

SCHOOL OF MEDICINE

CANCER BIOLOGY

Program Director: Amato Giaccia (Radiation Oncology)

Committee on Cancer Biology: Nicholas Denko (Radiation Oncology), Howard Chang (Dermatology), Jeffrey Axelrod (Pathology), Katrin Chua (Medicine, Endocrinology), Julien Sage (Pediatrics), Alexandro Sweet-Cordero (Pediatrics), Timothy Stearns (Biology, Genetics), Jonathan Pollack (Pathology)

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Participating Departments And Faculty:

Biochemistry: Patrick O. Brown (Professor)

Bioengineering: Jennifer Cochran (Assistant Professor)

Biology (School of Humanities and Sciences): William Burkholder (Assistant Professor), Martha Cyert (Professor), Guowei Fang (Assistant Professor), Judith Frydman (Associate Professor), Or Gozani (Assistant Professor), W. James Nelson (Professor), Virginia Walbot (Professor), Tim Stearns (Professor)

Chemical And Systems Biology: James K. Chen (Assistant Professor), Karlene Cimprich (Associate Professor), James E. Ferrell (Professor)

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

Developmental Biology: Roeland Nusse (Professor), Matthew Scott (Professor)

Genetics: Anne Brunet (Assistant Professor), Michele Calos (Professor), Stanley Cohen (Professor)

Medicine/Cardiovascular Medicine: Ching-pin Chang (Assistant Professor)

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

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

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

Medicine/Oncology: Gilbert Chu (Professor), Dean Felsher (Associate Professor), James Ford (Associate Professor), Ronald Levy (Professor), Beverly S. Mitchell (Professor; Director, Stanford Cancer Center)

Medicine/Pulmonary and Critical Care Medicine: Glenn Rosen (Associate Professor)

Microbiology and Immunology: Helen M. Blau (Professor)

Neurology and Neurological Sciences: Thomas Rando (Professor)

Neurosurgery: Albert J. Wong (Professor)

Otolaryngology: John Sunwoo (Assistant Professor)

Pathology: Jeff Axelrod (Associate Professor), Matthew Bogoy (Associate Professor), Michael Cleary (Professor), Gerald Crabtree (Professor), Edgar Engleman (Professor), Andrew Fire (Professor), Isabella Graef (Assistant Professor), Joseph Lipsick (Professor), Bingwei Lu (Assistant Professor), Jonathan Pollack (Associate Professor), Irving Weissman (Professor; Director, Stanford University School of Medicine Institute of Stem Cell Biology and Regenerative Medicine), Marius Wernig (Assistant Professor)

Pediatrics/Cancer Biology: Julien Sage (Assistant Professor), Alexandro Sweet-Cordero (Assistant Professor)

Pediatrics/Cardiology: Marlene Rabinovitch (Professor)

Radiation Oncology/Radiation Biology: Laura Attardi (Associate Professor), J. Martin Brown (Professor), Nicholas Denko (As-

stant Professor), Amato Giaccia (Professor; Director, Stanford University Cancer Biology Program)

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

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

Radiology/Diagnostic Radiology: Samira Guccione (Assistant Professor, Research), Jianghong Rao (Assistant Professor)

Structural Biology: William Weis (Professor)

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

Courses offered by the Cancer Biology Program are listed under the subject code CBIO on the *Stanford Bulletin's* Explore-Courses 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 gene expression arrays, protein arrays, and tissue arrays 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 beginning of the second 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 at Asilomar on the Pacific Ocean 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 60 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" 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, first year.

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:

- a. CBIO 241. Molecular, Cellular, and Genetic Basis of Cancer
 - b. GENE 203. Advanced Genetics
 - c. BIO 214. Cell Biology of Physiological Processes
 - d. CSB 210. Signal Transduction Pathways and Networks. Students can take GENE 211, Genomics, or SBIO 214, Biological Macromolecules, in lieu of CSB 210.
 - e. CBIO 280. Cancer Biology Journal Club; required for first- and second-year graduate students in Autumn, Winter, and Spring quarters.
 - f. MED 255. Responsible Conduct in Research; with consent, may be audited.
3. At least 6 units of additional cancer biology-related, graduate-level courses. Course work taken 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 on at least three occasions, at least one being an oral presentation.
 5. Completion of a qualifying examination in Cancer Biology is required for admission to Ph.D. candidacy. The exam consists of an NIH-style written grant proposal not to exceed ten 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 oral presentations of progress during the past year and a plan of study for the coming year are presented 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 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.

CANCER BIOLOGY (CBIO)

UNDERGRADUATE COURSES IN CANCER BIOLOGY

CBIO 101. Cancer Biology

(Same as PATH 101) Experimental approaches to understanding the origins, diagnosis, and treatment of cancer. Focus on key experiments and discoveries with emphasis on genetics, molecular biology, and cell biology. Topics include carcinogens, tumor virology, oncogenes, tumor suppressor genes, cell cycle regulation, angiogenesis, invasion and metastasis, cancer genomics, cancer epidemiology, and cancer therapies. Discussion sections based on primary research articles that describe key experiments in the field. Prerequisite: Biology or Human Biology core or equivalent, or consent of instructor.

4 units, Win (Staff)

GRADUATE COURSES IN CANCER BIOLOGY

CBIO 241. Molecular, Cellular, and Genetic Basis of Cancer

Core course required of first-year Cancer Biology graduate students. Focus is on key experiments and classic primary research papers in cancer biology. Letter grade required. Undergraduates require consent of course director.

5 units, Aut (Giaccia, A; Pech, M; Graves, E)

CBIO 242. Scientific Basis of Clinical Cancer Therapy

Required for first- and second-year medical students who wish to join the Cancer Biology Scholarly Concentration Program. The curriculum includes a sampling of recent biomedical research discoveries that led to the current cancer diagnosis and therapeutic treatments.

3 units, Spr (Giaccia, A)

CBIO 260. Teaching in Cancer Biology

Practical experience in teaching by serving as a teaching assistant in a cancer biology course. Unit values are allotted individually to reflect the level of teaching responsibility assigned to the student.

1-10 units, Aut (Giaccia, A), Win (Giaccia, A), Spr (Lipsick, J)

CBIO 275. Tumor Immunology

(Same as IMMUNOL 275) Focuses on the ability of innate and adaptive immune responses to recognize and control tumor growth. Topics include: tumor antigens, tumor immunosurveillance and immunoediting, tumor immunotherapy, cancer vaccines and dendritic cell therapy. Tracks the historical developments of our understanding of modulating tumor immune response and discusses their relative significance in the light of current research findings. Prerequisite: for undergraduates, human biology or biology core.

3 units, Aut (Engleman, E; Rothbard, J)

CBIO 280. Cancer Biology Journal Club

Required of and limited to first- and second-year graduate students in Cancer Biology. Recent papers in the literature presented by graduate students. When possible, discussion relates to and precedes cancer-related seminars at Stanford. Attendance at the relevant seminar required.

1 unit, Aut (Giaccia, A), Win (Giaccia, A), Spr (Giaccia, A)

CBIO 299. Directed Reading in Cancer Biology

Prerequisite: consent of instructor.

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

CBIO 399. Graduate Research

Students undertake investigations sponsored by individual faculty members. Cancer Biology Ph.D. students must register as soon as they begin dissertation-related research work.

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

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