Vision Science

Overview

Vision is one of the most valuable sensory modalities. It is also the source of a rich array of research questions relating to how we see, how and why vision fails, and what can be done about it. Investigators in Vision Science conduct human and animal research and modeling, yielding cutting-edge discoveries and applications in disciplines that include molecular genetics, clinical care, adaptive optics, neurobiology, cell biology, infectious disease, bioengineering, perception, and public health.

This PhD program (http://vision.berkeley.edu) emphasizes the interdisciplinary nature of vision science research through broad exposure to the basic concepts and techniques used in specialized fields. Engaged in both laboratory-based and clinical research, our students (http://vision.berkeley.edu/?page_id=37) are working with faculty (http://vision.berkeley.edu/?cat=2) advisers whose research matches their own interests. Current research topics include Biomedical Optics, Perception and Visual Cognition, Molecular and Cell Biology, Neuroscience, Computational Vision, Genetics, Immunology, Microbiology, and Clinical Science.

Vision Science alumni (http://vision.berkeley.edu/?page_id=2019) are represented on the faculty of world-class universities — in medical schools, schools of optometry, and a wide range of other disciplines spanning psychology, physiology, bioengineering, and ophthalmology. Many others hold research positions in private institutes and federally sponsored agencies, including NASA and the NIH. Still others are to be found in the research and development divisions of industry; currently, ophthalmic and biotechnology companies are among the major recruiters of our graduates.

Due to the interdisciplinary nature of the program, we accept students with various backgrounds including psychology, optometry, engineering, computer science, physics, chemistry, biophysics, neuroscience, mathematics, molecular and cell biology, and integrative biology. Because this program is designed to develop research scientists, it is also important that applicants are familiar with an experimental lab setting.

Undergraduate Program

There is no undergraduate program in Vision Science.

Graduate Program

Vision Science (http://guide.berkeley.edu/archive/2015-16/graduate/degree-programs/vision-science) : PhD

Vision Science

VIS SCI 24 Freshman Seminars 1 Unit
Offered through: Optometry
Terms offered: Fall 2017, Spring 2017, Fall 2016
The Freshman Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Freshman seminars are offered in all campus departments, and topics vary from department to department and semester to semester. Enrollment limited to 15 freshmen.
Rules & Requirements

Repeat rules: Course may be repeated for credit as topic varies. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Vision Science/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

VIS SCI 39 Freshman and Sophomore Seminar 1.5 - 3 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
Freshman and sophomore seminars offer lower division students the opportunity to explore an intellectual topic with a faculty member and a group of peers in a small seminar setting. These seminars are offered in all campus departments; topics vary from department to department and from semester to semester. Enrollment limits are set by the faculty but the suggested limit is 25.
Rules & Requirements

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1.5-3 hours of seminar per week

Additional Details

Subject/Course Level: Vision Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

VIS SCI 84 Sophomore Seminar 1 or 2 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Spring 2016
Sophomore seminars are small interactive courses offered by faculty members in departments all across the campus. Sophomore seminars offer opportunity for close, regular intellectual contact between faculty members and students in the crucial second year. The topics vary from department to department and semester to semester. Enrollment limited to 15 sophomores.
Rules & Requirements

Prerequisites: At discretion of instructor

Repeat rules: Course may be repeated for credit as topic varies. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring:
5 weeks - 3-6 hours of seminar per week
10 weeks - 1.5-3 hours of seminar per week
15 weeks - 1-2 hours of seminar per week

Summer:
6 weeks - 2.5-5 hours of seminar per week
8 weeks - 1.5-3.5 hours of seminar and 2-4 hours of seminar per week

Additional Details

Subject/Course Level: Vision Science/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

VIS SCI 199 Supervised Independent Study and Research 1 - 4 Units
Offered through: Optometry
Terms offered: Fall 2017, Summer 2017 8 Week Session, Spring 2017
Supervised independent study and research. Enrollment restrictions apply; see the Introduction to Courses and Curricula section of this catalog.
Rules & Requirements

Prerequisites: Upper division status and consent of instructor, the student's major adviser and the departmental chair

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer: 8 weeks - 1.5-7.5 hours of independent study per week

Additional Details

Subject/Course Level: Vision Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam required.

VIS SCI 201A Seminar in Vision Science 2 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
Graduate seminar in vision science.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

VIS SCI 201B Seminar in Vision Science 2 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
Graduate seminar in vision science.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

VIS SCI 203A Geometric Optics 4 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
Geometrical methods applied to the optics of lenses, mirrors, and prisms. Thin lens eye models, magnification, astigmatism, prism properties of lenses, thick lenses.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Formerly known as: 101

VIS SCI 203B Optical System and Physical Optics 4 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
Principles of optical systems, principles and clinical applications of aperatures and stops, aberrations and optical instruments. Optics of the eye. Selected topics in physical optics, diffraction, interference, polarization.
Rules & Requirements

Prerequisites: 203A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Formerly known as: 102

VIS SCI 205 Visual Perception Sensitivity 4.5 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
Psychophysical basis for clinical tests in acuity, perimetry, and color vision. The visual stimulus and photometry. Visual receptors. Psychophysical method and visual threshold. Light sensitivity. Contrast sensitivity. Light and dark adaptation. Temporal and spatial properties of visual function. Color vision and abnormalities. Changes with age and disease. Visual illusion. Basis for advanced diagnostic procedures.
Hours & Format

Fall and/or spring: 15 weeks - 3.5 hours of lecture and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Formerly known as: 104

VIS SCI 206A Anatomy and Physiology of the Eye 2 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
This course focuses on the anatomy and physiology of the eyeball. Overview of the gross anatomy of the eye followed by eye-relevant cellular and molecular biology. Cellular and molecular details of structure and function of each of the various non-neural components.
Hours & Format

Fall and/or spring: 7.5 weeks - 4 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Instructors: Gong, Fleiszig

VIS SCI 206B Anatomy and Physiology of the Eye and Visual System 3 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
Structure and function of the tissues of the eye, ocular appendages, and the central visual pathways. Basic concepts of physiological, neurological, embryological, and immunological processes as they relate to the eye and vision. Foster an appreciation of the pathophysiology of various disease processes. Convey the importance of anatomy and physiology in the medical approach to ocular disease processes.
Rules & Requirements

Prerequisites: VIS SCI 206A

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2.5 hours of lecture and 0.5 hours of laboratory per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

VIS SCI 206C Anatomy and Physiology of the Eye and Visual System 2 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
Problem-based learning approach using clinical case examples. Continuation of 206A-206B.
Rules & Requirements

Prerequisites: 206A-206B

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 7.5 weeks - 4 hours of seminar per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Formerly known as: 106C

VIS SCI 206D Neuroanatomy and Neurophysiology of the Eye and Visual System 2 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
Structure and function of the neurosensory retina, photoreceptors, RPE including blood supply. Current concepts of etiology and management of major retinal conditions. Overview of diagnostic techniques in retinal imaging, electrophysiologic testing and new genetic approaches. Structure and function of the early visual pathway including retinal ganglion cells, optic nerves, lateral geniculate nucleus and visual cortex. Pupillary responses. Specialization in the visual cortex.
Rules & Requirements

Prerequisites: 206A (must be taken concurrently)

Hours & Format

Fall and/or spring: 7.5 weeks - 4 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Instructors: Flannery, Freeman

Formerly known as: half of 206A

VIS SCI 212A Optics and Dioptrics of the Eye 2 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
Introduction for graduate students to basic principles of classic and modern geometric optics (thick lens systems, mirrors, prisms, apertures, and stops) and physical optics (interference, diffraction, and polarization) with emphasis on dioptrics of the human eye (including schematic eyes, aberrations, and entoptic phenomena).
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

VIS SCI 212B Visual Neurophysiology and Development 2 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
Introduction for graduate students. Visual pathways will be considered from retina to lateral geniculate to visual cortex. Basic organization at each stage will be covered. Primary focus will be studies of receptive field characteristics and associated visual function. Development and plasticity of the same visual pathways will also be covered. Evidence and implications will be explored from controlled rearing procedures and studies of abnormal visual exposure.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

VIS SCI 212D Anatomy and Vegetative Physiology of the Eye 2 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
Introduction for graduate students to a general survey of the orbit, anterior and posterior segment of the eye, extraocular muscles, and neuroanatomy of the eye. Vegetative physiology of the cornea and tear film, aqueous humor, crystalline lens, vitreous humor, epithelial tissue (iris, ciliary body and retina), and photochemistry.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

VIS SCI 212E Color Vision and Visual Sensitivity 2 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
Introduction for graduate students to sensory aspects of light and color vision including: psychophysical methods, spectral response of the eye, mechanisms of sensitivity control, dark adaptation, color discrimination, mechanisms of normal and defective color vision.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

VIS SCI 212F Spatial and Binocular Vision, Eye Movements, and Motion Perception 2 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
Introduction for graduate students to human spatial vision including contrast sensitivity, visual acuity, and spatial localization. Introduction to eye movements, motion perception, and motor and sensory aspects of binocular vision including pursuit, vergence, and saccadic eye movements, accommodation, stereopsis, and binocular space perception. Perception of real and apparent motion.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Instructors: Banks, Malik, Schor

VIS SCI 212G Molecular Genetics of Vertebrate Eye Development and Diseases 2 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
The primary focus of this course is to teach the molecular basis of vertebrate eye development and related disease. This course will cover some of the basic principles of molecular and cell biology, commonly used techniques and experimental approaches, as well as the biological mechanisms for vertebrate eye development and related eye diseases. Recent progress in identifying important ocular genes and the approaches used to identify them will be discussed.
Rules & Requirements

Prerequisites: Graduate student in vision science or consent of instructor in charge

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Instructor: Gong

VIS SCI 215 Visual System Development 2 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
Development of the eye and visual system. Normal development of the eye, retina, and central visual pathways. Effects of visual deprivation. Assessment of optical and visual function in human infants. Refraction and refractive error in infants and children. Development of visuomotor function, spatial vision, color vision, binocular vision, and depth perception.
Rules & Requirements

Prerequisites: 206B

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Formerly known as: 115

VIS SCI 217 Oculomotor Functions and Neurology 2 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
Neuro-anatomical pathways for the control of eye position and movement; gaze holding, image stabilization and tracking eye movement systems; oculomotor signs of disorders of the central nervous system (palsies, nystagmus, opthalmoplegia, cog-wheel pursuits, saccadic dysmetria); the near visual-motor response and the synergistic coupling of accommodation and convergence; binocular misalignment (heterophoria and fixation disparity); and presbyopia.
Rules & Requirements

Prerequisites: 203B or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture and 10 hours of laboratory per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Formerly known as: 117

VIS SCI 219 Binocular Vision and Space Perception 2 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
Perception of space, direction, and distance. Binocular retinal correspondence, horopters, differential magnification effects and anomalies of binocular vision development. Sensory vision, local stereopsis, static and dynamic stereopsis, binocular depth cues.
Rules & Requirements

Prerequisites: 203A-203B

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture and 10 hours of laboratory per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Formerly known as: 118

VIS SCI 230 Ethics in Scientific Research 2 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
This seminar will examine a range of ethical issues that arise in the process of doing science. Beginning with the philosophical and social foundations, we will consider the pathogenesis of fraud, statistics and deception, the ethics of authorship and publication, research with human subjects, the use of animals, the definition(s) of misconduct and the difference between misconduct and questionable research practices, the relationship between industry and science, and finally, the responsibilities and obligations of the scientist in society.
Hours & Format

Fall and/or spring: 15 weeks - 30 hours of seminar per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

VIS SCI 262 Visual Cognitive Neuroscience 3 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
The course will provide an overview of visual cognitive neuroscience, drawing from neuroanatomy, neurophysiology in humans and animal models, psychophysics, neuroimaging, neuropharmacology, neuropsychology, and computational models of vision and cognition. Topics will include basic anatomy and physiology of the mammalian visual system, motion perception and processing, depth perception and representation of visual space, brightness and color, object and face recognition, visual attention, developmental and adult plasticity, perceptual learning, multisensory integration, and visual awareness.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Instructor: Silver

VIS SCI 265 Neural Computation 3 Units
Offered through: Optometry
Terms offered: Fall 2017, Fall 2016, Fall 2015
This course provides an introduction to the theory of neural computation. The goal is to familiarize students with the major theoretical frameworks and models used in neuroscience and psychology, and to provide hands-on experience in using these models. Topics include neural network models, supervised and unsupervised learning rules, associative memory models, probabilistic/graphical models, and models of neural coding in the brain.
Rules & Requirements

Prerequisites: Calculus, differential equations, basic probability and statistics, linear algebra, and familiarity with high level programming languages such as Matlab

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Instructor: Olshausen

VIS SCI C265 Neural Computation 3 Units
Offered through: Optometry
Terms offered: Prior to 2007
This course provides an introduction to the theory of neural computation. The goal is to familiarize students with the major theoretical frameworks and models used in neuroscience and psychology, and to provide hands-on experience in using these models. Topics include neural network models, supervised and unsupervised learning rules, associative memory models, probabilistic/graphical models, and models of neural coding in the brain.
Rules & Requirements

Prerequisites: Calculus, differential equations, basic probability and statistics, linear algebra, and familiarity with high level programming languages such as Matlab

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Instructor: Olshausen

Also listed as: NEUROSC C265

VIS SCI C280 Computer Vision 3 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
Paradigms for computational vision. Relation to human visual perception. Mathematical techniques for representing and reasoning, with curves, surfaces and volumes. Illumination and reflectance models. Color perception. Image segmentation and aggregation. Methods for bottom-up three dimensional shape recovery: Line drawing analysis, stereo, shading, motion, texture. Use of object models for prediction and recognition.
Rules & Requirements

Prerequisites: Knowledge of linear algebra and calculus. Mathematics 1A-1B, 53, 54 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

Instructor: Malik

Also listed as: COMPSCI C280

VIS SCI 298 Group Studies, Seminars, or Group Research 1 - 6 Units
Offered through: Optometry
Terms offered: Fall 2017, Spring 2017, Fall 2016
Group studies of selected topics. Advanced studies in various subjects through special seminars on topics to be selected each year, informal groups studying special problems, group participation in experimental problems and analysis.
Hours & Format

Fall and/or spring: 15 weeks - 4 hours of lecture per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

VIS SCI 299 Research in Vision Science 1 - 12 Units
Offered through: Optometry
Terms offered: Fall 2017, Summer 2017 Second 6 Week Session, Spring 2017
Research.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer:
6 weeks - 1-16 hours of independent study per week
8 weeks - 1-12 hours of independent study per week

Additional Details

Subject/Course Level: Vision Science/Graduate

Grading: Letter grade.

VIS SCI 300 Teaching Methods in Vision Science 1 Unit
Offered through: Optometry
Terms offered: Fall 2017, Spring 2017, Fall 2016
Instruction in teaching methods and materials, in vision science and optometry; practice teaching in classrooms and laboratory.
Rules & Requirements

Prerequisites: Graduate standing in vision science

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Vision Science/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructor: Silver

VIS SCI 601 Individual Study for Master's Students 1 - 6 Units
Offered through: Optometry
Terms offered: Spring 2017, Spring 2016, Spring 2015
Individual study for the comprehensive requirements in consultation with the adviser in vision science.
Rules & Requirements

Prerequisites: Consent of instructor

Credit Restrictions: Course does not satisfy unit or residence requirements for master's degree.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Additional Details

Subject/Course Level: Vision Science/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.

VIS SCI 602 Individual Study for Doctoral Students 1 - 6 Units
Offered through: Optometry
Terms offered: Fall 2017, Spring 2017, Fall 2016
Individual study in consultation with the adviser in vision science, intended to provide an opportunity for qualified students to prepare themselves for the various examinations required for the Ph. D.
Rules & Requirements

Prerequisites: Consent of instructor

Credit Restrictions: Course does not satisfy unit or residence requirements.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Additional Details

Subject/Course Level: Vision Science/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.