

# IMMUNOLOGY

## *Chair, Executive Committee for the Immunology Program:*

Lawrence Steinman (Professor, Neurology and Neurological Sciences)

*Director for Immunology Program:* Olivia Martinez (Professor, Surgery)

*Director for Clinical Immunology Program:* C. Garrison Fathman (Medicine/Immunology and Rheumatology)

## **Participating Departments and Faculty:**

*Biology:* Anthony W. De Tomaso (Assistant Professor), Patricia P. Jones (Professor)

*Chemistry:* Harden M. McConnell (Professor, emeritus)\*

*Genetics:* Lenore A. Herzenberg (Professor, Research), Leonard A. Herzenberg (Professor, emeritus), Man-wah Tan (Assistant Professor)

*Medicine/Bone Marrow Transplantation Program:* Robert Negrin (Professor), David Miklos (Assistant Professor), Judith Shizuru (Associate Professor)

*Medicine/Endocrinology:* Ajay Chawla (Assistant Professor)

*Medicine/Hematology:* Calvin Kuo (Associate Professor), Peter Lee (Associate Professor)

*Medicine/Immunology and Rheumatology:* C. Garrison Fathman (Professor), William Robinson (Assistant Professor), Samuel Strober (Professor), Paul J. Utz (Associate Professor)

*Medicine/Oncology:* Gilbert Chu (Professor, and Biochemistry), Dean Felsher (Associate Professor, and Pathology), Ronald Levy (Professor), Shoshana Levy (Professor, Research)

*Medicine/Pulmonary and Critical Care Medicine:* Mark Nicolls (Associate Professor)

*Microbiology and Immunology:* Chang-Zheng Chen (Assistant Professor), Yueh-Hsiu Chien (Professor), Mark M. Davis (Professor), Hugh McDevitt (Professor), Garry P. Nolan (Professor), David Schneider (Assistant Professor)

*Molecular and Cellular Physiology:* K. Christopher Garcia (Professor, and Structural Biology), Richard S. Lewis (Professor)

*Neurology and Neurological Sciences:* Lawrence Steinman (Professor, and Pediatrics), Tony Wyss-Coray (Associate Professor)

*Pathology:* Eugene C. Butcher (Professor), Michael Cleary (Professor), Gerald R. Crabtree (Professor, and Developmental Biology), Edgar G. Engleman (Professor, and Medicine/Immunology and Rheumatology), Magali Fontaine (Assistant Professor), Stephen Galli (Professor and Chair), Sara Michie (Associate Professor), Raymond A. Sobel (Professor), Irving L. Weissman (Professor, Developmental Biology, and Director, Institute for Stem Cell Biology and Regenerative Medicine)

*Pediatrics:* Ann Arvin (Professor, and Microbiology and Immunology), Christopher Contag (Associate Professor, Research, and Microbiology and Immunology, and Radiology), David B. Lewis (Professor), Elizabeth Mellins (Associate Professor)

*Psychiatry and Behavioral Sciences:* Firdaus Dhabhar (Associate Professor)

*Structural Biology:* Peter Parham (Professor, and Microbiology and Immunology)

*Surgery:* Sheri Krams (Associate Professor, Research), Olivia Martinez (Professor, Research)

\* Recalled to active duty

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Courses offered by the Immunology Program have the subject code IMMUNOL, and are listed in the "Immunology (IMMUNOL) Courses" section of this bulletin.

## GRADUATE PROGRAMS IN IMMUNOLOGY

### MASTER OF SCIENCE IN IMMUNOLOGY

Students in the Ph.D. program in Immunology may apply for an M.S. degree in Immunology, assuming completion of appropriate requirements. Students must complete:

Three full-tuition quarters of residency as a graduate student at Stanford.

1. At least 45 units of academic work, all of which must be in courses at or above the 100 level, 36 units of which must be at or above the 200 level.
2. 2-3 quarters of graduate research (IMMUNOL 399), consisting of rotations in the labs of 3 faculty members.
3. Course work in Immunology as follows: basic immunology (for graduate students, BIO 230A, Molecular and Cellular Immunology Literature Review, and for medical students, IMMUNOL 205, Immunology in Human Health and Disease or equivalent), advanced Immunology such as IMMUNOL 201, 200, and 203. In addition, the student may take one elective course. Some possible electives are: MPHA 210, Signal Transduction Pathways and Networks; SBIO 241, Biological Macromolecules; C BIO 241, Molecular, Cellular, and Genetic Basis of Cancer; or DBIO 210, Developmental Biology. Other required core courses are: GENE 203, Advanced Genetics; IMMUNOL 215, Principles of Biological Technologies; and MCP 221, Cell Biology of Physiological Processes.
4. Graduate-level biochemistry and molecular biology (BIOC 220).
5. Course work in IMMUNOL 311, Seminar in Immunology, and IMMUNOL 311A, Seminar Discussion in Immunology.
6. Participation in the Immunology journal club (IMMUNOL 305), and attendance at the weekly Immunology seminar and at the annual Stanford Immunology Scientific Conference.
7. The qualifying examination process in Immunology before admission to Ph.D. candidacy has two parts: a comprehensive written exam on many fields in immunology, (qualifying examination process, Part I), in mid-June, first year; the thesis proposal (qualifying examination process, Part II), before December 15th, second year. In addition, an oral presentation is required on the research of one rotation, early-July, first year.

### DOCTOR OF PHILOSOPHY IN IMMUNOLOGY

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

The Immunology Program offers instruction and research opportunities leading to a Ph.D. in Immunology. The goal of the program is to develop investigators who have a solid foundation in immunology and related sciences to carry out innovative research. The program features a flexible choice of courses and seminars combined with extensive research training in the laboratories of participating Immunology faculty.

Students applying to the program typically have an undergraduate major in biological sciences, but majors in other areas are acceptable if the applicants have had sufficient course work in biology and chemistry. Formal application should be made by December 2. Applications are evaluated by the Immunology predoctoral committee based upon: GRE scores; grades; evidence of research experience; letters of recommendation, including letters from research sponsor(s); and commitment to a career in biomedical research. Subject tests are not required. Interested Stanford medical students are welcome to apply to the program and should submit a formal application by December 2.

Students admitted to the program are offered financial support covering tuition, a living stipend, insurance coverage, and an allowance for books/travel. Applicants are urged to apply for independent fellowships such as from the National Science Foundation. Fellowship applications are due in November of the year prior to matriculation in the graduate program, but Immunology graduate students may continue to apply for outside fellowships after matriculation. Because of the small number of department-funded slots, students who have been awarded an outside fellowship have an

improved chance of acceptance into the program. On matriculation, each student is assisted by a first-year advising committee in selecting courses and lab rotations in the first year and in choosing a lab for the dissertation research. Once a dissertation adviser has been selected, a dissertation committee including the dissertation adviser and two additional immunology faculty, is constituted to guide the student during the dissertation research. The student must meet with the dissertation committee once a year.

Candidates for Ph.D. degrees at Stanford must satisfactorily complete a three-year program of study that includes 72 units of graduate course work and research. At least 3 units must be taken with each of four different Stanford faculty members.

The requirements for the Ph.D. degree in Immunology include: Training in biology and cognate disciplines equivalent to that provided by the undergraduate Biology major at Stanford.

8. Completion of the following courses (or their equivalents from undergraduate work):
  - a. Basic Immunology (BIO 230A, Molecular and Cellular Immunology Literature Review)
  - b. Advanced Immunology (IMMUNOL 201, 202, 203)
  - c. Biochemistry and Molecular Biology (BIOC 220)
  - d. Advanced Genetics (GENE 203)
  - e. Cell Biology of Physiological Processes (MCP 221)
  - f. Biostatistics (BIO 141)
  - g. Principles of Biological Technologies (IMMUNOL 215)
  - h. One elective course; suggested courses include: MPHA 210, Signal Transduction Pathways and Networks; SBIO 241, Biological Macromolecules; CBIO 241, Cancer Biology; DBIO 210, Developmental Biology.
  - i. Responsible Conduct in Science (MED 255)
  - j. Immunology Journal Club (IMMUNOL 305)
9. First-year students are required to take both the IMMUNOL 311, Seminar in Immunology, and the companion course, IMMUNOL 311A, Seminar Discussion in Immunology, and participate in IMMUNOL 305, Immunology Journal Club. Students in their second year and above must participate in the IMMUNOL 311, Seminar in Immunology and may opt to take the companion course, IMMUNOL 311A. Students who have not yet achieved TGR status must register for 1 unit for IMMUNOL 311. Students attend the weekly Immunology Seminar Series (4-5 p.m., Tuesdays). Students read the papers of and have dinner with visiting seminar speakers two or three times each quarter, and meet to discuss the material.
10. Elective courses as agreed upon by the student, adviser, and advisory committee. Electives may be chosen from graduate courses and seminars in any of the biomedical science departments and programs.
11. Completion in the first year of three one quarter rotations. Two weeks after taking the comprehensive written examination (part 1 of the qualifying examination process) in mid-June, students, including MSTP and M.D./Ph.D. students, present their lab rotation research projects to the predoctoral committee. Medical students who have declared Immunology as their scholarly concentration major, and who are accepted later into the Ph.D. program, must do at least three rotations.
12. Teaching assistantship in two Immunology courses (IMMUNOL 290, Teaching in Immunology). A teaching assistantship requirement may be fulfilled by proposing a graduate student-initiated course IMMUNOL 315, Topics in Immunology. Before fulfilling their teaching assistantships, Immunology graduate students are required to undertake a teaching assistantship orientation offered at the beginning of every quarter by the Center for Teaching and Learning. MSTP students may submit one of their medical school TAs as partial fulfillment of the TA requirement for the Ph.D. in immunology.
13. For admission to Ph.D. candidacy, a comprehensive written examination (qualifying examination process, Part I) in immunology and related biomedical sciences, a rotation presentation on one of three lab rotations, must be completed satisfactorily by the middle of Summer Quarter of the first year. Students must prepare and defend a research proposal on their dissertation research (qualifying

examination process, Part II) by December 15th, the end of Autumn Quarter of their second year, and complete all core course requirements by the end of the second year. Administration and evaluation of these requirements leading to Ph.D. candidacy is the responsibility of the Predoctoral Committee; the student's dissertation committee is responsible for advising the student through the research and other courses as needed towards the completion of the Ph.D. dissertation.

14. Participation (through regular attendance and oral presentation) in the student-run immunology journal clubs for at least the first 2 years (IMMUNOL 305). First- through fourth-year students are also expected to attend the graduate students' journal club, the Tuesday evening immunology seminars, and the annual Stanford Immunology Scientific Conference at Asilomar. Students are required to give one poster and one scientific presentation at these annual Stanford Immunology scientific conferences.
15. Passing the University oral examination on the dissertation research, which is to be taken only after the student has substantially completed the research. The examination is preceded by a public seminar in which the candidate presents his/her research.
16. Completion of a Ph.D. dissertation, resulting from independent investigation and constituting a contribution to knowledge in the area of immunology.

## IMMUNOLOGY (IMMUNOL) COURSES

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For information on graduate programs in Immunology, see the "Immunology" section of this bulletin. Course and laboratory instruction in the Immunology Program 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/tph/8-2.html>.

### UNDERGRADUATE COURSES IN IMMUNOLOGY

#### **IMMUNOL 185. Brain and the Immune System**

(Same as IMMUNOL 285.) For advanced undergraduates, coterminous students, and graduate students. Molecular and cellular interactions between the nervous and immune systems. Focus is on the role of immune molecules in neural development, the bidirectional mechanisms by which the brain and immune system communicate with each other, and the role of the immune system in the diseased and infected brain. Topics include: molecular basis of fever, stress and inflammation, gender differences in autoimmune diseases, inflammation in neurodegenerative diseases, central nervous system infections, and the immune system in psychiatric disorders. Expert guest lectures, weekly discussion sections, and student presentations. Prerequisite: Biology or Human Biology core.

*3 units, Win (Steinman, L; Brownell, S; Price, J)*

### GRADUATE COURSES IN IMMUNOLOGY

Primarily for graduate students; undergraduates may enroll with consent of instructor.

#### **IMMUNOL 201. Advanced Immunology I**

(Same as MI 211.) For graduate and medical students and advanced undergraduates. Molecules and cells of the innate and adaptive immune systems; genetics, structure, and function of immune molecules; lymphocyte differentiation and activation; regulation of immune responses; autoimmunity and other problems in immune system dysfunction. Prerequisites: undergraduate course in Immunology and familiarity with experimental approaches in biochemistry, molecular biology, and cell biology.

*3 units, Win (Chien, Y)*

**IMMUNOL 202. Advanced Immunology II**

(Same as MCP 202.) Readings of immunological literature. Classic problems and emerging areas based on primary literature. Student and faculty presentations. Prerequisite: IMMUNOL 201.

3 units, Spr (Garcia, K)

**IMMUNOL 203. Advanced Immunology III**

Key experiments and papers in immunology. Student presentations and faculty participation; faculty describe their experimental process and scientific papers. Prerequisite: IMMUNOL 201/MI 211 or IMMUNOL 202/MCP 202.

3 units, Win (Utz, P)

**IMMUNOL 205. Immunology in Health and Disease**

Concepts and application of adaptive and innate immunology and the role of the immune system in human diseases. Case presentations of diseases including autoimmune diseases, infectious disease and vaccination, hematopoietic and solid organ transplantation, genetic and acquired immunodeficiencies, hypersensitivity reactions, and allergic diseases. Problem sets based on lectures and current clinical literature. Laboratory in acute and chronic inflammation.

2-4 units, Win (Lewis, D)

**IMMUNOL 215. Principles of Biological Technologies**

(Same as MI 215.) Required of first-year graduate students in Microbiology and Immunology, and the Immunology program. The principles underlying commonly utilized technical procedures in biological research. Lectures and primary literature critiques on gel electrophoresis, protein purification and stabilization, immunofluorescence microscopy, FACS. Prerequisites: biochemistry, organic chemistry, and physics.

3 units, Spr (Kirkegaard, K)

**IMMUNOL 240. Professional and Leadership Development**

Foundational skills for professional and leadership development. How to communicate, resolve conflict, negotiate, and present. Workshop format integrating intellectual and experiential learning.

2 units, Spr (Radermacher, A; Allen, J; Krams, S)

**IMMUNOL 285. Brain and the Immune System**

(Same as IMMUNOL 185.) For advanced undergraduates, coterminal students, and graduate students. Molecular and cellular interactions between the nervous and immune systems. Focus is on the role of immune molecules in neural development, the bi-directional mechanisms by which the brain and immune system communicate with each other, and the role of the immune system in the diseased and infected brain. Topics include: molecular basis of fever, stress and inflammation, gender differences in autoimmune diseases, inflammation in neurodegenerative diseases, central nervous system infections, and the immune system in psychiatric disorders. Expert guest lectures, weekly discussion sections, and student presentations. Prerequisite: Biology or Human Biology core.

3 units, Win (Steinman, L; Brownell, S; Price, J)

**IMMUNOL 290. Teaching in Immunology**

Practical experience in teaching by serving as a teaching assistant in an immunology course. Unit values are allotted individually to reflect the level of teaching responsibility assigned to the student. May be repeated for credit.

1-15 units, Aut (Staff), Win (Staff), Spr (Staff), Sum (Staff)

**IMMUNOL 299. Directed Reading in Immunology**

Prerequisite: consent of instructor.

1-15 units, Aut (Staff), Win (Staff), Spr (Staff), Sum (Staff)

**IMMUNOL 305. Immunology Journal Club**

Required of first- to fourth-year graduate students. Graduate students present and discuss recent papers in the literature. May be repeated for credit.

1 unit, Aut (Steinman, L), Win (Steinman, L), Spr (Steinman, L)

**IMMUNOL 311. Seminar in Immunology**

Enrollment limited to Ph.D., M.D./Ph.D., and medical students whose scholarly concentrations are in Immunology. Current research topics.

1 unit, Aut (Steinman, L; Fathman, C), Win (Steinman, L; Fathman, C), Spr (Steinman, L; Fathman, C)

**IMMUNOL 311A. Discussions in Immunology**

Students discuss papers of speakers in 311, and meet with the speakers. Corequisite: 311.

1 unit, Aut (Steinman, L; Fathman, C), Win (Steinman, L; Fathman, C), Spr (Steinman, L; Fathman, C)

**IMMUNOL 399. Graduate Research**

For Ph.D., M.D./Ph.D. students, and medical students whose scholarly concentrations are in Immunology.

1-15 units, Aut (Staff), Win (Staff), Spr (Staff), Sum (Staff)