GENETICS MAJOR: GENOMICS OPTION (B.S.)

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

**Description**

The Genetics:Genomics program (GEN) explores the world of genetics and genomics in plants, animals, and microbes. Genomics is the study of genomes and includes topics like DNA structure and function, high-throughput sequencing, and computational comparison of the genomes of different organisms. 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 biotechnology fields or for entry into a variety of graduate school or health professional programs.

The Genetics program offers course work and laboratories in:

- molecular genetics
- bioinformatics
- human genetics
- comparative genomics
- plant genetics
- microbial genetics
- 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)
- vet school
- graduate programs such as
  - Genetics and Genomics
  - Integrative Biology
  - Neurogenomics
  - Molecular Biology
  - Microbiology
  - Environmental Sciences
  - Public Health
  - Computer Science

**Requirements**

Students majoring in Genetics with the Genomics option take seven Foundation courses, six Bioscience Core courses, four Genetics Core courses and five Major Elective courses. One capstone experience, supervised and approved within the major, is required of all seniors. The capstone explores areas of interest based on the integration of prior learning. In addition, all other University requirements must be completed, including those for the Discovery Program and the University Writing Requirement.

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

### Foundation Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 403</td>
<td>General Chemistry I ¹</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 404</td>
<td>General Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 545</td>
<td>Organic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 546</td>
<td>General Microbiology &amp; Microbiology Laboratory ²</td>
<td>5</td>
</tr>
<tr>
<td>MATH 4248</td>
<td>Calculus for Life Sciences ³</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 528</td>
<td>Applied Biostatistics</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>
<td>4</td>
</tr>
</tbody>
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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, and 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 is suggested in addition to ENGL 401. See Pre-Professional Health Program advising.
³ Fulfills Quantitative Reasoning Discovery requirement

### Bioscience Core Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 411</td>
<td>Introductory Biology Molecular and Cellular ⁴</td>
<td>4</td>
</tr>
<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>
</tr>
<tr>
<td>BMS 503</td>
<td>General Microbiology</td>
<td>5</td>
</tr>
<tr>
<td>BMS 504</td>
<td>General Microbiology Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>BMCB 605</td>
<td>Principles of Cell Biology</td>
<td>4</td>
</tr>
</tbody>
</table>

⁴ Includes lecture and lab credit
Genetics Major: Genomics Option (B.S.)

Bioscience Major Electives (Select One)

Population or Evolutionary Genetics Major Electives (Select Two)

Major Electives

A total of five unique major electives is required: GEN 712, GEN 721, two courses from the population or evolutionary genetics elective group, and one course from the bioscience major elective group.

Required

Population or Evolutionary Genetics Major Electives (Select Two)

Bioscience Major Electives (Select One)

Approved GEN Capstone Courses

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. See your advisor for questions about capstones.

Must be a research project with a genetics focus

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Degree Plan

SAMPLE Course Sequence for Genomics

Course | Title | Credits
--- | --- | ---
**First Year**

**Fall**

GEN 401 | Professional Perspectives in Genetics | 1
BIOL 411 | Introductory Biology: Molecular and Cellular | 4
ENGL 401 | First-Year Writing | 4
CHEM 403 | General Chemistry I | 4

**Discovery course**

Spring

BIOL 412 | Introductory Biology: Evolution, Biodiversity and Ecology | 4
MATH 424B | Calculus for Life Sciences | 4
CHEM 404 | General Chemistry II | 4

Credits 17
Discovery course  4

Credits  16

Second Year

Fall
GEN 604 Principles of Genetics  4
BM CB 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 General Microbiology  5
& BMS 504 General Microbiology Laboratory  5
CHEM 545 Organic Chemistry  5
& CHEM 546 Organic Chemistry Laboratory  5
Discovery course  4

Credits  18

Third Year

Fall
GEN 712 Programming for Bioinformatics  5
BM CB 658 General Biochemistry  5
& BM CB 659 General Biochemistry Lab  5
PHYS 401 Introduction to Physics I  4
Discovery course  4

Credits  18

Spring
GEN 711 Genomics and Bioinformatics  4
GEN 721 Comparative Genomics  4
PHYS 402 Introduction to Physics II  4
Discovery course  4

Credits  16

Fourth Year

Fall
Genetics Core course  4
Major Elective (Pop/Evol Genetics; possible Capstone)  4
Elective (any course)  4
Elective (any course)  4

Credits  16

Spring
Major Elective (Bioscience)  4
Major Elective (Pop/Evol Genetics)  4
Elective (any course)  4
Elective (any course)  3-5

Credits  11-13

Total Credits  128-130

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.