaryotic Microbes
- **Credits:** 5

**GEN 705** Population Genetics
- **Credits:** 5

**GEN 725** and Population Genetics Lab
- **Credits:** 5

**GEN 715** Molecular Evolution
- **Credits:** 4

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

**GEN 790** Undergraduate Teaching Experience (4 credit minimum; classroom presentation required)
- **Credits:** 1-4

**GEN 795** Investigations in Genetics (4-credit minimum)
- **Credits:** 1-4

**GEN 795W** Investigations in Genetics (4-credit minimum)
- **Credits:** 1-4

**GEN 799** Senior Thesis (4-credit minimum)
- **Credits:** 1-4

**GEN 799H** Honors Senior Thesis (4-credit minimum)
- **Credits:** 1-4

**INCO 790** Advanced Research Experience (4-credit minimum)
- **Credits:** 1-4

Must be a research project with a genetics focus.

### Degree Plan

**SAMPLE Course Sequence for Genetics**

#### Course

**First Year**

**Fall**

**GEN 401** Professional Perspectives in Genetics
- **Credits:** 1

**BIOL 411** Introductory Biology: Molecular and Cellular
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<td>ENGL 401</td>
<td>First-Year Writing</td>
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<td>General Chemistry I</td>
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**Spring**

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<tr>
<td>BIOL 412</td>
<td>Introductory Biology. Evolution, Biodiversity and Ecology</td>
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<td>MATH 424B</td>
<td>Calculus for Life Sciences</td>
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<td>CHEM 404</td>
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**Second Year**

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<td>BMCB 605</td>
<td>Principles of Cell Biology</td>
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<td>BIOL 528</td>
<td>Applied Biostatistics I</td>
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<td>Discovery course</td>
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**Spring**

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<tr>
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<td>Genetics Lab</td>
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<tr>
<td>BMS 503</td>
<td>General Microbiology</td>
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<tr>
<td>&amp; BMS 504</td>
<td>and General Microbiology Laboratory</td>
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<tr>
<td>CHEM 545</td>
<td>Organic Chemistry</td>
<td>5</td>
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<tr>
<td>&amp; CHEM 546</td>
<td>and Organic Chemistry Laboratory</td>
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**Third Year**

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<tr>
<td>&amp; BMCB 659</td>
<td>and General Biochemistry Lab</td>
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<td>PHYS 401</td>
<td>Introduction to Physics I</td>
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<td>Discovery course</td>
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**Spring**

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<tr>
<td>GEN 711</td>
<td>Genomics and Bioinformatics</td>
<td>4</td>
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<tr>
<td>PHYS 402</td>
<td>Introduction to Physics II</td>
<td>4</td>
</tr>
<tr>
<td>Major Elective (Population or Evolutionary Genetics)</td>
<td>4</td>
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<tr>
<td>Discovery course</td>
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**Fourth Year**

**Fall**

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<tr>
<td>Genetics Core course</td>
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<tr>
<td>Major Elective (Laboratory based)</td>
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<td>4-5</td>
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<tr>
<td>Major Elective (Bioscience/possible Capstone)</td>
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<tr>
<td>Elective (any course)</td>
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<td>4</td>
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<tr>
<td></td>
<td><strong>Credits</strong></td>
<td><strong>16-18</strong></td>
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**Spring**

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<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Major Elective (Bioscience)</td>
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<tr>
<td>Elective (any course)</td>
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<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Credits</strong></td>
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**Student Learning Outcomes**

**SLO: 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.

**SLO: 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.

**SLO: 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.

**SLO: Written Communication**

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

**SLO: Oral Communication**

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