GENETICS

Emeritus: (Professor) Luca Cavalli-Sforza, Leonard Herzenberg
Chair: Richard M. Myers
Professors: Russ Altman, Gregory Barsh, Stanley Cohen, Ronald Davis, Andrew Fire, Uta Francke, Margaret Fuller, Mark Kay, Stuart Kim, Joseph Lipsick, Richard Myers, John Pringle, Matthew Scott
Associate Professors: Michele Calos, Arend Sidow, Tim Stearns, Anne Villenueve, Douglas Vollrath
Assistant Professors: Laura Attardi, Julie Baker, Anne Brunet, James Ford, Julien Sage, Joanna Mountain, Man-Wah Tan
Professor (Research): Leonore Herzenberg
Associate Professors (Research): J. Michael Cherry, Zijie Sun
Assistant Professor (Research): Gavin Sherlock
Courtesy Professor: Hank Greely
Consulting Professor: David Cox

Mail Code: 94305-5120
Phone: (650) 723-3335
Email: genetics-info@genome.stanford.edu
Web Site: http://genetics.stanford.edu/

Courses given in Genetics have the subject code GENE. For a complete list of subject codes, see Appendix.

GRADUATE PROGRAMS

University requirements for the Ph.D. degree are described in the "Graduate Degrees" section of this bulletin.

The Ph.D. program in the Department of Genetics offers graduate students the opportunity to pursue a discipline that encompasses both a set of tools and a coherent way of thinking about biology and medicine. All major areas of genetics are represented in the department, including human genetics (molecular identification of Mendelian traits and the pathophysiology of genetic disease, gene therapy, genetic epidemiology, analysis of complex traits, genetic anthropology, and human evolution), and application of model organisms such as bacteria, yeast, flies, worms, or mice to basic questions in biomedical research. The department is especially strong in genomic and bioinformatic approaches to genome biology and evolution, and includes several genome-scale databases such as the Saccharomyces Genome Database (SGD), the Stanford Microarray Database (SMD), and the Pharmacogenetics and Pharmacogenomics Knowledge Base (PharmGKB), the Stanford Human Genome Center (SHGC), and, administered through the Department of Biochemistry, the Stanford Genome Technology Center (SGTC).

Exposure to the intellectual scope of the department is provided by laboratory rotations, dissertation research, advanced courses in genetics and other areas of biomedical science, seminar series, journal clubs, and an annual three-day retreat of faculty, students, postdoctoral fellows, and staff scientists. Emphasis is placed on interactions and collaborations among students, postdoctoral students, and faculty within the department and throughout the campus.

During their first year, graduate students in the department take graduate courses and sample areas of research by doing rotations in three or four laboratories. At the end of the first three quarters, students may select a laboratory in which to do their dissertation research. While the dissertation research is generally performed in one laboratory, collaborative projects with more than one faculty member are encouraged. In addition to interacting with their faculty preceptor, graduate students receive advice regularly from other faculty members who serve as members of their dissertation committee. Study for the Ph.D. generally requires between four and five years of graduate work, most of which is focused on dissertation research.

Students are generally enrolled in the program to receive the Ph.D. degree, although a limited number of M.D. candidates can combine research training in genetics with their medical studies. Ph.D. candidates who have passed the qualifying exam in the second year can opt to receive the M.S. degree.

There are opportunities for graduate students to teach in graduate-level and professional-school courses. In addition, students are encouraged to participate in educational outreach activities coordinated by the department, which include opportunities to interact with secondary school students and teachers, lay groups, and local science museums.

Students who have recently received a bachelor's, master's, M.D., or Ph.D. degree in related fields may apply for graduate study. Prospective students must have a background in general biology, mathematics, physics, and chemistry. Decisions for admission are based on comparison of the relative merits of all the candidates' academic abilities and potential for research and the department's interest in promoting a diverse learning environment. Interviews take place in late February or early March and successful applicants are offered admission by early spring. Students who wish to pursue a combined M.D./Ph.D. degree are considered for admission into the graduate program in the Department of Genetics after they have been admitted to the M.D. program in the School of Medicine.

The Academic Senate has approved an M.S. program in Human Genetics effective for academic year 2007-08.

Students begin graduate studies in Autumn Quarter. Prospective students are encouraged to start the application process early to ensure that they are able to submit a complete application by the December deadline. All students accepted into the Ph.D. program in the Department of Genetics are provided with full tuition and a stipend to cover the cost of living. Two training grants from the National Institutes of Health provide major support for the graduate training program in the department. Other student support is provided by departmental funds and from research grants, both federal and private, of the faculty. In addition, a number of graduate students are funded by fellowships, including those from the National Science Foundation and the Stanford Graduate Fellows program.

COURSES

For further information on the availability of courses, consult the quarterly *Time Schedule*, or inquire at the departmental office. Additional courses in or related to genetics are included in the listings of the departments of Biological Sciences, Biochemistry, Developmental Biology, Microbiology and Immunology, Neuroscience, Biomedical Informatics, and Structural Biology.

GENE 104Q. Law and the Biosciences—Stanford Introductory Seminar. Preference to sophomores. Focus is on human genetics; also assisted reproduction and neuroscience. Topics include forensic use of DNA, genetic testing, genetic discrimination, eugenics, cloning, pre-implantation genetic diagnosis, neuroscientific methods of lie detection, and genetic or neuroscience enhancement. Student presentations on research paper conclusions.
3 units, Spr (Greely, H)

GENE 106Q. The Heart of the Matter—(Same as BIOSCI 106Q.) Stanford Introductory Seminar. Preference to sophomores. The molecular and biochemical basis of life. Emphasis is on the methods and scientific logic that lead to advances in knowledge. The human heart and circulatory system is the unifying theme for topics such as the constituents and activities of cells, tissues, and organs; the chemicals and proteins that carry on life processes; the biotechnology revolution; the role of genes in human disease and normal functions; and the Human Genome Project. How scientific knowledge is built up through research; how biology initiates advances in medicine; and how science, engineering, and economics interact in biotechnology. Student presentations, demonstrations, and field trips. GER:DB-NatSci
3 units, Win (Myers, R; Simoni, R)

GENE 109Q. Genomics: A Technical and Cultural Revolution—(Same as BIOMEDIN 109Q.) Stanford Introductory Seminar. For nonscience majors. Concepts of genomics, high-throughput methods of data collection, and computational approaches to analysis of data. The social, ethical, and economic implications of genomic science. Students may focus on computational or social aspects of genomics.
3 units, Win (Altman, R)

GENE 199. Undergraduate Research—Students undertake investigations sponsored by individual faculty members. Prerequisite: consent of instructor.
1-18 units, Aut, Win, Spr, Sum (Staff)

GENE 202. Human Genetics—Theoretical and experimental basis for the genetics of human health and disease. Molecular, chromosomal, biochemical, developmental, cancer, and medical genetics, emphasizing the last. Clinical case discussions. Prerequisites: Biochemistry; basic Genetics.

4 units, Aut (Ford, J; Myers, R)

GENE 203. Advanced Genetics—(Same as BIOSCI 203, DBIO 203.) For graduate students in Bioscience programs; may be appropriate for graduate students in other programs. The genetic toolbox. Examples of analytic methods, genetic manipulation, genome analysis, and human genetics. Emphasis is on use of genetic tools in dissecting complex biological pathways, developmental processes, and regulatory systems. Faculty-led discussion sections with evaluation of papers. Students with minimal experience in genetics should prepare by working out problems in college level textbooks.

4 units, Aut (Stearns, T; Barsh, G; Sidow, A; Kim, S)

GENE 206. Epigenetics—(Same as PATH 206.) Mechanisms by which phenotypes not determined by the DNA sequence are stably inherited in successive cell divisions. Begins with the discovery of position-effect variegation in Drosophila in the 1920s and proceeds to present-day studies of covalent modifications of histones and DNA methylation. Topics include: position effect, gene silencing, heterochromatin, centromere identity, genomic imprinting, "histine code", variant histones, and the role of epigentics in cancer. Open to advanced undergraduates with permission of instructor.

2 units, Win (Lipsick, J)

GENE 211. Genomics—Genome evolution, organization, and function; technical, computational, and experimental approaches; hands-on experience with representative computational tools used in genome science; and a beginning working knowledge of PERL.

3 units, Win (Cherry, J; Myers, R; Sidow, A; Sherlock, G)

GENE 212. Introduction to Biomedical Informatics Research Methodology—(Same as BIOMEDIN 212, CS 272.) Hands-on software building. Student teams conceive, design, specify, implement, evaluate, and report on a software project in the domain of biomedicine. Creating written proposals, peer review, providing status reports, and preparing final reports. Guest lectures from professional biomedical informatics systems builders on issues related to the process of project management. Software engineering basics. Prerequisites: 210, 211 or 214, or consent of instructor.

3 units, Aut (Altman, R; Cheng, B; Klein, T)

GENE 214. Representations and Algorithms for Computational Molecular Biology—(Same as BIOMEDIN 214, CS 274.) Topics: algorithms for alignment of biological sequences and structures, computing with strings, phylogenetic tree construction, hidden Markov models, computing with networks of genes, basic structural computations on proteins, protein structure prediction, protein threading techniques, homology modeling, molecular dynamics and energy minimization, statistical analysis of 3D biological data, integration of data sources, knowledge representation and controlled terminologies for molecular biology, graphical display of biological data, and machine learning (clustering & classification), and natural language text processing. Consent of instructor required for 3 units. Prerequisites: programming skills, interest in biology.

3-4 units, Spr (Altman, R)

GENE 215. Frontiers in Biological Research—(Same as BIOC 215, DBIO 215.) Literature discussion in conjunction with the Frontiers in Biological Research seminar series hosted by Biochemistry, Developmental Biology, and Genetics in which distinguished investigators present current work. Students and faculty meet beforehand to discuss papers from the speaker's primary research literature. Students meet with the speaker after the seminar to discuss their research and future direction, commonly used techniques to study problems in biology, and comparison between the genetic and biochemical approaches in biological research.

1 unit, Aut, Win (Harbury, P; Brunet, A; Kingsley, D)

GENE 221. Current Issues in Aging—(Same as DBIO 221, NENS 221.) Advanced course considers current research literature on genetic mechanisms of aging in animals and humans. Topics include: mitochondria mutations, insulin-like signaling, sirtuins, againg in flies and worms, stem cells, human progeria, and centenarian studies. Prerequisite: GENE 203.

1-2 units, Win, Spr (Kim, S; Brunet, A; Rando, T)

GENE 222. Method and Logic in Experimental Genetics—For graduate students only. How experimental strategies are applied to biological questions irrespective of discipline boundaries. Examples include purifying activities from complex mixtures, localizing molecules in space and time, discovering macromolecular interactions, inferences from sequence similarity, using structure to elucidate function, and applying genomics to biological problems. Weekly discussion of two representative papers selected by faculty and a student presentation of a third paper which illustrate principles of biochemistry and cell and molecular biology, and the historical context of important scientific advances.

3 units, Win (Baker, J; Brunet, A)

GENE 233. The Biology of Small Modulatory RNAs—(Same as MI 233, PATH 233.) Open to graduate and medical students. How recent discoveries of miRNA, RNA interference, and short interfering RNAs reveal potentially widespread gene regulatory mechanisms mediated by small modulatory RNAs during animal and plant development. Required paper proposing novel research.

2 units, alternate years, not given this year (Fire, A; Chen, C)

GENE 235. *C. Elegans* Genetics—Genetic approaches to *C. elegans*, practice in designing experiments and demonstrations of its growth and anatomy. Probable topics include: growth and genetics, genome map and sequence, mutant screens that start with a desired phenotype, reverse genetics and RNAi screens, genetic duplications, uses of null phenotype non-null alleles, genetic interactions and pathway analysis, and embryogenesis and cell lineage. Focus of action, mosaic analysis, and interface with embryological and evolutionary approaches.

2 units, Spr (Fire, A)

GENE 238. Current Concepts and Dilemmas in Genetic Testing—(Same as INDE 238.) Issues arising from the translational process from research to commercialization. Diagnostic inventions and applications, community implications, newborn screening, cancer genetics, and pharmacogenomics. Guest experts. For M.D. students and biomedical graduate students. Limited enrollment.

2 units, Spr (Tobin, S; Schrijver, I; Cowan, T; Magnus, D)

GENE 260. Supervised Study—Genetics graduate student lab research from first quarter to filing of candidacy. Prerequisite: consent of instructor.

1-18 units, Aut, Win, Spr, Sum (Staff)

GENE 262. Advanced Microbial Genetics and Genomics—(Same as BIOSCI 162/262.) Genetic tools for studying the cell biology and behavior of bacteria. Case studies on genetic approaches in combination with biochemistry, microscopy, and genomics to study mechanisms of gene expression, signal transduction, cell cycle regulation, development, and pathogenesis.

4 units, Spr (Tan, M; Burkholder, B)

GENE 299. Directed Reading in Genetics—Prerequisite: consent of instructor.

1-18 units, Aut, Win, Spr, Sum (Staff)

GENE 399. Graduate Research—Allows for qualified students to undertake investigations sponsored by individual faculty members. Prerequisite: consent of instructor.

1-18 units, Aut, Win, Spr, Sum (Staff)

COGNATE COURSE

See respective department listings for course descriptions. See degree requirements above or the program's student services office for applicability of these courses to a major or minor program.

MED 255. The Responsible Conduct of Research

1 unit, Aut, Win, Spr, Sum (Staff)