

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, physician assistant, and veterinary medicine can major in genetics while fulfilling the pre-professional requirements.

Student Learning Outcomes:

Upon graduation, students earning the B.S. 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 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 1100	Genetics Orientation	1
BIOL 2110	Principles of Biology I	3
BIOL 2110L	Principles of Biology Laboratory I	1
BIOL 2120	Principles of Biology II	3
BIOL 2120L	Principles of Biology Laboratory II	1

GEN 3130	Principles of Genetics	3
GEN 3130L	Genetics Laboratory	1
BIOL 3140	Principles of Molecular Cell Biology	3
BIOL 3150	Biological Evolution	3
One of the following:		3-4
GEN 3220	Introduction to Bioinformatics and Computational Biology	
GEN 3490	The Genome Perspective in Biology	
BCBIO 4060	Bioinformatics of OMICS	
GEN 4090	Molecular Genetics	3
GEN 4100	Analytical Genetics	3
One of the following:		3
GEN 4620	Evolutionary Genetics	
EEOB 5610	Evolutionary and Ecological Genomics	
EEOB 5630	Molecular Phylogenetics	
GEN 4910	Undergraduate Seminar, Professional Practice in Genetics Disciplines	1
MICRO 3020	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 4900, 4900R, 4900H, 4920, 4960, 4990, or 4990H may be used to meet this requirement.

3. Mathematical Sciences

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

MATH 1600	Survey of Calculus	
MATH 1650	Calculus I	
Complete at least one course from STAT, minimum of 3 credits.		3-4
STAT 1010	Principles of Statistics	
STAT 1040	Introduction to Statistics	
Complete at least one additional course from MATH or STAT, minimum of 4 credits.		4
MATH 1660	Calculus II	
STAT 3010	Intermediate Statistical Concepts and Methods	
Total Credits		11-12

4. Supporting Sciences

CHEM 1770	General Chemistry I	4
CHEM 1770L	Laboratory in General Chemistry I	1
CHEM 1780	General Chemistry II	3
CHEM 1780L	Laboratory in College Chemistry II	1
CHEM 3310	Organic Chemistry I	3
CHEM 3310L	Laboratory in Organic Chemistry I	1
CHEM 3320	Organic Chemistry II	3
CHEM 3320L	Laboratory in Organic Chemistry II	1
PHYS 1310	General Physics I	4
PHYS 1310L	General Physics I Laboratory	1
PHYS 1320	General Physics II	4
PHYS 1320L	General Physics II Laboratory	1
Choose one of the following options		6-7

Option 1

BBMB 4040	Biochemistry I	
And one of the following:		
BBMB 4050	Biochemistry II	
BBMB 4110	Techniques in Biochemical Research	
CHEM 2110 & 2110L	Quantitative and Environmental Analysis and Quantitative and Environmental Analysis Laboratory	
CHEM 3250	Chemical Thermodynamics	

Option 2

BBMB 4200	Mammalian Biochemistry	
And one of the following:		
BBMB 4110	Techniques in Biochemical Research	
CHEM 2110 & 2110L	Quantitative and Environmental Analysis and Quantitative and Environmental Analysis Laboratory	
CHEM 3250	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. Cultures and Communities: 3 cr. from university approved list

This course can satisfy **both** the university requirement for U.S. Cultures and Communities 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 2500 and advanced writing. (The College of Agriculture and Life Sciences requires a C or better in ENGL 1500, as well.)

ENGL 1500	Critical Thinking and Communication	3
ENGL 2500	Written, Oral, Visual, and Electronic Composition	3
	or ENGL 2500H Written, Oral, Visual, and Electronic Composition: Honors	
LIB 1600	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.

SPCM 2120	Fundamentals of Public Speaking	3
	or AGEDS 3110 Presentation and Sales Strategies for Agricultural Audiences	
Total Credits		3

C. Course required of majors in the College of Liberal Arts and Sciences only.

LAS 2030	Professional Career Preparation	1
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8. General Education electives

Courses from college approved lists that also appear on university approved lists of U.S. Cultures and Communities 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

Social Science courses from college approved list	9
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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
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Freshman

Fall	Credits	Spring	Credits
GEN 1100		1 ENGL 2500 or Social Sciences Choice	3
BIOL 2110	3	BIOL 2120	3
BIOL 2110L	1	BIOL 2120L	1
CHEM 1770	4	CHEM 1780	3
CHEM 1770L	1	CHEM 1780L	1
ENGL 1500 or 2500	3	MATH/ STAT choice or Humanities Choice	3-4
LIB 1600	1	Consider Research (HON 2900 or GEN 4990)	0-2
MATH/ STAT choice or Humanities Choice	3-4		

17-18

14-17

Sophomore

Fall	Credits	Spring	Credits	Summer	Credits
BIOL 3130	3	BIOL 3140	3	Consider Internship, Study Abroad	
BIOL 3130L	1	CHEM 3320	3		
CHEM 3310	3	CHEM 3320L	1		
CHEM 3310L	1	MICRO 3020	3		
SPCM 2120	3	MATH/ STAT Choice or Social Sciences*	3-4		

MATH/ STAT Choice or Social Sciences*	3-4 Ethics Choice	3
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Environmental Awareness Choice	3-4
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14-15		16-17		0
Junior				
Fall	Credits	Spring	Credits	Summer
				Credits
GEN 4090	3	BIOL 3150		3 Consider Research with Faculty
U.S. Cultures and Communities/ Social Sciences Choice	3 or	3 or Bioinformatics Choice		
BIOL 3150	3	BBMB 4050		3
BBMB 4040	3	GEN 4100		3
PHYS 1310 or 2310	4	GEN 4910 (or Fall of Senior Year)		1
PHYS 1310L or 2310L	1	PHYS 1320		4
		PHYS 1320L		1
17		15		0

Senior				
Fall	Credits	Spring	Credits	
GEN 4620	3	Advanced Science Electives		3-6
STAT 3010 (or Advanced Science Elective)	4	International Perspectives/ Humanities		3
ENGL 3120 (or other ENGL 3020-3160)	3	True Electives		3-6

13-14 9-15

Undergraduate Minor

The minor in Genetics may be earned by completing the following courses. At least 3 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 3130	Principles of Genetics	3
GEN 3130L	Genetics Laboratory	1
BIOL 3140	Principles of Molecular Cell Biology	3
GEN 4100	Analytical Genetics	3
GEN 4090	Molecular Genetics	3
Two or more additional credits in Genetics at the 3000 level or above.		2
Total Credits		15