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 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 [here](http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#enteringthecollegetext).

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 [here](http://guide.wisc.edu/undergraduate/#requirementsforundergraduatetext) section of the Guide.

### 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. Specific requirements for all majors in the college and other information on academic matters can be obtained from the Office of Academic Affairs [here](http://www.cals.wisc.edu/academics), College of Agricultural and Life Sciences, 116 Agricultural Hall, 1450 Linden Drive, Madison, WI 53706; 608-262-3003. Academic departments and advisors also have information on requirements. Courses may not double count within university requirements (General Education and Breadth) or within college requirements (First-Year Seminar, International Studies and Science), 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>
</tr>
</thead>
<tbody>
<tr>
<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>
<td></td>
<td></td>
</tr>
<tr>
<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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</tr>
<tr>
<td>First Year Seminar <a href="http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#requirementstext">here</a></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>International Studies <a href="http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#requirementstext">here</a></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physical Science Fundamentals</td>
<td>4-5</td>
<td></td>
</tr>
<tr>
<td>CHEM 103 or CHEM 108</td>
<td>General Chemistry I or Chemistry in Our World</td>
<td></td>
</tr>
<tr>
<td>or CHEM 109</td>
<td>Advanced General Chemistry</td>
<td></td>
</tr>
<tr>
<td>Biological Science</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Additional Science (Biological, Physical, or Natural)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Science Breadth (Biological, Physical, Natural, or Social)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CALS Capstone Learning Experience: included in the requirements for each CALS major (see &quot;Major Requirements&quot;) <a href="http://guide.wisc.edu/undergraduate/agricultural-life-sciences/#requirementstext">here</a></td>
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</tbody>
</table>
### MAJOR REQUIREMENTS

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 221</td>
<td>Calculus and Analytic Geometry 1</td>
<td></td>
</tr>
<tr>
<td>MATH 171</td>
<td>Calculus with Algebra and Trigonometry I</td>
<td></td>
</tr>
<tr>
<td>&amp; MATH 217</td>
<td>and Calculus with Algebra and Trigonometry II</td>
<td></td>
</tr>
<tr>
<td>STAT 371</td>
<td>Introductory Applied Statistics for the Life Sciences</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 103</td>
<td>General Chemistry I</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 104</td>
<td>and General Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 109</td>
<td>Advanced General Chemistry</td>
<td></td>
</tr>
<tr>
<td>CHEM 343</td>
<td>Introductory Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 344</td>
<td>Introductory Organic Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 345</td>
<td>Intermediate Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 103</td>
<td>General Physics</td>
<td></td>
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<tr>
<td>&amp; PHYS 104</td>
<td>and General Physics (recommended)</td>
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</tr>
<tr>
<td>PHYS 201</td>
<td>General Physics</td>
<td></td>
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<tr>
<td>&amp; PHYS 202</td>
<td>and General Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 207</td>
<td>General Physics</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 208</td>
<td>and General Physics (recommended)</td>
<td></td>
</tr>
<tr>
<td>BIOLOGY/</td>
<td>Introductory Biology</td>
<td></td>
</tr>
<tr>
<td>BOTANY/</td>
<td>and Introductory Biology (recommended)</td>
<td></td>
</tr>
<tr>
<td>ZOOLOGY 151</td>
<td></td>
<td></td>
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<tr>
<td>&amp; BIOLOGY/</td>
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<tr>
<td>BOTANY/</td>
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<tr>
<td>ZOOLOGY 152</td>
<td></td>
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</tr>
<tr>
<td>BOTANY/</td>
<td>General Botany</td>
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<tr>
<td>BIOLOGY 130</td>
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<tr>
<td>ZOOLOGY/</td>
<td>Animal Biology</td>
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<tr>
<td>BIOLOGY 101</td>
<td>and Animal Biology Laboratory</td>
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<tr>
<td>&amp; BIOLOGY/</td>
<td></td>
<td></td>
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<tr>
<td>BIOLOGY 102</td>
<td></td>
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</tr>
<tr>
<td>BICORE 381</td>
<td>Evolution, Ecology, and Genetics</td>
<td></td>
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<tr>
<td>&amp; BICORE 383</td>
<td>and Cellular Biology</td>
<td></td>
</tr>
<tr>
<td>BICORE 382</td>
<td>Evolution, Ecology, and Genetics Laboratory</td>
<td></td>
</tr>
<tr>
<td>BICORE 384</td>
<td>Cellular Biology Laboratory</td>
<td></td>
</tr>
<tr>
<td>BICORE 486</td>
<td>Principles of Physiology Laboratory</td>
<td></td>
</tr>
</tbody>
</table>

**Core Biology Requirements**

Select one of the following options: 6

- **Option 1:**
  - GENETICS 467 & GENETICS 468: General Genetics 1 and General Genetics 2 (preferred)

- **Option 2:**
  - GENETICS 466: Principles of Genetics (consult advisor (467 & 468 preferred))
  - additional 3 credit subset 1 course (see course list below)
  - BIOCHEM 501: Introduction to Biochemistry
  - or BIOCHEM 507: General Biochemistry

Select 2 credits from the following: 2

- GENETICS 545: Genetics Laboratory
- GENETICS 299: Independent Study
- GENETICS 699: Special Problems
- GENETICS 681: Senior Honors Thesis
- GENETICS 682: Senior Honors Thesis
- GENETICS 399: Coordinative Internship/Cooperative Education

**Electives**

Select 12 credits with 6 credits minimum from subset 1 (see course list below) 12

**Capstone**

Select one of the following: 3-9

- **Option 1:**
  - GENETICS 527: Developmental Genetics for Conservation and Regeneration (offered in fall semester)

- **Option 2:**
  - GENETICS 566: Advanced Genetics (offered in spring semester)

- **Option 3:**
  - GENETICS 564: Genomics and Proteomics (offered in spring semester)

- **Option 4 (must be taken concurrently):**
  - GENETICS 699: Special Problems (offered in fall semester)

- **Option 5 (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:** 67-82

---

1. Subset 1 course will not count toward 12 subset credits.
2. 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 in Subset 2 of electives.
3. Consult with your advisor if genetics-related research will be performed in a department other than Genetics.
4. May count for Subset 1 or Capstone.
### SUBSET COURSES

#### SUBSET 1

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>GENETICS 520</td>
<td>Neurogenetics</td>
<td>2</td>
</tr>
<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>
</tr>
<tr>
<td>GENETICS 546</td>
<td>EvoSysBio: Modeling in Evolutionary Systems Biology</td>
<td>3</td>
</tr>
<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/MD GENET/ZOOLOGY 562</td>
<td>Human Cytogenetics</td>
<td>2</td>
</tr>
<tr>
<td>GENETICS/MD GENET 565</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/MICROBIO 607</td>
<td>Advanced Microbial 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/MICROBIO 620</td>
<td>Eukaryotic Molecular Biology</td>
<td>3</td>
</tr>
<tr>
<td>GENETICS/CH2MED 562</td>
<td>Genomic Science</td>
<td>2</td>
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<tr>
<td>GENETICS 627</td>
<td>Animal Developmental Genetics</td>
<td>3</td>
</tr>
<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/MICROBIO/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>
</tr>
<tr>
<td>GENETICS/MD GENET 677</td>
<td>Advanced Topics in Genetics 1</td>
<td>1-3</td>
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<tr>
<td>MICROBIO 470</td>
<td>Microbial Genetics &amp; Molecular Machines</td>
<td>3</td>
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<tr>
<td>AGRONOMY/BOTANY/HORT 339</td>
<td>Plant Biotechnology: Principles and Techniques I</td>
<td>4</td>
</tr>
<tr>
<td>BIOCHEM 550</td>
<td>Topics in Medical Biochemistry</td>
<td>2</td>
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</table>

#### SUBSET 2

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>AGRONOMY/HORT 338</td>
<td>Plant Breeding and Biotechnology</td>
<td>3</td>
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<tr>
<td>AGRONOMY/HORT 340</td>
<td>Plant Cell Culture and Genetic Engineering</td>
<td>4</td>
</tr>
<tr>
<td>AGRONOMY/HORT 501</td>
<td>Principles of Plant Breeding</td>
<td>3</td>
</tr>
</tbody>
</table>

#### AGRONOMY/HORT 502
Techniques of Plant Breeding 1

#### BIOCHEM 508
General Biochemistry II 3-4

#### BIOCORE 485
Principles of Physiology 3

#### BIOCORE 587
Biological Interactions 3

#### B M I/COMP SCI 576
Introduction to Bioinformatics 3

#### BMOLCHEM 504
Human Biochemistry Laboratory 3

#### BOTANY 563
Phylogenetic Analysis of Molecular Data 3

#### BOTANY/ZOOLOGY 410
Evolutionary Biology 3

#### DY SCI/AN SCI 361
Introduction to Animal and Veterinary Genetics 2

#### DY SCI/AN SCI 362
Veterinary Genetics 2

#### DY SCI/AN SCI 363
Principles of Animal Breeding 2

#### GENETICS/BIOLOGY 522
Evolution Seminar Series-Undergraduate 1

#### HORT/PATH-BIO 500
Molecular Biology Techniques 3

#### MICROBIO 303
Biology of Microorganisms 3

#### MICROBIO 304
Biology of Microorganisms 2

#### MICROBIO/M M & I/PATH-BIO 528
Immunology 3

#### MICROBIO/ONCOLOGY 545
Topics in Biotechnology 1

#### MICROBIO/PL PATH 622
Plant-Bacterial Interactions 2-3

#### MICROBIO 632
Industrial Microbiology/Biotechnology 2

#### MICROBIO/ONCOLOGY/PL PATH 640
General Virology-Multiplication of Viruses 3

#### M M & I 341
Immunology 3

#### M M & I 460
Techniques in DNA Science for Microbiologists 3

#### PL PATH/BOTANY/ENTOM 505
Plant-Microbe Interactions: Molecular and Ecological Aspects 3

#### ZOOLOGY/ENVIR ST/F&W ECOL 360
Extinction of Species 3

#### ZOOLOGY 425
Behavioral Ecology 3

#### ZOOLOGY 470
Introduction to Animal Development 3

#### ZOOLOGY 555
Laboratory in Developmental Biology 3

#### ZOOLOGY 570
Cell Biology 3

A biological science course as approved by advisor (must have significant genetics component)

### 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. Demonstrate an understanding of genetic principles at the level of molecules, cells, systems, organisms, populations and ecosystems.
2. Use quantitative approaches to evaluate experimental design, critically interpret, and analyze data sets from primary research papers.
3. Integrate genetic data and apply the scientific method to formulate research questions.
4. Communicate genetic concepts to multiple audiences with written, oral and visual presentations.
5. Understand mechanisms of segregation and expression of genetic material during development and homeostasis.
6. Apply primary genetic approaches used to study biological processes, including the use of model organisms.
7. Describe how environmental influences may modify the inheritance and expression of the genetic material.
8. Apply the use of quantitative methods to implement genetic analysis, including the linkage of gene variants with traits.
9. Appreciate how the fields of genomics, proteomics and other data-driven approaches facilitate research and clinical assessment.
10. Understand the contribution of genetics analysis to elucidating population history and evolution.
11. Address the connection between genetics and trends in clinical practice, such as personalized medicine, cloning and regenerative biology.
12. Understand evolutionary processes, with current variation in human traits as its natural outcome.
13. Appreciate the contributions of genetic methods to sustainability, including food production, bio-energy generation and the preservation of ecosystems and biodiversity.

FOUR-YEAR PLAN

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 |

Sophomore

Fall | Credits | Spring | Credits
--------- | -------- | -------- | --------
CHEM 343 | 3 CHEM 344 & CHEM 345 | 5 |
ZOOLOGY/BOTANY/151 | 5 ZOOLOGY/BOTANY/152 | 5 |
Biostatistics Course | 3 Humanities / Literature / Arts / Ethnic Studies Course | 5 |
Humanities / Literature / Arts / Ethnic Studies Course | 3 GENETICS 299 (Independent Research) | 2 |
--------- | -------- | -------- | --------
14 | 17 |

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 Subset 1 elective & BIOCORE 587 if applicable) | 3 |
BIOCHEM 501 or 507 | 3 BIOCHEM 508 (or Advanced course) | 3 |
Electives | 5 Genetics Elective | 5 |
--------- | -------- | -------- | --------
15-16 | 15-16 |

Senior

Fall | Credits | Spring | Credits
--------- | -------- | -------- | --------
Advanced Genetics Electives | 6 Advanced Genetics Electives | 3 |
Senior Thesis (681-Research) | 2-3 Senior Thesis (682-Research) | 2-3 |
Electives (Humanities, Social Sciences, Ethnic Studies) | 3 Genetics Capstone | 3 |
Electives | 6 Electives | 6 |
--------- | -------- | -------- | --------
17-18 | 14-15 |

Total Credits 31-33

1 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 (ZOOLOGY/BIOLOGY 101 Animal Biology & ZOOLOGY/BIOLOGY 102 Animal Biology Laboratory).

2 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 year 2 (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

Current students may use scheduling assistant (https://calendar.wisc.edu/scheduling-assistant) to schedule an appointment with an undergraduate advisor.

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
Doebley, John (chair); Engels, Bill; Gasch, Audrey; Ikeda, Aki; Laughon, Al; Masson, Patrick; Paysen, Bret; Pelegri, Francisco; Perna, Nicole; Prolla, Tom; Schwartz, David; Skop, Ahna; Wassarman, David; Yin, Jerry

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

ASSISTANT PROFESSORS
Loewe, Laurence; Zhong, Xuehua

FACULTY ASSOCIATES;
Tilmann, Kit; Vermillion Kalmon, Katie

UNDERGRADUATE ADVISORS
Tilmann, Kit; Vermillion Kalmon, Katie

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.