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</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>5</td>
</tr>
<tr>
<td>CHEM 546</td>
<td>and Organic Chemistry Laboratory</td>
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<tr>
<td>MATH 424</td>
<td>Calculus for Life Sciences</td>
<td>4</td>
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<tr>
<td>BIOL 528</td>
<td>Applied Bioinformatics</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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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 651/652/654 should be taken in place of CHEM 545/546; ENGL 502 or 503 should be taken 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>
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<tbody>
<tr>
<td>BIOL 411</td>
<td>Introductory Biology Molecular and Cellular</td>
<td>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>
</tr>
<tr>
<td>BMS 503</td>
<td>General Microbiology</td>
<td>5</td>
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<tr>
<td>&amp; BMS 504</td>
<td>and General Microbiology Laboratory</td>
<td></td>
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<tr>
<td>BMCB 605</td>
<td>Principles of Cell Biology</td>
<td>4</td>
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</tbody>
</table>
Bioscience Major Electives (Select One)

Population or Evolutionary Genetics Major Electives (Select Two)

Required

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.

Population or Evolutionary Genetics Major Electives (Select Two)

Bioscience Major Electives (Select One)

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

Genetics Core Courses

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.

5 Where listed, this course can also count as a Bioscience Major Elective IF students take one additional Bioscience Major Elective.

6 Must be a research project with a genetics focus

Degree Plan

SAMPLE Course Sequence for Genomics

Course

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  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
University of New Hampshire

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  General Microbiology  5
- BMS 504  and General Microbiology Laboratory  5
- CHEM 545  Organic Chemistry  5
- CHEM 546  and Organic Chemistry Laboratory  5
- Discovery course  4

Credits  18

Third Year

Fall

- GEN 712  Programming for Bioinformatics  5
- BMCB 658  General Biochemistry  5
- BMCB 659  and General Biochemistry Laboratory  5
- PHYS 401  Introduction to Physics I  4
- Discovery course  4

Credits  18

Spring

- GEN 711  Genomics and Bioinformatics  4
- PHYS 402  Introduction to Physics II  4
- Discovery course  4
- Major Elective (Bioscience)  4

Credits  16

Fourth Year

Fall

- Genetics Core course  4
- Major Elective (Pop/Evol Genetics)  4
- Elective (any course)  4
- Elective (any course)  4

Credits  16

Spring

- GEN 721  Comparative Genomics  4
- Major Elective (Pop/Evol Genetics)  4
- Elective (any course)  4

Credits  12

Total Credits  129

Student Learning Outcomes

SLO: Core Knowledge

- Students will demonstrate an understanding of core knowledge in biochemistry, molecular biology, cell biology, genetics & biomedical sciences.

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.

Genetics; Genetics: Genomics option

- 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.