CANCER BIOLOGY

Courses offered by the Cancer Biology Program are listed under the subject code CBIO on the Stanford Bulletin's ExploreCourses web site.

The Cancer Biology Program at Stanford University is an interdisciplinary program leading to the Ph.D. degree. During the past three decades, understanding of cancer has increased with the discovery of oncogenes, tumor suppressor genes, pathways of DNA damage and repair, chromatin remodeling, cell cycle regulation, angiogenesis, and responses to hypoxia, and recent glimpses into the molecular basis of metastasis and cancer stem cell biology. In addition, methods of parallel analysis, including genomics and proteomics approaches, have begun to refine and redefine the taxonomy of cancer diagnosis. This explosion of basic and clinical science has resulted in the first successful cancer chemotherapies and immunotherapies based on the knowledge of specific molecular targets. Stanford presents a unique environment to pursue interdisciplinary cancer research because the schools of Medicine, Humanities and Sciences, and Engineering are located on a single campus.

The goal of the Cancer Biology Ph.D. program is to provide students with education and training that enables them to make significant contributions to this field. Course work during the first year is designed to provide a broad understanding of the molecular, genetic, cell biological, and pathobiological aspects of cancer. Students also learn about the current state of the epidemiology, clinical diagnosis, treatment, and prevention of human cancers. Equally important during the first year is a series of three rotations in research laboratories chosen by each student. By the end of first year, each student chooses a research adviser and begins work on the dissertation project. A qualifying examination must be completed by the end of the second year. An annual Cancer Biology conference provides students with an opportunity to present their research to one another and to faculty. The expected time to degree is four to five years.

Students are not limited to a single department in choosing their research adviser. The Cancer Biology Ph.D. program currently has approximately 65 graduate students located in basic science and clinical departments throughout the School of Medicine and the School of Humanities and Sciences.

Doctor of Philosophy in Cancer Biology

University requirements for the Ph.D. are described under the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees)" section of this bulletin.

A small number of applicants are admitted to the program each year. Applicants should have completed an undergraduate major in the biological sciences; applicants with undergraduate majors in physics, chemistry, or mathematics may be admitted if they complete background training in biology during the first two years of study. During the first year, each student is required to complete a minimum of three, one quarter laboratory rotations. Students must choose a dissertation adviser prior to the end of Summer Quarter, first year, but not before the end of Spring Quarter.

The requirements for the Ph.D. degree are as follows:

1. Training in biology equivalent to that of an undergraduate biology major at Stanford.
2. Completion of the following courses:

Units		
REQUIRED		
BIOS 200	Foundations in Experimental Biology (for students entering in 2012 or later. Students who entered in 2011 or earlier took GENE 203, Advanced Genetics.)	5
CBIO 240	Molecular and Genetic Basis of Cancer	4
CBIO 242	Cellular and Clinical Aspects of Cancer	4
CBIO 280	Cancer Biology Journal Club (required for first- and second-year graduate students in Autumn, Winter, and Spring quarters, totaling 6 units)	1
CBIO 245	Lecture Seminar Series in Cancer Biology Program (required for first- and second- year graduate student in Autumn, Winter, and Spring quarters, totaling to 6 units)	1
MED 255	The Responsible Conduct of Research	1
ELECTIVES (TOTAL OF 10 UNITS)		
Computational/Systems Cancer Biology Track		
Core Knowledge		
STATS 60	Introduction to Statistical Methods: Precalculus	5
GENE 218	Computational Analysis of Biological Information: Introduction to Python for Biologists	2
BIOS 205	Introduction to R for Data Analysis	1
NENS 230	Analysis Techniques for the Biosciences Using MATLAB	2
CS 106A	Programming Methodology	3-5
GENE 211	Genomics	3
CBIO 243	Principles of Cancer Systems Biology	3
BIOS 201	Next Generation Sequencing and Applications	2
Additional Courses		
CS 106B	Programming Abstractions	3-5
STATS 116	Theory of Probability	3-5
STATS 202	Data Mining and Analysis	3
STATS 216	Introduction to Statistical Learning	3
BIOMEDIN 214	Representations and Algorithms for Computational Molecular Biology	3-4
IMMUNOL 207	Essential Methods in Computational and Systems Immunology	3
CS 161	Design and Analysis of Algorithms	3-5
GENE 245	Statistical and Machine Learning Methods for Genomics	3
Other Cancer Biology Related Graduate-Level		
BIO 214	Advanced Cell Biology	4
SBIO 241	Biological Macromolecules	3-5
CSB 210	Cell Signaling	4
IMMUNOL 201	Advanced Immunology I	3
DBIO 201	Cells and Signaling in Regenerative Medicine.	2
MI 215	Principles of Biological Technologies	3
CBIO 275	Tumor Immunology	2

3. Other elective course is determined in consultation with the student's adviser and/or the Program Director.
4. Presentation of research results at the annual Cancer Biology Conference and Pizza Talks.
5. Completion of a qualifying examination in Cancer Biology is required for admission to Ph.D. candidacy. The exam consists of an F31 NRSA-style written grant proposal not to exceed seven pages (excluding references) and an oral examination. The examining committee consists of three faculty members from the Cancer Biology Program and does not include the student's dissertation adviser. The composition of this committee is chosen by the student and dissertation adviser and must be submitted to and approved

by the program director prior to the end of Autumn Quarter, second year. The qualifying examination must be taken prior to the end of Spring Quarter, second year. If necessary, one retake is permitted prior to the end of Summer Quarter, second year. After the qualifying examination has been completed, the student is required to form a dissertation reading committee that includes the student's adviser and three other members of the Academic Council with appropriate expertise. Each student is required to arrange annual meetings (more frequently, if necessary) of the dissertation reading committee, at which time progress during the past year and a plan of study for the coming year are presented orally and discussed. Completion of each annual committee meeting must be communicated in writing to the program director by the adviser by the end of Spring Quarter each year.

The major accomplishment of each successful Ph.D. student is the presentation of a written dissertation resulting from independent investigation that contributes to knowledge in the area of cancer biology. An oral examination is also required for the Ph.D. degree. In the Cancer Biology Program, a public seminar (one hour) is presented by the Ph.D. candidate, followed by a closed-door oral examination. The oral examination committee consists of at least four examiners (the members of the doctoral dissertation reading committee) and a chair. The oral examination chair must be from outside the Cancer Biology Program faculty and may not have a full or joint appointment in the adviser's or student's home department. However, a courtesy appointment does not affect eligibility. The oral examination chair may be from the same department as any other member(s) of the examination committee. All members of the oral examination committee are normally members of the Academic Council, as the oral examination chair must be. With the prior approval of the program director or school dean, one of the examiners may be a person who is not a member of the Academic Council if that individual contributes expertise not otherwise available. Official responsibility for selecting the oral examination chair rests with the program. Cancer Biology delegates this to the student and dissertation adviser.

Program Co-Directors: Laura Attardi (Radiation Oncology and Genetics) and Julien Sage (Pediatrics and Genetics)

Executive Committee on Cancer Biology: Laura Attardi (Radiation Oncology and Genetics), Edward Graves (Radiation Oncology), Peter Jackson (Microbiology and Immunology; Pathology), Julien Sage (Pediatrics and Genetics), Monte Winslow (Genetics)

Committee on Cancer Biology: Steven Artandi (Medicine, Hematology), Jeffrey Axelrod (Pathology), Katrin Chua (Medicine, Endocrinology), Max Diehn (Radiation Oncology), Amato Giaccia (Radiation Oncology), Ashby Morrison (Biology), Sylvia Plevritis (Radiology), Jonathan Pollack (Pathology), Alejandro Sweet-Cordero (Pediatrics)

Participating Departments and Faculty

Biochemistry: Philip Beachy (Professor), Mark Krasnow (Professor), Julia Salzman (Assistant Professor)

Bioengineering: Jennifer Cochran (Associate Professor), Jan Liphardt, (Associate Professor), Lei Stanley Qi (Assistant Professor)

Biology (School of Humanities and Sciences): Martha Cyert (Professor), Scott J. Dixon (Assistant Professor), Judith Frydman (Professor), Or Gozani (Professor), Ashby Morrison (Assistant Professor), W. James Nelson (Professor), Jan M Skotheim (Associate Professor), Tim Stearns (Professor)

Chemical And Systems Biology: James K. Chen (Professor), Karlene Cimprich (Professor), James E. Ferrell (Professor), Tobias Meyer (Professor), Mary Teruel (Assistant Professor)

Dermatology: Howard Y. Chang (Professor), Paul A. Khavari (Professor), M. Peter Marinkovich (Associate Professor), Anthony Oro (Professor), Kevin Wang (Assistant Professor)

Developmental Biology: Margaret Fuller (Professor), Seung Kim (Professor), Stuart Kim (Professor), Roeland Nusse (Professor)

Genetics: Michael Bassik (Assistant Professor), Anne Brunet (Professor), Michele Calos (Professor), Stanley Cohen (Professor), Christina Curtis (Assistant Professor), Monte Winslow (Assistant Professor)

Medicine/Endocrinology/Gerontology/Metabolism: Katrin Chua (Associate Professor), Andrew R. Hoffman (Professor)

Medicine/Gastroenterology and Hepatology: Christine Cartwright (Professor), Anson Lowe (Associate Professor)

Medicine/Hematology: Steven Artandi (Professor), Linda Boxer (Professor), Calvin Kuo (Professor), Ravindra Majeti (Associate Professor)

Medicine/Oncology: Ash Alizadeh (Assistant Professor), Gilbert Chu (Professor), Michael Clarke (Professor), Dean Felsher (Professor), James Ford (Associate Professor), Hanlee Ji (Associate Professor), Ronald Levy (Professor), Beverly S. Mitchell (Professor; Director, Stanford Cancer Institute), Mark Pegram (Professor), Rajat Rohatgi (Associate Professor), Branimir Sikic (Professor)

Microbiology and Immunology: Helen M. Blau (Professor), Peter Jackson (Professor), Garry Nolan (Professor)

Neurology and Neurological Sciences: Thomas Rando (Professor)

Neurology and Neurosurgery: Michelle Monje (Assistant Professor)

Neurosurgery: Albert J. Wong (Professor)

Orthopaedic Surgery: Nidhi Bhutani (Assistant Professor)

Otolaryngology: John Sunwoo (Associate Professor)

Pathology: Jeff Axelrod (Professor), Sean Bendall (Assistant Professor), Matthew Bogyo (Professor), Michael Cleary (Professor), Gerald Crabtree (Professor), Edgar Engleman (Professor), Andrew Fire (Professor), Isabella Graef (Assistant Professor), Joseph Lipsick (Professor), Bingwei Lu (Professor), Jonathan Pollack (Professor), Irving Weissman (Professor; Virginia & D.K. Ludwig Professor for Clinical Investigation in Cancer Research, Professor of Developmental Biology), Marius Wernig (Associate Professor)

Pediatrics/Cancer Biology: Matthew Porteus (Associate Professor), Julien Sage (Professor; Co-Director of Stanford Cancer Biology Program), Alejandro Sweet-Cordero (Associate Professor)

Pediatrics/Cardiology: Marlene Rabinovitch (Professor)

Pediatrics/Endocrinology: Brian Feldman (Assistant Professor)

Pediatrics/Human Gene Therapy: Mark Kay (Professor)

Pediatrics/Hematology/Oncology: Harvey Cohen (Professor), Kathleen Sakamoto (Professor)

Pediatrics/Neonatal & Developmental Medicine: Christopher Contag (Professor)

Radiation Oncology/Radiation Biology: Laura Attardi (Professor; Co-Director of Stanford Cancer Biology Program), Amato Giaccia (Professor)

Radiation Oncology/Radiation Physics: Edward Graves (Associate Professor)

Radiation Oncology/Radiation Therapy: Max Diehn (Assistant Professor), Susan Knox (Associate Professor), Albert Koong (Professor), Quynh-Thu Le (Professor)

Radiology/Diagnostic Radiology: Parag Mallick (Assistant Professor, Research), Sylvia Plevritis (Professor), Jianghong Rao (Associate Professor)

Structural Biology: William Weis (Professor)

Urology: Donna Peehl (Professor, Research), Zijie Sun (Professor)