

# Vision Science

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## Overview

The Group in Vision Science represents cross-disciplinary faculty from the School of Optometry and the Departments of Psychology, Computer Science, Molecular and Cell Biology, Neuroscience, and Bioengineering, among others. The faculty is distinguished in their accomplishments and diverse in their areas of expertise. Research facilities available to graduate students in vision science are among the best in the world. This Group offers a graduate program which leads to a PhD.

## Undergraduate Program

There is no undergraduate program in Vision Science.

## Graduate Program

Vision Science (<http://guide.berkeley.edu/archive/2014-15/graduate/degree-programs/vision-science>) : PhD

## Vision Science

VIS SCI 24 Freshman Seminars 1 Unit

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

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

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  
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  
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  
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

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

Principles of optical systems, principles and clinical applications of apertures 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

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**

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**

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**

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**

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**

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**  
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**  
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**  
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**

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**

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**

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**

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, oculomoplegia, 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**

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**

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**

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**

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**

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**

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  
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  
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  
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  
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  
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.