DEVELOPMENTAL BIOLOGY

Courses offered by the Department of Development Biology are listed under the subject code DBIO on the Stanford Bulletin's ExploreCourses web site.

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.

Master of Science in Developmental Biology

University requirements for the M.S. are described in the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees)" 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 DBIO 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 in Developmental Biology

University requirements for the Ph.D. are described in the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees)" 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 (http://mstp.stanford.edu)) in which individuals are candidates for both the M.D. and Ph.D. degrees.

		Units
Students are required to complete at least five courses, including:		
DBIO 210	Developmental Biology	4
DBIO 215	Frontiers in Biological Research (1 unit per quarter; students are required to take at least two quarters)	2
An advanced graduate course in genetics or genomics;		
An advanced graduate course in cell biology of biochemistry;		
A course in quantitative or computational biology.		

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 an off-topic proposal on a subject different from the dissertation research. The final requirements of the program include presentation of a PhD 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.

Emeriti: (Professors) David S. Hogness, A. Dale Kaiser, Harley McAdams, Ellen Porzig

Chair: Roeland Nusse

Associate Chair: David Kingsley

Professors: Ben Barres, Philip Beachy, Gerald Crabtree, Margaret Fuller, Seung Kim, Stuart Kim, David Kingsley, Roeland Nusse, Lucy Shapiro, William Talbot, Anne Villeneuve, Irving Weissman

Associate Professors: Gill Bejerano, James Chen, Joanna Wysocka

Assistant Professors: Maria Barna, Alistair Boettiger, Daniel Jarosz

Courses

DBIO 199. Undergraduate Research. 1-18 Unit.
Students undertake investigations sponsored by individual faculty members. Prerequisite: consent of instructor.

DBIO 200. Genetics and Developmental Biology Training Camp. 1 Unit.
Open to first year Department of Genetics and Developmental Biology students, to others with consent of instructors. Introduction to basic manipulations, both experimental and conceptual, in genetics and developmental biology.
Same as: GENE 200

DBIO 201. Development and Disease Mechanisms. 2 Units.
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, teratogenesis, inherited birth defects, fetal therapy, adolescence, cancer, and aging. Limit enrollment only to Medical Student and Masters in Genetics students.

DBIO 210. Developmental Biology. 4 Units.
Current areas of research in developmental biology. How organismic complexity is generated during embryonic and post-embryonic development. The roles of genetic networks, gene regulation ,organogenesis, tissue patterning, cell lineage, maternal inheritance, cell-cell communication, signaling, and regeneration 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.

DBIO 211. Biophysics of Multi-cellular Systems and Amorphous Computing. 2-3 Units.
Provides an interdisciplinary perspective on the design, emergent behavior, and functionality of multi-cellular biological systems such as embryos, biofilms, and artificial tissues and their conceptual relationship to amorphous computers. Students discuss relevant literature and introduced to and apply pertinent mathematical and biophysical modeling approaches to various aspect multi-cellular systems, furthermore carry out real biology experiments over the web. Specific topics include: (Morphogen) gradients; reaction-diffusion systems (Turing patterns); visco-elastic aspects and forces in tissues; morphogenesis; coordinated gene expression, genetic oscillators and synchrony; genetic networks; self-organization, noise, robustness, and evolvability; game theory; emergent behavior; criticality; symmetries; scaling; fractals; agent based modeling. The course is geared towards a broadly interested graduate and advanced undergraduates audience such as from bio / applied physics, computer science, developmental and systems biology, and bio / tissue / mechanical / electrical engineering. Prerequisites: Previous knowledge in one programming language - ideally Matlab - is recommended; undergraduate students benefit from BIOE 41, BIOE 42, or equivalent.
Same as: BIOE 211, BIOE 311, BIOPHYS 311

DBIO 215. Frontiers in Biological Research. 1 Unit.
Students analyze cutting edge science, develop a logical framework for evaluating evidence and models, and enhance their ability to design original research through exposure to experimental tools and strategies. The class runs in parallel with the Frontiers in Biological Research seminar series. Students and faculty meet on the Tuesday preceding each seminar to discuss a landmark paper in the speaker's field of research. Following the Wednesday seminar, students meet briefly with the speaker for a free-range discussion which can include insights into the speakers' paths into science and how they pick scientific problems.
Same as: BIOC 215, GENE 215

DBIO 219. Special Topics in Development and Cancer: Evolutionary and Quantitative Perspectives. 3 Units.
The course will serve as a literature-based introductory guide for synthesis of ideas in developmental biology and cancer, with an emphasis on evolutionary analysis and quantitative thinking. The goal for this course is for students to understand how we know what we know about fundamental questions in the field of developmental biology and cancer, and how we ask good questions for the future. We will discuss how studying model organisms has provided the critical breakthroughs that have helped us understand developmental and disease mechanisms in higher organisms. The students are expected to be able to read the primary literature and think critically about experiments to understand what is actually known and what questions still remain unanswered. Students will develop skills in the educated guesswork to apply order-of-magnitude methodology to questions in development and cancer.
Same as: BIOE 219

DBIO 220. Genomics and Personalized Medicine. 3 Units.
Principles of genetics underlying associations between genetic variants and disease susceptibility and drug response. Topics include: genetic and environmental risk factors for complex genetic disorders; design and interpretation of genome-wide association studies; pharmacogenetics; full genome sequencing for disease gene discovery; population structure and genetic ancestry; use of personal genetic information in clinical medicine; ethical, legal, and social issues with personal genetic testing. Hands-on workshop making use of personal or publicly available genetic data. Prerequisite: GENE 202, Gene 205 or BIOS 200.
Same as: GENE 210

DBIO 234. Elements of Grant Writing. 1 Unit.
Focus is on training first year graduate students in proposal writing. In an intensive 4-week period, students learn fundamental skills focused on scientific proposal writing, including writing and criticizing a proposal on the scientific topic of their choice. Students encouraged to use these new skills and the proposal they create to apply for external funding to support their research training.

DBIO 273A. A Computational Tour of the Human Genome. 3 Units.
Introduction to computational biology through an informatic exploration of the human genome. Topics include: genome sequencing (technologies, assembly, personalized sequencing); functional landscape (genes, gene regulation, repeats, RNA genes, epigenetics); genome evolution (comparative genomics, ultraconservation, co-option). Additional topics may include population genetics, personalized genomics, and ancient DNA. Course includes primers on molecular biology, the UCSC Genome Browser, and text processing languages. Guest lectures from genomic researchers. No prerequisites. Seehttp://cs273a.stanford.edu/.
Same as: BIOMEDIN 273A, CS 273A

DBIO 299. Directed Reading in Developmental Biology. 1-18 Unit.
Prerequisite: consent of instructor.

DBIO 299C. CURRICULAR PRACTICAL TRAINING. 1 Unit.
CPT Course required for international students completing degree requirements.

DBIO 370. Medical Scholars Research. 4-18 Units.
Provides an opportunity for student and faculty interaction, as well as academic credit and financial support, to medical students who undertake original research. Enrollment is limited to students with approved projects.

DBIO 399. Graduate Research. 1-18 Unit.
Students undertake investigations sponsored by individual faculty members. Prerequisite: consent of instructor.

DBIO 802. TGR Dissertation. 0 Units.
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