GENETICS AND GENOMICS, B.S.

Genetics and genomics is a bachelor’s program for students seeking to understand how genes shape life, from fundamental cellular functions to population dynamics, and for students preparing to apply genetic and genomic concepts in such areas as medicine, biotechnology, biomedical research, agriculture, journalism, and public policy.

Advances in genome sequencing, bioinformatics, and our ability to manipulate the DNA of many organisms, including humans, have brought genetics to the forefront of many issues facing our society. These advances drive the growing need for health care providers, scientists and other professionals with a strong foundation in genetic and genomic analysis. Through coursework and diverse research opportunities, genetics and genomics majors gain broad insight into inheritance, gene function, genome organization, evolution, cutting-edge genetic technologies and therapies, and more.

A B.S. degree with a major in genetics and genomics positions students for many jobs in the biotechnology industry. Genetics and genomics majors are well prepared to pursue research-focused Ph.D. programs that provide further training for careers in biomedical and agricultural research. Genetics and genomics majors are highly competitive for admission to top medical schools, where there is a growing focus on personalized medicine, and genetic counseling programs.

HOW TO GET IN

To declare this major, students must be admitted to UW–Madison and the College of Agricultural and Life Sciences (CALS). For information about becoming a CALS first-year or transfer student, see Entering the College (http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#enteringthecollegenotext).

Students who attend Student Orientation, Advising, and Registration (SOAR) with the College of Agricultural and Life Sciences have the option to declare this major at SOAR. Students may otherwise declare after they have begun their undergraduate studies. For more information, contact the advisor listed under the Advising and Careers tab.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatetext) section of the Guide.

General Education

- Breadth—Humanities/Literature/Arts: 6 credits
- Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
- Breadth—Social Studies: 3 credits
- Communication Part A & Part B *
- Ethnic Studies *
- Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

COLLEGE OF AGRICULTURAL AND LIFE SCIENCES REQUIREMENTS

In addition to the University General Education Requirements, all undergraduate students in CALS must satisfy a set of college and major requirements. Courses may not double count within university requirements (General Education and Breadth) or within college requirements (First-Year Seminar, International Studies, Science, and Capstone), but courses counted toward university requirements may also be used to satisfy a college and/or a major requirement; similarly, courses counted toward college requirements may also be used to satisfy a university and/or a major requirement.

COLLEGE REQUIREMENTS FOR ALL CALS B.S. DEGREE PROGRAMS

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td></td>
<td>Quality of Work: Students must maintain a minimum cumulative grade point average of 2.000 to remain in good standing and be eligible for graduation.</td>
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<td></td>
<td>Residency: Students must complete 30 degree credits in residence at UW–Madison after earning 86 credits toward their undergraduate degree.</td>
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<td></td>
<td>First Year Seminar (<a href="http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#requirementtext">http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#requirementtext</a>)</td>
<td>1</td>
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<tr>
<td></td>
<td>International Studies (<a href="http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#requirementtext">http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#requirementtext</a>)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physical Science Fundamentals 4-5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHEM 103 General Chemistry I</td>
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<tr>
<td></td>
<td>or CHEM 108 Chemistry in Our World</td>
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</tr>
<tr>
<td></td>
<td>or CHEM 109 Advanced General Chemistry</td>
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<td></td>
<td>Biological Science 5</td>
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<td></td>
<td>Additional Science (Biological, Physical, or Natural) 3</td>
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<tr>
<td></td>
<td>Science Breadth (Biological, Physical, Natural, or Social) 3</td>
<td></td>
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<td></td>
<td>CALS Capstone Learning Experience: included in the requirements for each CALS major (see “Major Requirements”) (<a href="http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#requirementtext">http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#requirementtext</a>)</td>
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MAJOR REQUIREMENTS

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td></td>
<td>Mathematics and Statistics</td>
<td>5-10</td>
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</tbody>
</table>
MATH 221  Calculus and Analytic Geometry I

MATH 171  Calculus with Algebra and
& MATH 217  Trigonometry I
and Calculus with Algebra and
Trigonometry II

STAT 371  Introductory Applied Statistics for
3  the Life Sciences

or STAT 301  Introduction to Statistical Methods

Chemistry
Complete one of the following:

CHEM 103  General Chemistry I
& CHEM 104  and General Chemistry II

CHEM 109  Advanced General Chemistry

CHEM 115  Chemical Principles I
& CHEM 116  and Chemical Principles II

Complete one of the following:

CHEM 341  Elementary Organic Chemistry

CHEM 343  Introductory Organic Chemistry
& CHEM 345  and Intermediate Organic Chemistry

Physics
Complete one of the following:

PHYSICS 103  General Physics
& PHYSICS 104  and General Physics

PHYSICS 201  General Physics
& PHYSICS 202  and General Physics

PHYSICS 207  General Physics
& PHYSICS 208  and General Physics

Biology
Complete one of the following options:

Option 1:

BIOLOGY/ BOTANY/ ZOOLOGY 151
& BIOLOGY/ BOTANY/ ZOOLOGY 152

Introductory Biology
and Introductory Biology
(recommended)

Option 2:

BOTANY/ BIOLOGY 130

ZOLOGY/ BIOLOGY 101
& ZOOLOGY/ BIOLOGY 102

Animal Biology
and Animal Biology Laboratory

Option 3:

BIOCORE 381  Evolution, Ecology, and Genetics
& BIOCORE 383  and Cellular Biology

Select two of the following labs:

BIOCORE 382  Evolution, Ecology, and Genetics

BIOCORE 384  Cellular Biology Laboratory

BIOCORE 486  Principles of Physiology Laboratory

Core Requirements
BIOCHEM 501  Introduction to Biochemistry 1

or BIOCHEM 507  General Biochemistry I

Complete one of the following options:

Option 1:

GENETICS 467  General Genetics 1
& GENETICS 468  and General Genetics 2 (preferred)

Option 2:

GENETICS 466  Principles of Genetics (consult
advisor (467 & 468 preferred))

additional 3 credit Genetics depth course (see course list below) 2

Select 2 credits from the following:

GENETICS 545  Genetics Laboratory

GENETICS 299  Independent Study 3

GENETICS 699  Special Problems 3

GENETICS 681  Senior Honors Thesis

GENETICS 682  Senior Honors Thesis

GENETICS 399  Coordinating Internship/Cooperative
Education

Genetics Depth
See course list below

Genetics Breadth
See course list below

Capstone
Select one of the following:

Option 1:

GENETICS/ BIOLOGY 522  Communicating Evolutionary
Biology (Three-credit version only) 4

Option 2:

GENETICS 527  Developmental Genetics for
Conservation and Regeneration
(offered in fall semester) 4

Option 3:

GENETICS 566  Advanced Genetics (offered in
spring semester)

Option 4:

GENETICS 564  Genomics and Proteomics (offered
in spring semester) 4

Option 5 (must be taken concurrently):

GENETICS 699  Special Problems (offered in fall
semester)

GENETICS 567  Companion Research Seminar
(offered in fall semester)

Option 6 (must be taken concurrently):

GENETICS 681  Senior Honors Thesis

GENETICS 682  Senior Honors Thesis

GENETICS 567  Companion Research Seminar
(offered in fall semester)

Total Credits 65-83

1 If BIOCHEM 507 is taken, it must be taken as a part of BIOCHEM 507
General Biochemistry I & BIOCHEM 508 General Biochemistry II,
which counts as Genetics Breadth requirement.

2 Additional Depth course will not count toward the 9-credit Genetics
Depth requirement.
Consult with your advisor if genetics-related research will be performed in a department other than Genetics.

May count for Genetics Depth or Capstone, but not both.

### GENETICS DEPTH & BREADTH COURSES

#### DEPTH

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>GENETICS 520</td>
<td>Neurogenetics</td>
<td>3</td>
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<tr>
<td>GENETICS/BIOLOGY 522</td>
<td>Communicating Evolutionary Biology</td>
<td>2-3</td>
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<tr>
<td>GENETICS 525</td>
<td>Epigenetics</td>
<td>3</td>
</tr>
<tr>
<td>GENETICS 527</td>
<td>Developmental Genetics for Conservation and Regeneration</td>
<td>3</td>
</tr>
<tr>
<td>GENETICS 528</td>
<td>Banking Animal Biodiversity, International Field Study in Costa Rica</td>
<td>1</td>
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<tr>
<td>GENETICS 548</td>
<td>The Genomic Revolution</td>
<td>3</td>
</tr>
<tr>
<td>GENETICS/HORT 550</td>
<td>Molecular Approaches for Potential Crop Improvement</td>
<td>3</td>
</tr>
<tr>
<td>GENETICS 562</td>
<td></td>
<td>2</td>
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<tr>
<td>GENETICS 564</td>
<td>Genomics and Proteomics</td>
<td>3</td>
</tr>
<tr>
<td>GENETICS/MD GENET 565</td>
<td>Human Genetics</td>
<td>3</td>
</tr>
<tr>
<td>GENETICS 566</td>
<td>Advanced Genetics</td>
<td>3</td>
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<tr>
<td>GENETICS 605</td>
<td>Clinical Cases in Medical Genetics</td>
<td>3</td>
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<tr>
<td>GENETICS/BIOCHEM/MICROBIO 612</td>
<td>Prokaryotic Molecular Biology</td>
<td>3</td>
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<tr>
<td>GENETICS/BIOCHEM/MD GENET 620</td>
<td>Eukaryotic Molecular Biology</td>
<td>3</td>
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<tr>
<td>GENETICS/MD GENET 620</td>
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<td>2</td>
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<tr>
<td>GENETICS CHEM 626</td>
<td>Genomic Science</td>
<td>2</td>
</tr>
<tr>
<td>GENETICS 627</td>
<td>Animal Developmental Genetics</td>
<td>3</td>
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<tr>
<td>GENETICS 631</td>
<td>Plant Genetics</td>
<td>2</td>
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<tr>
<td>GENETICS 633</td>
<td>Population Genetics</td>
<td>3</td>
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<tr>
<td>GENETICS/BOTANY/M M &amp; I/PL PATH 655</td>
<td>Biology and Genetics of Fungi</td>
<td>3</td>
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<tr>
<td>GENETICS/MD GENET 662</td>
<td>Cancer Genetics</td>
<td>3</td>
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<tr>
<td>GENETICS/MD GENET 677</td>
<td>Advanced Topics in Genetics</td>
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#### BREADTH

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>BIOCHEM 508</td>
<td>General Biochemistry II</td>
<td>3-4</td>
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<tr>
<td>BIOCHEM 550</td>
<td>Principles of Human Disease and Biotechnology</td>
<td>2</td>
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<tr>
<td>BMOLCHEM 504</td>
<td>Human Biochemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 344</td>
<td>Introductory Organic Chemistry Laboratory</td>
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<tr>
<td>CHEM 345</td>
<td>Intermediate Organic Chemistry</td>
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### Agricultural Ecosystems:

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<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>AGRONOMY/HORT 338</td>
<td>Plant Breeding and Biotechnology</td>
<td>3</td>
</tr>
<tr>
<td>AGRONOMY/BOTANY/HORT 340</td>
<td>Plant Cell Culture and Genetic Engineering</td>
<td>3</td>
</tr>
<tr>
<td>AGRONOMY/HORT 501</td>
<td>Principles of Plant Breeding</td>
<td>3</td>
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<tr>
<td>AGRONOMY/HORT 502</td>
<td>Techniques of Plant Breeding</td>
<td>1</td>
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<tr>
<td>AN SCI/DY SCI 361</td>
<td>Introduction to Animal and Veterinary Genetics</td>
<td>2</td>
</tr>
<tr>
<td>AN SCI/DY SCI 362</td>
<td>Veterinary Genetics</td>
<td>2</td>
</tr>
<tr>
<td>AN SCI/DY SCI 363</td>
<td>Principles of Animal Breeding</td>
<td>2</td>
</tr>
<tr>
<td>HORT/PATH-BIO 500</td>
<td>Molecular Biology Techniques</td>
<td>3</td>
</tr>
<tr>
<td>PL PATH/BOTANY/ENTOM 505</td>
<td>Plant-Microbe Interactions: Molecular and Ecological Aspects</td>
<td>3</td>
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### Computational Biology:

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>B M I/COMP SCI 576</td>
<td>Introduction to Bioinformatics</td>
<td>3</td>
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</tbody>
</table>
UNIVERSITY DEGREE REQUIREMENTS

Total Degree
To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.

Residency
Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.

Quality of Work
Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.

LEARNING OUTCOMES

1. Analyze the transmission of genes and chromosomes between cells during cell division and within pedigrees over generations.
2. Demonstrate a deep understanding of how information encoded in DNA can be mutated, epigenetically modified, transcribed into RNA, and translated for protein production, enabling this information to orchestrate the activities of cells singly or collectively throughout development in multicellular organisms.
3. Predict the impact of the forces of mutation, natural selection, chance, and genetic recombination on the amount of genetic variation in populations at the DNA and phenotypic levels using quantitative models.
4. Formulate research questions about the genetic control of biological processes and design experiments to answer these questions using appropriate genetic tools including model organisms.
5. Demonstrate team-work, interpersonal and problem-solving skills to address societal, ethical and scientific issues related to genetics, and communicate their findings through written, oral and multi-media reports.

FOUR-YEAR PLAN

SAMPLE GENETICS AND GENOMICS FOUR YEAR PLAN

Freshman
Fall | Credits | Spring | Credits
--- | --- | --- | ---
CHEM 103 or 109 | 4-5 | CHEM 104 (or elective course) | 5
MATH 221 (or math placement) | 5 | International Studies | 3
GENETICS 155 (Freshman Seminar) | 1 | COMM A Course (if needed) | 3

Sophomore
Fall | Credits | Spring | Credits
--- | --- | --- | ---
CHEM 343 or 341 | 3 | CHEM 345 (if CHEM 343 completed) | 3
ZOOL/Y/BIOLOGY/BOTANY 151 | 5 | ZOOL/Y/BIOLOGY/BOTANY 152 | 5
STAT 371 or 301 | 3 | Electives (Humanities, Social Science, Ethnic Studies) | 5

Junior
Fall | Credits | Spring | Credits
--- | --- | --- | ---
PHYSICS 103, 207, or 201 | 4-5 | PHYSICS 104, 208, or 202 | 4-5
GENETICS 467 or 466 (& BIOCORE 485 if applicable) | 3 | GENETICS 468 (or Genetics Depth elective) | 3
BIOCHEM 501 or 507 | 3 | BIOCHEM 508 (or elective) | 3

Senior
Fall | Credits | Spring | Credits
--- | --- | --- | ---
Genetics Breadth/Depth | 6 | Genetics Breadth/Depth | 3
Senior Thesis (681-Research) | 2-3 | Senior Thesis (682-Research) | 2-3
Electives (Humanities, Social Sciences) | 3 | Genetics Capstone | 3
Electives | 6 | Electives | 6

Total Credits 129-133

"Instead of BIOLOGY/BOTANY/ZOOLOGY 151 Introductory Biology, students can take either (BIOCORE 381 Evolution, Ecology, and Genetics & BIOCORE 382 Evolution, Ecology, and Genetics Laboratory) or (ZOOL/Y/BIOLOGY 101 Animal Biology & ZOOL/Y/BIOLOGY 102 Animal Biology Laboratory)."

"Instead of BIOLOGY/BOTANY/ZOOLOGY 152 Introductory Biology, students can take either (BIOCORE 383 Cellular Biology & BIOCORE 384 Cellular Biology Laboratory) or BOTANY/BIOLOGY 130 General Botany."

"Physics could be taken in Sophomore year (consult your advisor)."
If in CALS Honors in Research.

Notes:
- 120 total credits required for bachelor’s degree—aim for 15 credits per semester.
- Students who have not maintained a GPA of at least 2.5 by the end of their first two years, or transfer students by the end of their first year in residence, need to evaluate their major and career options with an advisor.
- Freshmen are recommended to take GENETICS 155 Freshman Seminar in Genetics, 1-credit freshman seminar course offered in the fall to fulfill the first year seminar requirement.
- Study Abroad is an enriching experience. Check with your advisor on how you can fulfill your curriculum and study abroad.
- UGA (Undergraduate Genetics Association): check out the club’s website: facebook.com/groups/UGA.UWMadison (https://www.facebook.com/groups/UGA.UWMadison/)

ADVISING AND CAREERS

UNDERGRADUATE ADVISORS
Tilmann, Kit; Vermillion Kalmon, Katie; Loewen, Carin; Foley, Lauren

Students should make advising appointments through the Starfish App on MyUW.

CAREERS

The biotechnology industry has exploded within the last decade, providing many diverse career opportunities for our graduates. A strong background in genetics will prepare you for careers in research technical support, technical writing, quality control, assay development, technical services, and sales or marketing. Entry level job titles: Research Laboratory Technician, Assistant Scientist, Clinical Research Associate, Agricultural Consultant, Science Writer

Many of our graduates continue their education by pursuing an advanced degree. Our students are competitive for admission to medical schools, veterinary schools, and graduate schools throughout the country. Students may elect a Ph.D. in genetics to prepare them for careers in research, academia, and industry. Others may elect an M.S. program for a career in genetics counseling.

PEOPLE

PROFESSORS
Pelegri, Francisco (chair); Gasch, Audrey; Ikeda, Aki; Doebley, John; Masson, Patrick; Paseur, Bret; Perna, Nicole; Pross, Tom; Schwartz, David; Skop, Ahna; Wassarman, David; Yin, Jerry

ASSOCIATE PROFESSORS
Chang, Qiang; Hittinger, Chris; Pool, John

ASSISTANT PROFESSORS
Brunkard, Jake; Richardson, Claire; Schroedi, Steven; Sharp, Nathaniel; Werling, Donna; Zhong, Xuehua

FACULTY ASSOCIATES;
Tilmann, Kit; Vermillion Kalmon, Katie; Loewen, Carin

UNDERGRADUATE ADVISORS
Tilmann, Kit; Vermillion Kalmon, Katie; Loewen, Carin; Foley, Lauren

WISCONSIN EXPERIENCE

Students are highly encouraged to apply what they are learning in the classroom to out-of-classroom experiences, connect with other students in genetics and other biological science majors, and to build relationships with faculty and staff.

- A minimum of one semester of mentored research is required, and most students elect to participate in more. The Genetics website (https://genetics.wisc.edu/) and undergraduate advisors can help students find these experiences. Students conduct research experiences for course credit or pay, depending on the lab. Many students present their work during lab meetings, professional conferences, and campus events.
- The Undergraduate Genetics Association (UGA) (https://www.facebook.com/groups/UGA.UWMadison/) is the pre-professional student organization for majors in genetics or students interested in genetics. They provide professional development opportunities, networking, information about current genetic research, how to get involved in research or internships, and career and job information.
- Students are also involved in pre-health organizations, volunteer and shadowing opportunities, publishing in an undergraduate science journal, biotechnology and agricultural internships, and other related experiences on and off campus.