

# GENETICS AND GENOMICS

## GRADUATE MAJOR

Work is offered for the master of science and doctor of philosophy degrees with a major in Genetics and Genomics in fourteen cooperating departments: Agronomy; Animal Science; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Ecology, Evolution and Organismal Biology; Entomology; Food Science and Human Nutrition; Genetics, Development and Cell Biology; Horticulture; Materials Science and Engineering; Plant Pathology and Microbiology; Natural Resource Ecology and Management; Veterinary Microbiology and Preventive Medicine; and Veterinary Pathology.

Students are admitted by the approval of the Chair after review by the Genetics and Genomics Admissions Committee. Students are admitted either to participate in research rotations with several faculty before deciding on a major professor and laboratory, or by direct admission into a specific lab and department. First year students participating in rotations with Genetics and Genomics faculty will take GENET 6970 Graduate Research Rotation.

The diversity of faculty in the Genetics and Genomics major ensures a broad, well-balanced education from the best instructors, while offering flexibility in choice of research area. Genetics and Genomics faculty have strengths in many areas, from fundamental studies at the molecular, cellular, organismal, and population levels, to research with immediate practical application. Ongoing research projects span all the major areas of theoretical and experimental genetics, including genomics, molecular studies of gene regulation, gene mapping, genetics of disease, transposable element studies, developmental genetics, quantitative and statistical genetics, computational molecular biology, evolutionary genetics, and population genetics.

## UNDERGRADUATE PREPARATION

Undergraduates wishing to prepare for graduate study in Genetics and Genomics should elect courses in basic biology, chemistry at least through organic chemistry, one year of college-level physics, mathematics at least through calculus, at least one thorough course in basic transmission and molecular genetics, one semester of upper level statistics and one semester of upper level biochemistry. Incoming students who have not completed an upper level statistics course and an upper level biochemistry course prior to beginning in the program will take STAT 5101 Statistical Methods for Data Analysis and BBMB 4040 Biochemistry I during their first year of graduate training. A waiver may be requested for these courses by providing appropriate documentation (catalog description and syllabus) to the curriculum committee showing completion of an upper level statistics and upper level

biochemistry course equivalent to STAT 5101 Statistical Methods for Data Analysis and BBMB 4040 Biochemistry I.

See information from the College of Agriculture and Life Sciences or the College of Liberal Arts and Sciences for information on a bachelor of science degree in Genetics (<https://catalog.iastate.edu/collegescurricula/>).

All Ph.D. candidates take a core curriculum comprising one course each from the following four categories and attend seminars and workshops as described:

### Transmission Genetics

GDCB 5100	Transmission Genetics
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### Molecular Genetics

GDCB 5110	Advanced Molecular Genetics
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### Quantitative, Population, and Evolutionary Genetics

ANS 5610	Population and Quantitative Genetics for Breeding
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EEOB 5070	Advanced Animal Behavior
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EEOB 5610	Evolutionary and Ecological Genomics
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EEOB 5630	Molecular Phylogenetics
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EEOB 5660	Molecular Evolution
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GDCB 5651	Statistical Genetics
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### Genomics, Bioinformatics and Statistical Genetics

ANS 5560	Current Topics in Genome Analysis
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BCB 5440	Fundamentals of Bioinformatics
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STAT 5216	Analysis of Gene Expression Data for the Biological Sciences
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BCB 5670	Bioinformatics Algorithms
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BCB 5680	Statistical Bioinformatics
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BCB 5690	Structural Bioinformatics
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BCB 5700	Systems Biology
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EEOB 5460	Computational Skills for Biological Data
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COMS 5510	Genomic Data Science
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Students will give two research presentations (GENET 6900 Graduate Student Seminar in Genetics), attend one genetics and genomics faculty seminar series (GENET 6910 Faculty Seminar in Genetics), and participate in two Workshops in Genetics and Genomics (GENET 5910 Workshop in Genetics) during their graduate training. First-year graduate students will take GENET 6920 Conceptual Foundations of Genetics.

Students may elect a computational molecular biology specialty within the genetics major. This requires that the research project be in the field of computational molecular biology. IGG majors will be expected to complete all of the courses required for the genetics and genomics major, except that one semester of BCB 6900 Student Seminar in Bioinformatics and Computational Biology can be substituted for GENET 6900 Graduate

Student Seminar in Genetics. Students will be expected to take additional courses in the area of specialization.

M.S. students will take the above core courses and seminars with the following changes: participate in one Workshop in Genetics (GENET 5910 Workshop in Genetics) and present their research once (GENET 6900 Graduate Student Seminar in Genetics). Additional coursework may be selected to satisfy individual interests or departmental requirements.

The course designator Genet applies to graduate courses taught by the interdepartmental major in Genetics and Genomics.

Students wishing to minor in genetics and genomics must submit a complete application to the graduate program. Requirements for the successful completion of a minor at the Ph.D. or M.S. levels are: completion of three of the four categories of the common-core required lecture courses listed above. One semester of Seminar in Genetics is recommended.

GENET 6900	Graduate Student Seminar in Genetics	1
GENET 6910	Faculty Seminar in Genetics	1
GENET 6920	Conceptual Foundations of Genetics	1

One member of the POS committee must be a Genetics faculty member.

Student Outcomes: Most students awarded doctoral degrees continue their training as postdoctoral associates at major research institutions in the U.S. or abroad in preparation for research and/or teaching positions in academia, industry, or government. A few go directly to permanent research positions in industry. Many students awarded master's degrees continue their training as doctoral students; however, some choose research support positions in academia, industry, or government. A more thorough list of outcomes is available at our web site.

#### **Courses primarily for graduate students, open to qualified undergraduates:**

##### **GENET 5900: Special Topics**

Credits: 1-30. Repeatable.

*Prereq: Instructor Permission for Course*

Contact individual faculty for special projects or topics. Graded. (Typically Offered: Fall, Spring, Summer)

##### **GENET 5910: Workshop in Genetics**

Credits: 1. Contact Hours: Lecture 1.

Repeatable.

*Prereq: Instructor Permission for Course*

Current topics in genetics research. Lectures by off-campus experts. Students read background literature, attend preparatory seminars, attend all lectures, meet with lecturers. (Typically Offered: Fall)

#### **Courses for graduate students:**

##### **GENET 6900: Graduate Student Seminar in Genetics**

Credits: 1. Contact Hours: Lecture 1.

Repeatable.

Research presentations by students to improve their ability to: orally present scientific work in a clear and meaningful way, critically evaluate oral presentations, and give and receive constructive criticism. Students may enroll in one seminar per school year. (Typically Offered: Fall, Spring)

##### **GENET 6910: Faculty Seminar in Genetics**

Credits: 1. Contact Hours: Lecture 1.

Repeatable.

Faculty research seminars that introduce students to the variety of genetics research projects on campus and provide an opportunity for students to become engaged in the scientific presentation to the point where they can think critically and ask meaningful questions. (Typically Offered: Fall)

##### **GENET 6920: Conceptual Foundations of Genetics**

Credits: 1. Contact Hours: Lecture 1.

Landmark papers in the development of genetics concepts. Papers are presented and discussions led by students, guided and mentored by the instructors. Instructors provide a broad overview and history of the development of fundamental concepts in genetics. (Typically Offered: Fall)

##### **GENET 6930: Entrepreneurship for Graduate Students in Science and Engineering**

(Cross-listed with AGRON 6930/ BCB 6930/ ENGR 6930/ EE 6930/ ME 6930).

Credits: 1. Contact Hours: Lecture 3.

Repeatable, maximum of 2 credits.

Understanding key topics of starting a technology based company, from development of technology-led idea to early-stage entrepreneurial business. Concepts discussed include: entrepreneurship basics, starting a business, funding your business, protecting your technology/ business IP. Subject matter experts and successful, technology-based entrepreneurs will provide real world examples from their experience with entrepreneurship. Learn about the world class entrepreneurship ecosystem at ISU and Central Iowa. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring)

##### **GENET 6970: Graduate Research Rotation**

Credits: 1-30. Repeatable.

Graduate research projects performed under the supervision of selected faculty members in the graduate Genetics major. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring, Summer)

**GENET 6990: Research**

Credits: 1-30. Repeatable.

*Prereq: Department Permission for Course*

Research. (Typically Offered: Fall, Spring, Summer)