COMPARATIVE MEDICINE

Courses offered by the Department of Comparative Medicine are listed under the subject code COMPMED on the Stanford Bulletin’s ExploreCourses web site.

The Department of Comparative Medicine at Stanford is an academic, basic science department, the department is comprised of eleven faculty, eight of whom are veterinarians. All of our faculty members are immersed in laboratory animal science and translational research. They teach at the undergraduate, graduate, professional and post-graduate levels. Our clinical and basic science faculty welcome, review and accept student candidates for participation in research projects. The Department of Comparative Medicine was established at Stanford in 1990.

The Department’s faculty are also engaged in collaborative and comparative research, with animal model expertise and programs in veterinary pathology, pain and anesthesia, rodent reproductive biology, infectious disease, cancer, bioengineering, animal welfare and neuroscience. In addition, the veterinary faculty in the Department of Comparative Medicine have oversight responsibility for the campus-wide animal research program and provide clinical service in the Veterinary Service Center. Our mission is to advance human and animal health through outstanding research, veterinary care and training.

Master of Science in Laboratory Animal Science

This degree is designed for individuals who wish to undertake in-depth study of biomedical research focusing on animal modeling and biomedicine, laboratory animal science, organizational management and facility design, regulation and compliance, and animal welfare.

The first year involves acquiring concepts and tools through course work and research project involvement. All first- and second-year students are expected to devote 50 percent or more of their time participating in research projects. Research rotations are not required, but can be done with approval of the academic adviser or training program director. This degree requires a master’s thesis project to be approved by two faculty members.

Admissions Requirements

Applicants must have a bachelor’s degree from an accredited U.S college or University or an equivalent international institution. Applicants should have completed courses in at least two of the following areas:

- Genetics
- Molecular Biology
- Chemistry
- Physiology

Official transcripts from all postsecondary institutions where courses were attempted or completed are also required. Applicants must submit GRE scores obtained within the last five years and three letters of reference must be provided with at least one from a science professor.

Degree Requirements:

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. At least 3 quarters of graduate research, COMPMED 399.
3. Completion of a biostatistics course.
4. Students must complete a master’s thesis, which may take the following form:
   a. Original analysis of original data
   b. A comprehensive literature review with a meta-analysis of data or a critical reanalysis of data.
   c. Evaluation of a methodological problem using real data
   d. A comprehensive literature review with a grant proposal (NIH style format) for a new study to bridge a gap in the existing knowledge.
5. Participation in the Comparative Medicine journal club, and attendance at the Laboratory Animal Medicine seminar series.

Master of Science in Laboratory Animal Science (Coterminal)

The coterminal degree program allows Stanford University undergraduates to study for a master’s degree while completing their bachelor’s degree(s) in the same or a different department. See the "Coterminal Degrees" section of this bulletin for additional information.

The coterminal Master of Science program follows the same program requirements as the Master of Science. The coterminal degree is available only to current Stanford undergraduates. Coterminal students are enrolled full-time and courses are taken on campus. Their added year focuses on biostatistics, the research laboratory experience, and animal modeling. The specific curriculum is tailored to the students’ needs. This degree requires a written research paper to be approved by two faculty members.

Programs of at least 45 Stanford units that meet the following guidelines are normally approved:

1. Completion of the core requirements with overall GPA of 3.0.
2. Students are expected to participate regularly in Comparative Medicine journal club, and attendance at the Laboratory Animal Medicine seminar series.
3. Electives: additional courses to bring the total to 45 or more units taken at Stanford to fulfill the University's residency requirement.

University Coterminal Requirements

Coterminal master’s degree candidates are expected to complete all master’s degree requirements as described in this bulletin. University requirements for the coterminal master’s degree are described in the “Coterminal Master’s Program (http://exploredegrees.stanford.edu/archive/2016-17/cotermdegrees) " section. University requirements for the master’s degree are described in the “Graduate Degrees (http://exploredegrees.stanford.edu/archive/2016-17/graduatedegrees/masterstext) " section of this bulletin.

After accepting admission to this coterminal master’s degree program, students may request transfer of courses from the undergraduate to the graduate career to satisfy requirements for the master’s degree. Transfer of courses to the graduate career requires review and approval of both the undergraduate and graduate programs on a case by case basis.

In this master’s program, courses taken three quarters prior to the first graduate quarter, or later, are eligible for consideration for transfer to the graduate career. No courses taken prior to the first quarter of the sophomore year may be used to meet master’s degree requirements.
Course transfers are not possible after the bachelor's degree has been conferred.

The University requires that the graduate adviser be assigned in the student’s first graduate quarter even though the undergraduate career may still be open. The University also requires that the Master's Degree Program Proposal be completed by the student and approved by the department by the end of the student’s first graduate quarter.

Chair: Sherril Green

Professors: Donna M. Bouley, Paul Buckmaster, Sherril Green, Shaul Hestrin

Associate Professors: Corinna Darian-Smith, Stephen Felt, Joseph Garner

Assistant Professors: Megan Albertelli, Monika Huss, Claude Nagamine, Cholawat Pacharinsak, Jose Vilches-Moure,

Courtesy Professor: Hannes Vogel

Courtesy Associate Professor: Mehrdad Shamloo

Courses

COMPMED 11SC. Life in the Zoo: Behavior, Welfare and Enrichment. 2 Units.

What makes for a good life in a zoo? For that matter, what makes a good zoo? The psychological and physical wellbeing of the animals? The contribution to research, conservation, and education? The guest experience? Students will learn first-hand how animal welfare science provides an evidence-based approach to optimize and balance each of these demands so that "good welfare is good business." Through a unique experience at San Francisco Zoo students will learn how to apply principles of animal behavior to design environmental enrichments which benefit both the animals and the complex mission of a zoo. Students will be guided through the process of assessing an exhibit from the point of view of the animal's behavior and wellbeing, educational opportunities, and guest experience; developing an enrichment plan; designing and building enrichments for the animals; interacting with the public as docents; and assessing the overall effectiveness of a new enrichment; before finally presenting their work at a "mini-conference." The course will be taught with an emphasis on self-guided learning, student-led class time, hands-on experience, and service-learning. Most days will begin with students presenting what they have learned the previous day to the class, followed by student-led discussion, preparation time for the day’s activities, and then time out in the zoo. The course will be taught by Dr. Garner (whose introductory seminar in Animal Behavior is strongly recommended, though not required) and Dr. Watters (Vice President of Animal Wellness and Animal Behavior, San Francisco Zoological Society).

COMPMED 80N. Animal behavior: sex, death, and sometimes food!. 3 Units.

Preference to freshman. Behavior is what makes animals special (thirsty plants don't walk to water), but why do animals behave the way they do? What does their behavior tell us about their inner lives, and about ourselves? What do lipstick and cuckoos and fireflies have in common? Why would nobody want to be a penguin? What do mice say to each other ourselves? What do lipstick and cuckoos and fireflies have in common? Why would nobody want to be a penguin? What do mice say to each other, and why do animals behave the way they do? What does their behavior tell us about their inner lives, and about ourselves? What do lipstick and cuckoos and fireflies have in common? Why would nobody want to be a penguin? What do mice say to each other? How and why animals are used in biomedical science. Addresses human and animal disease entities and how animal research has contributed to the treatment and cure of disease. Significan proportin of this course are devoted to documenting the humane care and treatment of laboratory animals in research, including, but not limited to such topics as laws and ethics, animal behavior, animal modeling, and the animal activist movement. Course topics will also include: What advances have been made as a result of the use of animals in research? Who conducts animal research? Predominant animal species used in biomedical research, facts and myths; the regulation of biomedical research; housing and care of laboratory animals; why new drugs must be tested; animal use in stem cell research, cancer research and genetically engineered mice; career choices in biomedical research.

COMPMED 85N. Animal Use in Biomedical Research. 3 Units.

Preference to sophomores. Focus is on the laboratory mouse, a widely used and important research model. Topics include the ethics of animal use in research; the natural history, origin and husbandry of the mouse; characteristics of key mouse strains; its anatomy and physiology; common diseases and their effects on research; coat color genetics relative to human diseases; immunodeficient mouse models; and genetic engineering of mice. The laboratory includes necropsy, handling, introduction to anesthesia and surgery, identification methods; and common research techniques using live and dead mice. Enrollment limited to 14 students.

COMPMED 84Q. Globally Emerging Zoonotic Diseases. 3 Units.

Preference to sophomores. Infectious diseases impacting veterinary and human health around the world today. Mechanisms of disease, epidemiology, and underlying diagnostic, treatment and control principles associated with these pathogens.

COMPMED 87Q. Laboratory Mouse in Biomedical Research. 3 Units.

Preference to sophomores. Focus is on the laboratory mouse, a widely used and important research model. Topics include the ethics of animal use in research; the natural history, origin and husbandry of the mouse; characteristics of key mouse strains; its anatomy and physiology; common diseases and their effects on research; coat color genetics relative to human diseases; immunodeficient mouse models; and genetic engineering of mice. The laboratory includes necropsy, handling, introduction to anesthesia and surgery, identification methods; and common research techniques using live and dead mice. Enrollment limited to 14 students.

COMPMED 83. Horse Medicine. 2 Units.

Preference to freshmen. How and why animals are used in biomedical science. Addresses human and animal disease entities and how animal research has contributed to the treatment and cure of disease. Significant portions of this course are devoted to documenting the humane care and treatment of laboratory animals in research, including, but not limited to such topics as laws and ethics, animal behavior, animal modeling, and the animal activist movement. Course topics will also include: What advances have been made as a result of the use of animals in research? Who conducts animal research? Predominant animal species used in biomedical research, facts and myths; the regulation of biomedical research; housing and care of laboratory animals; why new drugs must be tested; animal use in stem cell research, cancer research and genetically engineered mice; career choices in biomedical research.

COMPMED 86N. Comparative Anatomy and Physiology of Mammals. 3 Units.

Preference to freshmen. Emphasis is on a comparative approach to anatomy and physiology of a wide range of mammals, the unique adaptations of each species in terms of its anatomical, and behavioral characteristics, and how these species interact with human beings and other animals. Dissection required. Class size is limited to 16.

COMPMED 80Q. Ouch it Hurts! The Comparative Neurobiology of Pain. 3 Units.

Preference to sophomores. Focus is on understanding the basic neurobiology of pain pathways. Topics include the physiology, pharmacology, and clinical aspects of effective pain management. In both humans and animals pain is part of the protective mechanisms that prevent further injury to the body. However, if the pain process continues unchecked, it can become extremely detrimental.

COMPMED 107. Comparative Brain Evolution. 4 Units.

Functional organization and evolution of the vertebrate nervous system. Topics include paleoneurology, cladistic analysis, allometry, mosaic versus concerted evolution, and evolution of brain region structure, connectivity, and neurons. Comparisons between structure and function of vertebrate forebrains including hippocampi. Evolution of the primate visual and sensorimotor central nervous system as related to vocalization, socialization, and intelligence. Same as: COMPMED 207
COMP MED 110. Pre-Vet Advisory. 1 Unit.
For students interested in a career in veterinary medicine. How to meet
the academic and practical experience prerequisites for admission to
veterinary school. Networking with other pre-vet students. Periodic group
meetings with guest speakers presenting career options in veterinary
medicine. Prerequisite: consent of instructor.

COMP MED 198. Undergraduate Directed Reading in Comparative
Medicine. 1-3 Unit.
May be taken as a prelude to research and may also involve participation
in a lab or research group seminar and/or library research.

COMP MED 199. Undergraduate Research. 1-3 Unit.
Investigations sponsored by individual faculty members. Prerequisite:
consent of instructor.

COMP MED 200. Comparative Medicine Seminar and One Health Journal
Club. 1 Unit.
Focus is on animal modeling and translational research that examines
animal and human diseases. Teaches critical reading of scientific papers
and presentation skills. Participants report on recent scientific articles
and provide updates on their own research projects. Enrollment limited
to undergraduate and graduate students currently matriculated or planning
to enroll in the MS in Laboratory Animal Science degree program.

COMP MED 201. Neuro-Cellular Core. 2 Units.
Focuses on fundamental aspects of cellular neurophysiology. Topics
include exploration of electrophysiological properties of neurons,
synaptic structure and function and synaptic plasticity. The course
consists of didactic lectures and student-led discussions of classical
papers. Incorporates simulation program Neuron. Enrollment restricted to
students enrolled in Neurosciences Graduate Program.
Same as: NEPR 201

COMP MED 202. Training in Research and Biomethodology for Laboratory
Animal Science. 5 Units.
Emphasis is on providing introductory training and practical, hands-
on workshops for students interested in learning more about research
biomethodology and animal models of human and animal disease.
Topics include basic care and principals guiding the use of research
animals, animal health and welfare, and research animal enrichment,
basic mouse handling, rodent breeding, and the principals of rodent
surgery and anesthesia. Content delivered online and in-person.

COMP MED 207. Comparative Brain Evolution. 4 Units.
Functional organization and evolution of the vertebrate nervous system.
Topics include paleoneurology, cladistic analysis, allometry, mosaic
versus concerted evolution, and evolution of brain region structure,
connectivity, and neurons. Comparisons between structure and
function of vertebrate forebrains including hippocampi. Evolution of the
primate visual and sensorimotor central nervous system as related to
vocalization, socialization, and intelligence.
Same as: COMP MED 107

COMP MED 209. Laboratory Animal Medicine Seminar. 2 Units.
Focuses on husbandry, care and diseases of laboratory animal species;
experimental techniques; statistics; factors that influence animal
research and behavior. Course content is divided into seminars over a
two-year period. Department consent required for enrollment. May be
repeated for credit.

COMP MED 210. Introduction to Mouse Histopathology. 3 Units.
Focus is on anatomy and histology (microscopic anatomy) of the entire
mouse, proper instrument handling and dissection technique, proper
tissue fixation, trimming and orientation in cassettes, identification of
normal organ histology on H & E-stained slides using a light microscope,
use of special stains, and digital image acquisition. Basic pathological
processes (inflammation, necrosis, apoptosis, hyperplasia, cancer) and
how these manifest in different organs comprises the pathology aspect
of this course. Participants present the pathology of their lab's mouse
models. Preference to graduate students working with mouse models.
Dissection labs. Comfort with mouse handling and previous participation
in VSC mouse handling and euthanasia workshops recommended.

COMP MED 211. Biostatistics for the Life Sciences: Best practices for
reproducibility and translation. 2 Units.
Preference to students in the MLAS program. Interested students should
contact the Comparative Medicine Department to enroll. Emphasis
is on real-world experimental design and analysis in the life sciences,
with particular focus on modern techniques that maximize power and
minimize sample size, and avoiding common errors contributing to false
discovery and the reproducibility crisis. This is flipped-classroom. Class
time is devoted to discussion of assigned reading (primarily Grafen &
Hails 2002 "Modern statistics for the life sciences"), criticism of papers,
working through example data sets, and developing analyses for the
students' own data. The course studiously avoids the use of equations to
explain anything. Enrollment is limited to MLAS students, unless student
has course director consent.

COMP MED 215. Synaptic Properties and Neuronal Circuits. 2-3 Units.
Focus is on synapses and circuits in the central nervous system.
Objective is to demonstrate how the specific properties of different
synapses play a role in the function of neuronal circuits. The main types
of synapses are covered, including both ionotropic and metabotropic-
receptor-dependent synapses and their related circuits in the CNS.
Lectures and student presentations. If taken for 3 units qualifies
as a Core Course satisfying requirements in Cellular, Molecular &
Developmental Neuroscience in the Neurosciences Graduate Program.
Students enrolling for 3 units write an NIH-style proposal on a selected
synapse, proposing a study of its properties and related function and
presenting the proposal to the class for critique and discussion.

COMP MED 260. MLAS Practicum. 1-15 Unit.
Research Practicum for the Laboratory Animal Medicine Program..
Students enroll in Research advisor's section. Non-medical students
enroll for a letter grade. One unit = three hours of work per week (30 hours
for the quarter).

COMP MED 290. MLAS Career Development. 1-6 Unit.
Restricted to MLAS students. Focus is on career exploration for
students interested in the field of laboratory animal care, animal facility
management or animal welfare. Limited enrollment. Requires department
approval to enroll. May be taken up to six quarters.

COMP MED 299. Directed Reading in Comparative Medicine. 1-18 Unit.
Prerequisite: consent of instructor. (Staff).

COMP MED 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.

COMP MED 399. Graduate Research. 1-18 Unit.
Investigations sponsored by individual faculty members. Opportunities
are available in comparative medicine and pathology, immuno-
histochecmistry, electron microscopy, molecular genetics, quantitative
morphometry, neuroanatomy and neurophysiology of the hippocampus,
pathogenesis of intestinal infections, immunopathology, biology of
laboratory rodents, anesthesiology of laboratory animals, gene therapy
of animal models of neurodegenerative diseases, and development and
characterization of transgenic animal models. Prerequisite: consent of
instructor.
COMPMED 801. TGR Project. 0 Units.