DEVELOPMENTAL BIOLOGY

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Courses given in Development Biology have the subject code DBIO. For a complete list of subject codes, see Appendix.

A fundamental problem in biology is how the complex set of multicellular structures that characterize an adult animal is generated from the fertilized egg. Recent advances at the molecular level, particularly with respect to the genetic control of development, have been explosive. These advances represent the beginning of a major movement in the biological sciences toward the understanding of the molecular mechanisms underlying developmental decisions and the resulting morphogenetic processes. This new thrust in developmental biology derives from the extraordinary methodological advances of the past decade in molecular genetics, immunology, and biochemistry. However, it also derives from groundwork laid by the classical developmental studies, the rapid advances in cell biology and animal virology, and from models borrowed from prokaryotic systems. Increasingly, the work is directly related to human diseases, including oncogene function and inherited genetic disease.

The Department of Developmental Biology includes a critical mass of scientists who are leading the thrust in developmental biology and who can train new leaders in the attack on the fundamental problems of development. Department labs work on a wide variety of organisms from microbes to worms, flies, and mice. The dramatic evolutionary conservation of genes that regulate development makes the comparative approach of the research particularly effective. Scientists in the department labs have a very high level of interaction and collaboration. The discipline of developmental biology draws on biochemistry, cell biology, genetics, molecular biology, and genomics. People in the department have a major interest in regenerative medicine and stem cell biology.

The department is located in the Beckman Center for Molecular and Genetic Medicine within the Stanford University Medical Center.

GRADUATE PROGRAM

MASTER OF SCIENCE

University requirements for the M.S. are described in the "Graduate Degrees" section of this bulletin.

Students in the Ph.D. program in Developmental Biology may apply for an M.S. degree, assuming completion of their course requirements and preparation of a written proposal. The master's degree awarded by the Department of Developmental Biology does not include the possibility of minors for graduate students enrolled in other departments or programs.

Students are required to take, and satisfactorily complete, at least three lecture courses offered by the department, including 210, Developmental Biology. In addition, students are required to take three courses outside the department. Students are also expected to attend Developmental Biology seminars and journal clubs. In addition, the candidate must complete a research paper proposing a specific experimental approach and background in an area of science relative to developmental biology.

DOCTOR OF PHILOSOPHY

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

The graduate program in Developmental Biology leads to the Ph.D. degree. The department also participates in the Medical Scientists Training Program (MSTP) in which individuals are candidates for both the M.D. and Ph.D. degrees.

Students are required to complete at least six courses, including Developmental Biology (210); Advanced Genetics (203); Frontiers in Biological Sciences (215); and an advanced molecular biology, biochemistry, or biophysics course. Students are expected to attend Developmental Biology seminars and journal clubs.

Completion of a qualifying examination is required for admission to Ph.D. candidacy. The examination consists of two parts. One proposal is on a subject different from the dissertation research and the other proposal is on the planned subject of the thesis. The final requirements of the program include presentation of a Ph.D. dissertation as the result of independent investigation and constituting a contribution to knowledge in the area of developmental biology. The student must pass the University oral examination, taken only after the student has substantially completed research. The examination is preceded by a public seminar in which the research is presented by the candidate. The oral examination is conducted by a dissertation reading committee.

COURSES

Course and lab instruction in the Department of Developmental Biology conforms to the "Policy on the Use of Vertebrate Animals in Teaching Activities," the text of which is available at http://www.stanford.edu/dept/DoR/rph/8-2.html.

DBIO 12Q. The Evolution and Development of the Human Hand—Stanford Introductory Seminar. Preference to sophomores. Evolution of the human hand in the context of primate evolution; roles of the human hand in tool use, manufacture, art, music, and communication. Development of the hand: embryonic axes, appearance of the digit program, roles of cell death, molecular bases of normal and abnormal hand patterns. Prerequisite: advanced placement biology.

3-4 units, Win (Porzig, E)

DBIO 156. Human Developmental Biology and Medicine—(Same as HUMBIO 141.) The biological, medical, and social aspects of normal and abnormal human development. Topics: in vitro fertilization and embryo transfer; gene and cell therapy; gametogenesis; pattern formation in the nervous system and limb development; gene and grand multiple pregnancies; prematurity, in utero effects of teratogens; sex determination and differentiation; growth control; gigantism and dwarfism; neural tube defects; cardiac morphogenesis; progress in the developmental biology of humans. Limited enrollment. Prerequisites: Human Biology or Biological Sciences core, or consent of instructor.

4 units, not given this year

DBIO 199. Undergraduate Research—Investigations sponsored by individual faculty members. Prerequisite: consent of instructor.

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

DBIO 201. Development and Disease Mechanisms—Mechanisms that direct human development from conception to birth. Conserved molecular and cellular pathways regulate tissue and organ development; errors in these pathways result in congenital anomalies and human diseases. Topics: molecules regulating development, cell induction, developmental gene regulation, cell migration, programmed cell death, pattern formation, stem cells, cell lineage, and development of major organ systems. Emphasis on links between development and clinically significant topics including infertility, assisted reproductive technologies, contraception, prenatal diagnosis, multiparity, teratogenesis, inherited birth defects, fetal therapy, adolescence, cancer, and aging.

4 units, Aut (Porzig, E; Kim, S; Kingsley, D; Scott, M)

DBIO 202. Assisted Reproductive Technologies—(Same as OBGYN 202.) Primary literature in basic and clinical science, and demonstrations of assisted reproductive technologies (ART). Techniques include in vitro fertilization covering micromanipulation procedures such as intracytoplasmic sperm injection and the culture of blastocysts, using mouse gametes, and pre-embryos. Class only may be taken for 1 unit. 2 units includes papers and attendance at clinical demonstrations. 3 units includes a term paper. Prerequisite: DBIO 201 recommended, or consent of instructors.

1-3 units, Win (Porzig, E; Behr, B)

DBIO 203. Advanced Genetics—(Same as BIOSCI 203, GENE 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. The 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)

DBIO 210. Developmental Biology—Current areas of research in developmental biology. How organismic complexity is generated during embryonic and post-embryonic development. The roles of genetic networks, induction events, cell lineage, maternal inheritance, cell-cell communication, and hormonal control in developmental processes in well-studied organisms such as vertebrates, insects, and nematodes. Team-taught. Students meet with faculty to discuss current papers from the literature. Prerequisite: graduate standing, consent of instructor. Recommended: familiarity with basic techniques and experimental rationales of molecular biology, biochemistry, and genetics.

5 units, Spr (Villeneuve, A; Fuller, M; Beachy, P)

DBIO 215. Frontiers in Biological Research—(Same as BIOC 215, GENE 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; Villeneuve, A)

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

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

DBIO 232. Topics in Regenerative Medicine—(Same as MI 232.) Forum. Students and researchers discuss current developments in regenerative medicine at Stanford to spark collaboration. Topics include novel applications in biological and chemical engineering, stem cell biology, biotechnology, and human disease. May be repeated for credit.

2 units, Aut, Win, Spr (Blau, H; Fuller, M)

DBIO 257. The Stem Cell: Science, Ethics, and Politics—(Same as HUMBIO 157.) The biology of stem cells. Their role in human development and potential for treating disease. Guest lectures by biologists, ethicists, and legal scholars. Prerequisites: HUMBIO 2A,B, or consent of instructor.

3 units, Spr (Nusse, R; Fuller, M; Porzig, E)

DBIO 273A. A Computational Tour of the Human Genome—(Same as BIOMEDIN 273A, CS 273A.) Genomes as the ultimate biological information medium, carrying instructions for every organism's development, life cycle, and reproduction. Bioinformatics perspective. Advances in biology resulting from sequencing of human and related organisms. Genome sequencing: technologies, assembly, personalized sequencing. Functional landscape: genes, regulatory modules, repeats, RNA genes. Genome evolution: processes, comparative genomics, ultraconservation, exaptation. Topics may include population genetics and personalized genomics, ancient DNA, and metagenomics. Prerequisities: computational biology at the level of 262, 274, or BIOC 218.

3 units, Aut (Batzoglou, S; Bejerano, G)

DBIO 296. Stem Cell Biology and Regenerative Medicine—(Same as PATH 296.) For graduate and medical students. Embryonic and adult stem cells, including origin, regulation, self-renewal, differentiation, fate, and relationship to cancer; biological mechanisms and methods to translate findings to therapeutic applications. Medical students must enroll for 5 units; graduate students may choose to take only the basic science part for 3 units. Prerequisites: DBIO 201 and 210, or consent of instructor.

3-5 units, Win (Weissman, I; Fuller, M; Nusse, R)

DBIO 299. Directed Reading in Developmental Biology—Prerequisite: consent of instructor.

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

DBIO 399. Graduate Research—Investigations sponsored by individual faculty members. Prerequisite: consent of instructor.

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