

## Genetics - Undergraduate

Alan M. Myers, Chair, Genetics Major Committee

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 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. A minor in genetics through the College of Agriculture and Life Sciences is also offered for students majoring in several areas of the life sciences.

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, business, and genetic counseling.

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, research-related activities in the biological sciences.

The respective communications and communication proficiency requirements of both colleges are met by an average of C or better in:

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	
	And one additional English writing course	3

The lowest grade acceptable in any of these courses is C. Students in the College of Agriculture and Life Sciences must also achieve a C or better in an oral communications course.

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

A grade of C– or better is required in all biological science courses within the major and a cumulative GPA of at least 2.0 is required for graduation.

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, nursing, optometry, pharmacy, physical therapy, physicians assistant, and veterinary medicine can major in genetics while fulfilling the pre-professional requirements. (See Preprofessional Study .)

### Graduate Study

Graduate study in genetics leading to the Master of Science and Doctor of Philosophy degrees is offered at ISU. Graduate study is organized as a separate interdepartmental graduate major from the undergraduate program. For more information on graduate study in genetics see: Genetics - Interdisciplinary.

## Curriculum in Genetics - Requirements

In addition to basic degree requirements listed in the Curricula in Agriculture and Life Sciences, genetics majors must satisfy the following requirements:

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
BIOL 312	Ecology	4
BIOL 313	Principles of Genetics	3
BIOL 313L	Genetics Laboratory	1
BIOL 314	Principles of Molecular Cell Biology	3
BIOL 315	Biological Evolution	3
MICRO 302	Biology of Microorganisms	3

2.

GEN 110	Genetics Orientation	1
GEN 409	Molecular Genetics	3
GEN 410	Analytical Genetics	3
GEN 491	Undergraduate Seminar	1
GEN 462	Evolutionary Genetics	3
or EEOB 563	Molecular Phylogenetics	

3. Eleven credits of calculus and Statistics including at least one course in each.

4. Three years of chemistry and biochemistry.

5. Ten credits of general college physics.

6. Six additional credits of biological science support electives chosen from an approved list.

### Minor - Genetics

The minor in genetics may be earned by completing:

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

And a minimum of two additional credits in Genetics at the 300 level or above. At least nine of these credits must be used only to fulfill the requirements of the minor.

A Genetics major may not double major or minor in Biology.

## Curriculum in Genetics - Undergraduate Study

Undergraduate study in genetics is jointly administered by the Department of Biochemistry, Biophysics, and Molecular Biology, the Department of Genetics, Development, and Cell Biology, and the Department of Ecology, Evolution, and Organismal Biology.

**Total Degree Requirement: 120 cr.**

Only 65 cr. from a two-year institution may apply which may include up to 16 technical cr.; 9 P-NP cr. of free electives; 2.00 minimum GPA.

**International Perspective: 3 cr.**

**U.S. Diversity: 3 cr.**

**Communication/Library:**

C or better required (except for LIB 160).

ENGL 150	Critical Thinking and Communication	3
ENGL 250	Written, Oral, Visual, and Electronic Composition	3
LIB 160	Information Literacy	1
SP CM 212	Fundamentals of Public Speaking	3
or AGEDS 311	Presentation and Sales Strategies for Agricultural Audiences	

**Advanced English Writing:**

Choose 3 credits from the following:		3
ENGL 302	Business Communication	3
ENGL 303	Free-Lance Writing for Popular Magazines	3
ENGL 304	Creative Writing--Fiction	3
ENGL 305	Creative Writing--Nonfiction	3
ENGL 306	Creative Writing--Poetry	3

ENGL 309	Report and Proposal Writing	3
ENGL 310	Rhetorical Analysis	3
ENGL 312	Biological Communication	3
ENGL 313	Rhetorical Website Design	3
ENGL 314	Technical Communication	3
ENGL 315	Creative Writing--Screenplays	3
ENGL 316	Creative Writing--Playwriting	3
JL MC 347	Science Communication	3

**Humanities and Social Sciences: 6 crs**

Humanities course	3
Social Science course	3

**Ethics: 3 cr.**

3 cr. from approved list.

**Life Sciences: 6 cr.**

BIOL 211	Principles of Biology I	3
Approved Life Sciences course		3

**Mathematical Sciences: 11-12 cr.**

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

MATH 160	Survey of Calculus	
MATH 165	Calculus I	
MATH 181	Calculus and Mathematical Modeling for the Life Sciences 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	
MATH 182	Calculus and Mathematical Modeling for the Life Sciences II	
STAT 401	Statistical Methods for Research Workers	

Total Credits 11-12

**Supporting Sciences: 31-32 cr.**

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 111	General Physics	5
or PHYS 221	Introduction to Classical Physics I	
PHYS 112	General Physics	5
or PHYS 222	Introduction to Classical Physics II	

Choose one of the following options 6-7

## Option 1

BBMB 404	Biochemistry I	
----------	----------------	--

Choose one of the following:

BBMB 405	Biochemistry II	
BBMB 411	Techniques in Biochemical Research	
CHEM 211 & 211L	Quantitative and Environmental Analysis and Quantitative and Environmental Analysis Laboratory	
CHEM 325	Chemical Thermodynamics	

## Option 2

BBMB 420	Physiological Chemistry	
----------	-------------------------	--

Choose one of the following:

BBMB 411	Techniques in Biochemical Research	
CHEM 211 & 211L	Quantitative and Environmental Analysis and Quantitative and Environmental Analysis Laboratory	

CHEM 325	Chemical Thermodynamics	
Total Credits		33-34

**Genetics and Life Sciences: 36 cr.**

C- grade minimum; Minimum 2.0 GPA

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
BIOL 312	Ecology	4
GEN 313	Principles of Genetics	3
GEN 313L	Genetics Laboratory	1
BIOL 314	Principles of Molecular Cell Biology	3
BIOL 315	Biological Evolution	3
GEN 409	Molecular Genetics	3
GEN 410	Analytical Genetics	3
GEN 491	Undergraduate Seminar	1
GEN 462	Evolutionary Genetics	3
or EEOB 563	Molecular Phylogenetics	
MICRO 302	Biology of Microorganisms	3

Total Credits 36

**Advanced Sciences Electives: 6 cr.**

C- minimum grade; 6 cr. of advanced science electives from approved department list.

**Courses primarily for undergraduates:****GEN 110. Genetics Orientation.**

(1-0) Cr. 1. F.

Orientation to the area of genetics. For students considering a major in genetics. Specializations and career opportunities. Offered on a satisfactory-fail basis only.

**GEN 260. Human Heredity and Society.**(3-0) Cr. 3. Alt. S., offered 2013. *Prereq: One semester of college biology or ANTHR 202*

A survey course in genetics for non-biology majors interested in heredity and its importance, and implications to self and society. Not recommended for those intending to take advanced courses in genetics. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320, Biol 313 and 313L and Agron 320.

**GEN 298. Cooperative Education.**Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; sophomore classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

**GEN 308. Biotechnology in Agriculture, Food, and Human Health.**(3-0) Cr. 3. F.S.SS. *Prereq: BIOL 211 and BIOL 212*

Scientific principles and techniques in biotechnology. Products and applications in agriculture, food, and human health. Ethical, legal, and social implications of biotechnology.

**GEN 313. Principles of Genetics.**(Cross-listed with BIOL). (3-0) Cr. 3. F.S.SS. *Prereq: BIOL 211, BIOL 211L, BIOL 212, and BIOL 212L*

Introduction to the principles of transmission and molecular genetics of plants, animals, and bacteria. Recombination, structure and replication of DNA, gene expression, cloning, quantitative and population genetics. Students may receive graduation credit for no more than one of the following: Gen 260, Gen 313 and 313L, Gen 320, Biol 313 and 313L, and Agron 320.

**GEN 313L. Genetics Laboratory.**(Cross-listed with BIOL). (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in BIOL 313 Laboratory to accompany 313.* Students may receive graduation credit for no more than one of the following: Biol 313 and 313L, Gen 260, Gen 313, Gen 320, and Agron 320.

**GEN 320. Genetics, Agriculture and Biotechnology.**

(Cross-listed with AGRON). (3-0) Cr. 3. F.S. *Prereq: BIOL 212*  
Lee and Salas. Transmission genetics with an emphasis on applications in agriculture, the structure and expression of the gene, how genes behave in populations and how recombinant DNA technology can be used to improve agriculture. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320 and Biol 313 and 313L.

**GEN 340. Human Genetics.**

(3-0) Cr. 3. Alt. S., offered 2012. *Prereq: BIOL 313 or GEN 313*  
Fundamental concepts and current issues of human genetics. Human chromosome analysis, pedigree analysis, gene mapping, the human genome project, sex determination, genetics of the immune system, genetics of cancer, gene therapy, the genetic basis of human diversity, eugenics.

**GEN 398. Cooperative Education.**

Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; junior classification*  
Required of all cooperative education students. Students must register for this course prior to commencing each work period.

**GEN 409. Molecular Genetics.**

(3-0) Cr. 3. F. *Prereq: BIOL 313*  
The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes. Nonmajor graduate credit.

**GEN 410. Analytical Genetics.**

(3-0) Cr. 3. S. *Prereq: GEN 409*  
The principles and practice of genetic analysis. Mendelian genetic analysis, mutational analysis of gene function, linkage and gene mapping, chromosomal aberrations, aneuploidy and polyploidy, extrachromosomal inheritance, analysis of genetic pathways. Nonmajor graduate credit.

**GEN 444. Introduction to Bioinformatics.**

(Cross-listed with BCB, BCBIO, COM S, CPR E, BIOL). (4-0) Cr. 4. F. *Prereq: MATH 165 or STAT 401 or equivalent*  
Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics, systems biology. Nonmajor graduate credit.

**GEN 462. Evolutionary Genetics.**

(Cross-listed with BIOL). (3-0) Cr. 3. S. *Prereq: BIOL 315*  
The genetic basis of evolutionary processes in higher organisms. The role of genetic variation in adaptation, natural selection, adaptive processes, and the influence of random processes on evolutionary change. Nonmajor graduate credit.

**GEN 490. Independent Study.**

Cr. arr. Repeatable, maximum of 9 credits. *Prereq: GEN 313, junior or senior classification, permission of instructor*  
Students in the College of Agriculture may use no more than 6 credits of Gen 490 toward the total of 128 credits required for graduation; students in the College of Liberal Arts and Sciences may use no more than 9 credits of Gen 490 toward graduation.

**GEN 490R. Independent Study: Genetics research.**

Cr. 1-5. Repeatable, maximum of 9 credits. *Prereq: GEN 313, junior or senior classification, permission of instructor*  
Students in the College of Agriculture may use no more than 6 credits of Gen 490 toward the total of 128 credits required for graduation; students in the College of Liberal Arts and Sciences may use no more than 9 credits of Gen 490 toward graduation.

**GEN 490S. Independent Study: Attendance and Critique of Genetics Seminars.**

Cr. 1. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: GEN 313, junior or senior classification, permission of instructor*  
Offered on a satisfactory-fail basis only. Students in the College of Agriculture may use no more than 6 credits of Gen 490 toward the total of 128 credits required for graduation; students in the College of Liberal Arts and Sciences may use no more than 9 credits of Gen 490 toward graduation.

**GEN 490U. Independent Study: Laboratory teaching experience.**

Cr. 1-2. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: GEN 313, junior or senior classification, permission of instructor*  
For students registering to be undergraduate laboratory assistants. Offered on a satisfactory-fail basis only. Students in the College of Agriculture may use no more than 6 credits of Gen 490 toward the total of 128 credits required for graduation; students in the College of Liberal Arts and Sciences may use no more than 9 credits of Gen 490 toward graduation.

**GEN 491. Undergraduate Seminar.**

(1-0) Cr. 1. F. *Prereq: Junior classification*  
The investigation of current issues in genetics. Graduate school and employment opportunities discussed. Practice in resume writing and interview techniques. Required for majors in genetics.

**GEN 498. Cooperative Education.**

Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification*  
Required of all cooperative education students. Students must register for this course prior to commencing each work period.