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 697 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 587 Statistical Methods for Research Workers and BBMB 404 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 587 Statistical Methods for Research Workers and BBMB 404 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.

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 510 Transmission Genetics

Molecular Genetics

- GDCB 511 Advanced Molecular Genetics

Quantitative, Population, and Evolutionary Genetics

- AN S 561 Population and Quantitative Genetics for Breeding
- AGRON 561 Population and Quantitative Genetics for Breeding
- EEOB 562 Evolutionary Genetics
- EEOB 563 Molecular Phylogenetics
- EEOB 566 Molecular Evolution
- EEOB 567 Empirical Population Genetics
- GDCB 536 Statistical Genetics

Genomics, Bioinformatics and Statistical Genetics

- AN S 556 Current Topics in Genome Analysis
- BCB 544 Fundamentals of Bioinformatics
- STAT 516 Statistical Design and Analysis of Gene Expression Experiments
- STAT 581 Analysis of Gene Expression Data for the Biological Sciences
- BCB 567 Bioinformatics I (Bioinformatics Algorithms)
- BCB 568 Bioinformatics II (Statistical Bioinformatics)
- BCB 569 Bioinformatics III (Structural Bioinformatics)
- BCB 570 Bioinformatics IV (Systems Biology)
- EEOB 561 Evolutionary and Ecological Genomics
- COM S 549 Advanced Algorithms in Computational Biology
- COM S 551 Computational Techniques for Genome Assembly and Analysis

Students will give three research presentations (GENET 690 Graduate Student Seminar in Genetics), attend two genetics and genomics faculty seminar series (GENET 691 Faculty Seminar in Genetics), and participate in two Workshops in Genetics and Genomics (GENET 591 Workshop in Genetics) during their graduate training. First-year graduate students will take GENET 692 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. IG2 majors will be expected to complete all of the courses required for the genetics and genomics major, except that one semester of BCB 690 Student Seminar in Bioinformatics and Computational Biology can be substituted for GENET 690 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 591 Workshop in Genetics) and present their research once (GENET 690 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.

Courses primarily for graduate students, open to qualified undergraduates:

GENET 593: Ethics and Biological Sciences
(2-0) Cr. 2. Alt. S., offered odd-numbered years.
Introduction to Bioethics through case studies, discussion of contemporary work on central bioethics topics, and discussion of important emerging ethical issues associated with recent research or technological development. Issues covered will vary somewhat from year to year, but will include at least some of the following: ethics and responsible research practice, animal ethics and the use of animals in teaching and research, cloning, human reproductive and stem cell research, regulation of genetically modified crops and foods, plant biotechnology, gene patents. Students will be divided into groups to develop their own case study, to be presented in class at the end of the term. Offered on a satisfactory-fail basis only.

GENET 590: Special Topics
Cr. arr. Repeatable. F.S.SS.
Contact individual faculty for special projects or topics. Graded.

GENET 591: Workshop in Genetics
(1-0) Cr. 1. Repeatable. F.
Prereq: Permission of instructor
Current topics in genetics research. Lectures by off-campus experts. Students read background literature, attend preparatory seminars, attend all lectures, meet with lecturers.

Courses for graduate students:

GENET 690: Graduate Student Seminar in Genetics
(1-0) Cr. 1. Repeatable. F.S.
Prereq: Permission of instructor
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.

GENET 691: Faculty Seminar in Genetics
(1-0) Cr. 1. Repeatable. F.
Prereq: Permission of instructor
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.

GENET 692: Conceptual Foundations of Genetics
(1-0) Cr. 1. F.
Prereq: Permission of instructor
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.
GENET 697: Graduate Research Rotation
Cr. arr. Repeatable. F.S.S.
Graduate research projects performed under the supervision of selected faculty members in the graduate Genetics major. Offered on a satisfactory-fail basis only.

GENET 699: Research
Cr. arr. Repeatable. F.S.S.
Research.