

COMPARATIVE MEDICINE

Courses offered by the Department of Comparative Medicine are listed under the subject code COMPMED on the (<http://explorecourses.stanford.edu/CourseSearch/search/?view=catalog&catalog=&page=0&q=COMPMED&filter-catalognumber-COMP MED=on>) Stanford Bulletin's (<http://explorecourses.stanford.edu/CourseSearch/search/?view=catalog&catalog=&page=0&q=COMPMED&filter-catalognumber-COMP MED=on>) ExploreCourses web site (<http://explorecourses.stanford.edu/CourseSearch/search/?view=catalog&catalog=&page=0&q=COMPMED&filter-catalognumber-COMP MED=on>).

The Department of Comparative Medicine at Stanford is an academic, basic science department, the department is comprised of fourteen faculty, eleven of whom are veterinarians. All faculty members are immersed in laboratory animal science and translational research. They teach at the undergraduate, graduate, professional, and postgraduate levels. The department's 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 is 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 has oversight responsibility for the campus-wide animal research program and provides clinical service in the Veterinary Service Center (VSC). The mission of the department is to advance human and animal health through outstanding research, veterinary care and training.

To learn more about the Veterinary Service Center core and services provided, see the Veterinary Service Center (VSC) (<http://med.stanford.edu/vsc.html>) web site.

To learn more about Animal Research at Stanford, see the Animal Research at Stanford (<http://med.stanford.edu/animalresearch.html>) web site.

Master of Science in Laboratory Animal Science

The Master of Science (M.S.) in Laboratory Animal Science (MLAS) degree program in the Department of Comparative Medicine is a flexible, one- to two-year graduate program designed for students who want to pursue advanced careers in biomedical research, focusing on animal modeling and biotechnology, laboratory animal science, organizational management and facility design, regulatory and compliance issues, and animal welfare.

The program's academic courses are designed to build a solid foundation for a successful career in laboratory animal science and biomedical research. Graduates find employment in pharmaceutical companies and academia, or pursue advanced degrees or training in medical or veterinary schools. The program is designed to give students the ability to customize their academic research experience.

The Master of Science (M.S.) in Laboratory Animal Science degree program may also be taken by Stanford undergraduates as a coterminal master's degree program.

University requirements for the M.S. degree are described in the "Graduate Degrees (<http://exploreddegrees.stanford.edu/graduatedegrees/#masterstext>)" section of this bulletin.

How to Apply

External Applicants and Current Stanford Graduate Students

Review the information and instructions on the University Graduate Admissions web site (<https://gradadmissions.stanford.edu>). Submit your application online. The link to the online application is on the University Graduate Admissions web site (<https://gradadmissions.stanford.edu/plying/>).

Admissions Deadline: Application deadlines are listed on the Laboratory Animal Science (<http://med.stanford.edu/compmed/mlas.html>) webpage. For more information, contact compmed-mlas-info@stanford.edu.

Items which must be included in the online application:

- Completed School of Medicine Graduate Student Online Application Form (https://stanfordmedicine.qualtrics.com/SE/?SID=SV_eIIAYRZnPUqkPGJ)
- Resume or CV
- Transcript (unofficial transcripts are acceptable)
- GRE is not required
- Statement of Purpose (1-2 pages, 1 inch margins, 12 point font, single-spaced)
 - The statement of purpose should describe succinctly the reasons for applying to the proposed program at Stanford, preparation for this field of study, research interests, future career plans, and other aspects of the student's background and interests which may aid the admissions committee in evaluating aptitude and motivation for graduate study.
- Three letters of recommendation; at least one of the two reference letters should come from a science-related faculty member or professor.
- \$125 application fee is assessed by the Registrar at the time of the submission of the application.

Coterminal Applicants

The coterminal degree program allows current 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 (<http://exploreddegrees.stanford.edu/cotermdegrees/>)" section of this bulletin for additional information.

- Go to the Stanford Registrar's Office Applying to Coterm web site (<https://registrar.stanford.edu/students/coterminal-degree-programs/applying-coterm/>).
- Review the eligibility requirements, deadlines, and fees.
- Complete the online Coterm Application at the University Graduate Admissions web site (<https://gradadmissions.stanford.edu/plying/>).
- \$125 application fee is assessed by the Registrar at the time of the submission of the application.
- For additional questions, reach out to Tom Albert, Student Services Officer, tom.albert@stanford.edu.

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://exploreddegrees.stanford.edu/cotermdegrees/>)" section. University requirements for the

master's degree are described in the "Graduate Degrees (<http://exploreddegrees.stanford.edu/graduatedegrees/#masterstext>)" section of this bulletin.

After accepting admission to this coterminous 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 advisor 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.

Degree Requirements

- At least 45 units of academic work, all of which must be in courses at or above the 100 level. 36 of the 45 units must be at or above the 200 level. Students must complete all required courses listed below to count towards their 45 units. The remaining units can be used as research credit (COMP MED 260) or electives, as approved by each student's research mentor.
- Students must complete a master's thesis, which may take the following form:
 - Original analysis of original data
 - A comprehensive literature review with a meta-analysis of data or a critical reanalysis of data
 - Evaluation of a methodological problem using real data
 - A comprehensive literature review with a grant proposal (NIH style format) for a new study to bridge a gap in the existing knowledge.
- Per University policy (<http://exploreddegrees.stanford.edu/graduatedegrees/#masterstext>), the master's degree must be completed within three years.

Course Requirements

Required Courses	Units
Students are required to enroll in the following courses:	
COMP MED 200 One Health Journal Club (take twice)	2
COMP MED 202 Research Biostatistics for Laboratory Animal Science	2
COMP MED 205 Animal Use in Biomedical Research	3
COMP MED 209 Laboratory Animal Medicine Seminar	1
COMP MED 210 Form and Function of Lab Animals : Anatomy, Histology, and Pathology	4
COMP MED 211 Biostatistics for the Life Sciences	2
COMP MED 260 Masters Laboratory Animal Science Practicum/Laboratory Research	1-18
COMP MED 290 Laboratory Animal Science Professional Development and Career Exploration (take three times)	3

Elective Courses

COMP MED 114 Introduction to Veterinary Medical Terminology	2
COMP MED 123 Immunology of Infectious Disease	3
COMP MED 207 Vertebrate Brain Evolution	2
BIOS 285 Rodent Animal Models: Selection, Detection, Dissection, Inspection	1
Minimum Total Units	45

COVID-19 Policies

On July 30, the Academic Senate adopted grading policies effective for all undergraduate and graduate programs, excepting the professional Graduate School of Business, School of Law, and the School of Medicine M.D. Program. For a complete list of those and other academic policies relating to the pandemic, see the "COVID-19 and Academic Continuity (<http://exploreddegrees.stanford.edu/covid-19-policy-changes/#tempdeptemplatetabtext>)" section of this bulletin.

The Senate decided that all undergraduate and graduate courses offered for a letter grade must also offer students the option of taking the course for a "credit" or "no credit" grade and recommended that deans, departments, and programs consider adopting local policies to count courses taken for a "credit" or "satisfactory" grade toward the fulfillment of degree-program requirements and/or alter program requirements as appropriate.

Graduate Degree Requirements

Grading

In Academic Year 2020-21, the Department of Comparative Medicine considers courses in which a 'CR' (credit) is earned as satisfactory toward completion of the graduate degree.

Other Graduate Policies

The Department of Comparative Medicine is monitoring the impact of COVID-19 on its master's students' ability to conduct research in person. The thesis requirement, typically based on student's laboratory research project, may be amended at the discretion of the department.

Graduate Advising Expectations

The Department of Comparative Medicine (DCM) is committed to providing academic advising in support of graduate student scholarly and professional development. When most effective, this advising relationship entails collaborative and sustained engagement by both the advisor and the advisee.

Graduate students are expected to have selected a faculty mentor by their second quarter in the program.

Faculty mentors are expected to meet with graduate students at least once a quarter to discuss and to assist with development of the student's Individual Development Plans (<https://drive.google.com/open?id=1Xq4uWhbIKRgo25QQWsLeBbK7wx0rNNx1>). Additionally, the department encourages advisors and students to meet on a regular basis throughout the year to discuss the student's professional development in key areas such as selecting courses, designing and conducting research, and exploring academic opportunities and professional pathways.

Graduate students are active contributors to the advising relationship. They should proactively seek academic and professional guidance and take responsibility for informing themselves of policies and degree requirements for the M.S. in Laboratory Animal Science (MLAS) program. All new MLAS students are expected to enroll in and to participate in the

department's formal professional development and mentoring course, COMPMED 290, offered quarterly.

As a best practice, advising expectations should be periodically discussed and reviewed to ensure mutual understanding. Both the advisor and the advisee are expected to maintain professionalism and integrity.

Academic progress and student completion of program requirements and milestones are monitored by the program director and staff, and are reviewed during the Masters of Laboratory Animal Science Faculty Advisory Committee each quarter. A detailed description of the program's requirements, milestones, and advising expectations (for students and for their advisors) can be found on the program web site (<http://med.stanford.edu/compmed/mlas.html>).

Graduate students and their faculty mentors are encouraged to collaborate with the department's student services officer for referrals to campus resources, which include Biosci Careers Center, Vaden Health, etc.

Additionally, the program adheres to the advising guidelines and responsibilities listed by the Office of the Vice Provost for Graduate Education (<https://vpge.stanford.edu/academic-guidance/advising-mentoring/>) (VPGE) and in the Graduate Academic Policies (<https://gap.stanford.edu/handbooks/gap-handbook/chapter-3/subchapter-3/page-3-3-1/>) (GAP).

For more information regarding Graduate Student Advising and Postdoctoral/Resident Mentoring, contact the following people:

- Graduate Student Advising: Tom Albert (Student Services Officer), tom.albert@stanford.edu.
- Program Director: Sherril Green (Comparative Medicine Chair), sherril@stanford.edu.
- Postdoctoral Student/Residents: Megan Albertelli (Laboratory Animal Medicine Residency Director), megan.albertelli@stanford.edu.
- Postdoctoral/Resident: Monika Huss (Resident and Trainee Wellness Advisor), monikag@stanford.edu.

Emeriti: (Professors) Donna M. Bouley, Linda C. Cork

Chair: Sherril Green

Director of Graduate Studies: Sherril Green

Co-Director of Graduate Studies: Corinna Darian-Smith

Professors: David Bentzel (Clinical), Paul S. Buckmaster, Stephen Felt, Sherril Green, Shaul Hestrin

Associate Professors: Megan Albertelli, Corinna Darian-Smith, Joseph Garner, Claude Nagamine

Assistant Professors: Kerriann Casey (Clinical), Thomas Cherpes, Monika Huss (Clinical), Cholawat Pacharinsak, Jose Vilches-Moure

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). [This is a SOPHOMORE COLLEGE course. Visit soco.stanford.edu for full details.].

COMPMED 23N. Pandemics & Plagues: Biological Causes and Social Effects. 3 Units.

Massive scale infections or plagues have often occurred, affecting millions for years or quickly killing thousands. In this seminar, we will use both biological and social lenses to examine infectious agents and the plagues they caused. To provide helpful framework for this exploration, we will begin with a very brief overview of the principles of microbiology and immunology. This will be followed by specific looks at the biological causes and social responses to Black Death, cholera, tuberculosis, the 1918 influenza pandemic, polio, and the ongoing HIV pandemic. We will conclude our seminar with similar looks at some of the infectious agents most likely to cause new pandemics.

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 in their pee-mail? Learning how to think about questions like these gives us a unique perspective on the natural world. Format: Discussion and criticism of video examples, documentaries, and research papers. Topics: History and approaches to animal behavior; development of behavior, from genetics to learning; mechanisms of behavior, from neurons to motivation; function of behavior, from honest signals to selfish genes; the phylogeny of behavior, from domestication to speciation; and modern applications of behavior, from abnormal behavior, to conservation, to animal welfare, and animal consciousness.

COMPMED 81Q. Aardvarks to Zebras: The A to Z of Animal Anatomy. 3 Units.

Preference to sophomores. Ever wonder what cats and narwhals have in common? Maybe you haven't, but despite their seemingly different lifestyles and habitats (i.e. sleeping on couches versus swimming in oceans), they are both mammals! In this seminar, students will gain an appreciation for basic mammalian anatomic and physiologic principles that span across multiple species while emphasizing key differences that render each species unique. Through student projects, we will explore evolutionary adaptations that have driven the success of a variety of species within the context of their natural environments. In addition to lecture content, virtual laboratory sessions will reinforce anatomic principles through a combination of rodent cadaver dissection and examination of organ and bone specimens. Students with a passion for science will gain a fundamental understanding of anatomy that is applicable to future careers in medicine, biomedical research, veterinary medicine, and ecology/conservation.

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 85N. Animal Use in Biomedical Research. 3 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 87Q. Laboratory Mouse in Biomedical Research. 3 Units.

What is a nude mouse and why is it used in cancer research? How come my mouse pups have a different coat color than their parents? What is a knockout mouse? Answers to these and more are in this introduction to the laboratory mouse, one of the most widely used models in biomedical research. We will explore the natural history and origin of the laboratory mouse; the ethics and regulations on the use of mice in research; the characteristics and nomenclature of commonly used mouse strains; the anatomy, physiology, and husbandry of mice; common mouse diseases and their effects on research; mouse coat color genetics and its relevance to human diseases; immunodeficient mouse models and their uses in research; and the technology for genetically engineering mice (e.g., transgenic mice). Video demonstrations of necropsy, mouse handling, anesthesia and surgery, identification methods, and research techniques will be provided. Each student is expected to read research papers that use the mouse as a research model and give a presentation of a topic of their choice. Students interested in biomedical research and human or veterinary medicine will benefit from this seminar.

COMPMED 89Q. 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 91N. And that's why cats should never eat garlic!. 3 Units.

Did you know that although we love garlic, it could make cats very sick? And how come if a human or a dog gets a heart attack they'll end up with a scar, but some fish can regenerate parts of their hearts? In this course, we will explore how select diseases can manifest themselves similarly or differently in different animal species. This course will be of interest to those looking to pursue careers in biomedical fields including veterinary and human medicine. Oh, and one last thing: don't cook with non-stick pans if you have indoor birds. Why? Sign up for the course to find out!

COMPMED 107. Vertebrate Brain Evolution. 2 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.

Same as: COMPMED 207

COMPMED 109. Veterinary Clinical Shadowing Experience. 1-2 Unit.

Restricted to pre-veterinary students. Priority given to Seniors. The objective of this course is to provide students with practical experience in clinical laboratory animal veterinary medicine by shadowing veterinary staff at Stanford. Experience is gained in areas of laboratory animal veterinary care such as housing systems, husbandry, disease surveillance, enrichment, physical exams and clinical management. Enrolled students will work with multiple species and fully intend to apply to veterinary school. Limited Enrollment. Once registered, students must contact Dr. Sam Baker to create a shadowing schedule.

COMPMED 110. Pre-Veterinary 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.

COMPMED 114. Introduction to Veterinary Medical Terminology. 2 Units.

The Introduction to Veterinary Medical Terminology course will introduce students to medical terminology used in the veterinary profession and in biomedical research. This course is designed with the pre-veterinary student in mind, although pre-medical students and students in other fields are welcome. Upon successful completion of the course, students will be able to review, comprehend, and communicate basic medical reports and clinical assessments. Students can expect to complete 2-4 hours of reading per week, to meet 2 hours per week for lecture and to review cases.

COMPMED 123. Immunology of Infectious Disease. 3 Units.

Course utilizes active learning techniques to explore essential elements of the mammalian host response to infection. Focusing on overriding principles rather than rote learning, course delivers pragmatic understanding of this response. Topics include pathogenesis of clinically relevant pathogens, vital immune system cells and tissues, and how innate and adaptive immunity responses are coordinated to control infection. Integrated into this active learning experience are human and veterinary medicine clinical cases that provide an exciting way for participants to re-enforce understanding of these basic concepts of host defense and challenge their problem-solving abilities. UG prerequisites: Cell Biology or consent of instructor.

COMPMED 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.

COMPMED 199. Undergraduate Research. 1-3 Unit.

Investigations sponsored by individual faculty members. Prerequisite: consent of instructor.

COMP MED 200. One Health Journal Club. 1 Unit.

Participants report on and review scientific articles published in peer reviewed journals. Focus is on manuscripts which report basic and mechanistic discoveries, animal modeling and translational research. The objective is to introduce MLAS students to critical scientific review of hypothesis-based research and experimental design, data analysis and interpretation. Enrollment limited to undergraduate and graduate students currently matriculated or planning to enroll in the MS in Laboratory Animal Science degree program.

COMP MED 202. Research Biomethodology for Laboratory Animal Science. 2 Units.

Emphasis is on providing introductory training and practical, hands-on research animal biomethodology. Topics include basic care and principals guiding the use of research animals, animal health and welfare, enrichment, basic mouse handling, rodent breeding, and the principals of rodent aseptic surgery and anesthesia. The objective of this course is to teach basic skills in animal handling, animal care and biomethodological research techniques. Content delivered online and in-person.

COMP MED 205. Animal Use in Biomedical Research. 3 Units.

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 law and ethics, animal behavior, animal modeling, and the animal activist movement. Course topics will also include: history of animals in research, environmental enrichment for research animals, and research animals in the media.

COMP MED 207. Vertebrate Brain Evolution. 2 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.
Same as: COMP MED 107

COMP MED 209. Laboratory Animal Medicine Seminar. 1 Unit.

Focuses on husbandry, care and diseases of major laboratory animal species (rodents, fish and amphibians, swine, sheep, rabbits, monkeys); regulatory and compliance, applied principals of animal modeling, and factors that influence animal research, animal behavior and research reproducibility. The objective of this course is to provide students with an overview of the history of laboratory animal science, current industry standards and practices, and the fundamentals of laboratory animal diseases. Department consent required for enrollment. May be repeated for credit.

COMP MED 210. Form and Funkiness of Lab Animals : Anatomy, Histology, and Pathology. 4 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 210A. Form and Funkiness of Lab Animals I: Anatomy and Histology. 3 Units.

Have you ever wondered what dermatitis looks like on a histology slide? Does wondering about what a pancreas really looks like keep you up at night? Wonder no more! This course focuses on the anatomy and histology of laboratory animal species, with a focus on the laboratory mouse. Topics covered include: tissue dissection, tissue preparation for histology (collection, fixation, trimming and orientation), and identification of normal anatomy and histology through brightfield microscopy. This course involves dissection laboratories, and previous participation in the VSC Mouse Handling Workshop is recommended.

COMP MED 210B. Form and Funkiness of Lab Animals II: Introduction to Pathological Principles. 3 Units.

Have you ever ever wondered what dermatitis looks like on a histology slide? Have you ever lost sleep thinking about what an infarct really is? Well, it's your lucky quarter! This course focuses on the microscopic assessment of tissue pathology, with a focus on the laboratory mouse. Topics covered include: cell injury and cell death, inflammation, healing, and neoplasia. Common diseases of the laboratory mouse will also be covered. Prerequisites: COMP MED 210A (Form and Funkiness of Laboratory Animals I: Anatomy and Histology).

COMP MED 211. Biostatistics for the Life Sciences. 2 Units.

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 a flipped-classroom. Class time is devoted to discussion of assigned reading (primarily Grafen & Hails 2002 "Modern statistics for the life sciences"), critique of papers, working through example data sets, and developing analyses for the students' own research data. The objective is to provide MLAS students with a fundamental understanding of basic statistics, particularly as applied to the design and planning of animal-based research projects.

COMP MED 260. Masters Laboratory Animal Science Practicum/ Laboratory Research. 1-18 Unit.

Research laboratory and clinical service (pathology, diagnostic laboratory, surgery, husbandry, anesthesiology, aquatics, facility business and management, etc.), quarterly rotations for students enrolled in the Master's of Laboratory Animal Science program. The objective of this course is to provide students with hands on experience in research laboratories using animal models and to provide experience working in the daily operations of a large, veterinary service center. Fulfills the practicum and research requirements of MLAS students.

COMP MED 290. Laboratory Animal Science Professional Development and Career Exploration. 1 Unit.

Focus is on career development for graduate students and trainees enrolled in a trainee program in the Department of Comparative Medicine. Seminar topics include career pathways in laboratory animal science, resume preparation, manuscript preparation and authorship, life in academics, life in industry and biopharma, regulatory agencies, veterinary and medical school. Speakers include faculty, speakers from industry and pharmaceutical companies, veterinary school and medical school graduates, regulatory and compliance professionals, research scientists, and animal research program/laboratory managers. Students may choose to shadow veterinary clinical faculty or rotate through basic science laboratory, by special arrangement. The objective is to introduce students to the multiple career pathways available to individuals with advanced training in laboratory animal science. 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, immunohistochemistry, 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.

COMP MED 801. TGR Project. 0 Units.