IMMUNOLOGY

Courses offered by the Immunology Program are listed under the subject code IMMUNOL on the Stanford Bulletin's ExploreCourses web site.

Stanford Immunology is home to faculty, students, postdocs, and staff who work together to produce internationally recognized research in many areas of immunology. The long tradition of collaboration among the immunology laboratories at Stanford fosters productive interdisciplinary research, with an emphasis on the application of current approaches to problems in cellular, molecular and clinical immunology. Faculty research interests include both bench-to-bedside and basic science research. Graduate students and postdoctoral scholars receive outstanding training through their participation in research, teaching, seminars, journal clubs, and the annual Stanford Immunology Scientific Conference.

Mission of the Ph.D. Program in Immunology

The Immunology doctoral program offers instruction and research opportunities leading to a Ph.D. in Immunology. Two tracks are offered:

1. Track 1: Molecular, Cellular, and Translational Immunology
2. Track 2: Computational and Systems Immunology

The goal of the Ph.D. Program in Immunology is to develop investigators who have a strong foundation in Immunology and related sciences in order 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. Specifically, immunology graduate students:

1. acquire a fundamental, broad, and comprehensive body of knowledge and skills through an extensive curriculum.
2. identify important scientific questions, design, and conduct experiments using the most appropriate methods.
3. read and critically analyze current literature in immunology and other relevant fields.
4. present research findings and communicate ideas effectively to a variety of audiences.
5. prepare manuscripts that will be published in leading journals.
6. learn to teach effectively.

Master of Science in Immunology

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

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. 3 quarters of graduate research (IMMUNOL 399 Graduate Research), consisting of rotations in the labs of three faculty members.
3. Participation in the Immunology journal club (IMMUNOL 305 Immunology Journal Club), and attendance at the Immunology seminar series (Immunol 311 Seminar in Immunology) and at the annual Stanford Immunology Scientific Conference.
4. First Year Rotations Presentations and General Advising Sessions, June. Students present on one of three lab rotations.
5. Students must submit a master's thesis paper on one of their rotations. This requirement may be waived under special circumstances.

Course work in Immunology as follows:

Track: Molecular, Cellular and Translational Immunology

		Units
BIOS 200	Foundations in Experimental Biology	5
IMMUNOL 201	Advanced Immunology I	3
IMMUNOL 202	Advanced Immunology II	3
IMMUNOL 203	Advanced Immunology III	3
IMMUNOL 311	Seminar in Immunology	1
IMMUNOL 305	Immunology Journal Club	1
IMMUNOL 399	Graduate Research	1-15
BIO 141	Biostatistics	3-5
MED 255	The Responsible Conduct of Research	1
Take one of the following courses:		
MI 210	Advanced Pathogenesis of Bacteria, Viruses, and Eukaryotic Parasites	4
BIO 214	Advanced Cell Biology	4
IMMUNOL 206	Introduction to Applied Computational Tools in Immunology	2

Track: Computational and Systems Immunology

		Units
BIOS 200	Foundations in Experimental Biology	5
IMMUNOL 201	Advanced Immunology I	3
IMMUNOL 202	Advanced Immunology II	3
IMMUNOL 206	Introduction to Applied Computational Tools in Immunology	2
IMMUNOL 207	Essential Methods in Computational and Systems Immunology	3
IMMUNOL 310	Seminars in Computational and Systems Immunology	1
BIOMEDIN 212	Introduction to Biomedical Informatics Research Methodology	3
BIOMEDIN 214	Representations and Algorithms for Computational Molecular Biology	3-4
IMMUNOL 399	Graduate Research	1-15
MED 255	The Responsible Conduct of Research	1

Doctor of Philosophy in Immunology

The University's basic requirements for the Ph.D. degree are outlined in the "Graduate Degrees (http://exploredegrees.stanford.edu/graduatedegrees)" section of this bulletin.

Admissions

Students seeking admissions to the Immunology Ph.D. Program typically have an undergraduate major in biological sciences, but majors from other areas are acceptable if the applicants have sufficient coursework in biology, chemistry, general physics, and mathematics (through calculus). Applications are evaluated by the Immunology Graduate Program 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. The GRE Subject test is not required. Applicants should plan on taking the GRE at least one month prior to the application deadline of Wednesday, November 28, 2018 to ensure that official scores are available when applications are evaluated. Candidates who are selected to visit Stanford and interview are notified in January. The selected applicants are invited to the Biosciences interview session, February 27-March 2, 2019 (Wednesday-Sunday). This is the program's only interview session.

Interested Stanford medical students are welcome to apply to the program and should also submit a formal application by Wednesday, November 28, 2018.

Prospective graduate students must apply via Stanford's online graduate application (https://gradadmissions.stanford.edu/applying).

Financial Aid

Students admitted to the program are offered financial support for tuition, a living stipend, insurance coverage, and for first-year graduate students, a small allowance for books/travel. Applicants are urged to apply for independent fellowships such as from the National Science Foundation or National Defense Science and Engineering Graduate Fellowships. NSF Fellowship applications are due in November of the year prior to matriculation in the graduate program, and only one more NSF application is permitted in the first or second year. Immunology graduate students may continue to apply for outside fellowships after matriculation. Admitted students are typically offered financial support in the form of Stanford Graduate Fellowships, NIH traineeships, or research assistantships.

General Requirements

Immunology Startup and the First-Year Advising Process

Since students enter with differing backgrounds, each student is assisted by the first-year adviser in selecting courses and lab rotations in the first year and in choosing a lab for the dissertation research. In addition, the Immunology Startup, a five-day introduction to immunology in early September, exposes incoming Immunology Ph.D. students to a variety of techniques and concepts. Students learn basic laboratory techniques in immunology and participate in in-depth discussions with faculty.

All students must be enrolled in exactly 10 units during Autumn, Winter, Spring, and Summer quarters until reaching Terminal Graduate Residence (TGR) status in the spring or summer quarter of their fourth year. Students are required to pass all courses in which they are enrolled; required and elective courses must be taken for a letter grade. Students must earn a grade of 'B-' or better in all courses applicable to the degree that are taken for a letter grade. Satisfactory completion of each year's general and track specific requirements listed below is required. During the first year, degree progress is monitored closely by the first-year adviser in quarterly meetings and by the Stanford Graduate Program Committee in a final advising session in June.

First-year students are required to complete three rotations in at least two immunology labs. In the Spring Quarter, two mini-rotations of six weeks each may be arranged. After joining a lab, students are required to meet with their thesis adviser within 30 days to complete the Individual Development Plan (IDP). Students continue to complete the IDP annually.

Students apply for any fellowships for which they are eligible (NSF, NDSEG, AHA, NIH NRSA are just a few).

A specific program of study for each student is developed individually with the first-year adviser.

Immunology Ph.D. Curriculum:

All students in the two tracks, Molecular, Cellular, and Translational Immunology (MCTI) and Computational and Systems Immunology (CSI) are required to enroll in the following core courses:

		Units
BIOS 200	Foundations in Experimental Biology	5
IMMUNOL 201	Advanced Immunology I	3
IMMUNOL 202	Advanced Immunology II	3
IMMUNOL 305	Immunology Journal Club	1
IMMUNOL 311	Seminar in Immunology	1
BIO 141	Biostatistics	3-5
IMMUNOL 399	Graduate Research	1-15
IMMUNOL 290	Teaching in Immunology	1-15
MED 255	The Responsible Conduct of Research	1
IMMUNOL 258	Ethics, Science, and Society	1

Candidates for Ph.D. degrees at Stanford must satisfactorily complete a program of study that includes 135 units of graduate course work and research. At least 3 units must be taken with each of four different Stanford faculty members. Students in the MCTI track are expected to complete all their core course requirements by the end of their second year; students in the CSI track should complete their core course work by the end of the third year.

In the third through fifth year, students are required to take IMMUNOL 258 Ethics, Science, and Society, a refresher ethics course that is required by NIH and is offered every other year.

Immediately after the final examination period in Spring Quarter of the first year, first-year immunology graduate students are required to give a presentation on one of their three rotations to the Immunology graduate program committee (Qualifying Examination Process, Part I). After the rotation presentation, the first-year student will meet with the Stanford graduate program committee in a one-on-one advising session to review degree progress and choice of a Ph.D. thesis lab.

In Autumn Quarter of the second year, students focus on preparing for Part II of the Qualifying Examination Process, the general oral examination and the Ph.D. thesis dissertation proposal. The student is required to pass the oral examination and write a thesis dissertation proposal which is presented to and evaluated by a qualifying examination committee composed of three faculty members, two of whom may be from the Immunology program faculty and the third faculty member from a department outside the program. The Ph.D. adviser is not present for Part II, but is required to submit an evaluation and grade for the Ph.D. thesis dissertation proposal. Upon successful completion of Part II, the student files a petition for Ph.D. candidacy and form their reading dissertation committee.

The dissertation reading committee (generally known as the Ph.D. thesis committee) must be comprised of at least four faculty members who guide the student in the Ph.D. research, and read and approve the final dissertation. Typically three of the four dissertation reading committee members are from the Immunology program faculty.

In the first through third years, the student must meet with the Ph.D. thesis committee at least once a year. In the fourth and fifth years, the student is expected to meet twice a year with the Ph.D. thesis committee. In addition, if requested by the student, a secondary adviser is assigned who can provide additional advice on issues such as career path choices and other non-academic issues.

Individual Development Plan: Graduate students are required to meet with their faculty mentors once a year to discuss an individual development plan (IDP). The IDP is intended to help the students take ownership of their training and professional development. The goals of the IDP are to: 1) pause, reflect and intentionally think on short-, mid- and long-term goals; 2) identify resources that help to achieve these goals; and 3) have open and direct dialogue with the Ph.D. thesis adviser and establish clear expectations and steps.

Track Specific Requirements

In addition to the general requirements listed above, students must also complete requirements within their track. Written petitions for exemptions to core curriculum and lab rotation requirements are considered only in the first year by the advising committee and the chair of the Graduate Program committee. Approval is contingent upon special circumstances and is not routinely granted.

Molecular, Cellular, and Translational Immunology

MCTI first-year students are required to take the following courses in their first year for a letter grade:

		Units
IMMUNOL 203	Advanced Immunology III	3
Take one of the following courses:		
MI 210	Advanced Pathogenesis of Bacteria, Viruses, and Eukaryotic Parasites	4
BIO 214	Advanced Cell Biology	4
IMMUNOL 206	Introduction to Applied Computational Tools in Immunology	2

Electives:

One elective (see elective list below)

		Units
IMMUNOL 275	Tumor Immunology	3
CSB 210	Cell Signaling	4
SBIO 241	Biological Macromolecules	3-5
DBIO 210	Developmental Biology	4
CBIO 240	Molecular and Genetic Basis of Cancer	4

Computational and Systems Immunology

The CSI curriculum trains students to be computational and experimental scientists, who are expected to identify important problems in immunology and to devise integrated computational/ experimental plans for addressing them.

CSI Core (Required):

Students in the CSI track are required to take the following core courses in their first and second years, unless demonstrated by proficiency or coursework. For example, a student, with proficiency in concepts taught in CS 106A, may petition to be exempt from this course and go on to take CS 106B. Petitions to exempt from the courses CS 106A, CS 109, and CS 161 must be approved by the Chair of the CSI track.

		Units
CS 106A	Programming Methodology	3-5
CS 106B	Programming Abstractions	3-5
CS 109	Introduction to Probability for Computer Scientists	3-5
CS 161	Design and Analysis of Algorithms	3-5
IMMUNOL 206	Introduction to Applied Computational Tools in Immunology	2
IMMUNOL 207	Essential Methods in Computational and Systems Immunology	3
IMMUNOL 310	Seminars in Computational and Systems Immunology	1
BIOMEDIN 214	Representations and Algorithms for Computational Molecular Biology	3-4

CSI Electives:

Two electives (see elective list below):

		Units
BIOMEDIN 212	Introduction to Biomedical Informatics Research Methodology	3-5
BIOMEDIN 217	Translational Bioinformatics	4
BIOMEDIN 260	Computational Methods for Biomedical Image Analysis and Interpretation	3-4
CME 206	Introduction to Numerical Methods for Engineering	3
CME 263	Introduction to Linear Dynamical Systems	3
CME 309	Randomized Algorithms and Probabilistic Analysis	3
CME 334		3
CME 364A	Convex Optimization I	3
CME 372	Applied Fourier Analysis and Elements of Modern Signal Processing	3
EE 376A	Information Theory	3
EE 278	Introduction to Statistical Signal Processing	3
STATS 116	Theory of Probability	4
STATS 201		
STATS 202	Data Mining and Analysis	3
STATS 216	Introduction to Statistical Learning	3
STATS 217	Introduction to Stochastic Processes I	3
Other		

Journal Clubs

Both MCTI and CSI students are required to attend the IMMUNOL 305 Immunology Journal Club for their first through third years. Attendance is optional for fourth year and above graduate students.

Immunology and CSI Seminar Series

Graduate seminars are an important means of attaining a broad and comprehensive exposure to all areas in immunology as well as gaining a professional perspective and competence in the field. First-year students are required to attend all immunology seminars (IMMUNOL 311 Seminar in Immunology). Students in their second year and above are required to attend 50% of the seminar series each academic year until the last quarter in which their Ph.D. oral defense takes place. Students in the CSI track are required to attend the Computational and Systems Immunology Seminar Series (IMMUNOL 310 Seminars in Computational and Systems Immunology) held every Summer Quarter.

Immunology Scientific Retreat

In the autumn quarter, the annual Retreat is held at the Asilomar Conference Grounds, Pacific Grove, CA, and is attended by students, staff, postdocs and faculty of the Stanford immunology community. All immunology graduate students are required to attend. In the third through fifth years, students will present a poster and give a talk on their graduate research.

Teaching Assistantships

Teaching experience and training are part of the graduate curriculum. Each student assists in teaching two courses in the immunology core or electives. A TA match process is held in summer quarter in order to match the graduate student's research and teaching preferences to the appropriate courses. Before beginning their assigned teaching assistantships, students are required to attend a TA orientation workshop held by VPTL once a year in late September.

First Author Paper Submission

By the fourth or fifth year, graduate students are expected to submit a first author paper for publication. This milestone should be completed before defending a Ph.D. thesis.

Doctoral Dissertation

Before embarking on the dissertation defense process, the graduate student must submit a Petition to Defend to the Director of the Immunology Graduate Program. Important milestones and degree requirements must be met before proceeding to the oral examination. A substantial draft of the dissertation must be turned in to the student's oral examination committee at least one month before the oral exam is scheduled to take place. At the time of the Ph.D. orals defense, an

orals chair is chosen to lead the orals committee, which is a distinct committee, but the basic membership is identical to that of the dissertation reading committee. The correct number of faculty committee members for the orals committee is five. For students with two Ph.D. thesis co-advisors, the exact number of faculty committee members is still five. The final written dissertation must be approved by the student's reading committee and submitted to the Registrar's Office. Upon completion of this final requirement, a student is eligible for conferral of the Ph.D. degree.

Graduate Advising Expectations

The Immunology Program is committed to providing academic advising in support of graduate student scholarly and professional development. This includes first year advising by the program director and ongoing advising with the research mentor in subsequent years. When most effective, this advising relationship entails collaborative and sustained engagement by both the adviser and the advisee. As a best practice, advising expectations should be periodically discussed and reviewed to ensure mutual understanding. Both the adviser and the advisee are expected to maintain professionalism and integrity.

Faculty advisers guide students in key areas such as selecting courses, designing and conducting research, developing of teaching pedagogy, navigating policies and degree requirements, and exploring academic opportunities and professional pathways.

In addition, the advising process includes guidelines and expectations for graduate student professional conduct, which prepares the student to be responsible members of professional communities. https://gap.stanford.edu/handbooks/gap-handbook/chapter-5/subchapter-6/page-5-6-1.

Graduate students are active contributors to the advising relationship, proactively seeking academic and professional guidance and taking responsibility for informing themselves of policies and degree requirements for their graduate program.

For a statement of University policy on graduate advising, see the "Graduate Advising (http://exploredegrees.stanford.edu/graduatedegrees/#advisingandcredentialstext)" section of this bulletin.

Faculty

Director, Stanford Immunology and Chair, Executive Committee for the Immunology Program and Director, Ph.D. Program in Immunology: Olivia Martinez (Professor, Research, Surgery, Abdominal Transplantation)

Participating Departments and Faculty (Molecular, Cellular, Translational Immunology Track)

Biochemistry: Peter Kim (Professor), Lingyin Li (Assistant Professor)

Bioengineering: Jennifer Cochran (Associate Professor and Chair, and by courtesy, Chemical Engineering), Stephen Quake (Professor, and Applied Physics and Physics)

Biology: Patricia P. Jones (Professor)

Chemistry: Carolyn Bertozzi (Professor, of Radiology and of Chemical and Systems Biology)

Genetics: William Greenleaf (Associate Professor, and by courtesy, Applied Physics), Leonore A. Herzenberg (Professor, Research), Karla Kirkegaard (Professor, and of Microbiology & Immunology), Michael Snyder (Professor)

Medicine/Biomedical Informatics Research: Purvesh Khatri (Assistant Professor, Research)

Medicine/Blood and Bone Marrow Transplantation Program: Everett Meyer (Assistant Professor), David Miklos (Associate Professor), Robert Negrin (Professor), Judith Shizuru (Professor)

Medicine/Cardiovascular Medicine: Joseph Wu (Professor, and Radiology)

Medicine/Endocrinology: Joy Wu (Assistant Professor)

Medicine/Gastroenterology and Hepatology: Aida Habtezion (Associate Professor)

Medicine/Hematology: Ravi Majeti (Associate Professor)

Medicine/Immunology and Rheumatology: C. Garrison Fathman (Professor), Jorg Goronzy (Professor), William Robinson (Professor), Samuel Strober (Professor), Paul J. Utz (Professor), Cornelia Weyand (Professor)

Medicine/Infectious Diseases: Catherine Blish (Associate Professor), Paul Bollyky (Assistant Professor, and of Microbiology & Immunology), Prasanna Jagannathan (Assistant Professor), Taia T. Wang (Assistant Professor)

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

Medicine/Nephrology: Jonathan Maltzman (Associate Professor)

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

Microbiology and Immunology: John Boothroyd (Professor), Yueh-Hsiu Chien (Professor), Mark M. Davis (Professor, and Director, Institute for Immunity, Transplantation and Infection), Juliana Idoyaga (Assistant Professor), Holden Maecker (Professor, Research), Hugh McDevitt (Professor, Emeritus), Denise Monack (Professor), Garry P. Nolan (Professor), David Schneider (Professor)

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

Neurology and Neurological Sciences: Katrin Andreasson (Professor), May Han (Associate Professor), Lawrence Steinman (Professor, and of Pediatrics), Tony Wyss-Coray (Professor)

Neurosurgery: Theo Palmer (Professor)

Otolaryngology/Head and Neck Surgery (ENT): Jayakar Nayak (Associate Professor), John B. Sunwoo (Professor)

Pathology: Robert Michael Angelo (Assistant Professor), Sean Bendall (Assistant Professor, Research), Scott Boyd (Associate Professor), Eugene C. Butcher (Professor), Michael Cleary (Professor), Gerald R. Crabtree (Professor, and of Developmental Biology), Edgar G. Engleman (Professor, and of Medicine/Immunology and Rheumatology), Andrew Fire (Professor, and Genetics), Stephen Galli (Professor), Michale Howitt (Assistant Professor), Siddhartha Jaiswal (Assistant Professor), Sara Michie (Professor), Bali Pulendran (Professor, and of Microbiology & Immunology), Raymond A. Sobel (Professor), Irving Weissman (Professor, and Director, Stem Cell and Regenerative Medicine Institute, and of Developmental Biology, Biology)

Pediatrics: Rosa Bacchetta (Associate Professor, Research, Stem Cell Transplantation), Alice Bertaina (Associate Professor, Stem Cell Transplantation), Agniexzka Czechowicz (Assistant Professor, Stem Cell Tranplantation), David B. Lewis (Professor, Immunology and Allergy), Crystal Mackall (Professor, Hematology/Oncology, and of Medicine), Maria Grazia Roncarolo (Professor, Stem Cell Transplantation, and of Medicine/Blood and Marrow Transplantation), Elizabeth Mellins

(Professor, Human Gene Therapy), Kari Nadeau (Professor, Allergy and Clinical Immunology, and of Otolaryngology, Head & Neck Surgery)

Psychiatry and Behavioral Sciences: Emmanuel Mignot (Professor, Sleep Medicine)

Radiology: Parag Mallick (Assistant Professor, Research, and of Diagnostic Radiology)

Structural Biology: Peter Parham (Professor, and of Microbiology and Immunology), Theodore Jardetzky (Professor)

Surgery/Multi-Organ Transplantation: Charles F. Chan (Assistant Professor, Plastic Surgery and Reconstructive Surgery), Sheri Krams (Professor, Research), Olivia Martinez (Professor, Research)

Participating Departments and Faculty (Computational and Systems Immunology)

Anesthesiology, Perioperative and Pain Medicine: Nima Aghaeepour (Assistant Professor)

Bioengineering: Stephen Quake (Professor, and Applied Physics and Physics)

Genetics: Michael Snyder (Professor), Karla Kirkegaard (Professor, and of Microbiology & Immunology)

Biomedical Data Science: Aaron Newman (Assistant Professor)

Medicine/Biomedical Informatics Research: Andrew Gentles (Assistant Professor, Research, and by courtesy, of Biomedical Data Science), Purvesh Khatri (Assistant Professor, Research)

Medicine/Immunology and Rheumatology: Paul J. Utz (Professor)

Medicine/Oncology: Ash Alizadeh (Associate Professor)

Microbiology and Immunology: John Boothroyd (Professor), Mark M. Davis (Professor, and Director, Institute for Immunity, Transplantation and Infection), Holden Maecker (Professor, Research), Garry Nolan (Professor)

Pathology: Sean Bendall (Assistant Professor, Research), Scott Boyd (Associate Professor), Andrew Fire (Professor, and of Genetics)

Radiology: Parag Mallick (Assistant Professor, Research, and of Diagnostic Radiology)

Affiliate Members:

Biochemistry: Ron Davis (Professor, and of Genetics)

Bioengineering: Russ Altman (Professor, and of Genetics and of Computer Science)

Health and Research Policy - Biostatistics: Robert Tibshirani (Professor, and of Statistics