

GENETICS

Genetics is the scientific study of heredity. Understanding the basis of heredity is fundamental to all aspects of the life sciences, from the most basic molecular study to applied studies of agricultural species. At Iowa State University the study of the life sciences is interdepartmental, involving faculty in the basic, agricultural, and veterinary sciences. Faculty in 20 different departments are involved in genetics research. This large group of faculty presents a broad range of possibilities for students to learn from faculty who are at the forefront of research in many areas of genetics.

UNDERGRADUATE STUDY

Undergraduate study in genetics is jointly administered by three departments: the Roy J. Carver Department of Biochemistry, Biophysics, and Molecular Biology; the Department of Genetics, Development, and Cell Biology; and the Department of Ecology, Evolution, and Organismal Biology. Undergraduate degrees are offered through both the College of Agriculture and Life Sciences and the College of Liberal Arts and Science. Programs of study for genetics majors leading to a B.S. degree are available.

Training in genetics may lead to employment in teaching, research, or a variety of health-related professions. Although some students find employment directly after their baccalaureate training, many students continue their education in graduate or professional programs. Students with the B.S. degree may find employment in the biotechnology, health, or food industries. Recent graduates have also developed careers in conservation biology, technical writing, science journalism, technical sales, and business.

The required course work and associated electives provide students with the foundation in basic life sciences, mathematics, chemistry, and physics that is essential for professions involving modern biological/ biomedical sciences. As part of these courses students develop skills in problem solving, critical thinking, writing, and research-related activities in the biological sciences.

Specific entrance requirements for medical and health-related professions are established by the professional schools. Students interested in fulfilling pre-professional requirements for such professions as dentistry, human medicine, genetic counseling, optometry, pharmacy, physical therapy, physicians assistant, and veterinary medicine can major in genetics while fulfilling the pre-professional requirements.

Student Learning Outcomes:

Upon graduation, students earning the BS degree in Genetics are expected to have achieved the following skills and capabilities:

- Comprehensive, detailed understanding of the chemical basis of heredity.
- Comprehensive and detailed understanding of genetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.
- Understanding of how genetic concepts affect broad societal issues including health and disease, food and natural resources, environmental sustainability, etc.
- Understanding the role of genetic mechanisms in evolution.
- The knowledge required to to design, execute, and analyze the results of genetic experimentation in animal and plant model systems.
- The ability to recognize the experimental rationale of genetic studies as they are described in peer-reviewed research articles and grant proposals to federal and other funding agencies.
- The ability to evaluate conclusions that are based on genetic data.
- Insight into the mathematical, statistical, and computational basis of genetic analyses that use genome-scale data sets in systems biology settings.
- Understanding the role of genetic technologies in industries related to biotechnology, pharmaceuticals, energy, and other fields.
- Communication skills required in the discipline including oral presentations of research data, published research articles, grant proposals, and poster presentations at conferences.
- Teamwork and leadership skills including group analysis of data, working together in the research laboratory, joint compositions of written reports, substantive participation in research group meetings, etc.

CURRICULUM IN GENETICS - REQUIREMENTS

Total Degree Requirement: 120 cr.

.A maximum of 65 cr. from a two-year institution can be applied that may include up to 16 technical cr.; up to 9 Pass-Not Pass cr. of free electives can be applied; a cumulative GPA of at least 2.0 is required for graduation. Program-approved lists can be found on the Genetics website.

1. Genetics and Life Sciences

A grade of C- or better is required in all Genetics and Life Science courses.

A. Courses required of all Genetics majors

GEN 110	Genetics Orientation	1
BIOL 211	Principles of Biology I	3
BIOL 211L	Principles of Biology Laboratory I	1
BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1

GEN 313	Principles of Genetics	3
GEN 313L	Genetics Laboratory	1
BIOL 314	Principles of Molecular Cell Biology	3
BIOL 315	Biological Evolution	3
One of the following:		3-4
GEN 322	Introduction to Bioinformatics and Computational Biology	
GEN 349	The Genome Perspective in Biology	
BCBIO 406	Bioinformatics of OMICS	
GEN 409	Molecular Genetics	3
GEN 410	Analytical Genetics	3
One of the following:		3
GEN 462	Evolutionary Genetics	
EEOB 561	Evolutionary and Ecological Genomics	
EEOB 563	Molecular Phylogenetics	
GEN 491	Undergraduate Seminar, Professional Practice in Genetics Disciplines	1
MICRO 302	Biology of Microorganisms	3
Total Credits		35-36

B. Course required of majors in the College of Agriculture and Life Sciences only

A minimum of 3 cr. of coursework in the area of environmental science from program approved list

Total Credits 3

2. Advanced Sciences Electives: 6 cr. from program approved list

A grade of C- or better is required in each course. No more than 3 cr. of GEN 490, 490R, 490H, 492, 496, 499, or 499H may be used to meet this requirement.

3. Mathematical Sciences

Complete at least one calculus course from MATH, minimum of 4 credits.

MATH 160	Survey of Calculus	
MATH 165	Calculus I	
Complete at least one course from STAT, minimum of 3 credits.		3-4
STAT 101	Principles of Statistics	
STAT 104	Introduction to Statistics	
Complete at least one additional course from MATH or STAT, minimum of 4 credits.		4
MATH 166	Calculus II	
STAT 301	Intermediate Statistical Concepts and Methods	
Total Credits		11-12

4. Supporting Sciences

CHEM 177	General Chemistry I	4
CHEM 177L	Laboratory in General Chemistry I	1
CHEM 178	General Chemistry II	3
CHEM 178L	Laboratory in College Chemistry II	1
CHEM 331	Organic Chemistry I	3
CHEM 331L	Laboratory in Organic Chemistry I	1
CHEM 332	Organic Chemistry II	3
CHEM 332L	Laboratory in Organic Chemistry II	1
PHYS 131	General Physics I	4
PHYS 131L	General Physics I Laboratory	1
PHYS 132	General Physics II	4
PHYS 132L	General Physics II Laboratory	1
Choose one of the following options		6-7

Option 1

BBMB 404 Biochemistry I

And one of the following:

BBMB 405 Biochemistry II

BBMB 411 Techniques in Biochemical Research

CHEM 211 Quantitative and Environmental Analysis & 211L and Quantitative and Environmental Analysis Laboratory

CHEM 325 Chemical Thermodynamics

Option 2

BBMB 420 Mammalian Biochemistry

And one of the following:

BBMB 411 Techniques in Biochemical Research

CHEM 211 Quantitative and Environmental Analysis & 211L and Quantitative and Environmental Analysis Laboratory

CHEM 325 Chemical Thermodynamics

Total Credits 33-34

5. International Perspectives: 3 cr. from university approved list

This course can satisfy **both** the university requirement for International Perspectives and the college requirement for a General Education elective (item 8) if the selection appears on both lists of approved courses.

6. U.S. Diversity: 3 cr. from university approved list

This course can satisfy **both** the university requirement for U.S. Diversity and the college requirement for a General Education elective (item 8) if the selection appears on both lists of approved courses.

7. Communications/Information Literacy

A. Courses required of all Genetics majors

Grades of C or better are required in ENGL 250 and advanced writing. (The College of Agriculture and Life Sciences requires a C or better in ENGL 150, as well.)

ENGL 150	Critical Thinking and Communication	3
ENGL 250	Written, Oral, Visual, and Electronic Composition	3
or ENGL 250H	Written, Oral, Visual, and Electronic Composition: Honors	
LIB 160	Introduction to College Level Research	1
One advanced English writing course from program approved list		3
Total Credits		10

B. Course required of majors in the College of Agriculture and Life Sciences only.

A grade of C or better is required by the college.

SP CM 212	Fundamentals of Public Speaking	3
or AGEDS 311	Presentation and Sales Strategies for Agricultural Audiences	
Total Credits		3

8. General Education electives

Courses from college approved lists that also appear on university approved lists of U.S. Diversity or International Perspectives courses can be used to satisfy both requirements.

A. College of Agriculture and Life Sciences

Humanities course from college approved list	3	
Social Science course from college approved list	3	
Ethics course from college approved list	3	
Total Credits		9

B. College of Liberal Arts and Sciences

Humanities courses from college approved list; one of these should be a Science/Humanities bridge course from program approved list	12	
Social Science courses from college approved list	9	
Students must have completed 3 years of a single world language in high school or take 4-8 credits of World Languages at the university level.		
Total Credits		21

Genetics, B.S.

Freshman

Fall	Credits	Spring	Credits
GEN 110		1 BIOL 211	3
BIOL 212		3 BIOL 211L	1
BIOL 212L		1 CHEM 178	3
CHEM 177		4 MATH/ STAT or college requirement choice	3-4
CHEM 177L		1 ENGL 250 or college requirement choice	3
MATH/ STAT choice		3-4 LIB 160	1
ENGL 150 or 250		3 (or semester 1 with ENGL 250)	
LIB 160		1 Consider Research	1-2
(if taking ENGL 250)			

17-18

15-17

Sophomore

Fall	Credits	Spring	Credits	Summer	Credits
BIOL 313		3 BIOL 314		3 Consider Internship, Study Abroad	
BIOL 313L		1 CHEM 332		3	
CHEM 331		3 CHEM 332L		1	
CHEM 331L		1 MICRO 302 or BIOL 315 (or Bioinformatics/ Genomics Choice)		3	
College requirement or Elective		3 MATH/ STAT or college requirement choice		3-4	

MATH/ STAT choice	3-4 College Requirement or Elective	3	
		14-15	16-17
Junior			
Fall	Credits	Spring	Credits
GEN 409	3	GEN 410	3
BBMB 404*	3	PHYS 132 or 232*	4
PHYS 131 or 231*	4	PHYS 132L or 232L*	1
PHYS 131L or 231L*	1	BBMB 405*	3
MICRO 302 or BIOL 315 (or Bioinformatics/ Genomics Choice)	3	MICRO 302 or BIOL 315 (or Bioinformatics/ Genomics Choice)	3
College Requirement or Elective	3	GEN 491	1
		17	15
Senior			
Fall	Credits	Spring	Credits
GEN 462	3	Advanced Science Elective(s)	3-6
Advanced science elective or STAT 301	3-4	College Requirement or Elective	3
College Requirement or Elective	1-6	Elective or STAT 301	3-4
Advanced Writing (ENGL 302-316)	3	College Requirement or Elective	3
		10-16	12-16
Total Credits: 116-131			

Undergraduate Minor

The minor in Genetics may be earned by completing the following courses. At least 9 cr. must be used **only** to fulfill the requirements of the minor and not be applied to any other major, college, or university requirement.

GEN 313	Principles of Genetics	3
GEN 313L	Genetics Laboratory	1
BIOL 314	Principles of Molecular Cell Biology	3
GEN 410	Analytical Genetics	3
GEN 409	Molecular Genetics	3
Two or more additional credits in Genetics at the 300 level or above.		2
Total Credits		15

* Summer: Students taking the MCAT need to have completed biochemistry and physics by this time. Others can complete during the senior year.